COPSULE Edition 10

Edition 10.0

Lifting Equipment Engineers Association

www.leeaint.com

Code of Practice for the Safe Use of Lifting Equipment



Published by the

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INTRODUCTION

THE LIFTING EQUIPMENT ENGINEERS ASSOCIATION

Founded in 1944 as the Chain Testers Association of Great Britain, the Association adopted its present title in 1988 in order to reflect, more accurately, the present-day activities of its members. The association now has a global membership of over 1300 organisations operating from over 2000 locations in 83 countries.

The members' strength derives from their accumulated expertise and from the adoption of the Association's technical requirements. These are published in a document reference LEEA 042 together with guidance notes as an aid to implementation. The technical requirements demand the highest standards of equipment, personnel, procedures and records. Members are subjected to regular compliance audits by LEEA. No organisation is admitted as a Full Member until it has met all the requirements.

Besides the design, manufacture, modification, sale or hire of lifting equipment, members offer a complete service of periodic examination, testing, repair, re-certification, maintenance, modernisation and general servicing. Some also offer training courses for the competent person in lifting operations and in-service inspection. Many are members of the LEEA accredited training scheme and offer courses whose content and delivery have been audited and accredited by LEEA.

Many large organisations, including government agencies, electricity generators, oil and gas producers, port authorities, chemical plants, steel producers and dockyards are Associate Members.

The Association makes a substantial contribution to the preparation of standards and codes through its membership of British, European, ASME, Australian and International Standards bodies. It also works closely with government and legal authorities, such as the UK Health and Safety Executive, and with other bodies concerned with safety globally.

The Association provides comprehensive training courses for member personnel engaged in the examination, supplementary testing and certification of lifting equipment. These can be delivered in several ways:

- Instructor-led practical courses at our specially equipped training centre in Huntingdon, UK
- Instructor-led training courses at members' premises worldwide
- Combined Member Training Events – worldwide, providing access for regional delegates
- E-Learning through the LEEA Academy online platform
- Zoom training courses delivered over specific course dates
- Blended learning that combines e-Learning and Instructor-led delivery methods.

The courses include safety in use and legal requirements. Candidates successful in LEEA's end-point assessments qualify for the Foundation and Advanced Programme awards. A technician who is employed by a LEEA member and has passed the end-point assessment for an Advanced Programme award will receive a LEEA TEAM Card which provides evidence of the holders' LEEA qualifications. The TEAM Card bears a photograph of the holder, their name and that of their employer and states the subjects in which they have achieved LEEA Advanced Programme awards (previously known as LEEA Diplomas).

The Association's activities are devoted to quality, safety, training and the development of products and services at the highest level of integrity.

The benefits of the Lifting Equipment Engineers Association are not confined to its members. When dealing with member companies the user can be confident that they are dealing with organisations that are capable, have adequate facilities for the work they undertake and that the personnel concerned are qualified to do their jobs.

FOREWORD TO THE TENTH EDITION

Following a major restructuring of the Code of Practice in 2001, the sixth edition in 2006 included an update of all the relevant standards, which had been published or amended since 2001. It also reflected the changes in practice which had occurred in recent times. This resulted in a large number of small changes throughout the work. First published in 1981, the Code has expanded in stages as more sections have been added. The seventh edition and eight editions added a further six sections bringing the total to twenty seven sections, making it an even more comprehensive guide to the safe use of all types of lifting equipment.

The previous eight editions closely followed UK legislation and standards, whereas this edition builds on these requirements to provide a globally applicable and accepted industry specific best practice guidance to the safe use of lifting equipment. Its sets a common language which breaks down barriers to trade while maintaining a safe and level playing field.

The code is a practical guide covering manual and power operated lifting machines and structures, such as bridge and gantry cranes and runway structures, together with a wide range of below hook equipment, from general purpose slings and lifting accessories, to the various types of vacuum and magnetic lifters. Its contents will be found useful in devising safe working practices for anyone using lifting equipment, as well as providing all the information necessary for safety training in this critical area of activity at work.

This code is based on the 'risk based' philosophy of modern legislation that places duties on those involved in every aspect of the manufacture, supply and use of lifting equipment, which together, collectively and comprehensively address all health and safety issues.

The terminology used in earlier editions of the code was that used in older legislation and standards. New legislation and standards often use different terms, and, over time, we have made necessary changes to keep it up to date. However, terminology varies globally, and the code is intended to apply to equipment commonly in use and that will include older equipment made to earlier standards and still serviceable. The reader is asked to bear this in mind if there is any apparent conflict in terms. Further revisions of the Code will be necessary as new standards are published and new technologies are integrated into common industrial practice.

This Code of Practice will be found to be a useful and authoritative source of information for all those people who are responsible for meeting legal obligations and indeed, for everyone concerned with safety at work.

Nothing contained in this Code of Practice in any way absolves the persons or organisations having responsibilities under legislation from their specific obligations. In particular, certain items covered by this code are supplied in the form of propriety designs for which the designer, manufacturer, etc. must accept full responsibility.

Every effort has been made to achieve the highest degree of accuracy in the preparation of the data and advice supplied, but ultimate responsibility for safety must continue to rest with the persons and organisations charged with specific duties in current legislation.

Readers are advised to obtain and read the relevant legislation in order to ascertain their duties and obligations. In some cases, these are available with guidance or codes of practice prepared by the local enforcing bodies.

ACKNOWLEDGEMENTS

LEEA wishes to thank the member organisations who have provided information and technical assistance and, in particular, the members of the Drafting Committee without whose help the preparation of this Code of Practice would not have been possible. In addition, we offer our sincere thanks to the national enforcing authorities for their assistance.

Section 1 - GENERAL REQUIREMENTS

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1.1 FOREWORD

This code of practice was first published by the Lifting Equipment Engineers Association (then called the Chain Testers' Association of Great Britain) in 1981. Since then the code has been regularly updated and expanded.

Most modern legislation, which forms the basic philosophy of this code, places responsibilities on designers, manufacturers, importers, and suppliers of equipment to ensure that the articles are designed and constructed to be safe and without risk to health; to carry out the necessary testing and examination and to ensure that the person supplied is provided with adequate information to ensure safety in use and maintenance, including information about any foreseeable hazards. They also place responsibilities on employers to ensure the health and safety at work of employees by the provision of equipment and systems which are safe and without risk to health; to provide maintenance of the equipment to ensure continued safety and to provide employees with information, instruction, training and supervision to ensure health and safety at work.

Manufacturers of lifting equipment, or other responsible persons with the duty of a manufacturer, must comply with applicable national supply legislation. Although this legislation varies globally the fundamental requirements, supported by EN ISO 12100 for lifting machines and accessories are the same in that they identify the 'essential safety requirements' to be addressed by the manufacturer to overcome the hazards related to lifting equipment.

In many countries' employers, those responsible for the control of work equipment and self-employed persons, have duties under use of work equipment legislation. This legislation therefore forms the basis of this code of practice. Fundamentally this means that employers are assumed to be responsible for ensuring that work equipment complies with any requirements relating to its design or construction, that it is regularly inspected, maintained, thoroughly examined and is selected and used correctly for the required task.

This code has been published in order to provide guidance for all those persons and organisations having responsibility for safety in the selection and use of lifting equipment. Every effort has been made to achieve a high degree of accuracy and to ensure that all the advice given is in line with what is regarded by LEEA as best practice at the time of publication, but ultimate responsibility for safety must continue to rest with the above mentioned persons and organisations. Certain of the products covered by the code may be supplied either in the form of proprietary designs or to the design requirements of individual users and the persons and organisations concerned must accept responsibility for safety requirements.

The code covers many items of equipment available. However, it is not possible in a document of this nature to cover every application in detail and it is hoped that most problems can be settled by reference to the principles contained herein. For convenience, the code is presented in sections classified according to types of lifting equipment. This general section must be read in conjunction with other appropriate sections dealing with specific items of equipment.

Whilst it is the intention that this code shall apply to new and repaired equipment supplied by LEEA members, the practices covered can also be applied to existing equipment, although caution is advised on the use of older equipment where special requirements may apply. The respective sections highlight these requirements as appropriate and it is the user's responsibility to ensure such equipment, and the use of that equipment, meets with the legal requirements currently in force.

The practices set out in this code, particularly the descriptions of the equipment, align to or quote current International or National Standards where they exist, as the working party consider that these provide a benchmark level of safety and performance in use. Whilst it is recognised that a variety of equipment can be supplied by LEEA members to their clients, it is not the intention to be restrictive on this aspect, apart from indicating that where equipment is purchased which does not conform to such a recognised standard, then the advice of a Competent Person should be sought before purchase. Where other national standards are invoked, users should ensure that the safety and performance requirements are equivalent to and definitely not inferior to the standards adopted by their national standards body. Throughout the code, references to Standards relate to the current issue in print, unless the date of the Standard is quoted.

1.2 SCOPE

The contents of this section comprise the GENERAL REQUIREMENTS common to most items of lifting equipment. Separate sections of the code each deal with a particular item of equipment. For any particular item therefore, the specific section dealing with that equipment should be read in conjunction with these general requirements.

The information given in all sections of the code reflects current industry best practices.

1.3 DEFINITIONS

For the purposes of this code the following definitions shall apply:

1.3.1 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 practical and theoretical 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 Competent Person should have the maturity to seek such specialist advice and assistance as may be required to enable them to make necessary judgements and be a sound judge of the extent to which he/she can accept the supporting opinions of other specialists. It is the view of LEEA that competency can be a corporate responsibility.

1.3.2 Factor of Safety (FOS)

The factor of safety is the ratio between minimum breaking load and SWL (see section 1.3.17 Single Purpose Equipment page 5), sometimes referred to in standards and legislation as the working coefficient, coefficient of utilization or design factor.

1.3.3 Inspection

There are three levels of inspection to ensure the safety of equipment, i.e. pre-use inspection, interim inspection and thorough examination.

1.3.3.1 Pre-use inspection

This is normally completed by the operator of the equipment before each use and in accordance with the manufacturer's instructions. It is a basic check for obvious signs of damage. Typically, the operator will be looking for damage such as dents to protective cases, permanent deformations, abnormal noises, presence of and correct marking, or changes in function for example. Any such findings should be reported to the inspection / maintenance personnel.

1.3.3.2 Interim Inspection

The interim inspection, also referred to as frequent inspection, is the second level of inspection. The nature and extent of the inspections is derived from a risk assessment. Interim inspections focus on critical components identified in the risk assessment that may become a danger before the next periodic thorough inspection (examination). The number and frequency of these inspections is also determined by the risk assessment and the manufacturers literature.

Interim Inspections are often done at the same time as planned maintenance or following a repair.

1.3.3.3 Thorough examination

A thorough examination, also known as periodic inspection or thorough inspection, is a visual examination of the lifting equipment carried out by a Competent Person carefully and critically and, where appropriate, supplemented by other means such as measurement and testing in order to check whether the equipment is safe to use. Although other terms are used for simplicity of this code the term thorough examination is used throughout.

It is also used as a check of the suitability of the equipment and the inspection / maintenance regime. This means that the thorough examination should not find any defect affecting the safety of the equipment, if it does, that suggests there is an issue with the inspection/maintenance regime, the competency of the inspectors or maintainers, the product's fitness for purpose, etc. In essence it is a safety net, used to identify inadequacies in the inspection/maintenance regime and thereby provide a means of improvement and prevent recurrence.

This means that the root cause of any defect found following a thorough examination should be investigated and rectified with appropriate measures to prevent reoccurrence.

(1) The term 'testing' includes, for example, proof load testing, operational testing at lower loads and non- destructive testing.

(2) The period between thorough examinations must be established by the competent person on the basis of statutory requirements for the equipment, LEEA recommends the following maximum intervals between thorough examination,

a. 12 monthly for goods lifting appliances

b. 6 monthly for lifting accessories and people carrying equipment.

(3) Thorough examination shall be carried out following installation and after exceptional circumstances, i.e. substantial repair or modification, following a collision, etc

(4) The examination should identify issues that could become a danger in the period before the next thorough examination and the subsequent report should advise the appropriate action to be taken.

1.3.4 Lifting Accessory (rigging equipment / lifting gear / lifting tackle)

The term lifting accessory, or accessory for lifting, is used in current legislation to mean an item of equipment used to attach the load to the lifting appliance. Such equipment is also known as 'rigging equipment', 'lifting gear' or 'lifting tackle'. For the purpose of this code the term Lifting Accessory is used throughout.

In terms of supply legislation, the term can include equipment which is intended to constitute an integral part of the load and which is independently placed on the market.

In terms of use legislation items that are incorporated into the load are generally considered as work equipment only. The lift plan must ensure that they are of adequate strength and integrity and have been inspected and found free from defect.

1.3.5 Lifting Appliance (Lifting Device)

A lifting appliance is any machine which is able to raise, lower or suspend a load but excluding machines incorporating a guided load (i.e. lifts) and continuous mechanical handling devices (i.e. conveyors). Also commonly referred to as lifting devices. Examples of lifting appliances are cranes, hoists, jacks, etc.

1.3.6 Lifting Equipment

Lifting equipment is a generic term used throughout this code to indicate loosely all lifting accessories and appliances.

The COPSULE uses this term to mean 'work equipment for lifting or lowering loads and includes its attachments used for anchoring, fixing or supporting it' and makes clear that 'load' includes persons.

1.3.7 Manufacturer

Is any natural or legal person who designs and/or manufacture lifting equipment or partly completed lifting equipment and is responsible for the conformity of the equipment with the applicable legal requirements with a

view to its being placed on the market, under his own name or trademark or for his own use. In the absence of manufacturer as defined above, any natural or legal person who places the equipment on the market or puts it into service shall be considered a manufacturer.

(1) Manufacturers placing lifting equipment onto the EU market from outside of the EU, must have an authorised representative within the EU. The authorised representative is any natural or legal person established in the EU who has a written mandate from the manufacturer to perform on his behalf all or part of the obligations and formalities connected with directive 2006/42/EC. As a minimum this means compiling the technical file.

(2) The manufacturer or authorised representative are also commonly referred to under the collective term 'Responsible Person'

1.3.8 Manufacturer's Certificate or Statement of Conformity

Dependent on the standard being worked to, the manufacturer will usually issue a manufacturer's certificate, or statement of conformity confirming the verification of the equipment. It is the manufacturer's confirmation that any necessary manufacturing test, or other product verification required by the standard, has been carried out and states the working load limit. Unless a specific document is required by the national supply legislation, then this document is also known as the 'birth certificate' for the product and it should be retained as part of the lifting equipment records.

A statement of conformity is not the same as an EC Declaration of Conformity which is a document required by European law. See section 1.3.9 EC or UK Declaration of Conformity page 4

1.3.9 EC or UK Declaration of Conformity

An EC or UK Declaration of Conformity is a declaration made by the manufacturer, or his authorised representative, that the equipment described complies with the relevant EU or GB supply legislation. It is the legal document enabling an item to be placed on the European Economic Area (EEA) or GB markets respectively and taken into service.

For the user of lifting equipment, the EC or UK Declaration of Conformity is the product 'birth certificate' and confirmation that the equipment complies with the relevant EU or UK requirements and it should be retained as part of the lifting equipment records. For lifting equipment, the EU requirements are in the Machinery Directive 2006/42/EC and also, for electrically operated lifting equipment, the Electromagnetic Compatibility Directive (89/336/EEC) as amended by EC Directive 92/31/EEC for the GB requirements these are The Supply of Machinery (Safety) Regulations 2008.

1.3.10 Minimum Breaking (or Failure) Load

The minimum breaking or failure load is the specified load (mass or force) below which the item of equipment does not fail either by fracture or distorting to such an extent that the load is released.

1.3.11 Multipurpose Equipment

Multipurpose equipment is any equipment designed to a standard specification to lift a variety of loads up to the marked SWL (see section 1.3.17 Single Purpose Equipment page 5), i.e. used for general (multi) purposes, and not designed for one specific lifting application.

1.3.12 Operative

An Operative is a trained person actually using the equipment.

1.3.13 Rated Capacity

This is the maximum gross load that a lifting appliance can lift for its specific configuration. It is generally used for lifting appliances in the same way as Working Load Limit is generally used for lifting accessories. It is not to be confused with Safe (Specific application) Working Load, see section 1.3.17 Single Purpose Equipment page 5 and the notes there to.

1.3.14 Proof or Test Load

A proof or test load is a load (mass or force) applied by the Competent Person for the purpose of a test. This load appears on reports of thorough examination, if a proof test has been made by the Competent Person in support of their examination, and on test certificates.

> Proof load tests are also done as part of the verification of new lifting equipment or following installation.

1.3.15 Report of a Thorough Examination

A report of a thorough examination (also known as a report of thorough inspection or report of periodic inspection) is a report issued by the Competent Person giving the results of the thorough examination, which will detail the defects found or include a statement that the item is fit for continued use. Where the Competent Person has carried out a test as part of the inspection/examination, the report will also contain details of the test.

> (1) The report of thorough examination must be retained as part of the lifting equipment records.
>
> (2) In some cases, a reference to the test report appears as an appendix to the thorough examination.

1.3.16 Safe (Specific application) Working Load (SWL)

The safe working load or specific application load (SWL) is the maximum load (mass) as assessed by a Competent Person which an item of lifting equipment may raise, lower or suspend under the particular service conditions. The SWL is marked on the equipment and appears in statutory records.

> (1) The SWL will normally be the same value as the working load limit, maximum safe working load or rated capacity where the term is used in a particular section of the code; but it may be less (see section 1.3.20 Working Load Limit (WLL) page 6 and the note there to).
>
> (2) In some geographical regions the word ‘safe’ is not used in the description but the requirement is the same, so instead of safe the phrase ‘specific application’ is used instead and the acronym SWL will be used throughout this code.

1.3.17 Single Purpose Equipment

Single purpose equipment is any equipment designed for and dedicated to lifting a specific load in a specified manner or working in a particular environment, i.e. used for a single purpose.

1.3.18 Report of Test

Report of test, previously known as ‘test certificate’ is a report issued by the competent person who did the test and details the specifics of the test. Test reports are not legal documents allowing the equipment to be used, except when used in support of legal documents such as the EC Declaration of Conformity, Manufacturers Certificate or Report of Thorough Inspection/Examination.

> For new equipment for the EU or GB markets,, this will be an EC or UK Declaration of Conformity, respectively, For products intended for other markets a manufacturers certificate is advised. Supporting structures that are not within the scope of the EU or GB supply legislation will be issued with a report of test and examination following installation and proof load. Older equipment may will have been supplied with a “test certificate” and such equipment may still be found .in-service. All of these documents are sometimes referred to as the ‘birth certificate’. In some cases the legislation and the standards may require a combination of these documents and the information from each can be merged into a single document.
>
> A test does not just mean load testing it is a phrase that covers other tests such as non-destructive testing.

1.3.19 Verification

Verification is the generic term used to describe the procedures adopted by the manufacturer or Competent Person to ensure that lifting equipment is to the required standard or specification, meets legal requirements

and is safe to operate. This includes proof load tests, sample break tests, non-destructive tests, calculation, measurement and thorough examination.

For new equipment, the verification methods used by the manufacturer will depend on the standard being worked to. Some equipment is unsuitable for proof load testing due to the nature of the materials used, e.g. textile slings. Some items are assembled from components verified to their own standards so no further tests are required, e.g. grade 8 mechanically assembled chain slings. Once in service, the verification methods used will be those deemed necessary by the Competent Person in reaching their conclusions about fitness for purpose.

1.3.20 Working Load Limit (WLL)

The working load limit is the maximum load (mass) that an item of lifting equipment is designed to raise, lower or suspend. In some standards and documents WLL is referred to as 'maximum SWL.' This term is more generally used for lifting accessories, but lifting appliances are now commonly marked with a rated capacity, see section 1.3.13 Rated Capacity page 4

(1) Much confusion exists between the terms 'SWL', 'working load limit' and 'rated capacity'. By way of explanation, working load limit or rated capacity is the load value assigned to the 'maximum' SWL under ideal conditions (by calculation) and in most cases the working load limit or rated capacity and the SWL will be the same. However, depending upon the conditions of use, it may be necessary for the Competent Person to reduce this to a lower SWL and it is in these cases that the working load limit or rated capacity and SWL will differ.

(2) If the risk assessment of the application indicate that such reduction may be required, it is essential that the user declares this information at the time of ordering so that the correct SWL may be attributed to the equipment and documentation. In the absence of such a declaration, the manufacturer or supplier will assume that the application is suitable for equipment rated with the SWL equal to the working load limit. If the equipment is in service or the user has not declared this information to the manufacturer, then it is the user's responsibility to determine and mark the appropriate SWL.

(3) The conditions where it may be necessary to reduce the working load limit to a lower SWL are HAZARDOUS DUTIES. Hazardous duties could, for example, be environmental conditions such as extremes of temperature, high windspeeds or lifting procedures such as a likelihood of shock loading or inaccuracy of weight. When such circumstances arise, it is essential that systems should be instituted to prevent normally rated equipment being used to its full capacity.

(4) Whilst it is the responsibility of the user to take such steps, the following advice should be considered:

a. For specific installations where the equipment is fixed permanently in position, the equipment may be marked with the reduced SWL for that specific duty.

b. For specific installations where the equipment is portable, the user should provide written instructions to the operative which include an instruction to use a normally rated piece of equipment (i.e. SWL = WLL) but of appropriately higher capacity thus achieving the same effective reduction.

c. For an industry or a definable section of an industry where the majority of tasks require equipment having a reduced working load, then all the equipment should have a reduced working load i.e. that corresponding to the most hazardous duty.

1.4 GENERAL LEGAL REQUIREMENTS

1.4.1 General

Throughout the world there are numerous national legislative requirements concerning the supply and use of lifting equipment. This code is based upon industry best practice or legislation offering the highest level of safety that either meets or exceeds the minimum requirements globally. This has been done to set a minimum benchmark for safety and a level playing field for LEEA members and ensure that they and this guidance is compliant. Much of the legislation emphasizes subjects like planning and supervision of lifting operations. The following is a summary of the legal requirements which reflects the spirit of the legislation where everyone has a legal responsibility for safety, i.e. manufacturers, designers, suppliers, employers, employees, etc. For the full details, you should always refer to the legislation, its associated Approved

Code of Practice (ACoP) and guidance. In the context of lifting operations and lifting equipment, the following eight requirements must be considered:

(1) The equipment must be safe and suitable for the intended purpose.

(2) Manufacturers and suppliers must provide information on the use including any incorrect use of their equipment, including information and inspection/rejection criteria.

(3) Those obtaining equipment for others to use at work must ensure that it is safe and suitable for the intended purpose.

(4) The lifting operation must be adequately planned, supervised and carried out in a safe manner.

(5) The personnel who use the equipment must be suitably trained.

(6) The equipment must be maintained in a safe condition.

(7) The equipment must be inspected and thoroughly examined to check whether it is safe to use.

(8) Records of conformity, test and examination need to be kept in accordance with national regulations.

1.5 PRINCIPLES FOR THE SELECTION OF LIFTING EQUIPMENT

1.5.1 Verification

All lifting equipment should be of adequate strength, sound material, of good construction and suitable for the duty which it must perform. It should be verified in accordance with the requirements of the standard being worked to. New equipment should comply with the essential health and safety requirements stipulated in the applicable legislation, product standard where available, and issued with the required conformity documentation specified therein. This documentation is often combined with the results of the verification and together they form the 'birth certificate' (see definitions in section 1.3.8 Manufacturer's Certificate or Statement of Conformity page 4 and section 1.3.9 EC or UK Declaration of Conformity page 4) which is an important legal document. When selecting lifting equipment, the guidance outlined in section 1.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER page 8 should be followed.

1.5.2 Factor of safety (FOS)

Good practice requires that any lifting equipment shall have an adequate factor of safety incorporated in its design. Where appropriate in each of the separate sections, a minimum factor of safety for the specific item is recommended and this should not be reduced.

The purposes of a factor of safety are numerous, including allowance for wear, impact, dynamic loading and accidental overloading. For example, chain slings are more robust and defects can be more apparent than textile slings and therefore tend to have a lower factor of safety. However, it cannot be too highly stressed that such allowances are a contingency only and must never be purposely eroded. Care should always be taken to avoid circumstances which can overload (e.g. impact, shock) and care should also be taken in circumstances where inadvertent overload can occur (e.g. multi point lifts. See section 1.9 SAFE USE OF LIFTING EQUIPMENT page 10). In extreme cases, multiple adverse circumstances may cause failure even if the nominal load does not exceed the SWL. If such circumstances are likely to occur, reference should be made to a Competent Person who will advise whether it is necessary to use higher rated equipment to achieve a higher factor of safety.

1.5.3 Standards

Many items are covered by international standards and national standards. Where applicable, these are listed under individual headings.

1.5.4 Intended use

Some lifting equipment (e.g. lifting beams) can be used in a variety of ways. It is, therefore, important that information on the specific intended use, including potential misuse, should be indicated to the manufacturer/ supplier in such cases and the advice of a Competent Person sought before any change of use is authorised.

1.5.5 Compatibility

A final point to be considered when selecting equipment for a particular operation is compatibility between the various items required. Care must therefore be taken to ensure that each item of equipment seats correctly and aligns with its neighbour, Additional specific information relating to various types of equipment is given in each section of the code.

1.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

The following is a typical list of information which should be exchanged. It should be noted that the list is confined to information relating to the safety of the equipment and excludes any information of a purely commercial nature. Additional specific information relating to various types of equipment is given in each section of the code.

Care should be taken to explain to the Competent Person the particular requirements of a load to be lifted and the proposed manner in which the equipment is to be used. This is essential in order to establish the required SWL when considered against the working load limit or rated capacity. (See the explanatory note under section 1.3.20 Working Load Limit (WLL) page 6)

(1) Geometry and total maximum weight of the load to be lifted.

(2) Detailed description and/or drawing of the load to be lifted giving all principal dimensions which affect the lifting operation and method of lifting envisaged. In particular, emphasis on (a) headroom, (b) height of lift, (c) transport when suspended, (d) manipulation of suspended load, (e) centre of gravity. In addition, methods of lift and means of attachment should be stated together with external obstructions likely to be encountered in the use of the items.

(3) Details of any adverse environmental conditions such as extremes of temperature, humidity, chemical attack, corrosive atmospheres.

(4) Details of frequency of use and average loadings so that a duty rating can be established.

(5) Details of where to send operating instructions and legal documentation including information on correct maintenance, storage and limitations on its use.

1.7 MARKING, STORAGE AND HANDLING

1.7.1 Marking

1.7.1.1 Verified Marking Requirements

Equipment which has been satisfactorily verified in accordance with the product specification and has passed the subsequent thorough examination should be marked with:

(1) the WLL/SWL or rated capacity; and

(2) an unambiguous means of identification to cross refer to the associated documentation; and

(3) such other marks as are required by the standard being worked to and by legislation.

1.7.1.2 Marking Methods and Placement

Marking should be by suitable means, i.e. plate, metal tab, textile label, etc, permanently attached or by stamping directly into the equipment, preferably in a non-load bearing or low stress area. Stamping into a stressed area may also be permissible provided that the mechanical properties of the component are not significantly impaired. Where applicable, the position and size of stamping should be as indicated in the relevant standard. When the means of marking can be lost, additional information should be used to convey this information. It is therefore recommended that the identification mark (see section 1.7.1.1 Verified Marking Requirements page 8 (2)) should also be put directly onto the equipment so that in the event of the original means of marking becoming detached, the identity is not lost, and the other information can be recovered from the related documentation.

1.7.1.3 Control of Illegible or Missing Markings

Should any of the required marking become obliterated or illegible, the equipment should be withdrawn from service and referred to a Competent Person for re-marking or, if necessary, for re-verification and re-marking. See section 1.7.1.2 Marking Methods and Placement page 8.

1.7.1.4 Marking of Changeable Information

Where the user wishes to mark the equipment with information which is liable to change (e.g. plant location reference, date of examination, etc.) it is recommended that a tag is used as the frequent stamping and subsequent obliteration of stamp marks on load bearing components is detrimental and will, at best, shorten the life of the equipment.

1.7.1.5 SWL Marking: Metric and Imperial Units

The SWL of new equipment will be in the metric units of tonnes (t) or kilograms (kg) or imperial units of Tons (T) and Pounds (lb). The generally accepted rule is that a SWL of less than one tonne or Ton are marked in kilograms or pounds respectively.

1.7.1.6 Grade Marking

Certain items of lifting equipment are marked with a grade or quality mark, particularly where this information is required for safe use.

1.7.2 Storage and Handling

1.7.2.1 Importance of Safe Storage

In order to reduce to a minimum the risk of damage or deterioration which may affect the safety of equipment, it is essential to provide suitable storage for equipment not in use and in many cases to prepare it for storage first.

1.7.2.2 Guidelines for Safe Storage

The ideal storage requirements vary according to the nature of equipment and reference shall be made to manufacturers literature. However, in general the storage area should be dry, free from injurious pollution and not subject to extreme temperatures. Equipment embodying exposed threads or machined bearing surfaces (e.g. eyebolts, shackles) should be protected and handled with care. Equipment which is returned to stores wet or has been subject to other substances liable to cause deterioration should be treated with special care. In particular, it should be remembered that solutions of chemicals will become more concentrated as the solvent evaporates, e.g. weak acids will become strong acids. In these circumstances the general advice is to clean and dry the equipment into storage.

1.7.2.3 Secure Controlled Storage Area

The area should be designated for the purpose and preferably controlled to restrict access of unauthorised persons.

1.7.2.4 Suitable Storage Equipment

Bins, racks, etc. should be provided and only the heavier, more robust, items allowed to lie on the floor. Requirements for storing individual items are given in the appropriate sections of the code.

1.8 INSPECTION

1.8.1 Requirements for Interim and Pre-Use Inspection

Lifting equipment can be subjected to operational and environmental conditions which may affect its safe working characteristics. Legislation therefore requires that lifting equipment is properly maintained and safe to operate at all times. To ensure that this is the case, current good practice requires pre-use inspections and interim inspections at suitable intervals between the statutory thorough examinations. Regular 'interim' inspections should be instituted, at appropriate intervals, to ensure the legal requirements are met. The period between the 'interim' inspections will be determined by the utilization, age of the equipment and remaining design life, environment, manufacturers literature and similar factors based on the history of the equipment. Inspections are particularly important before issue for use.

> ⓘ In terms of the age of the equipment and the remaining design life, some standards call for an enhanced inspection or major overhaul at specific intervals. Otherwise this interval is determined by the risk assessment.

1.8.2 Competency and Control of Interim Inspections

The interim inspection should be carried out by a Competent Person. For organisations handling a large and varied amount of equipment, it may be more economical to invest in a planned control system using a series of controlled stores, colour coding systems, etc. Information on such systems can be provided by LEEA Members.

1.8.3 Statutory Thorough Examinations and Maintenance

Users are reminded that notwithstanding any interim inspections carried out, they are required by this code to have all lifting equipment thoroughly examined by a Competent Person at statutory periods. This is also a legal requirement in many countries. It is also recommended that procedures be instituted to ensure that manufacturers' recommendations with regard to regular maintenance are carried out.

1.8.4 Repairs with Certified Parts and Record Keeping

When repairs to load bearing parts of the equipment are carried out using certified spare parts, the equipment should subsequently be thoroughly examined by a Competent Person to ensure that the work has been performed correctly. In addition, the records for the equipment should be amended taking account of the replacement parts fitted.

1.8.5 Repairs with Uncertified Parts and Record Keeping

When repairs are carried out with uncertified spare parts, the equipment should be verified in accordance with the original product specification and thoroughly examined by a Competent Person. Otherwise this may be considered as making new equipment from second-hand components and the repairer is responsible for ensuring the equipment meets the essential health and safety requirements of the supply legislation.

1.8.6 Issuing Reports of Thorough Examination and Record Keeping

On completion of the thorough examination by a Competent Person, a report of thorough examination should be issued. This should be kept with the records for the equipment.

1.9 SAFE USE OF LIFTING EQUIPMENT

1.9.1 General Procedure

The objective of good lifting practice is to ensure that the load is safe and, when lifted, is as secure in the air as it was on the ground. The following is a general procedure which can be adapted to any lifting operation irrespective of the type of lifting appliance or the method of attaching the load to the appliance.

There are two terms commonly used to describe the attaching of the load to the lifting appliance, 'slinging' and 'rigging', but for simplicity of this code the term 'slinging' has been used throughout.

(1) Determine the weight of the load and the position of its centre of gravity in relation to the lifting (pick up) points. In all lifting operations, care should be taken to ensure that the load imposed on any item does not exceed its SWL. Where there is any uncertainty about the weight of the load or the load applied to a particular part of the equipment, it is recommended that load sensing devices be used.

(2) Decide upon the method of lifting and slinging the load. The equipment selected should only be used in accordance with the manufacturer's instructions and should not be used or adapted for any other purpose without the approval of the manufacturer or other competent design authority. The equipment and its method of use should be suitable for the load and the method of attachment of slings to the load and slings to the lifting appliance should be secure. No item of lifting equipment should be overloaded either by the weight of the load or the weight and method of slinging.

(3) The slinging method must ensure that the load is balanced, does not violently or unintentionally change its attitude when lifted and at all stages of the lift remains in a stable condition. In general the load will swing and may be unstable if at any time the centre of gravity of the load is not vertically beneath the crane hook, or the centre of gravity of the load is higher than the point of attachment of the slings to the load. (For details see 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16)

(4) Care must also be taken to ensure that the load is not damaged by the lifting equipment and equally that the lifting equipment is not damaged by the load. Depending upon the slinging method chosen, packing may be required between the sling and the load. For guidance on this see appendix 5, paragraph 1. A5.4.1 Sling Types page 20.

(5) A pre-use inspection (see section 1.3.3.1 Pre-use inspection page 2) of the lifting equipment should be completed to check for obvious defects before use.

(6) If required by the risk assessment, ropes or 'tag lines' or other load manipulating devices should be used to control the load once it is in the air. This is particularly recommended in the case of long loads where tag lines should be attached at one or both ends so that rotational movement may be controlled. The tag line should be of such length that the operative(s) need not stand under the load during the lift. Under no circumstances must tag lines be used to balance the load, or for any other purpose than controlling the rotation of the load.

(7) The lift plan shall take into account any obstacles which may have to be avoided, such as overhead power lines, pipe work or other lifting operations for example.

(8) Before commencing the operation, a suitable landing site should be prepared. The site chosen must be of adequate size and capable of taking the weight of the load. The operative should be wary of any cellars, suspended floors, underground ducts, etc. which affect the load bearing capacity of the floor. In addition, it may be necessary to provide suitable landing pads, e.g. timber bearers, to enable the slings to be removed from under the load.

(9) Ensure that the load is free to be lifted and not restrained by fixing bolts, jigs, etc. Seals or joints, which may offer considerable resistance, should be separated by other means before the lift commences.

(10) Ensure that any loose parts of the load are adequately secured, either by the slinging method or by other means such as, containers, bindings or secondary positive holding devices, or that they are removed.

(11) There must be a clear method of communication between all those with duties under the lift plan and involved in the lifting operations. Hand signals are preferred to voice communication particularly where noise might interfere. Examples of crane signals commonly used are described in appendix 1.1. If the operatives involved in the lifting operation have not worked together before they should check before starting that they have a common understanding of the signal system. If voice communication is used, there should be an agreed protocol to ensure that misunderstandings do not occur.

(12) Unless unavoidable, no-one should be allowed under a suspended load and, as far as possible, all people should be kept clear of the area of operations. Where it is not possible measures shall be provided to protect persons in the danger zone, e.g. secondary load restraints to secure the load if the primary fails.

(13) With ALL lifting operations, the load should be lifted a nominal distance only in the first instance. This trial lift allows the operative to check and confirm the balance, stability and general security of the load whilst it is in a relatively safe position. If any discrepancies are found, the load should be lowered and the slinging revised within the limitations of use. The sequence of trial lift and adjustment should be repeated until the operative is satisfied that the load is balanced, stable and secure.

(14) When lowering the load, it should be brought to a halt a short distance above the landing site to allow the operative to steady it, check its position and the position of any landing pads, etc. and to ensure that all personnel are clear of the danger area. The load should then be carefully lowered down into position. Before slackening off the slings, check that the load is safe and stable. If not, it should be lifted slightly to allow the landing blocks, etc. to be adjusted and lowered again. The trial landing procedure is very similar to the trial lift procedure and should be repeated until the operative is satisfied that the load is safely landed. THE LOAD SHOULD NOT BE LOWERED SO AS TO TRAP THE SLINGS AS THIS MAY RESULT IN SERIOUS DAMAGE TO THEM.

(15) The operative should always be careful when setting down to avoid injury. Having set the load down correctly, the sling legs should be manually withdrawn by the operative. The lifting appliance should never be used to drag a sling out from under a load.

(16) If, when the lifting operation is complete, the equipment is no longer required, it should be returned to proper storage. For guidance on storage of equipment covered by this code see section 1.7 MARKING, STORAGE AND HANDLING page 8 and appropriate sections.

(17) If slings are to be left on the lifting appliance for further lifts, the sling legs should be hooked back onto the upper terminal fitting to minimise the risk of inadvertently becoming hooked onto surrounding objects or striking someone.

1.9.2 Other Requirements

Other requirements to be taken into account are given to the following additional points:

(1) All operatives and supervisors shall be adequately trained in the methods and safe use of the equipment. This training and instruction should be documented. It is also a duty for operatives to use only equipment for which they have received training or instruction and to use it only in accordance with such training and instruction. It should be noted that in some countries this is a legal requirement.

(2) Operatives and supervisors shall be supplied with any operating instructions provided by the manufacturer or supplier and any current updates relating to the use of the equipment which the manufacturer or supplier may provide at a later date.

(3) Where an operation requires more than one operative, it is essential that communication between operatives is clear. Reference should be made to the appropriate standard for hand signals applicable to the country of use, e.g. BS 7121- 1, ISO 16715, ASME B30 series. (See appendix 1.1). Due to the variances in standards and nationality of personnel, steps should be taken to ensure that all operatives place the same interpretation on any signal as part of the pre-operational briefing.

(4) Where an operation requires more than one operative to handle the slings or guide the load, it is good practice that only one operative should give signals to the crane driver or person operating the lifting appliance. The exception to this rule is the emergency stop signal which any operative may give to

override the previous signal. In the case of a complex operation involving multiple lifting appliances where the above is impractical, procedures should be laid down beforehand to ensure that drivers and appliance operators do not receive conflicting signals.

(5) If special circumstances indicate that the standard signals in appendix 1.1 will not be adequate, then other methods of communication should be considered such as voice communication by radio or hard-wired systems. Whatever method of communication is decided upon, it is important that there should be no risk of signals being confused or being misunderstood.

(6) When undertaking a multi-point lifting operation (i.e. where two or more lifting appliances are used together) steps must be taken to ensure that no item of equipment or lifting point is at any time subjected to a load in excess of its SWL. There are numerous ways of ensuring this according to the nature of the operation. For example, where total lifting capacity is not unduly limited, then each lifting point together with its associated lifting machine and tackle could be selected to be capable of sustaining the entire load. Where the capacity is limited, or there is any uncertainty regarding the lift, the use of load sensors will provide continuous guidance on individual lift-point equipment loadings as the operation proceeds. An alternative is to calculate carefully the loads which will be imposed; but care must be taken to ensure that no false assumptions are made especially with regard to the weight and the position of the centre of gravity. The load calculation should take into account the weight of lifting accessories and attachments.

(7) Where it is reasonably practicable to do so when using cranes for multi-point lifting, the lifting appliances should be linked and controlled from a single control station and be fitted with load limiting and monitoring devices. This is to ensure the load on individual components is not exceeded during the lifting operation. Where this is not possible the lifting operation should be planned and executed with extreme care. The lifting medium, i.e. rope, should remain vertical to prevent side loading particularly when slewing. If one lifting appliance leads when lifting, lowering, slewing or traversing, then the load magnitude can be transferred from one crane to another and therefore means should be provided to prevent overloading. The use of cranes of equal capacity, geometry and motion characteristics is recommended to minimise variation in the direction and magnitude of the applied forces acting on the lifting appliances. Unless load sensors or some other special method is used, the SWL of each lifting point and its associated equipment should be not less than 1.5 times the share of the load which it is intended to take. As the lift proceeds, a constant check should be kept on the various angles of the equipment and load as these provide an indication of the way the load is distributed. Instruments are available that can perform these checks and should be used. In the case of rigid loads lifted on more than two lifting points, then number of lifting points will bear the load at any time must be taken into account, as in practice the majority of the load may be taken on only two or at best three lifting points. In such cases, the SWL of each lifting point and its associated equipment should be not less than half the total load.

> ⓘ It is not recommended to use tower cranes for multi-point lifting.

(8) Lifting equipment should not be altered or modified in any way without the approval of the manufacturer or other competent design authority and if so should be re-verified, examined and certified before further use.

1.10 TRAINING

1.10.1 Operative Training

All operatives are required by this code of practice to be trained in the use of the lifting equipment they will operate. This code of practice also imposes a duty on them to use only equipment for which they have received training or instruction and to use it only in the manner for which they have been trained or instructed. It is recommended that formal training be undertaken and a record kept that the operative reached a satisfactory standard. The following lists the general matters which the operative training should take into account. Each section of the code then refers to the product specific matters to be addressed.

(1) They shall be informed of the specific use for which the item of lifting equipment is intended and have access to the manufacturers and any appropriate instructions for use.

(2) They shall be shown the correct method of use of the item(s). Warning should be given as to incorrect methods of use and dangerous practices, together with an explanation of the possible outcome.

(3) They should be instructed in the recognition of the marking on the equipment and its meaning, including any limitations this may impose on the use.

(4) They should be instructed in the daily check procedure, including any requirements imposed by the manufacturer, supplier or Competent Person.

(5) They should be informed of the pre-use inspections to be made, including load and angle estimation, where applicable, and the identification of basic equipment defects together with the procedure for reporting these to the Competent Person.

(6) They should be instructed in the correct methods of attaching the load, slings and other accessories to the load hook of the appliance.

(7) They should be informed of the pre-lift checks to be carried out, e.g. trial lift.

(8) They should be instructed in the lifting and lowering procedures to be adopted. For complicated lifting operations, written systems of work, complete with diagrams, should be issued to operatives or be on permanent display in the vicinity of the lifting operation. Operatives should be familiar with their role within the lift plan.

(9) Where applicable, they should be instructed in the signals to be used when more than one operative is involved in the lifting operation.

(10) They should be conversant with the possible faults which can occur in use and understand the withdrawal from service and reporting procedures applicable to the site.

(11) They should be instructed in the procedures to be adopted on completion of the lifting operation, including the correct methods of preparing portable items and accessories for transportation and storage.

(12) They should understand the correct methods of storage and the need to ensure these requirements are observed.

(13) Emphasis should be given to safe systems of work and operatives should be encouraged to seek advice when in doubt.

1.10.2 Lifting Operation Supervisor

The training of the Lifting Operation Supervisor, whilst covering similar points, is likely to require a different emphasis to the above. Formal training should also be undertaken and a record kept that the Supervisor reached a satisfactory standard.

1.A1 APPENDIX 1 Not available in the latest release of the COPSULE

1.A2 APPENDIX 2 - LOAD ESTIMATION - WEIGHT AND CENTRE OF GRAVITY

1.A2.1 FOREWORD

The importance of knowing with reasonable accuracy the weight of a load to be lifted and the position of its centre of gravity is stressed throughout this code. The following provides guidance on various methods to obtain this information.

> ⓘ Various systems of weights and measurement are used throughout the world, but for simplicity this code refers only to the metric system. To assist the user of other systems of weight and measurements conversion equations are given in this appendix.

1.A2.2 WEIGHT

(1) Check if the weight is marked on the load. If it is, verify that it represents the weight of all parts of the load (e.g., a machine tool might not include the drive motor).

(2) Check the weight stated on any documentation.

(3) Look at a drawing of the load. If the weight is marked, check as in (1) above to ensure it includes all parts of the load.

(4) If the load is still on a trailer or truck, weigh it on a weighbridge.

(5) Estimate the weight of the load using tables of weights. These can be found in standards or suppliers literature.

The 1 Weights of materials page 14 gives the weight per unit volume for a range of materials:

Table 1 Weights of materials

Material	Weight in kilograms per cubic metre	Weight in pounds per cubic foot
Aluminium	2700	170
Brass	8500	530
Brick	2100	130
Coal	1450	90
Copper	8800	550
Concrete	2400	150
Earth	1600	100
Iron-steel	7700	480
Lead	11200	700
Magnesium	1750	110
Oil	800	50
Paper	1120	70
Water	1000	62
Wood	800	50

(1) In some cases, the above figures are average only and the actual weight may vary according to the particular composition/water content, etc.

(2) All figures have been rounded for convenience of use.

(3) When dealing with a hollow body, check whether it contains anything and whether any such contents are liable to move.

1.A2.3 VOLUMES OF COMMON SHAPES

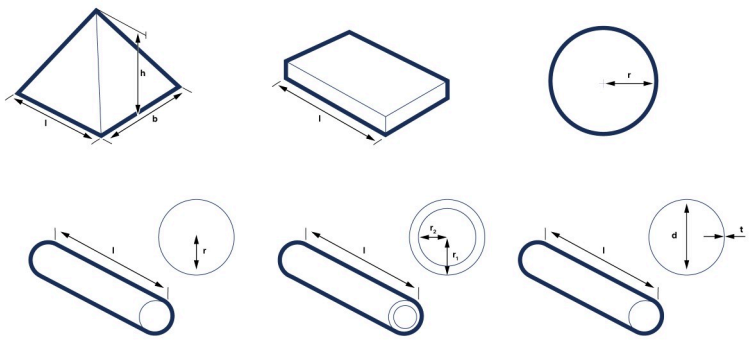


Figure 1.A2.3-1

1.A2.3.1 Value of π

π is approximately equal to 3.142

1.A2.3.2 Weight Conversion

1 ton (US) = 2000lb = 907.185kg

1 tonne (metric) = 1000kg = 0.9842tons (imperial) = 2204.6lb (imperial)

1.A2.3.3 Force Conversion

1tf (US) = 2000lbf = 8.896kN

1tonnef (metric) = 2204.6lbf = 9.806kN

Ensure compatibility of units in all calculations.

1.A2.4 CENTRE OF GRAVITY (C of G)

The centre of gravity is the point at which the total weight of the body may be regarded as being concentrated. Another way of saying this is that the centre of gravity is the point about which the parts of a body exactly balance each other.

With a regularly shaped load the position of the centre of gravity can easily be judged by measuring out the midpoint in each direction. For more complex shapes, however, it may be necessary to estimate the centre of gravity of the various parts of the load and then combine them to get a centre of gravity for the whole.

If, in Figure 1.A2.4-1 page 15, the weights of the three parts A,B and C are Wa, Wb and Wc respectively, then having estimated them and the positions of their centres of gravity, we can take moments about a given point (e.g. one end) and thus determine the position of the line through which the centre of gravity of the whole acts and which is an unknown distance X from the given point.

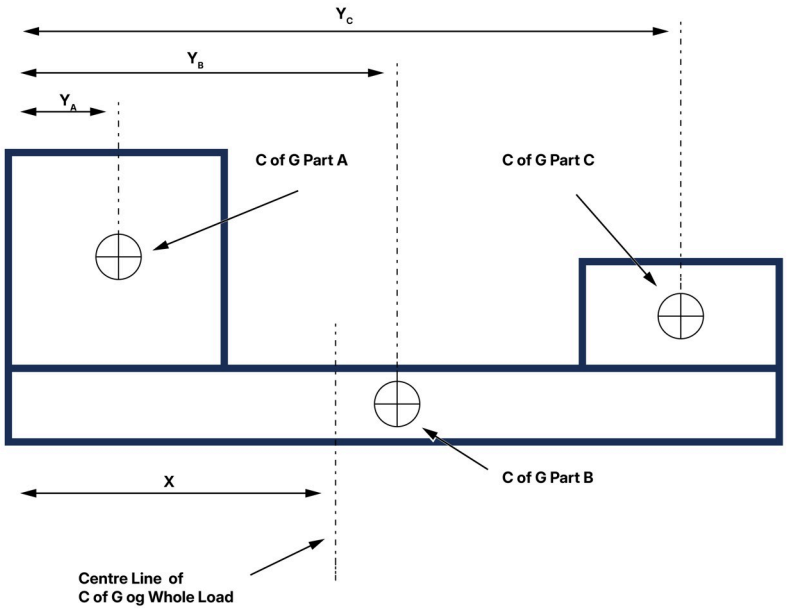


Figure 1.A2.4-1

Thus from the formula (Wa + Wb + Wc) X = Wa Ya + Wb Yb + Wc Yc the unknown distance X can then easily be found.

Once the position has been estimated, it should be marked in some way (e.g. chalk, sticky tape) to guide the operative when attaching the slings.

This calculation will determine the position of the centre of gravity in one plane only. By applying the same method in the other two planes, the precise position can be determined.

1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY

1.A3.1 FOREWORD

Before lifting, it is essential to ensure that when clear of the ground, the load will adopt the intended attitude and remain securely attached to the lifting appliance without overloading any of the lifting accessories. This means that the load must be both balanced and stable.

1.A3.2 BALANCE

In the majority of lifts, it will be intended that the load will remain level when clear of the ground. To achieve this, it is first necessary to position the hook of the lifting appliance vertically above the centre of gravity of the load.

The legs of the sling(s) should be distributed as evenly as is practicable according to the lifting points available. The angle which the individual leg makes with the vertical affects the proportion of the load which will be imposed upon it and all legs should therefore be, so far as is practicable, at a similar angle to provide equal loading.

If the load tilts on lifting, the load in the sling legs will become unequal. This effect is especially significant at small included angles between sling legs.

With rigid loads lifted on two or more lifting points, consideration should be given to how many of the legs will bear the weight as it may be found that only two or three will take the majority with the remaining legs providing a relatively small 'balance force' only. If this is the case, larger capacity slings will be required. The use of load sensors will provide a means of monitoring individual leg loadings.

1.A3.3 STABILITY

In this context, stability means 'resistance to toppling'. An object with a narrow base and a high centre of gravity will need less force to topple it than one with a wide base and a low centre of gravity.

As the height of the centre of gravity increases relative to the width of the base, a point will be reached where the object will fall over unless it is supported by external means. At this point, the object is regarded as being unstable and the greater the support required the more unstable it is. A similar situation exists with a suspended load. Forces which try to topple the load will inevitably be present (e.g. wind, acceleration, braking).

It is essential, therefore, when slinging a load to ensure that it is sufficiently stable to resist these toppling forces. A load will be inherently stable if the lifting sling is attached ABOVE the centre of gravity and properly disposed around it.

Where the sling is attached below the centre of gravity, the degree of stability will depend on two relationships: firstly, the ratio of b/h; and secondly the ratio of α/β (See Figure 1.A3.3-1 page 17)

The larger these ratios, the more stable the load. It will be noted that decreasing dimension 'h' has the effect of increasing both ratios at the same time and this is the most desirable solution if practicable.

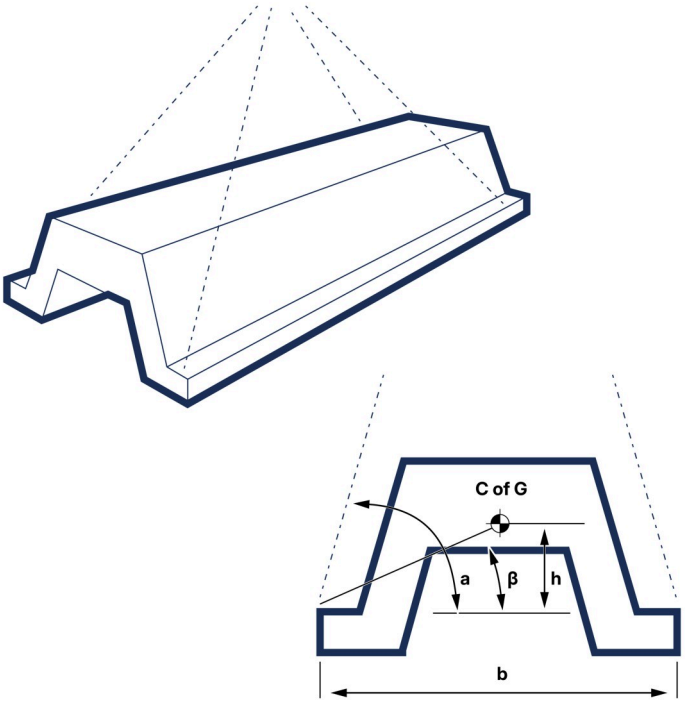


Figure 1.A3.3-1

Particular care must be taken when lifting loads from below the centre of gravity using a lifting beam. (See Figure 1.A3.3-2 page 18)

Such an arrangement is often employed where headroom is restricted. It should be recognised however that if dimension Y is equal to or greater than dimension X, then the system WILL BE INHERENTLY UNSTABLE AND DANGEROUS.

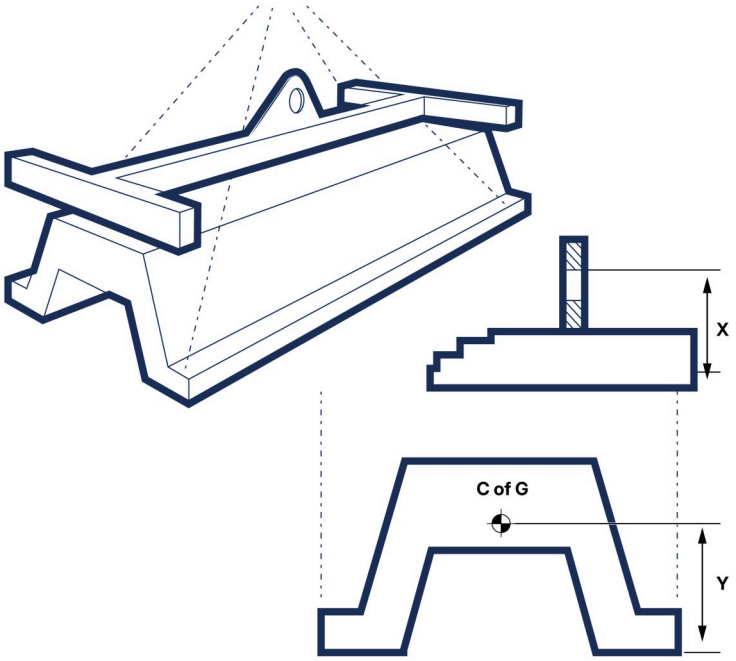


Figure 1.A3.3-2

Where it is intended to 'turn over' the load when in the air or position it at an inclined attitude, special consideration should be given to the questions of balance and stability to ensure that at all stages of the operation the load remains balanced, stable and securely attached without overloading any item of lifting equipment.

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

1.A3.4 SLING EQUALIZERS

To improve balance and ensure that the hook is positioned above the centre of gravity, slingers are increasingly using pulley blocks in the rigging arrangement. Although this can be beneficial where the COG may be difficult to estimate or when lifting multiple loads with a varying COG are to be lifted, the practice can introduce a number of risks that need to be properly planned and controlled, either by the rigging arrangement itself or through control and safe systems of work during the lifting operation.

Pulley blocks do not have a positive holding mechanism, so as the lifting machine hoists, they will naturally position themselves and the crane hook above the centre of gravity. However, this can only be safe if the position of the COG does not or cannot change during the lifting operation. For example, if during a lifting operation the load should collide or become snagged the COG will shift and when used with a pulley block this can result in destabilisation, uncontrolled movement and potentially loss of the load. Similarly, lifting dynamics due to horizontal travel can cause the load to tip or swing. Again, this can cause the COG to shift and again cause potential loss of load control.

If considering the use of load equaliser, it is important that these factors are properly assessed, and the associated risks are reduced to an acceptable minimum. This can be achieved through the rigging arrangement or by motion control devices or restraints.

When selecting sling equalisers use only those that have been designed specifically for the task. LEEA only supports the selection and use of equipment designed for the purpose. In the UK and EU such equipment shall be conformity marked as a lifting accessory, be issued with a declaration of conformity and suitable instructions for safe use.

If in any doubt with respect to load stability and balance when using pulley systems, LEEA recommends the use of other equipment that has been designed for the purpose, such as sling shortening devices, refer to SECTION 14 - CHAIN SLINGS page 237 – SECTION 18 - FIBRE ROPE SLINGS page 295 and SECTION 23 - RIGGING SCREWS AND TURNBUCKLES page 355 for further guidance and alternatives.

1.A4 APPENDIX 4 - STRUCTURES

1.A4.1 FOREWORD

In this context, structure refers to any support or anchorage for lifting equipment.

Frequently, such structures are primarily designed for other purposes, e.g. a building from which a runway is suspended. It is important to ensure that they are adequate for the purposes of lifting but, owing to other loads which may be imposed, proof load testing alone is not adequate. The following procedure is therefore recommended.

1.A4.2 DEDICATED SUPPORTING STRUCTURES

A theoretical check on the dedicated supporting structure, e.g. runway, should be carried out by a structural engineer or other suitably qualified person. To do this, the engineer will need to know the nature, positions and values of the loads to be imposed. With regard to the allowances to be made for dynamic loading, the structure should be designed in accordance with the applicable National standard.

The dedicated supporting structure itself should be constructed, tested and certified in accordance with, SECTION 10 - SLEWING JIB CRANES page 181, SECTION 11 - RUNWAYS page 193 and SECTION 12 page 205 of this code and should, together with all connections to the supporting structure, be subject to periodic thorough examination at appropriate intervals.

1.A4.3 OTHER LIFTING POINTS

As with dedicated supporting structures, a theoretical check should be conducted by a suitably qualified person and written confirmation obtained and kept with the lifting equipment records.

The connection between the lifting appliance and the structure should be properly designed for lifting purposes, tested and certified, e.g. a beam clamp (see SECTION 9 - BEAM CLAMPS page 173section of this code). All such connections should be subject to periodic thorough examination at the appropriate intervals.

1.A4.4 MARKING

All dedicated supporting structures and approved lifting points should be clearly identified and marked with their SWLs. It should be noted that, when designing lifting equipment support structures for use with power operated hoists, the allowance made for dynamic loading is higher than that for structures used with manually operated hoists. It is therefore important to ensure that power operated appliances are not used on structures or lifting points designed for manually operated equipment without a due allowance being made. To avoid confusion, it is recommended that the SWL marking should include the word 'MANUAL' or 'POWER' as appropriate.

1.A4.5 USE OF ROPE BLOCKS WITH SUPPORTING STRUCTURES

It should be noted that when rope blocks are used, the load imposed on the supporting structure is increased by the value of the hoisting effort. This additional load is also imposed on any equipment used to connect the top hook or eye of the pulley blocks to the structure. Care should therefore be taken to ensure that the structure, together with all other above hook equipment (e.g. trolleys, beam clamps, shackles, eyebolts) is of adequate capacity. The increase in load is as shown below:

Number of Sheaves							
Top Block	1	1	2	2	3	3	
Bottom Block	0	1	1	2	2	3	
Load on Top Shackle = load lifted x Factor	2.08	1.56	1.39	1.3	1.25	1.22	*Figure 1. A4.5-1*
Assuming 8% per sheave for friction							

1.A5 APPENDIX 5 - PRINCIPLES FOR THE SELECTION AND USE OF MULTIPURPOSE SLINGS

1.A5.1 FOREWORD

Although there is considerable variety in the type, characteristics, and performance of slings currently available (e.g., chain, wire rope, textile, etc.), certain principles in the selection and use are common to all types.

This appendix to section 1 of the code identifies these principles and makes general recommendations, but for specific details reference must be made to the relevant section of this code, to National Standards or manufacturer's published literature.

1.A5.2 SCOPE

This appendix is concerned firstly with the selection of suitable general-purpose slings for a lifting purpose and, secondly, with the use of those slings. Only matters common to all types of sling are dealt with here and matters peculiar to particular materials are covered elsewhere.

1.A5.3 DEFINITIONS

Definitions are as stated in section 1.3 DEFINITIONS page 2 of this code. Other terminology is explained by illustrations and text.

1.A5.4 PRINCIPLES FOR THE SELECTION OF SLINGS

There are numerous factors to be considered in the selection of a sling for a particular task or range of tasks. These will include sling type (i.e. material) configuration (i.e. number of legs) terminal fittings (e.g. hooks) and environmental conditions.

1.A5.4.1 Sling Types

1.A5.4.1.1 Chain

Chain slings can be supplied as mechanically assembled or welded assemblies, with the former being the most common. The current standards and grades for these slings are listed in SECTION 14 page 237 of this code.

Further information on the use of chain slings is given in section 14.1 FOREWORD page 237 of this code.

1.A5.4.1.2 Wire rope

Wire rope slings are available in several different grades, constructions and terminated by various means. The current standards for wire rope slings are detailed in section 15 of this code.

Further information on the use of wire rope slings is given SECTION 15 page 255 of this code.

1.A5.4.1.3 Fibre ropes

Fibre rope slings are generally available in a range of natural and man-made fibres and should be purchased to the applicable national standards, for full standards listings and available materials, please refer to SECTION 18 - FIBRE ROPE SLINGS page 295 of this code.

Further information on the safe use of fibre rope slings is given SECTION 18 - FIBRE ROPE SLINGS page 295 of this code.

1.A5.4.1.4 Webbing

Flat woven webbing slings should always be purchased in accordance with the nationally adopted and current product standards, refer to SECTION 16 page 273 for specific standard details. They are manufactured in a similar variety of textile materials to fibre ropes.

Further information on the safe use of webbing slings is given in SECTION 16 page 273 of this code.

1.A5.4.1.5 Roundslings

Roundslings are endless textile slings and should always be purchased in accordance with the nationally adopted and current product standards.

Further information on standards and the use of roundslings is given in section SECTION 17 - MAN-MADE FIBRE ROUNDSLINGS page 285 of this code.

1.A5.4.2 Sling Configurations

Each of the different material types of sling described in section 1.A5.4.1 Sling Types page 20 and the respective specific sections of this code may be encountered in any one of five different basic configurations for general purpose slings, i.e. single leg, two leg, three leg, four leg and endless slings. Selecting a suitable sling configuration depends mainly on the type of load. Examples of different types are provided below. For abnormal loads special slings are available and recommended. Users should seek the advice of their LEEA member supplier if in doubt.

1.A5.4.2.1 Single leg sling

A single leg sling may be used to connect a lifting appliance to a load with a single lifting point such as the eyebolt on an electric motor. (See Figure 1.A5.4.2.1-1 page 21) It may also be used in choke hitch either by back hooking or reeving one end of the sling through the other. (See Figure 1.A5.4.2.1-2 page 21)

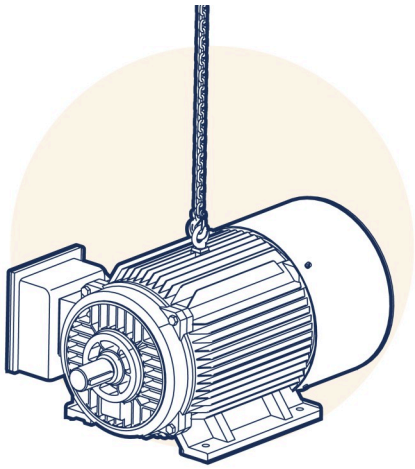


Figure 1.A5.4.2.1-1

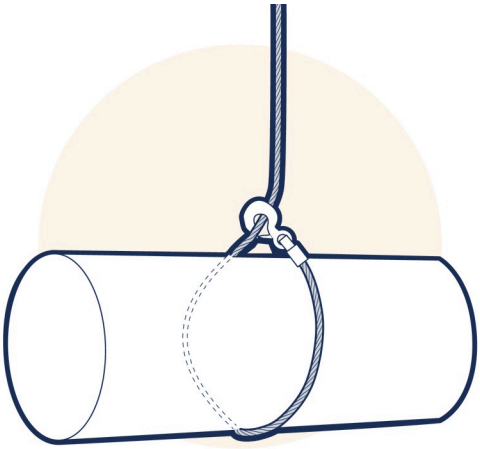


Figure 1.A5.4.2.1-2

Two identical single leg slings may be used in combination to form, in effect, a two leg sling. (See Figure 1. A5.4.2.1-3 page 22) Care is necessary to ensure that the hook of the lifting appliance is not overcrowded and it is recommended that the upper end of the sling legs to be connected by a shackle or link. (See Figure 1. A5.4.2.1-4 page 22) Where this is done the legs must be symmetrically disposed and the angle of a leg should not exceed 45° to the vertical.

The method of attaching the slings to the crane hook should ensure that the sling eyes or links are not damaged. Two single leg slings used as a two leg sling must be treated as a two leg sling for rating purposes. The combined SWL when the legs are at an angle between 0 and 45° to the vertical (0 to 90° included angle) is 1.4 times the SWL of the single leg.

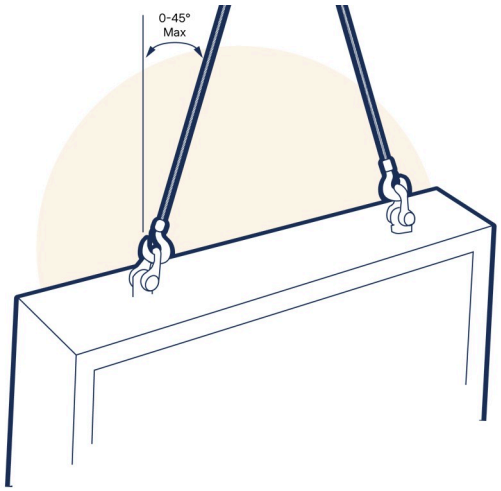


Figure 1.A5.4.2.1-3

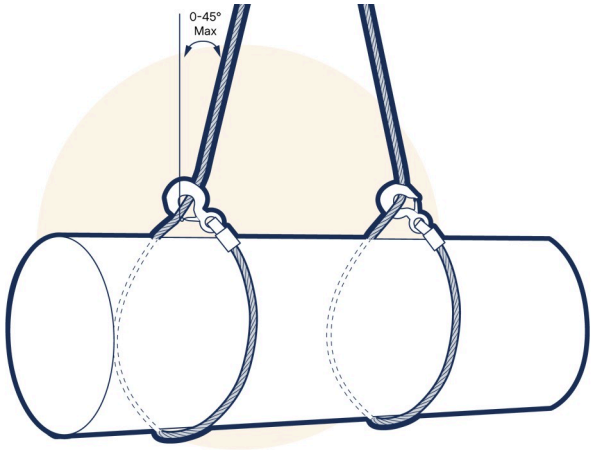


Figure 1.A5.4.2.1-4

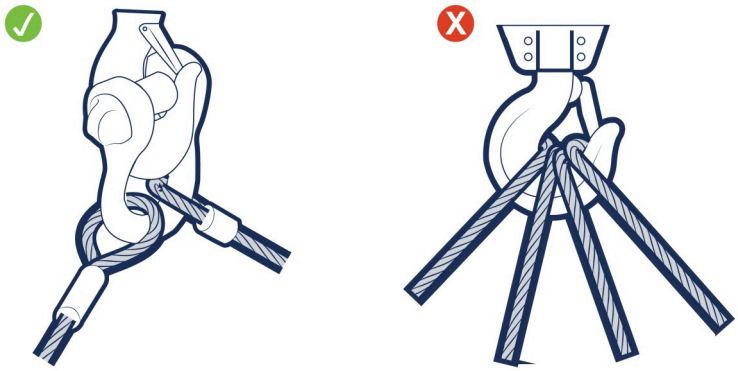


Figure 1.A5.4.2.1-5

1.A5.4.2.2 Two leg sling

A two leg sling comprises two legs permanently connected at their upper ends by a suitable link and marked as an assembly. Two leg slings may be used to handle a wide range of loads. (See Figure 1.A5.4.2.2-1 page 23
Figure 1.A5.4.2.2-2 page 23)

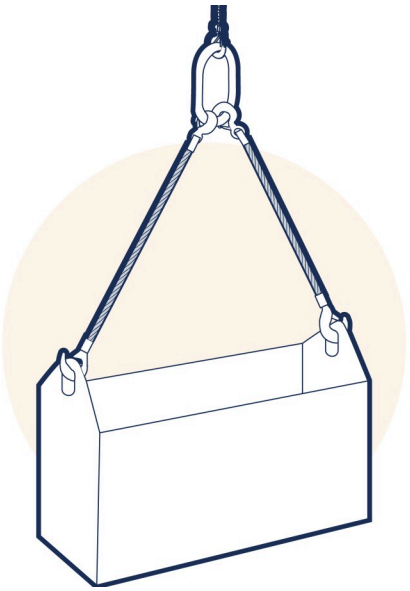


Figure 1.A5.4.2.2-1

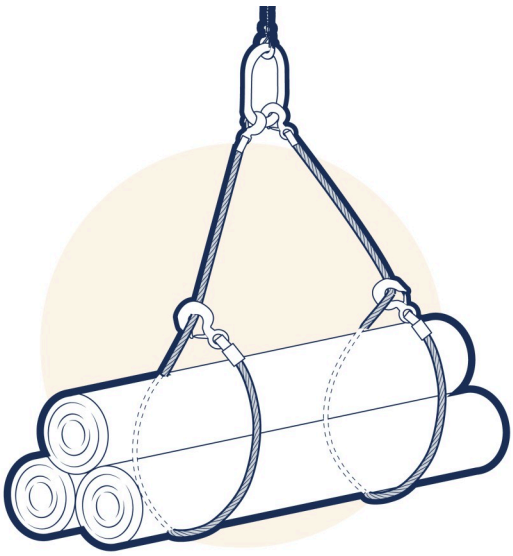


Figure 1.A5.4.2.2-2

1.A5.4.2.3 Three leg sling

A three leg sling comprises three legs permanently connected at their upper ends by a suitable link assembly and marked as an assembly. Three leg slings are commonly used to handle circular or irregularly shaped loads where the legs can be equally spaced. (See Figure 1.A5.4.2.3-1 page 24)

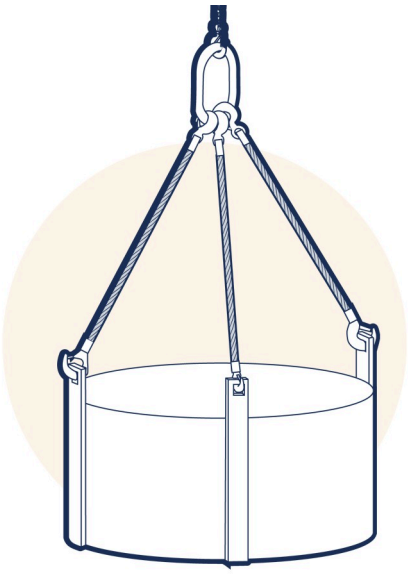


Figure 1.A5.4.2.3-1

1.A5.4.2.4 Four leg sling

A four leg sling comprises four legs permanently connected at their upper ends by a suitable link assembly and marked as an assembly. Four leg slings are mainly used to handle square or rectangular (four cornered) loads. (See Figure 1.A5.4.2.4-1 page 24)

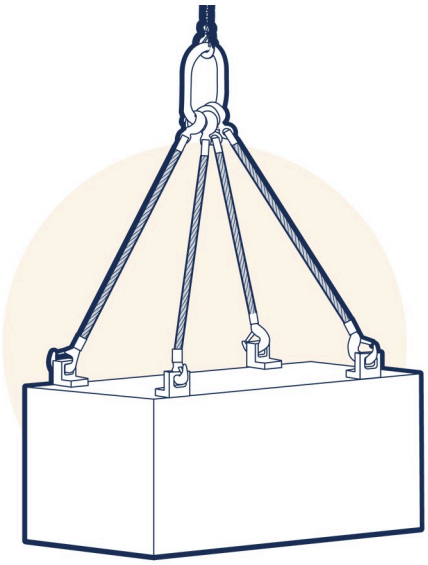


Figure 1.A5.4.2.4-1

1.A5.4.2.5 Endless sling

Although there are some exceptions, an endless sling is usually used in choke hitch. (See Figure 1.A5.4.2.5-1 page 25)

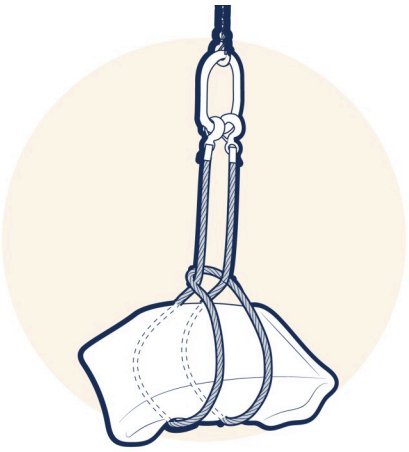


Figure 1.A5.4.2.5-1

1.A5.4.3 Methods of Rating Lifting Slings

1.A5.4.3.1 Multi-Leg Slings: Load Angles and Rating Methods

When a multi-leg sling is used with the sling legs at an angle, the load in the individual sling legs will increase as the angle to the vertical (included angle between the legs) becomes greater. This is illustrated in Figure 1. A5.4.3.1-1 page 25.

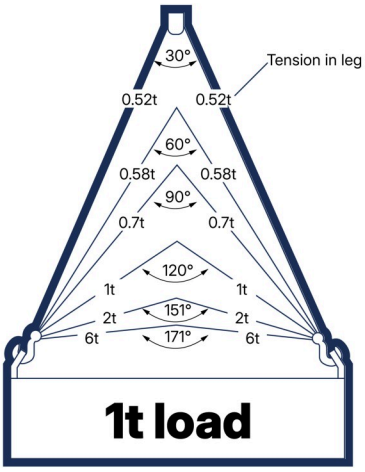


Figure 1.A5.4.3.1-1

Traditionally the angle has been measured as the included angle α (alpha) between the legs of a two leg sling and between the diagonally opposite legs of a four leg sling. As three leg slings do not have an 'opposite' leg it was taken for these as twice the angle to the vertical. This assumed that the legs would be symmetrically disposed in plan. (See section 1.A5.5.2 Rating Assumptions page 28) In order to emphasise that the angle of each leg to the vertical affects the share of the load it will carry and to remove the anomaly with three leg slings. It should therefore be noted that the traditional method of measuring the included angle α (alpha) between the legs of a two leg sling and between the diagonally opposite legs of a four leg sling is no longer recommended by this code and the angle between the leg and the vertical β (beta) should be used instead.

It is possible that some multi-leg slings in service will be marked with the rating expressed at the included angle or range of angles, e.g. 0-90°. However, based on the above for this code the rating will be expressed at the range of angles of a leg to the vertical, e.g. 0-45°. It should be noted that this is based on new methods that have been used in previous versions of this code however, as the code is written to reflect equipment that will be found in service and the acceptance that some geographical regions have not yet adopted the new approach, reference is also made to the included angle. If a sling is to be used safely, allowance must be made for this angle and this is achieved by rating the sling in one of two ways. This matter is discussed in some detail in the following section, which specifies the methods and factors to be used in calculating the SWL. The two methods of rating are often known as the 'uniform load method' and the 'trigonometric method'.

1.A5.4.3.2 Uniform Load Method

The uniform load method is the simpler option, having inherent safety advantages, permitting only one working load limit up to an angle of 45° to the vertical (90° included angle) and a reduced working load limit at angles between 45° and 60° to the vertical (90° and 120° included angle). This is the recommended method which should be used for all multipurpose slings Working load limits are derived from the following:

Single leg sling = 1.0 x WLL of a single leg

Two leg sling 0-45° (included angle 0-90°) = 1.4 x WLL of a single leg

Two leg sling 45°-60° (included angle 90° -120°) = 1.0 x WLL of a single leg

Three and four leg sling 0-45° (included angle 0-90°) = 2.1 x WLL of a single leg

Three and four leg sling 45°-60° (included angle 90° -120°) = 1.5 x WLL of a single leg

Standards where the uniform load method has been used, rate a multipurpose four leg sling at the same working load limit as a three leg sling of the same size and grade. This is on the assumption that the load might be taken by only three of the four legs. However, some national standards have now been amended such that they work on the assumption that the load may be carried by two of the legs.

> Some standards do not recommend the rating of three leg slings at included angles greater than 90°. This is due to the possible hazard of a user assuming that the 'included angle' referred to the angle between the legs of the sling instead of twice the angle of a leg to the vertical. Where slings are rated and marked on the basis of the angle to the vertical this hazard does not exist.

1.A5.4.3.3 Trigonometric Method

The trigonometric method provides for a variation in the working load limit as the angle to the vertical (or the angle between the sling legs) varies. This method is the one which was previously used in many standards, but in order to use it for multipurpose applications, the operative must calculate the SWLs at various angles for each size of chain, rope, etc. It also requires the operative to be trained in determining a range of angles and has the inherent danger that if misjudged the sling may be overloaded. Reference to drawings are therefore recommended.

Although the uniform load method was introduced to some standard practices, some manufacturers continue to rate and mark multipurpose slings by the trigonometric method. Slings intended for multipurpose use marked this way will not comply with those standards that have adopted the uniform load method and it is strongly recommended that this method should be used only for slings designed for a single purpose or in accordance with the applicable national standards that permit it. Working load limits are derived from the following:

Single leg sling = 1 x WLL of a single leg

Two leg sling = 2 x WLL of a single leg x cos β

Three leg sling = 3 x WLL of a single leg x cos β

Four leg sling = 4 x WLL of a single leg x cos β

Where β is equal to the angle between the sling leg and the vertical (i.e. half the included angle α).

In the case of a single purpose four leg sling designed for exclusive use in an application where the load will clearly be shared by the four legs, it is permissible to calculate the working load limit on that basis.

1.A5.4.3.4 Advantages of the Uniform Load Method

The uniform load method simplifies matters by removing the need for calculations and reducing the need for the operative to determine angles. Whilst the uniform load method of rating is most easily applied to equipment such as multi-leg slings, it may, with advantage, also be applied to such items as, for example, eyebolts when used in pairs.

1.A5.4.3.5 Recommendation of the Uniform Load Method

Many national and international standards are now in favour of the uniform load method, largely on the grounds of safety and simplicity. However, this does not exclude the trigonometric method when working to national standards that allow it within their scope or with justified reason to deviate from the uniform load method. This code recommends that the uniform load method is used for all multipurpose applications and that the trigonometric method should be restricted to slings designed and used for a single purpose.

1.A5.4.3.6 Use of Consistent Rating Methods

It should be clearly understood however that whilst equipment designed to be used under the trigonometric method may be re-rated and marked according to the uniform load method, the reverse is NOT always possible and may be dangerous. It is therefore recommended that, to avoid confusion, all items of a given type (e.g. all chain slings) at the location should be rated and marked by the same method.

1.A5.4.3.7 Re-Marking and Training for Rating Methods

The method of expressing and marking the rating at the angle to the vertical also raises the question of how a user, with existing slings rated by the uniform load method but marked with the 'included angle' will avoid confusion when introducing new slings marked with the 'angle of inclination'. It is LEEA's recommendation that the user should consider whether a programme of re-marking is worthwhile, bearing in mind the expected life of the slings and respective national requirements. Regardless of whether existing slings are re-marked, there is a possibility that both systems will be encountered in use. We therefore further recommend that all operatives are made aware and trained to recognise the differences.

1.A5.4.4 Sling Terminations

Slings may be terminated in a variety of ways and the specific sling sections of this code identify the common types used

1.A5.4.5 Factors Influencing Choice Of Sling

If faced with lifting a fragile load, for example a grand piano, a different type of sling would be selected (probably a flat woven webbing sling) from that chosen for lifting hot metal ingots (probably a chain sling).

The following factors are not necessarily in order of importance, nor do they represent an exhaustive list, but are some of the considerations which may be appropriate in selecting a sling. Users are advised to consult a LEEA member if in any doubt as to the suitability of a sling for any lifting purpose, environment, etc. In making a selection, a balance will be struck between various, sometimes conflicting, considerations and the final decision may be one of several compromise solutions.

1.A5.4.5.1 The nature of the load

According to the nature of the load, the aspects to be considered include the temperature of the load, the presence of sharp edges and polished surfaces. Textile slings are not suitable for a hot load. If the load has sharp edges, chain might be more durable but even so, edge protection will be necessary. If the load is polished or delicate in some other way, then a flat woven webbing sling, a roundsling or fibre rope sling is likely to be best.

1.A5.4.5.2 The environment in which the sling operates

Hot, corrosive and outdoor environments might be encountered. If the atmosphere is hot, e.g. near a furnace, a chain sling is likely to be more suitable. See section 14.4.3 Sling Construction page 239 of this code.

If a corrosive environment is involved, e.g. use in a plating shop, then this is a complex problem and specialist advice should always be sought. It should also be remembered that laundries, swimming baths, pumping stations, sewage works, etc., can also give rise to corrosive conditions.

If outdoor use is involved, then natural fibre ropes are liable to rot and mildew and ungalvanized wire ropes to corrode. Marine conditions, atmospheric pollution, construction sites involving rock, mud, etc., will all aggravate outdoor environmental problems.

Natural fibre ropes are not recommended for use in chemical environments. Man-made fibre ropes have varying resistance to chemicals, e.g. acids, alkalis and solvents. Textile slings are prone to deterioration at high temperatures. Man-made fibres rarely show a sharp melting point; they will either soften over a range of temperatures or they will char or decompose before melting.

1.A5.4.5.3 Handling of the sling

Weight, flexibility, hand contact and length adjustment are some of the factors likely to be important when handling the sling. Textile slings are lightest for a given lifting capacity and may be most suitable where frequent lifting and carrying of the sling is necessary. It should be remembered that chain and roundslings flex easily but cannot readily be pushed through a narrow gap, whereas wire rope may. The effect of hand contact may be a consideration. If so, wire rope or chain is hard and cold to touch, whereas fibre is relatively larger in diameter (useful if pulling is involved) and warmer to handle. Wire rope is liable to broken wires which can injure hands.

1.A5.4.5.4 Durability

Durability can be influenced by factors such as abrasion, storage and repeated use. If abrasion is likely, then chain is most durable and fibre slings are most subject to abrasion damage. If storage for long periods between use is contemplated, a chain sling might be most suitable as other types are prone to various forms of deterioration unless stored under ideal conditions. (See section 1.7.2 Storage and Handling page 9)

1.A5.4.5.5 Extension (stretch)

Man-made fibre ropes may be less suitable if stretch is likely to be a problem, e.g. for precise positioning. It can also be problematic when using two or more slings of different materials

1.A5.5 SAFE USE OF SLINGS

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

1.A5.5.1 Basic Principles

(1) The sling and its method of use should be suitable for the load.

(2) The method of attachment of the sling to the load and the sling to the lifting appliance should be secure.

(3) No part of the sling should be overloaded either by the weight of the load or by the method of slinging.

(4) The slinging method should ensure that the load is secure and that the load will not fall from the sling.

(5) The load should be balanced and stable and should not violently change its attitude when lifted.

(6) The load must not be damaged by, or cause damage to, the sling.

Advice on load estimation, load security, centre of gravity, balance and stability is given in appendices 1.A2 APPENDIX 2 - LOAD ESTIMATION - WEIGHT AND CENTRE OF GRAVITY page 13 and 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16 of this section of the code.

1.A5.5.2 Rating Assumptions

The two methods of rating multi-leg slings have been described in section 1.A5.4.3 Methods of Rating Lifting Slings page 25. Both of these methods do however assume certain conditions of use which are imposed to ensure that no part of the sling can become overloaded. It is important to understand that although the weight to be lifted may be within the maximum lifting capacity of the sling, lifting in the wrong way can place an excess of load onto one part of the sling. Although deviations from the assumed conditions have the same effect whichever method of rating is used, it varies in degree and it is with the multipurpose slings where the designer has least information about possible applications and where the onus to make allowance for the actual method of slinging employed therefore falls on the user.

The first of the assumptions is that the sling legs are symmetrically disposed in plan, i.e. for three leg slings, all included angles between the legs in plan are equal; for four leg slings, opposite included angles between adjacent legs, in plan, are equal.

The effect of tilt of the load during the lifting operation is also significant and becomes increasingly more so as the included angle between the legs decreases. As tilt increases, the loading in the leg on the ‘downhill’ side (i.e. the leg with the smaller angle to the vertical) increases.

A further assumption, particularly applicable to multi-leg slings but also applicable to single leg and endless slings where more than one are used, is that all legs are of identical materials and load bearing capacity.

Assumptions are also made with regard to the method of attachment. Single leg and multi-leg slings are rated for use with the leg or legs in a ‘straight pull’, i.e. the legs are not bent around the load, choked, back hooked or otherwise prevented from taking up a straight line under load.

There may be some variation from these assumptions, and this may in fact be desirable offering a more secure way of attaching to certain loads. The options, together with the appropriate changes to the slinging factors to be applied to the standard ratings, are given in 2 Summary of Mode Factors page 29.

Table 2 Summary of Mode Factors

MODE FACTORS Maximum load to be lifted = mode factor x SWL marked on the sling Key: NP = non preferred, NA = not applicable								
1	2	3	4	5	6	7	8	9
Material	Single leg in line  *Figure 1. A5.5.2-1*	Single leg choked  *Figure 1. A5.5.2-2*	Single leg basket  *Figure 1. A5.5.2-3*	Single leg back hooked  *Figure 1. A5.5.2-4*	Single leg halshed  *Figure 1. A5.5.2-5*	Endless in line  *Figure 1. A5.5.2-6*	Endless Choked  *Figure 1. A5.5.2-7*	Endless basket  *Figure 1. A5.5.2-8*
Chain	1	0.8	1.4	1	NP	NP	1	NP
Wire rope	1	0.8	1.4	1	1.6	NP	1	1.4
Webbing	1	0.8	1.4	NA	NP	1	0.8	1.4
Fibre rope	1	0.8	1.4	1	1.6	1	0.8	1.4
Rounds-ling	NA	NA	NA	NA	NA	1	0.8	1.4

Endless slings have fewer variations of use, but it should be remembered that the slinging factor for endless chain and wire rope slings assumes choke hitch, whereas the standard rating for textile slings assumes a straight pull.

In all cases, it is also assumed that, at the points of attachment to both the lifting appliance and the load, the radii around which the sling passes are large enough to avoid damage to the sling. In the case of chain and wire rope endless slings, the rating takes account of the chain and wire rope being bent around itself on the bight.

The mode factors in 2 Summary of Mode Factors page 29are common factors applicable to most slings. However some manufacturers may deviate from these and therefore it is advised that the manufacturer's instructions take precedence.

1.A5.5.3 Sling Geometry

1.A5.5.3.1 General

If the slinging geometry does not comply with the assumptions given in section 1.A5.5.2 Rating Assumptions page 28, then the load will not usually be evenly distributed amongst the legs. The amount of load that will be imposed on an individual leg depends upon the following:

(1) The angle between each of the legs and the vertical.

(2) The number of legs in the sling, or in use.

(3) The distribution of the legs in plan view.

(4) The total load being lifted.

The relationship between these factors is a complex one especially for three and four leg slings. What happens as these factors vary can be identified in general terms although to quantify the effect requires calculation.

1.A5.5.3.2 Two leg slings

For a two leg sling, if each leg has the same angle to the vertical, then the load will be shared equally between them. If, however, one leg has a smaller angle to the vertical than the other, that leg will have a greater share of the load imposed upon it. This will result in the load tilting. The sling may also not be symmetrical due to the position of the attachment points

The effect of unequal angles increases as the difference between the angles increases. Additionally, the effect is more significant as the angle between the legs decreases although with a uniform load rated sling this is offset to a certain extent because at such an angle there is a degree of redundancy available. This redundancy is however insufficient to fully counter the effect.

As a guide, at an included angle of 30° a difference of angles to the vertical of 12°, i.e. equal to 6° of tilt, will load the downhill leg, i.e. the leg with the smaller angle to the vertical, to its maximum rating if the sling is lifting to its maximum rated capacity. This effect becomes even more significant for three and four leg slings.

1.A5.5.3.3 Three and four leg slings

For three and four leg slings, a difference between the angle each leg has to the vertical has a similar effect to a different degree, but in addition the problem becomes three-dimensional in that the distribution of the legs, when viewed in plan, also affects the share of the load imposed on each leg. The sling geometry of three and four leg slings is as follows:

(1) Three leg slings: With a three leg sling it is assumed that, viewed in plan, the legs are at 120° to each other. If two of the legs are closer than that, the third leg will receive a greater share of the load. Ultimately, if two of the legs are side by side, i.e. at zero angle to each other then they will receive only half the load between them leaving the third leg to take the other half on its own and thus be overloaded.

(2) Four leg slings: With a four leg sling, it is assumed that viewed in plan, the legs are symmetrically disposed, the lower attachment points making the corners of a rectangle. Ideally, the nearer the rectangle is to a square the better, but this is by no means essential. However, as for the two leg slings, the smaller the included angle between the legs the greater the effect of unequal angles. On a four leg sling, the unequal effect can occur across either or both of the horizontal axes, i.e. along the length of the rectangle and/or across the width of the rectangle.

The four leg sling is also affected by the rigidity of the load. Even if all the legs have the same angle to the vertical and are symmetrically disposed in plan, small differences in the leg lengths due to manufacturing tolerances or the positions of attachment points may prevent the load being equally distributed. The uniform load method of rating takes some account of this by assuming that only three of the legs are bearing the load. However, in extreme cases the load may be carried on only two diagonally opposite legs with the other two providing balance only. In such cases, the sling should be de-rated to two-thirds of its standard rating.

If any of the assumed conditions are not met, then it is possible that a large portion of the load will be imposed on only one or, at best, two legs of the sling. In such circumstances, it should be assumed that all of the load is being carried by one leg, so the sling should be de-rated accordingly as described in the following paragraph by assuming that only one leg is in use.

1.A5.5.3.4 Multi-leg Slings with Less Than the Full Number of Legs in Use

If a multi leg sling is used with less than its actual number of legs attached to the load, then obviously the SWL of the sling must be reduced. The amount by which it should be reduced can be calculated exactly, but it is rather complex, as a number of factors need to be taken into account including the method of rating. An easy way of ensuring that the sling is never overloaded is to reduce the SWL from that marked on the sling according to the number of legs in use.

e.g. a 4 leg sling with only 2 legs in use, REDUCED SWL = 2/4 i.e. ½ x WLL MARKED

a 3 leg sling with only 2 legs in use, REDUCED SWL = ⅔ x WLL MARKED

This inevitably means that in some cases the sling will be under-utilised. If maximum utilisation is required, then reference should be made to a person who understands the factors involved and can therefore perform the necessary calculations.

1.A5.5.4 Methods of Slinging

Slings can be used in a variety of ways according to the requirements of the job. These ways are closely dependent on the six basic principles discussed earlier in section 1.A5.5.1 Basic Principles page 28. Table 1 at the end of this appendix summarises the alternatives.

1.A5.5.4.1 Straight leg slings

A single or multi-leg sling may be used with the legs straight if, for example, the legs are terminated in a hook (s) which can be attached directly to a suitable lifting point on the load as shown in Figure 1.A5.4.2.1-1 page 21, Figure 1.A5.4.2.1-2 page 21, Figure 1.A5.4.2.2-1 page 23, Figure 1.A5.4.2.3-1 page 24 and Figure 1.A5.4.2.4-1 page 24. There is no particular problem in this method of use provided, of course, that normal precautions are observed and the angle factor, in the case of multi-leg slings, is taken into account.

1.A5.5.4.2 Choke hitch

Single leg or multi-leg slings may both be used in choke hitch, which is illustrated in figures Figure 1.A5.4.2.1-2 page 21, Figure 1.A5.4.2.1-2 page 21, Figure 1.A5.4.2.2-2 page 23 and Figure 1.A5.4.2.3-1 page 24. The basic advantages of a choke hitch are firstly that a sling may be attached to a load which has no suitable lug, eyebolt, etc., and secondly that the sling tends to bind the load together.

In forming a choke hitch, the sling is bent round a small diameter, which may be the eye of the sling itself or the saddle of a hook, link or other fitting. In these circumstances, the load in the sling will be increased at the point of choke and for this reason some de-rating is necessary in order to prevent the sling being locally overloaded. For the convenience of the operative, the same factor is used for all types of slings. The SWL should be reduced to 0.8 of the SWL of the straight leg.

Care should be taken when applying choke hitch to select a sling of sufficient length to ensure that the angle at the choke does not exceed 120° and that the sling positions itself naturally. Slings should never be 'battered' down to achieve an angle greater than 120°, unless further de-rated in accordance with national standards

1.A5.5.4.3 Double wrap choke hitch

Double wrap choke hitch is a variation on choke hitch where the sling is passed one complete turn around the load before being choked. (See figure Figure 1.A5.5.4.3-1 page 31) This increases the binding effect and should be used on loose loads such as bundles of tubes. The sling should be de-rated by the same amount as for ordinary choke hitch.

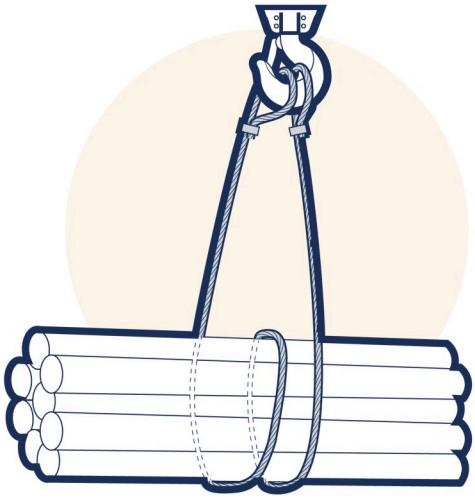


Figure 1.A5.5.4.3-1

1.A5.5.4.4 Basket hitch

The basket hitch is normally used with slings in pairs (1A5.12) for handling loads such as a large cylindrical object but it is not suitable for cradling loose bundles. If only one sling is used, the sling should be passed through the load at a point above the centre of gravity to ensure it is safely secured. (See Figure 1.A5.5.4.4-1 page 32)

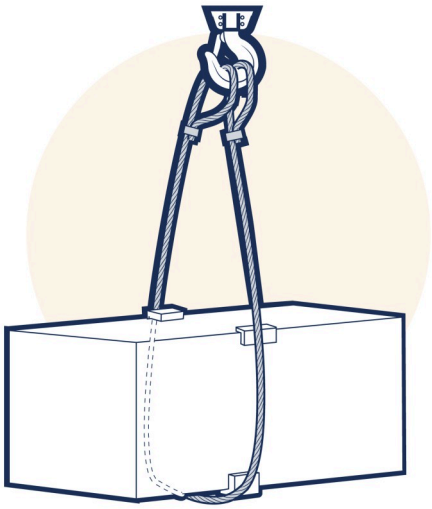


Figure 1.A5.5.4.4-1

If a sling in basket hitch is used with both legs parallel, i.e. with an included angle of 0° between the legs of the basket, then twice the WLL may be lifted. With the terminations of both ends of the sling on the hook (see Figure 1.A5.5.4.4-1 page 32) the load lifted may be increased to not more than 1.4 x the WLL provided the angle to the vertical does not exceed 45°.

If two slings are used in basket hitch in the same manner (see Figure 1.A5.5.4.4-2 page 32) the load may be increased to 2.1 x the WLL, again provided that no angle to the vertical between adjacent or diagonally opposite legs exceed 45°. The above factors for basket hitch assume that all sharp edges are adequately packed.

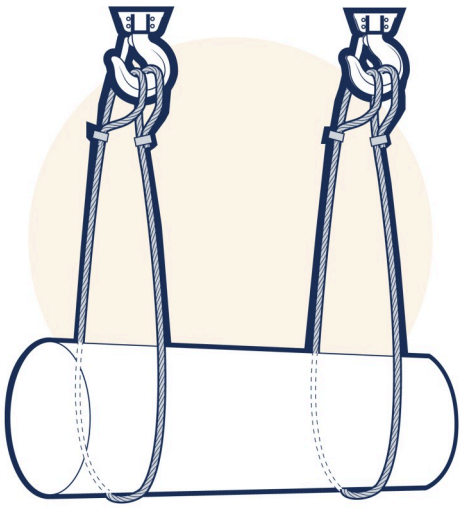


Figure 1.A5.5.4.4-2

1.A5.5.4.5 Double wrap basket hitch

A double wrap basket hitch is when the sling is passed completely around the load as shown in Figure 1.A5.5.4.5-1 page 33. This will help to ensure the security of loose bundles. If security of the load is the prime consideration, then double wrap choke hitch is recommended. The factors are the same as for basket hitch.

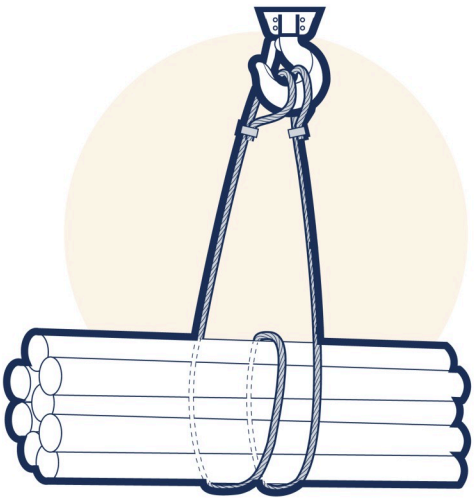


Figure 1.A5.5.4.5-1

1.A5.5.4.6 Double choke hitch

Double choke hitch is a variation of choke hitch where the load is carried on two parts and for this reason the SWL in choke hitch may be varied in accordance with the manufacturer's or supplier's advice. Where this is not available, the single choke hitch rating should be used. (See Figure 1.A5.5.4.6-1 page 33) This is sometimes known as 'halshing'.

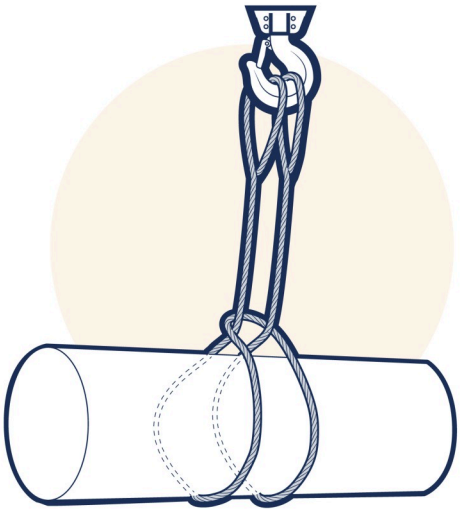


Figure 1.A5.5.4.6-1

1.A5.5.4.7 Endless slings

Endless slings are generally used in choke hitch and may need de-rating as recommended by relevant standards or the manufacturer or supplier. For instance, fibre rope slings should be de-rated to 0.8 x WLL. Endless chain slings require no de-rating when used in choke hitch as the sling is designed for this method of use. It is assumed that at the points of attachment to both the lifting appliance and the load, the radii around which the sling passes are large enough to avoid damage to the sling.

1.A5.5.5 Some Essential Precautions

1.A5.5.5.1 Before lifting the load

The weight of the load should be ascertained before lifting. (See section 1.A2 APPENDIX 2 - LOAD ESTIMATION - WEIGHT AND CENTRE OF GRAVITY page 13) The lifting method selected should be suitable for the load. The sling should be strong and long enough for the load, both in terms of its WLL and its actual condition. The sling should be carefully inspected for obvious defects before use.

The load should be secure, stable and balanced when lifted so an assessment of the position of its centre of gravity will be necessary (see section 1.A2 APPENDIX 2 - LOAD ESTIMATION - WEIGHT AND CENTRE OF GRAVITY page 13) to ensure that the lifting point is approximately over it. Failure to do this is likely to cause the load to swing wildly on being lifted, or even to fall out of the sling.

Any loose parts of the load should be adequately secured either by the lifting method or by other means.

1.A5.5.5.2 When fitting the sling to the load

The sling must be firmly secured to the load, e.g. by means of hooks on to purpose designed lifting points, eye-bolts, etc or by a suitable method of slinging. The sling must not be twisted, knotted or kinked in any way, nor should the lifting points be overloaded by the slinging method.

It is also essential that there is adequate packing between sling and load and guidance on this subject is given in section 1.A5.5.7 Control of Lifting Equipment, Storage, Handling and Inspection page 39.

The rated angle (e.g. 45° to the vertical or 90° included angle) must not be exceeded and the angle at any choke must not exceed 120°, unless in accordance with the de-rating in applicable national standards, or at any basket should not exceed 90°.

When using three or four leg slings with out of balance loads or with unequally spaced legs, two legs may support the majority of the weight while the other leg or legs merely act as a balancer. If the lifting points on the load are not in the same horizontal plane, the load, if it is flexible enough, will distort to accommodate the equal leg lengths of the sling. Alternatively, if the load is rigid, two legs will be likely to support the majority of the weight and may be overloaded while the remainder provide the balancing load.

1.A5.5.5.3 On raising or lowering the load

Before commencing a lift, a recognised code of signals should be used between the slinger and the crane driver. Ensure that the load is free to be lifted, e.g. all holding down bolts and/or dowels have been released and any seals broken. Check for overhead obstacles such as power lines, pipe work etc.

The slinger should always ensure that everyone is clear before giving the signal to lift. Unless unavoidable, no one should be allowed under a suspended load and as far as possible, all people should be kept clear of the area of operations. If unavoidable, additional measures to mitigate the associated risk and consequence of failure should be included, i.e. secondary positive holding devices to hold the load should the primary holding device fail. A trial lift should be made. People should not ride on loads except in very exceptional circumstances and only when authorised by a Competent Person and additional risk reduction measures have been provided.

1.A5.5.5.4 Suspended Load Manipulation

Traditionally tag lines have been used to help to control long or bulky loads (See figure Figure 1.A5.5.5.4-1 page 35). The slinger should always ensure that everyone is clear before commencing the lift. It must be noted however that their use must be carefully considered at the planning stage as there are potentially hazards associated with their use such as, when using polypropylene or fibre ropes

(1) They tend to wrap around objects

(2) They get caught in pinch points

(3) They may fray and are then knotted to stop the fraying causing the line to catch

(4) They get slippery when worn, wet or dirty with grease or oil.

Which may lead to common injuries such as trapped hands or fingers; therefore consideration should also be given to other devices that are available for load manipulation –

- Push Pull Rods
- Lifting Beams or Spreaders specifically designed to rotate, spin and manoeuvre the load
- Tag lines that are specifically designed to resist entanglement, and in wet and slippery conditions aid by design gripping of the rope.

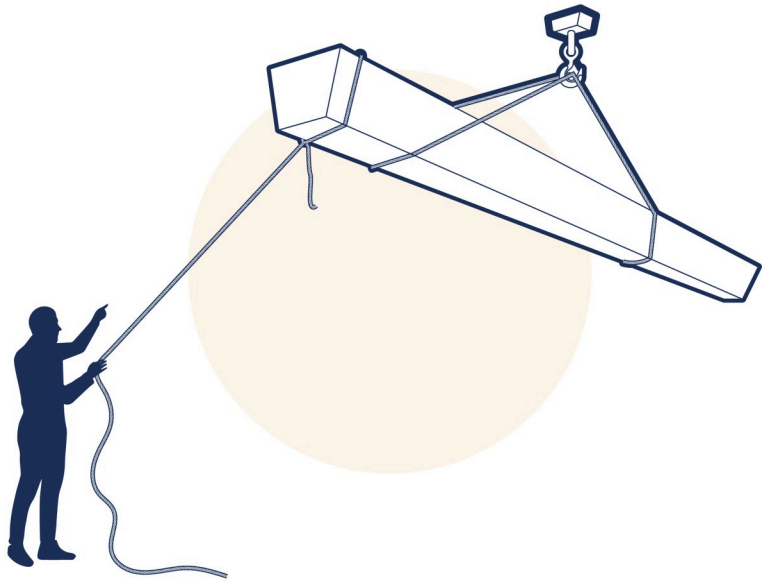


Figure 1.A5.5.5.4-1

A suitable setting down area should be selected before lifting. When lowering, a trial set down should be made before the slings are released. Make sure that the load is placed on battens, dunnage or packing so that the slings can be readily withdrawn. Trapped slings should never be dragged out from under a load, nor should slings be used to drag a load. (See Figure 1.A5.5.5.4-2 page 35)

The slinger should always be careful not to set the load down on his own toes, another common accident. Having set the load down correctly, the empty sling legs should be manually withdrawn by the slinger and hooked back on to the crane hook or upper terminal fitting to prevent accidental 'hook-up' to surrounding objects or striking an individual. (See Figure 1.A5.5.5.4-3 page 36)

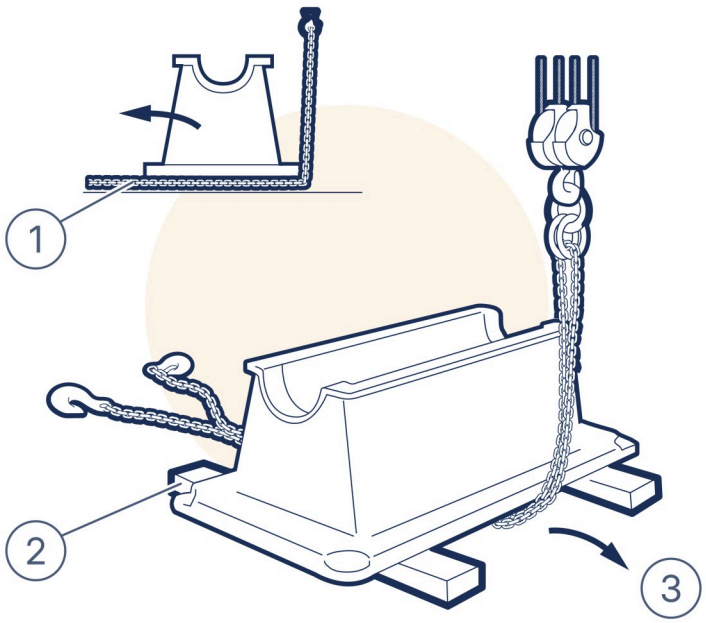


Figure 1.A5.5.5.4-2

(1) Do not pull sling from beneath load

(2) Rest load on timber or other suitable material

(3) Pull by hand

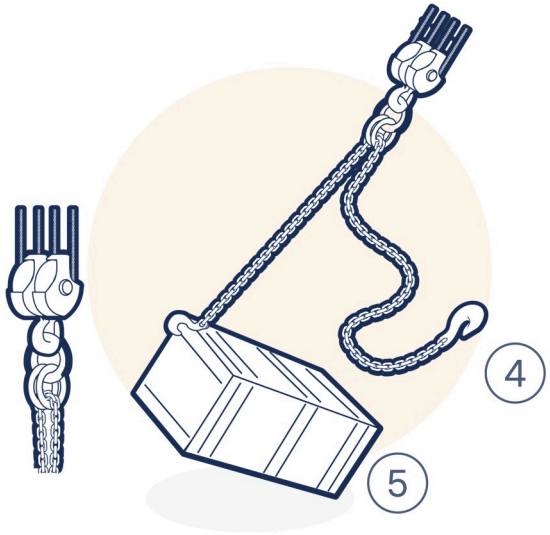


Figure 1.A5.5.5.4-3

(4) Avoid lashing legs

(5) And accidental "hook-ups"

1.A5.5.6 Protection

The need for adequate protection between sling and load is emphasised throughout this code. The objectives of the protection are:

(1) To provide an adequate radius around which a sling may pass without unacceptable loss of load carrying capacity.

(2) To assist the sling in gripping the load.

(3) To prevent damage to the load and sling .

With regard to (1) above, it is important to realise that when a sling is bent around a corner its strength will be considerably reduced. Whilst a small radius will prevent the cutting action of a sharp edge, IT WILL NOT PREVENT THE LOSS OF STRENGTH DUE TO THE SLING BEING LOADED IN THIS WAY.

For example, a chain sling passing around a corner may have one or more links loaded in bending, which could result in premature failure of the chain. (See figure Figure 1.A5.5.6-1 page 37 and section 14)

In the case of a wire rope sling, too small a radius would result in a permanent kink (see Figure 1.A5.5.6-2 page 37 and section 15) and some of the individual wires being overloaded. Although in both of these examples failure may not occur immediately, permanent damage will have been done which may subsequently result in failure. A radius equal to four times rope diameter will give a reduction in strength of approximately 25%.

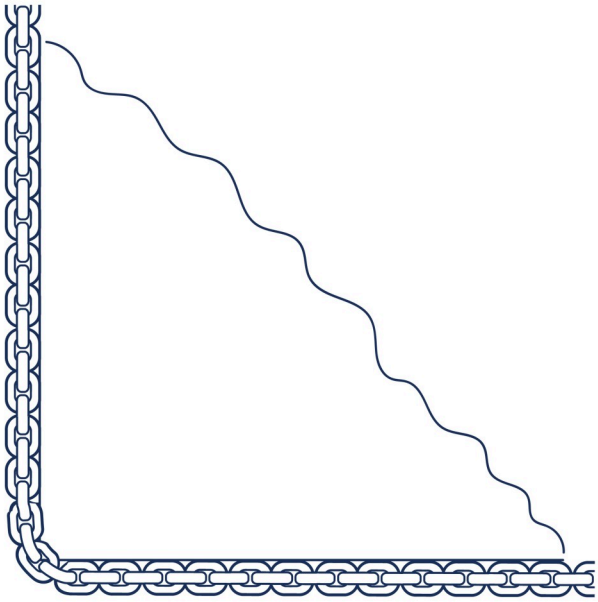


Figure 1.A5.5.6-1

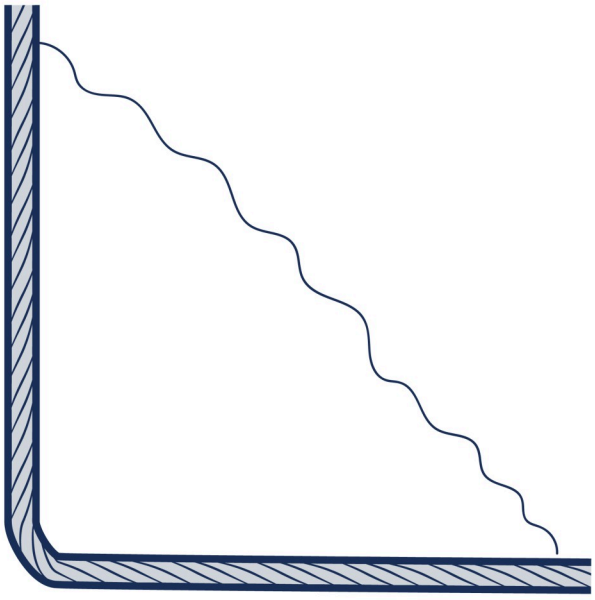


Figure 1.A5.5.6-2

Various materials are suitable for protection. Whatever is used must be capable of taking the crushing forces which will be imposed upon it, and it should be positioned to make best use of its strength. Where a particular load is lifted regularly, purpose designed re-usable packing may be found economical but for general purposes, the operative should have available a good selection of materials according to the nature of the work (e.g. timber blocks, rubber, sections of vehicle tyres, conveyor belts, etc.).

When positioning protection, it is essential to ensure that it will stay in place throughout the lift, as packing which falls or flies out will be a hazard in itself as well as imposing shock loads upon the lifting equipment. It may, therefore, be necessary to provide some independent means of securing the packing in place.

The amount of protection required varies according to the particular situation. The illustrations in Figure 1.A5.5.6-3 page 38, Figure 1.A5.5.6-4 page 38, Figure 1.A5.5.6-5 page 39 and Figure 1.A5.5.6-6 page 39provide some examples of good and bad practice.

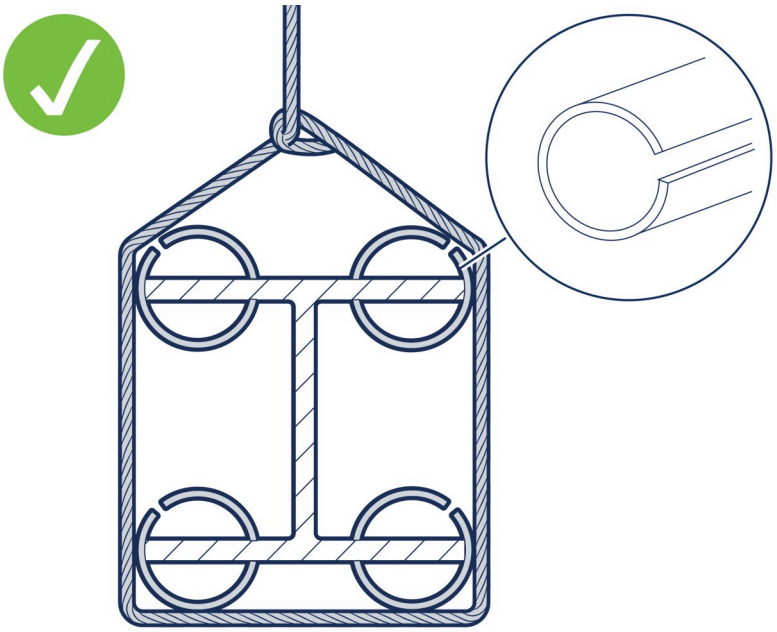


Figure 1.A5.5.6-3 Good standard - adequate radius - no kinking

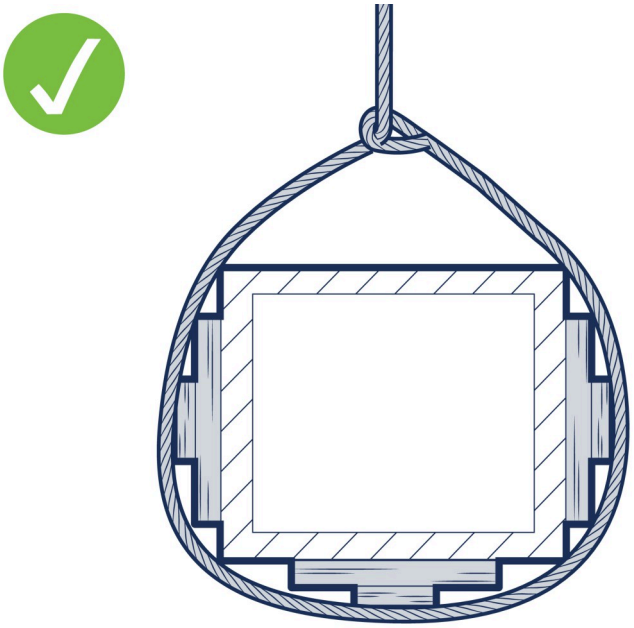


Figure 1.A5.5.6-4 Good standard - adequate radius - no kinking

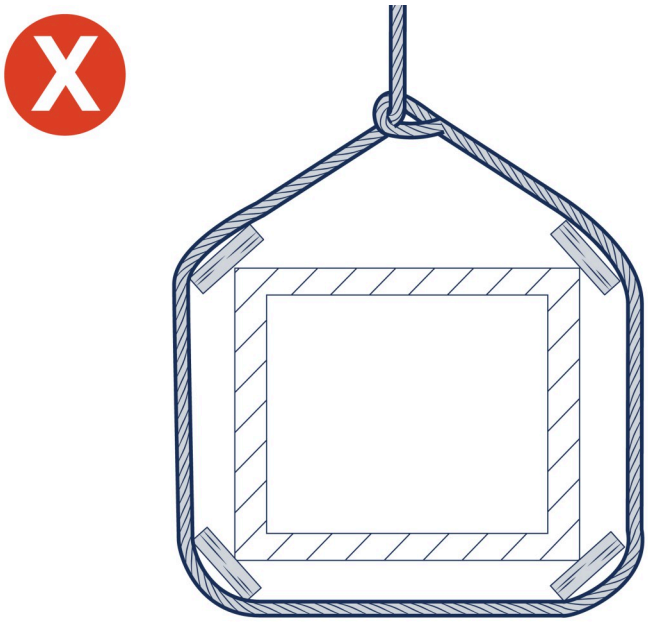


Figure 1.A5.5.6-5 Bad practice - timber packing will split and may fall out

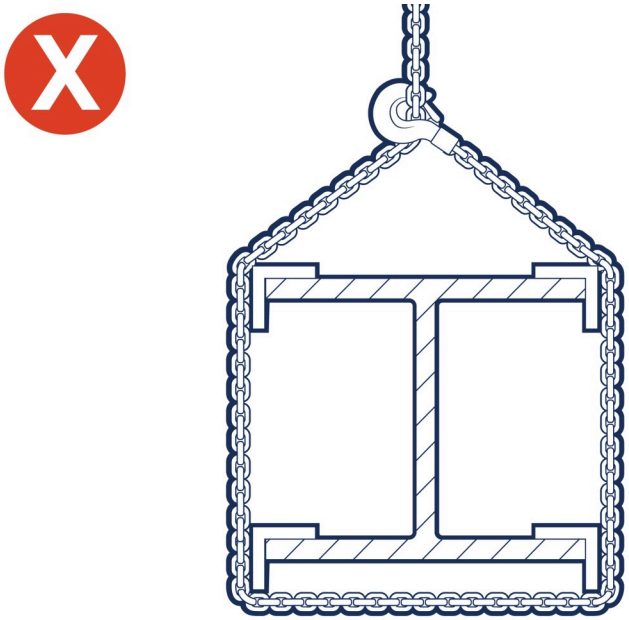


Figure 1.A5.5.6-6 Bad practice - packing ineffective chain links may be bent

1.A5.5.7 Control of Lifting Equipment, Storage, Handling and Inspection

For information on the control of lifting equipment, storage, handling and inspection, see section 1.7 MARKING, STORAGE AND HANDLING page 8 and section 1.8 INSPECTION page 9 of this code and the section specific to the equipment. Standards, manufacturer's literature and statutory requirements may also be applicable.

1.A5.5.8 Training

For information on training see section 1.9 SAFE USE OF LIFTING EQUIPMENT page 10 of this code.

1.A6 APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES

1.A6.1 FOREWORD

In many countries manual handling legislation has been introduced with a view to reducing the number of injuries as the result of manually handling loads. Injury can be the result of many factors, from attempts to manually handle excessive weight or bad lifting practices and postures through to repetitive strain injuries from repeatedly performing the same task with even very light loads. The basic principle adopted by this code is in line with legislative requirements where they exist calls for an assessment to be made of all lifting operations and appropriate steps to be taken to reduce or remove the risk of such injuries. One of the best ways of reducing such risks is to introduce a mechanical handling device or lifting appliance.

In any event, mechanical handling devices and lifting appliances are commonplace in lifting and moving loads of all weights in industry. This appendix of the code offers guidance on the selection and safe use of specific lifting appliances and the first step in their selection must be an assessment of the operation to ensure the correct type and size of appliance is selected. Careful consideration must be given to selection as a bad choice can be costly, result in the selected item being under-utilized or, in the worst case, be a danger to personnel.

1.A6.2 SCOPE

This appendix is concerned with the selection of suitable lifting appliances to enable loads to be raised and lowered and, where applicable, moved whilst raised. It outlines the general principles in making the initial selection of lifting appliances and covers general aspects of their safe use. Specific guidance is given in the detailed sections of this code. This appendix also offers some guidance on power supply systems and safety devices for power operated appliances.

1.A6.3 DEFINITIONS

Definitions are as stated in section 1.3 DEFINITIONS page 2 of this code but with the addition of the following:

1.A6.3.1 Jacking

Jacking is the act of raising a load with an appliance (known as a jack or ram) which is placed under the load and which effectively pushes the load upward or lowers the load whilst supporting it from beneath.

1.A6.3.2 Lifting

Lifting is the act of raising and/or lowering a load with an appliance and other lifting equipment which is placed above the load and which effectively picks the load up or lowers it whilst supporting it from above.

1.A6.3.3 Lifting Appliance

A lifting appliance is defined in section 1.3.6 Lifting Equipment page 3 as any machine which is able to raise, lower or suspend a load but excluding machines incorporating a guided load (e.g. lifts) and continuous mechanical handling devices (e.g. conveyors). However, in discussing the general selection of lifting appliances, it is necessary to differentiate between the component parts and therefore to extend this definition. For the purpose of this appendix therefore, lifting appliance is considered to be a generic term and may be a lifting mechanism, trolley or a structure which is fitted with a lifting mechanism.

1.A6.3.4 Lifting Application

A lifting application is any application where, a load is suspended or supported on inclined planes where removal of the lifting force or any failure of the lifting mechanism or lifting medium results in either movement of the load, or a movement that can present a significant hazard.

1.A6.3.5 Lifting Mechanism

A lifting mechanism is that part of a lifting appliance which provides the motive effort and performs the actual lifting operation. It may also be capable of travelling the load.

1.A6.3.6 Pulling Application

A pulling application is any application where, a load supported on level or inclined planes where the removal of the pulling force or a failure of the pulling mechanism or pulling medium results either in no movement of the load, or a movement that cannot result in a significant hazard.

1.A6.3.7 Structure

A structure is that part of a lifting appliance which supports the lifting mechanism. It may be static providing a track upon which the lifting mechanism is able to travel or it may have means that enable it to be moved, as in the bridge of a bridge and gantry crane or the boom of a tower crane.

1.A6.4 PRINCIPLES FOR THE SELECTION OF LIFTING APPLIANCES

There are numerous factors to be taken into account when selecting a lifting appliance for a particular task or range of tasks. These will include assessing the operation, deciding on the type of appliance together with any control options and what it will be suspended from. In the case of power operated lifting appliances, the type of power, for example diesel or electric, and, if appropriate, the power feed system will also have to be considered. In the case of mobile cranes sufficient space and support for outriggers. Finally, some additional safety devices may be required to ensure that the system as a whole is safe.

1.A6.4.1 Assessing the Operation

Before considering the type of appliance to be selected, an assessment of the operation is necessary. This must include an appraisal of the operation, other possible uses to which the appliance may be subject to, and an over- view of possible future handling needs. This should also take into consideration any special requirements that may be necessary due to the site, nature of the operation, nature of load or to meet regulations. In this way a list of requirements which need to be met can be drawn up. This should include the following:

(1) Weight of load to be lifted.

(2) Size, shape of load and the centre of gravity.

(3) Nature of load, e.g. if it is hazardous, if it is fragile, etc.

(4) Total height it is necessary to lift the load.

(5) If the load is to be lifted, jacked or pulled. It may be necessary initially to raise the load by jacking to gain sufficient access for other forms of lifting equipment to be employed in the final lifting and/or moving operation.

(6) If it is necessary to move the load, in which plane(s) and over what distance.

(7) Utilization, frequency of use, etc.

(8) If the requirement is temporary or ongoing.

(9) If the equipment will be used solely for the application or if it will be used for other purposes either now or in the future.

(10) If the application does not require the suspended load to be moved, whether a suitable suspension point is available or if it is necessary to provide a means of suspension.

(11) If a structure is required to enable the load to be moved, whether this can be attached to the building members, or if it is to be free standing or if an existing building member is suitable for the purpose.

(12) Headroom available.

(13) If there are any obstructions which may impede the operation.

(14) If the working area is spacious or confined.

(15) If there is an electrical supply available, distance, voltage, phase(s) and frequency.

(16) If the ground is suitable to withstand the applied loads.

(17) If there is an air supply available, pressure and delivery rate.

(18) If the application is indoors or outside.

(19) If the area is affected by any contaminants or substances which may affect the equipment or the operative or that require special measures to be taken.

(20) If the operative needs to be in a remote position.

(21) If any special measures are necessary to comply with regulations which affect the site or operation.

(22) If any special safety requirements need to be met.



this list is not exhaustive.

A further factor in making the final selection will be the cost. To justify the lifting appliance that is finally selected, compromise may be necessary. A well-chosen appliance that is fully utilized or reduces the time taken to perform an operation is easily justified, whereas a costly installation which will stand idle for long periods cannot be. However, at no time must cost be placed before safety. It is important that the selected appliance does not impose unacceptable restrictions on its use. The various options must therefore be carefully taken into account and a balance found so that the selected equipment is safe for the intended use and achieves most or all of the requirements.

1.A6.4.2 Types of Lifting Appliance

In the most basic case, a lifting appliance provides a mechanism which is capable of lifting a load only, e.g. a chain hoist. For most applications, it is necessary to both lift and move loads and many lifting appliances provide a means of doing this. With the use of a simple structure, e.g. a runway with trolley, it becomes possible to move the chain hoist whilst it is supporting the load, but movement is limited to a single plane. A more complicated structure such as an overhead travelling crane or crawler crane allows the load to be raised and moved in any plane.

There are then three distinct areas within the heading of lifting appliances, these are:

(1) Mechanisms, e.g. chain hoist. These are mechanisms which lift the load and/or in some cases provide a means of moving the load when used in conjunction with other appliances.

(2) Static structures which in themselves are incapable of carrying out a lifting operation unless fitted with a mechanism, e.g. mobile supporting structure. These are structures which provide a means of supporting a lifting mechanism and may provide a track on which the machine can move in a single plane.

(3) Moving structures which when fitted with a mechanism are capable of carrying out lifting and moving operations in any plane, e.g. tower crane.

Lifting appliances may be manually operated, power operated or be operated by a combination of both. This gives the user options which must be carefully considered when making his selection. If power operated equipment is to be selected further consideration is necessary as to the type of power, i.e. electric, pneumatic or hydraulic, which is to be used and the provision of a suitable power source and supply system.

Mechanisms require some form of supporting structure or suspension point. Several options exist to allow the lifting mechanism to be mounted on the supporting structure. Where the lifting mechanism is designed to be suspended from a fixed suspension point or trolley, they are available with hook, eye or shackle top fittings or they may have mountings which allow them to be directly bolted into position. Where the mechanism is designed to run on a track, e.g. runway, they are available with built-in trolley arrangements. Guidance in this respect is given in the specific sections of this code.

An important feature of any lifting mechanism is that it should be self-sustaining, i.e. it will support the load at any position throughout the lift without the application of effort by the operative. An exception to this requirement is sometimes made in the case of pulley blocks where the effort is applied by hand, but special care should be taken. (See section 1.A6.4.3 Pulley blocks page 42)

Some types of manually operated winch and jacks achieve the self-sustaining properties by a low back drive efficiency. Hydraulic jacks use non-return valves to control the flow of oil and thus sustain the load. In other cases it is normal to incorporate a brake into the design of the lifting appliance. These may be friction brakes or incorporate a ratchet and pawl. The brakes used in the construction of power operated equipment are usually arranged so that when power is supplied to the motor the brake is released. Devices are used to apply the brake so that when the power supply is terminated, either intentionally or accidentally, the brake operates to sustain the load. In this way, the braking mechanism is failsafe and arrests the downward movement of the load in the shortest possible time.

Whether or not brakes are incorporated into travel motors will depend on the design and intended duty. They may not be fitted as standard but are usually available as optional extras. Travel brakes do not instantly arrest the travel but apply slowly so as avoid causing the load to swing. This feature must be borne in mind when applications call for precise load positioning and when setting automatic stopping devices.

The range of standard equipment available and the flexibility of many lifting appliances for adaptation for specific duties makes selection a matter for careful consideration. LEEA members will offer advice and assist in the selection of suitable equipment for both general and specific applications.

1.A6.4.3 Pulley blocks

For the lightest of loads, it may be possible to use a simple pulley block arrangement to lift the load. The pulley block is probably the oldest lifting mechanism known to man and is certainly the most basic. In its simplest form, a single sheave pulley block comprises a pulley wheel or sheave, the axle of which also connects with side straps from which a suspension hook, eye or shackle is supported. A rope is then passed over the pulley and is connected to the load. The pulley block serves only to alter the direction of the effort applied to the rope, i.e. downward effort on the rope results in an upward movement of the load. Mechanical advantage is gained by increasing the number of sheaves in the system and this is done by reeving the rope through a top and bottom pulley block arrangement.

Pulley blocks are used in association with fibre rope or wire rope. However, it must be realised that when used without a mechanical means of applying the effort, the operative carries the proportion of the load in relation to the number of rope falls and that pulley blocks are not self-sustaining. It is therefore strongly recommended that manually operated arrangements are avoided wherever possible and, in any event restricted to only the lightest of loads. They are more commonly used in association with winches, where the winch provides the effort and self-sustaining feature, thus enabling heavier loads to be lifted. In this respect section SECTION 7 - WINCHES USED FOR LIFTING PURPOSES page 141 of this code offers some advice on their safe use.

A feature of the use of pulley blocks which must not be overlooked is the resulting load imposed on the supporting structure. This load comprises the weight of the pulley blocks and rope, the load including any slings, etc. used to connect the load, the applied effort used in raising and sustaining the load and the effects of friction at the sheaves. This matter is dealt with in section 1.A4 APPENDIX 4 - STRUCTURES page 19 of the code.

1.A6.4.3.1 Hand operated chain hoists

Hand operated chain hoists are self-sustaining lifting mechanisms which provide an easy means of manually raising loads with acceptable operative effort. In the case of the larger capacities, they may be intended and arranged for more than one operative. Most chain hoists are designed for vertical lifting operations where the load is positioned directly below the hook although some are designed for use at an angle. They may be used in association with girder trolleys to move suspended loads along suitable tracks, e.g. runways.

The lower capacities are ideal for general use whilst the larger capacities are suitable for less frequent operations. Due to their comparative light weight and ease of installation, they are often used for temporary applications. They are also ideal for applications where no power source is available and are commonly used for maintenance purposes, in general workshops and storage areas where a lifting facility is required.

All modern hand operated chain hoists have a brake mechanism which makes them self-sustaining. However, some old types were not self-sustaining and these types are no longer considered suitable for use.

Some national standards require hand operated chain hoists to have load limited devices fitted.

For specific guidance on the selection and safe use of hand operated chain hoists see SECTION 3 - HAND OPERATED CHAIN HOISTS page 87 of this code.

1.A6.4.3.2 Hand operated chain lever hoists

Hand operated chain lever hoists are a self-sustaining lifting mechanism which offers a simple means of raising loads manually through short distances. They are arranged to operate in any position, making them suitable for applications where some pulling may be involved. They may be used in association with girder trolleys to move suspended loads along suitable tracks, e.g. runways.

Hand operated lever hoists are ideal for applications requiring frequent re-positioning. They are often used for short lifting applications, in maintenance work, in the erection of structures and positioning of machinery and other plant.

For specific guidance on the selection and safe use of hand operated lever hoists see SECTION 4 - HAND OPERATED CHAIN LEVER HOISTS page 99 of this code.

1.A6.4.3.3 Lifting and pulling machines using a gripping action on the wire rope

Machines which use a gripping action to haul a wire rope may be used for both lifting and pulling applications. They are self-sustaining and offer fixed position lifting facilities.

The wire rope passes through the machine and can be stored on a special coiler separate from the machine. This makes them ideal for applications calling for extremely long lifts. They are frequently used for maintenance and construction work. A special version of this type of machine is available for people-carrying applications and they are often used for access and rescue applications.

For specific guidance on the selection and safe use of lifting and pulling machines using a gripping action on the wire rope see SECTION 5 - LIFTING AND PULLING MACHINES USING A GRIPPING ACTION ON THE WIRE ROPE page 109 of this code.

1.A6.4.3.4 Power operated hoists

Power operated hoists are available in a wide range of designs and capacities. They may be used in association with girder trolleys to move suspended loads along suitable tracks, e.g. runways.

Power operated hoists are self-sustaining. Whilst they may be used for temporary or permanent applications, some designs are only intended for permanent installations. They are widely used throughout industry for general and specific lifting operations, offering quicker operation and less operative fatigue than with manual equipment. Power operated hoists are ideal for repetitive lifting operations, such as on production lines, where long lifting heights are necessary or applications requiring heavy loads to be handled.

For specific guidance on the selection and safe use of power operated hoists, see SECTION 6 - POWER OPERATED HOISTS page 119 of this code.

1.A6.4.3.5 Winches

Self-sustaining winches are often used in association with pulley blocks. They offer a means of lifting or pulling loads.

Winches may be built into structures or arranged in association with diverter pulleys to operate on their own. However, it should be noted that they offer a fixed-point lifting arrangement. They can be arranged to occupy less headroom than either hand operated hoists or power operated hoists, and the operative may be remote from the load. They are therefore ideal for use in confined spaces.

The range of designs and intended duties of winches is probably more diverse than with any other type of lifting mechanism. They are often used on construction sites, on vehicle mounted lifting arrangements, in theatres as well as fixed position lifting requirements in factories and stores. A type of winch, known as the suspended mounting hand operated winch or pole hoist, is available for people carrying applications.

For specific guidance on the selection and safe use of winches used for lifting purposes see SECTION 7 - WINCHES USED FOR LIFTING PURPOSES page 141 of this code.

1.A6.4.3.6 Travelling girder trolleys

As mentioned above, hand operated chain hoists, hand operated lever hoists and power operated hoists are often used in association with travelling girder trolleys. Whilst not themselves a lifting mechanism, trolleys enable the lifting mechanism, together with its suspended load, to be moved along suitable tracks such as runways. They may be separate from the lifting mechanism, which may be suspended by its top fitting to the trolley load bar, or built into the mechanism as an integral item.

For specific guidance on the selection and safe use of travelling girder trolleys see SECTION 8 - TRAVELLING GIRDER TROLLEYS page 161 of this code.

1.A6.4.3.7 Jacks

Jacks are placed under the load, when the floor or other base on which it stands is capable of sustaining the imposed loading.

Some loads lend themselves to being jacked rather than slung and lifted. Often jacks are used to lift loads a short distance to enable lifting accessories to be attached, which in turn will then be used with other lifting appliances to perform the final lifting operation. Jacks are also commonly used in applications where the load has to be lowered into its final position, such as plant installation.

It is important that jacks are used only on floors or supporting members capable of withstanding the force exerted by the jack base when the load is raised. This is usually on a smaller area than the contact area of the load and therefore greater stresses are imposed. Care must be taken to avoid hidden hazards, such as underground pipes, drains or cables, and the use of floor spreader plates should always be used if the assessment highlights a need to distribute the force over a larger surface area. A wide range of types and designs of jack is available to suit varying applications.

For specific guidance on the selection and safe use of jacks see SECTION 13 page 223 of this code.

1.A6.4.4 Suspension Points and Structures

When assessing structures, there are several options available and the selection will depend on the site, operation and duty to be performed. Where simple fixed position lifting operations are carried out indoors, it is not uncommon to support the appliance with suspension points which are a part of the building. Similarly, building members are often used either directly as runways or to support structures on which lifting appliances are mounted. This may not always be possible or desirable and a free standing or self-supporting structure or appliance will be necessary. Similarly, when lifting operations are outdoors, free standing structures and appliances are usually necessary.

Suspension points and runways which form a part of the building or other building members to which a runway or other lifting appliance is to be attached require special attention and must be checked by a structural engineer or other suitably qualified person in accordance with the recommendations given in section 1.A4 APPENDIX 4 - STRUCTURES page 19 of this code.

Permanent self-supporting structures, i.e. those bolted to or set into a foundation, also require special attention. The foundation must be designed to sustain the imposed loads and should be designed and checked by a suitably qualified person.

Temporary free-standing structures, i.e. those that rest on the floor, also require care to ensure that the surface on which they are placed is capable of sustaining the imposed loads. In this case, it is often left to the

Competent Person to assess the suitability of the surface, but the matter should be referred to a suitably qualified person should any doubt arise. Care must be taken to avoid unseen weaknesses, such as underground pipes, drains and cables. The use of floor spreader plates, to distribute the imposed loads over a larger surface area, should always be used where necessary.

1.A6.4.4.1 Tripods and shearlegs

Where an application requires only a simple suspension point to permit a load to be lifted and lowered and a suitable suspension point or building member is not available, the use of tripods or shearlegs may be an appropriate option. These are particularly suited to temporary applications where a low-cost facility is required. They provide a fixed suspension point from which a lifting mechanism can be supported.

They are usually constructed from tube or light sections and have three, or occasionally four, legs which hinge from the top where the suspension point is provided. Alternatively, they may have provision for a winch to be mounted on the legs with a top sheave over which the rope passes. They are free standing and the legs may have feet or points at their bases.

No specific guidance is given in this code and the manufacturer's instructions should be sought and followed. It should be noted however that they are suitable for vertical lifting and lowering only as any sideways movement of the load may cause them to become unstable and/or become effectively overloaded due to the increased stresses caused by angular loading. To avoid the danger of inadvertently overloading the legs, it is important that the legs are correctly spread. Safety chains, or similar devices, are often fitted so that the legs are held in the correct position when erected. Under no circumstances should they be altered without the manufacturer's specific approval.

1.A6.4.4.2 Runways

Where repeated lifting and movement along the same path is required and for general lifting duties, runways fitted with a lifting mechanism incorporating a trolley provide a suitable permanent facility. Runways may form part of the building structure, be built onto the building members or be built into self supporting structures. They may also be used for fixed position lifting when fitted with a beam clamp or suspension eye, (e.g. over lift shafts) but such arrangements are suitable for vertical lifting and lowering only.

Runways may be constructed from standard rolled steel sections or from special purpose tracking. They can be made to any length to suit the application and/or building and may be straight, curved or made to form a continuous loop. The height to the underside of the track will of course depend on the building or supporting structure and the capacity will depend on the size of track section, nature and position of supports. As runways are often custom built, suppliers usually carry out a site survey and will advise on the most suitable design for specific applications.

For specific guidance on the selection and safe use of runways see SECTION 11 - RUNWAYS page 193 of this code.

1.A6.4.4.3 Mobile Supporting Structures

As an alternative to a permanent runway installation, where an occasional application calls for both lifting and limited movement of the load in a single plane, a mobile supporting structure may be considered. They are ideal for use where there is no runway or the application does not justify a permanent installation. They are, in effect, a runway mounted on its own free-standing supporting structure. Whilst the structure itself is portable, and is usually mounted on wheels or castors for ease of positioning, they are generally unsuitable for movement under load. They are intended to be positioned over the load which can then be raised, moved along the track and lowered.

Various types of mobile supporting structures are available, and designs range from heavy duty supporting structures intended for permanent erection to light duty fold away designs intended for one off lifting operations. The former are often used in workshops and yards and the latter are ideal for maintenance purposes. Capacities vary with the design and it is necessary to consult the manufacturer to establish the available range.

For specific guidance on the selection and safe use of mobile supporting structures see SECTION 12 - MOBILE SUPPORTING STRUCTURES page 205of this code.

1.A6.4.4.4 Bridge and gantry cranes

Where lifting and movement of the load in all planes is required, consideration should be given to the use of bridge and gantry cranes, which includes light cranes systems. These range from small moving beams with hand chain hoist arrangements to massive bridge structures which incorporate specially manufactured crab units. They are ideal where repeated lifting and movement of loads anywhere within the area of coverage is required.

Bridge and gantry cranes run on tracks, which may be fixed to the building structure or form a self-supporting structure. In other cases, the crane bridge may be supported on a moving supporting structure which runs on rails which are floor mounted. These are known as gantry or portal cranes. A version of the gantry crane, known

as the semi-portal crane has one end of the crane bridge supported on a raised track whilst the other end is supported by a leg, usually in the form of an 'A' frame, which runs on a floor mounted track.

Bridge and gantry cranes are most commonly used in large workshops where loads have to be transported from one area to another, in assembly plants, in storage areas and warehouses, in outdoor applications such as stockyards and applications where other forms of moving loads may prove costly or be impracticable.

As a wide range of designs is available and cranes are usually custom built from standard components, suppliers should carry out a site survey and advise on the most suitable design for specific applications.

For specific guidance on the selection and safe use of overhead travelling cranes see SECTION 2 - ELECTRIC BRIDGE AND GANTRY CRANES page 69of this code.

1.A6.4.4.5 Slewing jib cranes

Bridge and gantry cranes are generally high cost capital items and for many general applications the cost cannot be justified as the utilization will not warrant the expenditure. In these cases, or where the use of an bridge or gantry crane is impracticable, consideration should be given to the use of slewing jib cranes.

Slewing jib cranes offer a moving runway onto which a lifting mechanism may be fitted to give lifting and limited movement in all planes. The jib arm is cantilevered on a pivot which enables it to slew. Loads may then be lifted and moved to any position within the arc of coverage. They may be mounted onto suitable building columns, walls or similar structures or be built into their own self-supporting column.

They are ideal for use in applications where loads may require to be swung out over the edge of loading docks, buildings and similar operations. They are also widely used in machine shops to lift items in and out of machine tools or on and off work benches etc. and in this context, they are often used to supplement bridge or gantry cranes.

Slewing jib cranes are usually custom built from standard components to suit specific applications. Suppliers will usually carry out a site survey and advise on the most suitable design for specific applications.

For specific guidance on the selection and safe use of slewing jib cranes see SECTION 10 - SLEWING JIB CRANES page 181of this code.

1.A6.4.5 Methods of Operation

When considering the operation of lifting appliances, manual handling restrictions must be taken into account. The introduction of a manually operated appliance may reduce the operative effort required to acceptable levels and/or change the way in which the effort is applied to make the operation more convenient. However, it is implicit that manual operation still calls for manual effort, so when selecting manually operated appliances, consideration must be given to the effort required from the operative and the resulting fatigue. The time required to perform the operation should also be considered.

The means by which manual effort is applied varies. It may be by physically pushing or pulling, by hand chain which turns a drive gear arrangement, by a reciprocating lever or rotation of a handle or hand wheel. The means must be suitable for the confines of the working space available to the operative. If the method of operation requires him to be adjacent to the load, he must be able to operate the appliance safely without risk of being trapped or injured should the load fall.

Manual operation can be confined to the less frequent or less onerous part of the operation by the introduction of power for part of the operation, e.g. lifting the load by power but moving the load by manual operation. Such arrangements are frequently used where repetitive lifting with occasional movement of the load is called for.

Power operated lifting appliances are available using electric, pneumatic or hydraulic power and mobile equipment is available with petrol/diesel engine drives.

Although not within the scope of this code, users of power operated equipment are reminded of the need for power systems to be installed, maintained and examined in accordance with the relevant regulations, and their need to meet any obligations these regulations impose.

Power operated equipment has the advantages of quicker operation than with manually operated equipment, often operatives can be remote from the load and heavier loads can be handled conveniently without operative fatigue.

In summary, manual operation may be considered when no power source is available, light loads need lifting, operations are infrequent, or precision placement is required. Where heavy loads are to be lifted, frequent operation is called for or a more rapid operation is necessary power operation should be chosen.

1.A6.4.5.1 Push/pull operation

The simplest form of manual operation associated with lifting appliances is by pulling or pushing, either directly pushing on the load or appliance or by pulling on a rope or cord and is usually confined to the travel motion. This is the cheapest method of manual operation and calls for the greatest operative effort. In most cases this

requires the operative to be in direct contact with the load and care must be taken to avoid the dangers of uncontrolled loads that can result from careless operation. A clear working area is therefore required to enable the operative(s) to manoeuvre and measures should be in place to ensure the operative is not in the load travel path.

Girder trolleys and appliances with built in trolleys, bridge and gantry cranes and slewing jib cranes are all available with push/pull travel operation.

1.A6.4.5.2 Reciprocating lever operation

Reciprocating lever operation is used on hand operated lever hoists, lifting and pulling machines which use a gripping action on the wire rope, most jacks and certain lever operated winches. The necessary effort is kept to acceptable levels by the use of gears or linkages, but this depends on the design of the appliance and varies greatly. In most cases, the velocity (or movement) ratio is high and therefore the operative must move the lever a great many strokes to obtain relatively short movements of the load. This results in a slow operation.

In the case of mechanical jacks, the required effort to raise a load can be high. Part of the mechanical advantage is obtained by the length of the lever bar which can be as long as 2 metres. The space required by the operative(s) must be carefully assessed. Lever operation usually requires the operative to be directly adjacent to the load.

1.A6.4.5.3 Hand chain operation

Hand chain operation, where the operative pulls on a chain which turns a drive wheel, is used on hand chain hoists, girder trolleys, bridge and gantry cranes and for the slewing motion on jib cranes. The necessary effort is kept to acceptable levels by the use of gears but varies greatly with the design of the appliance. As with lever operation, the velocity (or movement) ratio is high and therefore the operative must pull a considerable length of chain to achieve comparatively short movements of the load. This results in a slow operation. In most cases hand chain operation requires the operative to be directly adjacent to the load.

1.A6.4.5.4 Rotating handle or hand-wheel

The use of rotating handles is almost exclusive to winches. Although now rare, hand-wheel drives may also occasionally be used on some types of jack and to drive the slewing motion on jib cranes. In order to keep the required effort to acceptable levels, very high gear ratios are employed. This calls for the operative to revolve the handle or hand-wheel a great number of times to move the load very short distances and the resulting operation is slow. In the case of winches, they can usually be arranged so that the operative is remote from the load. In the case of jacks, the operative is directly adjacent to the load.

1.A6.4.5.5 Electric power operation

Electricity is the most common form of power used with lifting appliances. It is used on hoists, winches, trolleys and cranes to provide power for both lifting and travelling or slewing motions. Although examples of DC supply appliances still exist, AC supply is considered to be the norm. Most types of electric power operated lifting appliances are available for three phase operation. Single phase and low voltage hoists and winches are available in the lower capacities and some types of vehicle winches are available for battery operation.

1.A6.4.5.6 Pneumatic power operation

Pneumatic power operation is used on hoists, trolleys, winches and some cranes. It is less efficient and more difficult to carry to the appliance than electricity. For this reason, it is less common in general use than electricity, but it has many advantages making it more suitable for certain applications.

1.A6.4.5.7 Hydraulic power operation

Hydraulic power is the least common form of power operation associated with lifting appliances, usually being restricted to special purpose equipment and to some types of winch. The hydraulic pressure is obtained by means of an electric or petrol/diesel driven unit. It has many similarities to pneumatic power, the main difference being that where air is allowed to exhaust to atmosphere, oil is kept within a sealed system.

1.A6.4.5.8 Petrol/diesel power operation

Petrol or diesel driven motors are used to power mobile cranes, winches, crawler cranes, telescopic handlers, kerb handler, etc. thereby providing a means of power operation where no other power source is available. One of the main disadvantages of petrol and diesel engines is the production of toxic fumes. They are therefore only suitable for use in outdoor applications or where very good ventilation is assured.

1.A6.4.6 Electricity, its Supply Feed Systems and Controls

The use of electricity is highly developed throughout industry. It has the advantage over other forms of power of being more readily available and is easily carried from the power source to the appliance by cable or busbar conductor systems. As a result, electricity is the most common form of power associated with general purpose lifting appliances. The dangers associated with electricity are well known and there is much experience in protection to guard against them and in overcoming them.

It is necessary to protect the operative from the dangers of electric shocks, either by insulation or by the use of low voltages. Single phase and low voltage drives are less common in lifting appliances and are restricted to the lower capacity items due to the difficulties associated in providing motors of adequate capacities and ratings. It is therefore more normal to protect the operative by the use of low voltage control circuits as it is in this area that the main danger to the operative exists.

The current supply should include a means of isolating the equipment from the power source. In practice, switch fuses and isolators are used to fulfil this requirement. The isolator, which is considered to be part of the supply system, should be positioned at the start of the conductor system so that the system will be isolated from the power source as well as the appliance.

Electricity has the disadvantage of requiring special protection in certain environments, e.g. explosive atmospheres, and steps are necessary to contain the danger within the appliance. Such appliances and their power feed systems are far more expensive than standard equipment. They tend to be heavy and bulky and armoured cable offers little flexibility making travel difficult.

1.A6.4.6.1 Power Feed Systems

Various methods of supplying power to electric power operated appliances are available and, to some extent, the method selected depends on the specific application. Although variations exist, the main electric power feed systems are:

(1) Coiled cable.

(2) Festooned cable.

(3) Cable reeling drum.

(4) Enclosed conductor.

(5) Energy Chain

Bare wire conductors were very common in the past, but they are now considered unsuitable for new installations due to the inherent danger to personnel. They may still be found on older installations. In these cases, their continued use should be investigated, and an assessment made of the risk, e.g. they may be safe by virtue of their position. Where any doubt as to their safe use exists, they should be changed to an alternative system.

All of these systems permit movement of the appliance. Fixed-position, permanently installed appliances can of course be wired directly to the supply and trailing cables, with plugs, can be used for temporary fixed position equipment.

It should also be noted that the power feed system must include an earth as the practice of earthing through trolley wheels is no longer considered acceptable. In addition, in the case of a three-phase supply system, the earth must not be used as a neutral. If required a separate neutral conductor must be included.

1.A6.4.6.2 Bare wire conductors

Bare wire conductors were at one time the usual method of supplying power both along the gantry and across the crane bridge. The conductors were tensioned between insulated anchor points at each end and supported at intervals by insulated brackets. The connection to the conductor was usually by a conducting wheel or shoe which travelled under the wire, lifting it from the insulated supports as it passed.

This system has the disadvantage that the conductors are exposed. Although usually safe by virtue of their position, in time the wire will break and fall whilst still live. The consequences are then a matter of luck but can obviously be serious. This can be addressed by additional guards, but they can make the system difficult to maintain and it is likely to be more economical to replace the system. Because of the potential dangers, bare wire conductors are no longer considered acceptable and any remaining systems should be reviewed in the light of current legislation.

1.A6.4.6.3 Coiled cable

With a coiled cable (Figure 1.A6.4.6.3-1 page 49) the supply cable is coiled in the manner of a tension spring giving an extension ratio of approximately 3 to 1. This system is suitable for short travel distances only due to the sag in the cable. Not only will a hanging loop of cable be a potential hazard, but cable sag causes a drag on the trolley which, in the case of push/pull units, can pull the trolley back along the runway track. By positioning

the cable in a central position, double the length of coverage may be achieved. Coiled cable may be used on curved runway tracks.

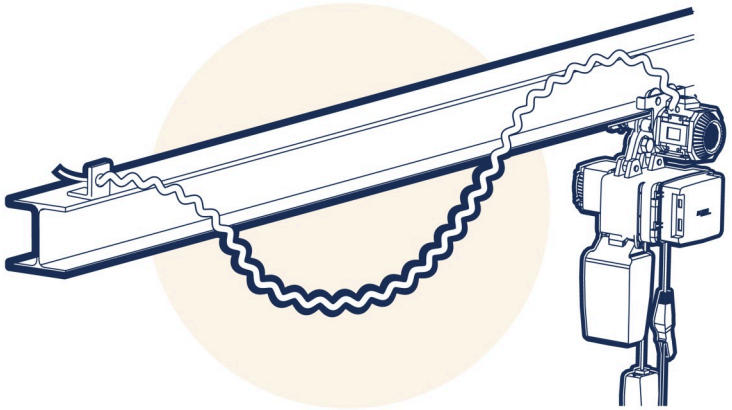


Figure 1.A6.4.6.3-1

1.A6.4.6.4 Festooned cable

With a festooned cable (Figure 1.A6.4.6.4-1 page 49) system, the supply cable is looped along a taut wire or 'C' rail running parallel to the runway track. Small sliding hangers or trolleys, from which the cable is suspended, allow it to move freely back and forth whilst maintaining the power supply. The cable may be of circular or flat-form construction, the latter being the most common. Taut wire systems are limited to lengths not exceeding 30 metres due to sag in the support wire and are only suitable for use in straight runs. They are however ideal for dirty and dust laden environments. 'C' rail systems are not limited in the same way. They are therefore suitable for longer runs and some types are suitable for applications which include bends. However, they are unsuitable for use in areas where a build-up of dust or other deposits can form in the rail. Both types are limited by the space required to house the bunched-up cable when the appliance is at the end of the runway track.

Festoon conductors have the advantage that the electrical connection is permanent and does not depend upon a sliding shoe which will require maintenance. However the disadvantage is that they are limited in length because space is required to accommodate the loops when bunched close. They are often used to supply the power across the bridge of electric bridge and gantry cranes and are suitable to supply power along short runway tracks.

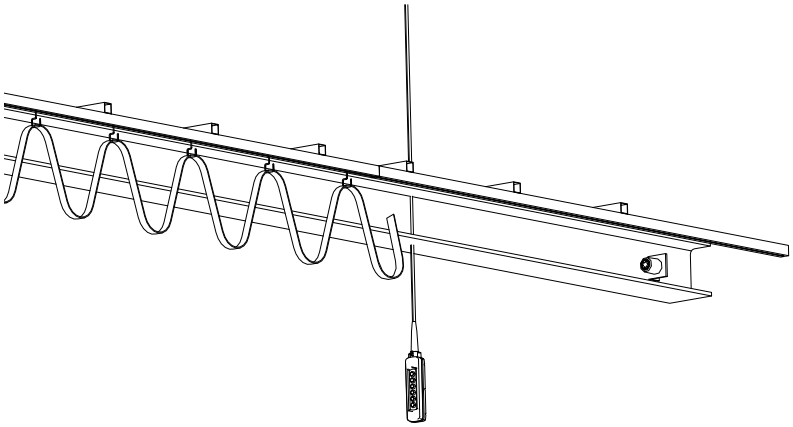


Figure 1.A6.4.6.4-1

1.A6.4.6.5 Cable reeling drum

There are several distinct variations of this type, but they all work by storing the power supply cable on a drum and paying it out to allow movement. Some incorporate a spring to reel in the cable. When the cable reeling drum is positioned high up, the spring also provides sufficient tension to hold the cable in a shallow loop which can keep it clear of people and obstacles. This system is limited by the size of the drum and, as the cable is always under tension, it exerts a pull on the trolley which can, in extreme cases, cause the travel to be arrested or even cause the appliance to be pulled back along the runway track. However, incorporation of a swivel

mounting, or a fairlead enable them to be positioned centrally and double the length served. Cable reeling drums may be used on curved runway tracks.

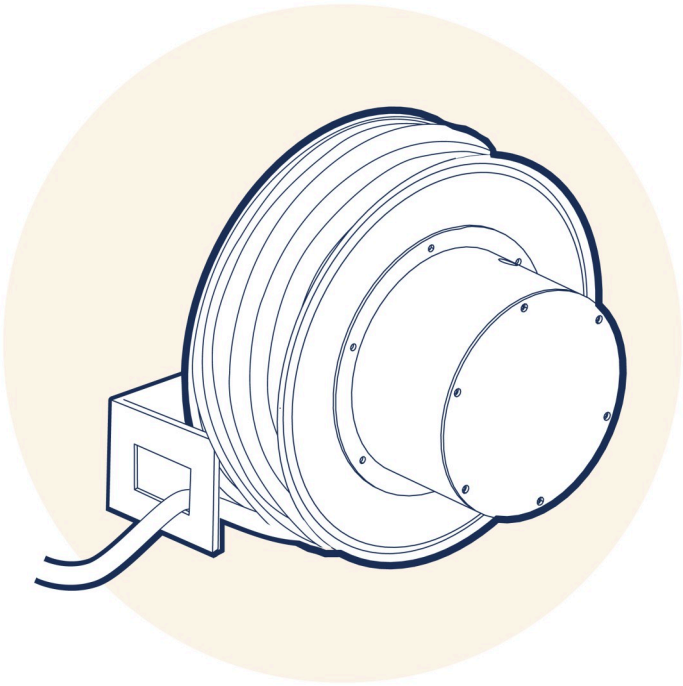


Figure 1.A6.4.6.5-1

Another variation is most commonly used to supply power to portal cranes. These are usually mounted on one of the crane legs and lay the cable into a trough on the ground as the crane moves and cable is paid out. A power drive incorporated into the drum winds the cable back when the travel direction is reversed. These reeling drums can be quite large and accommodate a considerable length of cable. Also, as the cable is not in any significant tension, they can service a long crane track.

1.A6.4.6.6 Enclosed conductors

In this system (Figure 1.A6.4.6.6-1 page 51, Figure 1.A6.4.6.6-2 page 51) a linear conductor is enclosed within a protective insulating cover which has a narrow opening on the underside. A sliding shoe connects with the conductor through this opening. For a three phase power supply, four conductors are required, one for each phase and one for the earth.

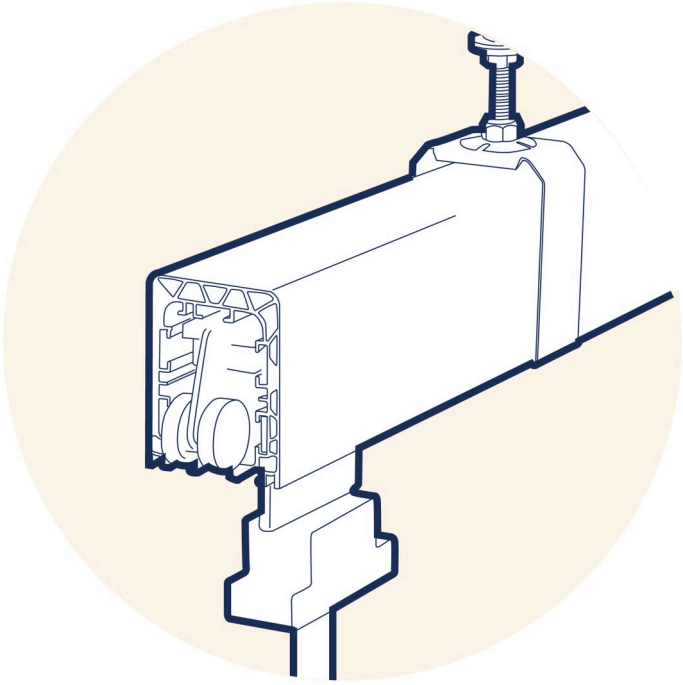


Figure 1.A6.4.6.6-1 Shrouded conductor system

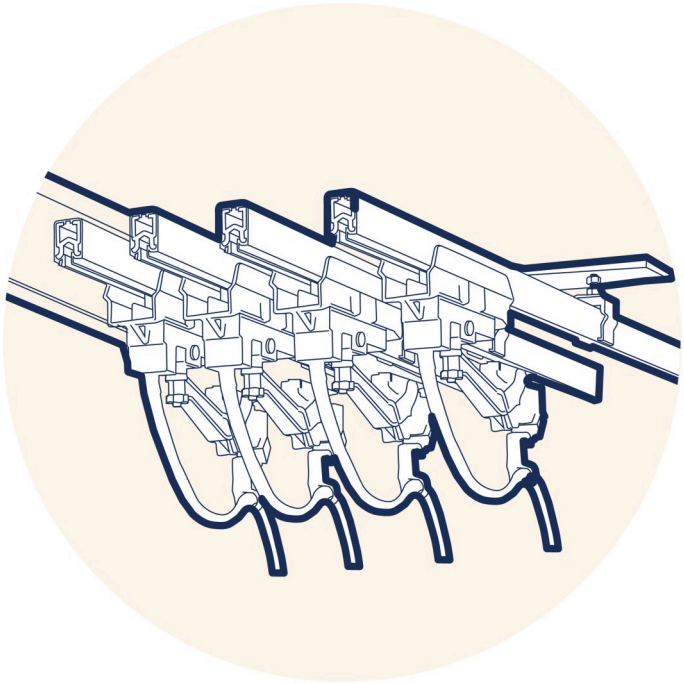


Figure 1.A6.4.6.6-2 3 phase - 4 conductor system

This system has the advantage of being able to supply power along an almost unlimited length. Because of this it is very suitable for supplying down shop power. Whilst some voltage drop will inevitably occur with long lengths, it can be countered by connecting the supply at the mid point or in extreme cases, at several points along the length.

A variation of this type is the shrouded conductor system in which the required number of conductors are enclosed within a single insulating shroud. This type has all the advantages of the individual insulated conductor and is also more compact.

These systems are unsuitable for use in certain environments, e.g. those that would require flame proofed or explosion proofed equipment. They are ideal for long travel distances and may be used on curved runway tracks.

1.A6.4.6.7 Energy Chain Cable Carrier Systems

In this system, Figure 1.A6.4.6.7-1 page 52, the conductors are encased in an articulated chain which lays in a trough. Cross bars along the length of the carrier can be opened from the outside, so that cables can be easily inserted and plugs connected. Internal separators in the carrier separate the cables. Cables can also be held in place with an integrated strain relief. Mounting brackets fix the ends of the carrier to the machine. Besides only bending in one plane due to the rigid jointed structure, cable carriers also often only permit bending in one direction. In combination with rigid mounting of the ends of the carrier, this can entirely prevent the enclosed cables from flopping in undesired directions and becoming tangled or crushed. Cable carriers are used anywhere on cranes where moving components require power, control and communication power feeds in a flexible media. Energy Chain cable carriers are quiet in operation, lightweight and provide covered cable design that can be quickly opened. They can be used in extreme conditions such as heat-resistant or clean room environments.

It has the advantage that the electrical connection is permanent and does not depend upon a sliding shoe which will require maintenance. They are particularly suitable for feeding power across the crane bridge when the chain can be positioned alongside a bridge girder avoiding the potential hazards arising from suspended cable loops. However, there is a limit to the length which they can service.

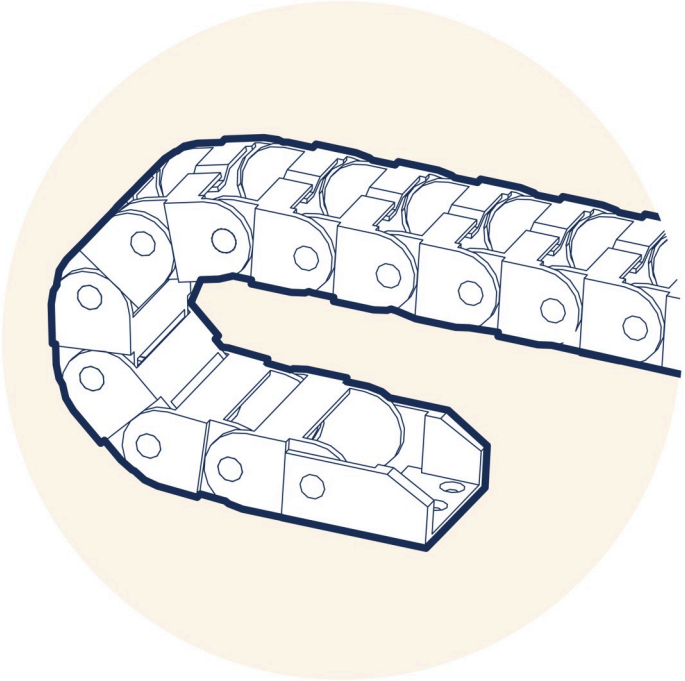


Figure 1.A6.4.6.7-1 Energy chain (shown without conductors)

1.A6.4.6.8 Trailing cables

Trailing cables, with plug and socket arrangements, may be used in certain circumstances. They enable temporary installations to be made quickly and economically. Although they may be used for short travel distances, their use should be limited as it is undesirable to have long trailing mains voltage cables. The installation must take account of the possible dangers of such a system. Any trailing cable should be suitable for the conditions of service and armoured cable should always be used. When used for temporary installations, it is important that a check is made to ensure the correct phase connection prior to operation of the appliance as the polarity of sockets is not assured.

1.A6.4.6.9 Types of control for electric power operated appliances

Modern electric power operated appliances are usually fitted with low voltage control as standard. However older hoists, special purpose hoists, winches and some cranes may not have low voltage control. Low voltage control may be 110 volt or less. Although it is quite common in many European countries to use mains voltage control, low voltage systems at 24 or 48 volt AC or DC, often referred to as Extra Low Voltage, are strongly recommended. Where fitted, this is the voltage at which all components of the lifting appliance control circuit function and is supplied by a transformer within the appliance.

Various types of controls are used with electric power operated appliances. In addition to controlling the hoist/lower and travel motions and any speed variations, they may include other control functions such as emergency stop, a key switch for isolation of the appliance, etc. Further details for on control types can be found in the specific appliance sections of this code.

Pendant cable suspended handheld push button controls are supplied as standard with hoists. They are also commonly used with bridge and gantry cranes although larger cranes may be fitted with cabs with control panels, older types utilize drum controllers. Pendant control permits the operative to move position during operation whilst still remaining in close association with the load.

For some appliances, e.g. winches, direct online starters may be used. Wall mounted push buttons are suitable for some applications. These are often used for multi-station control applications and are useful in cases where the load has to be lifted through many floor levels or where loads have to be passed from one area to another as they allow the operative to be remote from the load. An essential requirement with this type of arrangement is the provision of emergency stop buttons to override all control positions until manually reset. They should be positioned so that they are easily accessible for the operatives or others who may need to use them. Emergency stop controls should be of a type that must be manually reset, thereby ensuring operatives are able to confirm the danger has passed or take remedial action before it is possible to operate the appliance again.

Non-conductive controls, e.g. infra-red, radio, etc. have become more commonplace in recent years. They are particularly useful in areas where direct access may not be possible as they permit the operative to be completely remote from the load and appliance. It is necessary to have the area scanned before introducing this type of control to ensure that no false signals will be sent or received as the result of interference with other equipment. As this type of control may be operated from any position, the control legends should clearly identify the direction of travel motions with symbols or clearly defined wording, e.g. east, west, etc. The appliance should be marked in a similar way. Such marking must be positioned so that it is clearly visible to the operative from any position.

1.A6.4.7 Compressed Air, its Supply Feed Systems and Controls

The production of a clean, dry supply of compressed air suitable for pneumatic power operated lifting appliances is expensive and it is less easily carried from the power source to the appliance than electricity. Due to these reasons, its use is more limited than that of electricity.

Although electric power operated lifting appliances are the usual choice for general purposes, pneumatic power operated appliances have advantages for certain applications as most of the dangers associated with electricity do not exist with compressed air.

In many cases standard pneumatic equipment can be used in atmospheres where electric equipment would require special insulation and protection to contain the danger of explosion.

> when selecting pneumatic equipment for explosive environment, care should be taken to ensure that the moving components are suitable for the specific gas category and hazardous area classification.

Pneumatic motors offer variable speeds of operation. Air flow rate to the motor is controlled by the operative via a supply valve. By careful manipulation the operative can control the air delivery rate, the motor speed being governed by the volume of air supplied. At normal working pressure it is impossible to overload a pneumatic motor. Once the load increases beyond the design load of the motor, it will stall and, unlike an electric motor, it will not be harmed by this.

Although pneumatic motors are robust in design, capacity for capacity they tend to be smaller and lighter than equivalent electric motors. They will withstand a high degree of heat and moisture. Due to the internal pressure whilst in operation, the motor is self-purging. This makes standard pneumatic equipment suitable for use in steamy atmospheres, such as paper mills and laundries, and in dusty conditions, such as flour mills without any special steps being taken, unlike electrical equipment which requires enclosures to protect the equipment from their effects. If the hoist brake fails, the load will not free fall as in the case of electric equipment. The motor will act as a compressor and resist the downward movement of the load. As a result, the load will be lowered slowly by gravity.

Compressed air is less efficient than electricity. It contains a high proportion of moisture which has to be removed. Whilst motors will purge and expel this moisture when in operation, condensation will occur when the motor is idle. This will lead to corrosion and contamination of residual lubricants unless steps are taken to prevent this.

Pneumatic appliances usually exhaust spent air to atmosphere direct from the motor. The associated noise levels will be higher than with electric motors. In extreme cases, the sudden cooling of the air resulting from its expansion on release, either from the exhaust or from leaks, can cause the moisture present to freeze. This can cause a back pressure and in extreme cases blockage of the system. Although compressed air is generally considered to be less dangerous than electricity, some dangers do exist. Small leaks are usually harmless, though expensive. However, in dusty environments exhausting air and leaks can cause particles to be propelled through the air and be a hazard to eyes, etc.

Provision of a suitable air supply to travelling appliances is more difficult than with an electrical supply. High pressure flexible hoses can be considerably stiffer than electric cables. Where long travel distances are necessary, this is usually achieved by a series of supply points necessitating the disconnection and reconnection of the supply at regular intervals throughout the travel operation as pressure loss can occur in long supply systems resulting in a reduction in the effective capacity of the appliance. If hoses are subject to abrasion and wear, they can, when under pressure, suddenly burst resulting in a sudden release of compressed air. Hoses which are severed will snake and flay around when compressed air is passed through them resulting in a hazard to personnel.

1.A6.4.7.1 Air feed systems

The working capacity and operational speed of pneumatic power operated lifting appliances relies on the provision of an air supply which is at the design pressure and delivery rate. In the event of the pressure being below that for which the appliance is designed, the actual lifting capacity will be lower than that for which the appliance is rated. Equally, if the pressure is higher than intended, it may, depending on design, be possible to raise a load greater than that for which the appliance is designed, resulting in an overload situation, unless fitted with suitable overload protection. This is a danger which must be averted and this can be done by the provision of a pressure regulator in the air line near to the appliance entry port. If the air delivery rate is below that for which the appliance was designed, the operational speed will be slower than intended.

Unless steps are taken to remove it, moisture will condense in the air line and in the appliance. Although the complete removal of moisture is impracticable a suitable filter/drainer should be placed in the air line to limit this. This should be positioned at a low point in the air supply line and before any coiled or spiral hoses.

Due to the self-purging nature of air motors and the associated loss of lubricant, a regular supply of lubricant is necessary. This can be provided by an oil mist lubricator. Lubricators should be placed in the air feed as near to the appliance entry port as possible.

The air supply line should be fitted with a suitable valve to enable the appliance and its associated feed to be disconnected from the air supply. Such valves are part of the feed system which is considered to start at this point.

Although the air feed system may be plumbed directly onto the air supply line, the use of bayonet connectors has advantages. They enable appliances to be more easily removed for maintenance, relocation or storage. They also permit the ready replacement of worn or damaged hoses.

There are three main methods of feeding the air supply to pneumatic appliances:

(1) Coiled hose.

(2) Festooned hose.

(3) Hose reeling drum.

1.A6.4.7.2 Coiled hose

With a coiled hose, the high-pressure hose is coiled in the manner of a tension spring giving an extension ratio of approximately 3 to 1. It is normally supplied with an extended length of 3 metres, but due to stiffness and the drag imposed on the appliance, it is best suited to shorter travel distances. In the case of push/pull units, this drag can cause the trolley to be pulled back along the runway track. By positioning the coiled hose in a central position, double the length of coverage may be achieved. Coiled hose supplies are suitable for use on curved runway tracks.

1.A6.4.7.3 Festooned hose

With a festooned hose system (Figure 1.A6.4.7.3-1 page 55), the high-pressure hose is formed in a loose spiral. This is supported by a taut wire which passes through the centre of the spiral and runs parallel to the runway track. The hose is then free to slide back and forth along the taut wire. Some drag is imposed on the appliance and large hanging loops of high-pressure hose can be a possible hazard. A further limit to the length of this system is the space required to house the bunched-up hose when the appliance is at the end of the runway track. Festooned hose air feed systems are suitable for use on straight runway tracks only.

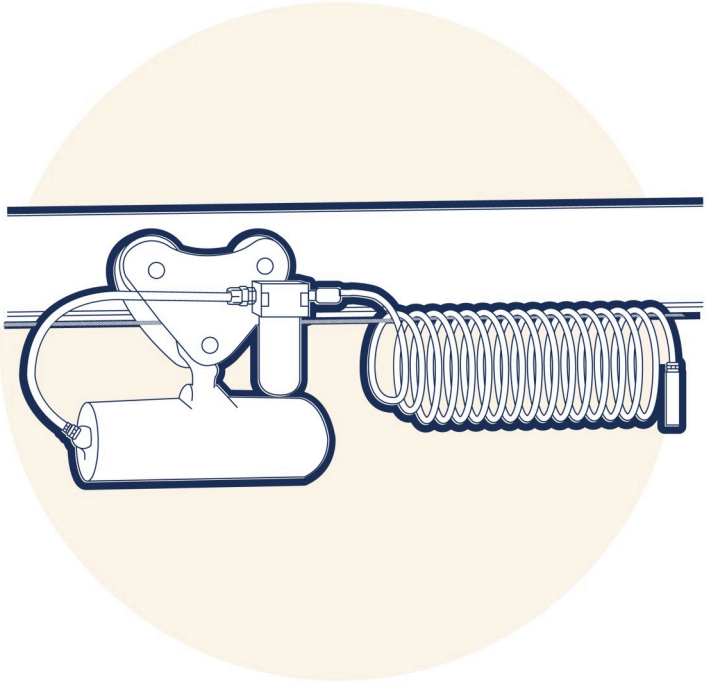


Figure 1.A6.4.7.3-1

1.A6.4.7.4 Hose reeling drum

With a hose reeling drum, the supply hose is stored on a spring-loaded drum and is paid out and recovered as the appliance travels the runway track. This system is limited by the size of the drum and, as the hose is always under tension, places a drag on the trolley which in extreme cases can cause the travel to be arrested or even cause the appliance to be pulled back along the runway track. By positioning the reeling drum in a central position, double the length of coverage may be achieved. Hose reeling drums may be used on curved runway tracks.

1.A6.4.7.5 Rigid tubing

Fixed-position, permanently installed appliances may be connected directly to the air supply line with suitable rigid tubing. However, it may be desirable to have a short flexible hose and bayonet connector feeding to the appliance to enable it to be removed for maintenance or storage.

1.A6.4.7.6 Types of control for pneumatic power operated appliances

The control of pneumatic equipment is very basic, requiring the simple opening and closing of a supply valve but this can be achieved in several ways.

The most basic method of control is the pull cord. This is the simplest option and is commonly used on pneumatic power operated hoists and trolleys. The motor control valve is fitted with a double lever arm from which the control cords are suspended. By pulling on the cord, the operative directly opens the control valve in the selected direction. An alternative to this is the twist rod control. In this case, the motor control valve stem is fitted with a twist rod. By turning the rod, the operative directly opens the control valve in the selected direction.

Pneumatic power operated winches are often fitted with lever controls. The motor control valve stem is fitted with a lever. By pulling or pushing the lever, the operative directly opens the control valve in the selected direction.

Pendant hose suspended hand held controls are available for use with hoists and winches. The hand held control houses valves which control the motions, either directly or by using air to operate the main control valve. Similar arrangements are used where remote control is necessary although these may include rigid pipe lines.

If the control is remote or utilizes a long pendant control, hose signal delay can occur resulting in over travel of the motion or a delay in commencing the operation. In some cases, electric control systems can be fitted which operate solenoid valves fitted to the appliance. These have the advantage of overcoming signal delay over long distances, but such systems may not be flame/explosion proof.

1.A6.4.8 Lifting Media

Various flexible lifting media, e.g. rope and chain, are used in association with lifting appliances. Many appliances are available with a choice of lifting media and the selection will often be a matter of personal preference. However, each has its own characteristics and will be found to be more suitable for particular applications. The individual sections of this code offer advice on the selection and safe use of the lifting media for specific appliances. Where any doubt exists, the advice of the supplier should always be sought. The following general points should however be noted.

1.A6.4.8.1 Fibre rope

The use of fibre rope is limited to low capacity manually operated winches and pulley blocks. Fibre ropes are made in a wide range of base materials, each with their own characteristics. Capacity for capacity, a larger size of rope is required than for any of the other lifting media. It is unsuitable for arduous conditions, but man-made fibres have good selective chemical resistance.

1.A6.4.8.2 Short link chain

Various grades of short link chain are used with hand and power operated hoists and with lever hoists. As a general rule, capacity for capacity, short link chain is the heaviest of the lifting media. As the links are free to articulate fully, one with another, short link chain provides the most flexible lifting medium.

Appliances which utilize short link chain incorporate a pocketed load wheel over which the chain passes, and it is this which provides the means of movement. In the case of power operated hoists, where constant speed of movement for lengthy periods of time is experienced, the action of the chain passing over the load wheel can cause long load chains to oscillate. This can lead to the load swinging and, as a result, manufacturers often impose limits on the extended dimension of their equipment.

As the chain passes over the load wheel, the slack side of the chain hangs freely in a loop. This presents a hazard which, in some cases, can be avoided by the use of a purpose made slack chain collecting box, bucket or bag. It should be noted however that such devices hang below the appliance and therefore restrict the height to which some loads may be lifted.

Chain is suitable for use in most conditions although special care must be taken when selecting the grade of chain for use in chemical and acidic environments and the supplier's advice should always be sought in these conditions. It is particularly suited to arduous conditions as the effects of wear are less onerous than with other lifting media. To improve wear characteristics, modern chains for use in power operated hoists are case hardened.

1.A6.4.8.3 Roller chain

Roller chain is used with lever hoists and pneumatic power operated hoists. At one time, it was also used with electric power operated hoists and it is possible that an odd example of this may still be found.

Appliances which utilize roller chain incorporate a load sprocket over which the chain passes, and it is this which provides the means of movement. The pitch of roller chain is much shorter than that of short link chain and, as a result, the movement of the chain is much smoother than that of the latter. This makes it suitable for handling delicate loads and for other applications where this feature is desirable. Roller chain is the most rigid of the lifting media as it only articulates in one plane, making storage of the slack chain more difficult than with other lifting media. The slack chain is usually allowed to hang from the appliance, and it can therefore be an obstruction in certain applications. As a result, roller chain is normally used for shorter lifting applications than the other lifting media.

Roller chain is not suitable for prolonged use in dusty environments as deposits will easily build up in the small spaces between chain rollers.

1.A6.4.8.4 Wire rope

Wire rope is perhaps the most adaptable of the lifting media. It is used on power operated hoists, winches and lifting and pulling machines which use a gripping action to haul wire rope.

In the case of winches and power operated hoists, the rope is stored on a drum the capacity of which limits the available lifting height. The movement of the rope on and off the drum is very smooth and, as a result, faster speeds of operation are possible than with other lifting media. Some designs of hoist utilize a double start drum. In this case, the bottom hook follows an upward path which is central to the drum. Others utilize a single start drum where the bottom hook moves across the drum as it travels, and this can be restrictive where close end approach, or a true vertical lift is necessary.

Various constructions of wire rope are available to suit most conditions of use and the supplier's advice should be sought as to the most suitable for the particular application.

1.A6.4.8.5 Flat woven webbing

The use of flat woven man-made webbing is occasionally used for lifting appliances. It is mostly used on lower capacity manual and power operated hoists. Although it is less resilient to arduous conditions than the other lifting media, it does have selective resistance to chemicals and is less liable to harm delicate surfaces.

1.A6.4.8.6 Safety Devices

Various safety devices are used in lifting appliances to limit the amount of movement, to protect the appliance from the worst effects of overloading or otherwise protect the appliance. These may be essential to the safe use and therefore be fitted as standard or provide additional features to the safe use of the appliance and be available as optional extras. It is therefore necessary to consult the manufacturer's specification to establish what provisions are made as standard and discuss any additional or special requirements with the supplier.

1.A6.4.8.6.1 Motion limits

It has been a requirement that power operated wire rope hoists are provided with an upper (hoisting) limit for many years. This was required to prevent the bottom hook travelling up into the hoist body, which would result in the wire rope breaking and the load being dropped. Although prior to modern requirements it was not a mandatory requirement it is still advisable that consideration must also be given to the use of a bottom limit. If a hoist without a bottom limit is over lowered, it is possible for the rope to wind onto the drum in the reverse direction. The result will be a reversal of motion control sense and the non-operation of the upper limit. Similar limits are advisable on power operated chain hoists. In practice, it will be found that most in-service power operated wire rope and chain hoists have both upper and lower limits as standard although the method of achieving this may vary greatly. For modern hoist units it is a mandatory requirement of most modern standards to have upper and lower limits fitted that conform to the minimum essential health and safety and functional requirements.

In the now rare case of a power operated hoist found in-service and not fitted with a bottom limit, it is advisable that one is fitted. However, unless the power operated hoist is modified or taken into a new undertaking, then this advice is not mandatory and in the case of winches which are not normally fitted with motion limits, additional precautions are necessary. To prevent over-winding, steps must be taken to ensure that the bottom hook reaches the floor before the rope is fully paid out and that the rope is marked with a visual indicator, e.g. coloured marker, to warn the operative that the maximum travel has been reached. It should be noted that new safety devices are becoming increasingly more advanced and in many cases they can be retrofitted to existing lifting appliances. It is therefore recommended that users of lifting equipment continual assess older in-service equipment and fit such devices appropriate to any identified risk.

Hoisting and lowering limits are safety devices which are intended for occasional use only. In some cases, they may require manual resetting before further operation is possible. They must not be used as a means of positioning the bottom hook. In applications where this is necessary, e.g. on a production line, additional limits, known as working limits should be considered. These are of a heavy-duty type intended for regular use and are available as an optional extra.

In the case of power operated travelling appliances, the runways and tracks to which they are fitted must be provided with positive end stops to prevent the appliance running off the end of the track or colliding with the supporting structure. Again, these are ultimate safety devices and are not intended for regular use or to position the appliance. Various types of travel limits are available for applications which require the appliance to be positioned on the track or prevent the appliance travelling beyond a specified area of the track. These are available as an optional extra.

1.A6.4.8.6.2 Anti-collision and approach limiting devices

Where more than one travelling appliance is fitted to the same track, it is necessary to prevent collision or it may be necessary to prevent more than one of the appliances entering a specified area of the track. This can be achieved in several ways, the choice of which will to some extent depend on the application.

Manually operated travelling appliances, and indeed certain power operated appliances, can be fitted with extended arms and simple buffers which will limit the approach of the appliances. To prevent collision or limit the approach of power operated travelling appliances, sensor switches may be fitted to the appliances. Various types are available ranging from simple trigger switches which are mechanically operated to disconnect the power and isolate selected areas of the track, to infra-red and microwave sensors which disconnect the approach travel motions when the set distance between the units is reached. These devices permit the movement of the appliances in the reverse direction and automatically reset once the distance between the units exceeds that for which they are set.

1.A6.4.8.6.3 Overload protection

Lifting appliances can be protected from the worst effects of physical overload in several ways depending on the design of the appliance. The simplest form of overload protection used on manually operated appliances is

the shear pin. This is used on lifting and pulling machines which use a gripping action on the wire rope and similar appliances to prevent excessive effort being applied to the operating lever.

Slipping clutches are sometimes used in power operated chain hoists and may also be found on some manually operated equipment. These are set to slip when the load increases beyond a predetermined amount, e.g. working load limit plus an allowance which takes into account the effects of dynamic loading. Slipping clutches are also used in some designs of lifting appliances as the upper (hoisting) limit, thereby serving a dual purpose.

To protect the electrical systems of electric power operated appliances, a wide variety of overload protection devices are used in their construction. These operate to disconnect the supply if physical or electrical overloading occurs. In some cases, it may be necessary to reset the device manually before further operation is possible whilst others automatically reset after a period of time or when the overload is removed. The primary purpose of electro-magnetic and thermo-electric devices is to prevent damage by electrical overload. They will therefore permit an excessive load to be lifted for some distance before they operate.

Load measuring or sensing devices are used to prevent physical overload by stopping the appliance operating if the load exceeds that intended. At one time these were not generally fitted as standard but since improvements to safety legislation and standards, they have become a standard feature of many appliances.

In all cases of electric power operated appliances, fuse protection must be provided in the supply system.

Although pneumatic motors stall to safety, pneumatic appliances may include a device which uses pressure springs or washers which compress under load and, if the design load is exceeded, they open a vent valve which carries the air supply to the exhaust stopping the motor from operating.

Hydraulic appliances utilize pressure relief valves which release the internal pressure in a system once this exceeds the design maximum, thereby preventing further operation until the load is reduced.

1.A6.4.8.6.4 Warning devices

Travelling or moving appliances can present a hazard to personnel. It is often sufficient to paint or mark them in distinctive colours to ensure that they are clearly visible. In some cases, greater steps are necessary. The use of warning lights and/or audio alarms should be assessed and incorporated where necessary to mitigate risk.

1.A6.5 SAFE USE OF LIFTING APPLIANCES

The basic objectives of any lifting operation are to move the load to the desired location, land it and to do so safely, efficiently and without damage to the load, the equipment used or the surrounding buildings, plant, etc. Having selected suitable equipment, it is important to ensure that it is properly installed/erected and fit for use. It is also important to ensure that the operatives using the equipment understand how it is designed to be used and follow a good procedure which ensures they remain in control of the load at all times throughout the operation. The following gives general guidance on these matters but as a first step always ask for, and ensure you obtain, keep and follow, the manufacturer's instructions.

1.A6.5.1 Installation/Erection of the Equipment

The installation/erection should be in accordance with the manufacturer's instructions, paying particular attention to the following:

(1) Prior to installing equipment that has been in storage, a check should be made to ensure that no damage or deterioration has occurred whilst in store.

(2) Ensure that the structure from which a lifting appliance is suspended is adequate for the load it is intended to carry. (See section 1.A4 APPENDIX 4 - STRUCTURES page 19)

(3) Where a travelling trolley is used it is essential that the track is level at all loads up to the maximum for which it is designed and that the trolley, appliance, etc. will not run away under gravity. When fitting a trolley onto an 'I' section track, ensure it is correctly adjusted for the width of beam, that the wheels align, are in full contact with the track and that anti-tilt devices are correctly set. (See SECTION 8 page 161) Check also that end stops are in place, are effective and do not make contact with the wheel flanges.

(4) With a hook suspended appliance, the top hook should be fitted with a safety latch to prevent displacement and the support should fit freely into the seat of the hook and not exert any side thrust upon the point or latch.

(5) After erection, a check should be made to ensure that the lifting medium e.g. load chain or rope hangs freely and is not twisted or knotted. This is especially important with power operated chain hoists. Special care should also be taken with multi-sheave hoists to ensure that the bottom hook has not been turned over between the falls, imparting a twist to the chain or rope.

(6) The height of lift of the appliance should be checked to ensure that the hook will reach its lowest point without the chain or rope running out fully.

(7) Where the controls allow the operative to face any direction, it is advisable to mark travel motions clearly to show the travel direction, e.g. East - West, and mark the control unit in an identical way. Ensure any limits are correctly set and functioning.

(8) Ensure the brake is operating correctly. This is particularly important if the equipment has been in storage a long time. Raise and lower a load equal to the marked SWL; the brake should sustain this at any position throughout the range of lift. If it is a manual appliance such as a hand chain hoist or lever hoist check also that it will sustain a very light load.

1.A6.5.1.1 Connecting the electrical power supply

(1) The electrical power supply, cables and conductor system should be of correct size and type for the appliance and should be installed in accordance with the manufacturer's instructions and to the requirements of national regulations and the supplier's instructions by an appropriately qualified person.

(2) The power supply must be taken via fuses or other protective devices rated in accordance with the appliance manufacturer's instructions and must include a means of isolating from the power source.

(3) For travelling appliances with a cable supply, ensure the cable is long enough to allow the appliance to travel to its furthest point without the cable coming under tension. It is good practice to leave the earth wire longer than the others so that if an accidental force on the cable pulls the wires from their terminals, the earth wire will be the last to be disconnected.

(4) With an enclosed conductor supply, ensure that the collectors align correctly with the conductors. If spring loaded collectors are fitted, they should be compressed by the conductors to approximately half of their full movement.

(5) Before connection of the power supply, insulation resistance, polarity and earth continuity tests should be carried out, care being taken not to damage any low voltage circuits or electronic devices.

(6) After connection of the power supply, check that all motions work as the controls indicate e.g. when the 'down' button is depressed the appliance lowers and vice versa. This is especially important in the case of plug in connections as the phasing at the socket is not guaranteed. If the direction of motion is incorrect, disconnect the mains supply and either reverse two phases at the appliance entry terminals or change over two phases at the fuse box. Under no circumstances should any other changes be made. Some appliances may be fitted with phase protection equipment which prevents operation if the phases are incorrectly connected.

1.A6.5.1.2 Connecting the compressed air supply

(1) The air feed line should be of the correct size and provide the required pressure and delivery rate for the appliance as specified by the manufacturer. It should be installed in accordance with the supplier's instructions by an appropriately qualified person.

(2) The air should be dry and, depending on the source, this may require the incorporation of a filter to remove moisture. Many pneumatic lifting appliances also require the air to be lubricated.

(3) For travelling appliances ensure that the supply hose is long enough to allow the appliance to travel to its furthest point without undue stress on the hose and connections.

1.A6.5.2 Maintenance

A routine preventive maintenance programme should be drawn up. For power operated appliances, this can be combined with maintenance of the associated power supply/air supply system and control equipment. The programme should conform with the manufacturer's maintenance instructions in addition to any special requirements due to the conditions of service and of course legal requirements.

1.A6.5.2.1 Maintenance of electric power feed systems

The inspection and maintenance of power feed systems will vary dependent on the type and the working environment. In general, the termination points of electric cables into their entry glands are areas of wear due to flexing. With festooned cables, continual flexing and rubbing as they open and close into loops can cause a breakdown of the outer insulation. Collector shoes of enclosed conductor systems are liable to wear and support springs may weaken. They should be checked for correct fitting and adjusted or replaced accordingly.

Cable reeling drum springs should be checked for correct adjustment. Trailing cables require special attention as, due to the nature of use, they are more liable to external damage than other conductor systems. Due to the associated dangers of such systems, the Competent Person should conduct a daily check to ensure they are free of any defect. In all cases, the isolator should be considered to be part of the conductor system and should be checked for correct operation. Regular insulation and earth continuity tests should be conducted, and records of the results should be maintained.

1.A6.5.2.2 Maintenance of air feed systems

Air feed systems should be inspected on a regular basis and action taken to close leaks and replace damaged or worn hoses. Movement and flexing of hoses at the appliance entry port can cause a breakdown of the hose wall. Oil mist lubricators should be checked on a regular basis and oil levels topped up as necessary. Drain filters should be cleared of any moisture which has accumulated. If left, this will eventually return to the air supply or prevent further moisture from being collected. Shut off valves should be checked to ensure they operate correctly.

When working on compressed air lines and systems, care must be exercised to ensure no residual pressure remains. Before disconnecting hoses or attempting maintenance work on pneumatic appliances, it is advisable to close shut off valves and then operate the appliance so as to release any residual pressure.

1.A6.5.2.3 Some Essential Precautions When Using Lifting Appliances

In addition to any specific instructions relating to the safe use of the lifting appliance issued by the manufacturer, the following points should be observed:

(1) Lifting appliances must not be used to raise, lower or suspend a load greater than the marked SWL.

(2) With the exception of appliances designed to pull as well as lift, always ensure that the load is directly under the lifting appliance so that the line of pull is vertical.

(3) Do not use the lifting medium e.g. the load chain or wire rope to form a sling, i.e. it must not be wrapped around the load and back hooked, snickled or choke hitched.

(4) The bottom hook should be attached to the load such that no part of the load is in contact with the point of the hook. The sling should be located in the seat of the hook and the safety catch closed.

(5) The bottom hook should not be crowded with terminal fittings of slings. If more than one sling is to be placed on the hook, a shackle, ring or link should be used to connect them.

(6) Care should be taken to ensure that the lifting appliance is not subjected to shock loading. When using lifting appliances with dual speed, commence the lift in slow speed before progressing to full speed.

(7) The majority of manually operated lifting appliances, and especially the lower capacity models, are designed for operation by one person only. If it is found that more than one person is required, it is probable that either the load exceeds the SWL of the appliance and/or it is in need of maintenance. Whichever may be the case, an unduly high operating effort requires investigation before the lift proceeds. For larger capacity appliances, the manufacturer will advise on the number of persons normally required to lift the maximum capacity. This guidance is not intended to preclude the use of more than one person to operate the appliance, which may in certain circumstances be found advantageous, but is to indicate the degree of operating effort normally required.

(8) The majority of power operated lifting appliances are fitted with some form of overload device designed to protect the lifting appliance. This may be mechanical, electrical or thermo-electrical. Should the lifting appliance fail to lift the load, it is probable that the load exceeds the SWL and should be checked before resetting the controls.

(9) With electrically powered appliances, never change motion direction without first allowing the motor to stop running. Quick reversal of direction causes shock loading and heavy current surges. This will result in burnt contacts and imposes unnecessary strain on transmission shafts and gears.

(10) Avoid unnecessary rapid and frequent incremental movements as this causes burning and pitting of contacts. Excessive rapid and frequent incremental movements could result in burning out of the motor.

(11) Loads should not be left suspended from lifting appliances for any length of time unless absolutely essential. In such cases, or where it is as a result of a breakdown the operative should ensure that the danger area is cordoned off to prevent personnel from being at risk in the event of a falling load.

(12) As a general rule, at no time should the operative permit either himself or other personnel to be beneath or on a suspended load.

(13) With a lifting appliance having a push travel motion, move a suspended load by pushing rather than pulling wherever possible. To move an unladen appliance, pull on the bottom hook. Never attempt to move a power operated appliance by pulling on the pendant control or a supply cable or hose. Care must also be taken to ensure the load is not allowed to swing as this may endanger the operative and result in increased loadings on the lifting appliance and its supporting structure.

(14) In the case of lifting appliances with power travel, care must be taken to prevent the load swinging unduly. If the travel motion is dual speed, always start in the slow speed before proceeding to full speed.

(15) Avoid running any travelling appliance into the end stops as this will cause the load to swing unsafely and will result in shock loading of the lifting appliance and its supporting track or structure. End stops are a final safety device only.

(16) Avoid excessive or intentional use of motion limit devices, they are a safety feature intended to protect the lifting appliance. Where the operation requires regular approach to the highest and lowest possible hook positions, a positional or working limit should be fitted for this purpose.

(17) No person other than a Competent Person or someone under the supervision of a Competent Person should attempt to dismantle the lifting appliance or replace load bearing components.

(18) Never remove guards or protective covers such as weather proof covers or heat shields without the authority of a Competent Person.

(19) Ensure the travel path is clear and free from obstructions before operating the lifting appliance. This is especially important in the case of unladen hooks or remote control units. The operative must always have a clear vision of the travelling hook path to ensure accidental hook engagement or collisions do not occur.

(20) Ensure the operative and other personnel are fully protected from hazardous materials which may form part of the load.

(21) Before continuing with a lifting operation, the load should be raised just clear and the lift halted to ensure the integrity of the lifting appliance and method of slinging which must sustain the load in any position. Only if the load is stable and balanced should the lift proceed. (See section 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16)

(22) Do not use a lifting machine to lift people unless it has been specifically assessed and is found fit for the intended purpose.

1.A6.5.3 Basic Procedure for Lifting, Moving and Landing a Suspended Load

The following provides the basic procedure for any lift where the load is to be suspended from above. It should be supplemented as appropriate for the particular circumstances. Further details of the slinging aspects are contained in section 1.A4 APPENDIX 4 - STRUCTURES page 19 of this code. For jacking see SECTION 13 page 223.

(1) Assess the operation, select, install/erect and check the lifting appliance, structure, etc. Select and check the slings and associated accessories required.

(2) Check and prepare the landing site. Ensure it will bear the load and, if the slings are to go around the load, have available timber battens or similar to prevent the slings being trapped when the load is landed.

(3) Check the route for obstacles, other personnel, etc.

(4) If more than one person is involved in the lift ensure each knows who is in charge and how to communicate with them. (See SECTION 1 - GENERAL REQUIREMENTS page 1, appendix 1 for standard signals)

(5) Sling the load.

(6) Check that the load is free to be lifted and not fixed down in any way.

(7) Make a trial lift just clear of the ground and check the slinging. If not satisfactory, set the load down, adjust and repeat the trial lift until it is satisfactory.

(8) Consider the use of load manipulation devices such a tag lines etc, to control the load in the air particularly if it has to be threaded through or past obstacles or rotated for landing.

(9) When setting down the load, a trial landing should be made. Check that the load will be stable before the slings are released.

1.A6.5.4 Storage and Handling

When not in use, lifting appliances should be returned to storage or parked in a safe position such as at the end of a runway. When parked, the hook should be raised so as not to be a danger to persons who may be walking by or working in the area and to ensure it cannot become accidentally engaged with anything in the vicinity. In the case of chain, the slack chain should be housed in the slack chain collecting box if fitted. If a slack chain collecting box is not fitted, ensure the hanging loop of chain does not present a danger.

When lifting appliances are returned to storage, the conditions should meet the requirements recommended in section 1.7.2 Storage and Handling page 9 of this code unless the equipment is suitable for outdoor storage.

1.A6.5.5 Training

For information on training see section 1.10 TRAINING page 12 of this code.

1.A7 APPENDIX 1.7 - PLANNING THE LIFTING OPERATION

1.A7.1 FOREWORD

Correctly planning and supervising a lifting operation, whether routine or complex, is core to ensuring safety. Therefore, every employer shall ensure that every lifting operation involving lifting equipment is;

(1) properly planned by a competent person;

(2) appropriately supervised; and

(3) carried out in a safe manner.'

The various sections of this code detail the principles for the selection of appropriate lifting equipment, the general requirements for its safe use and make recommendations for the training of operatives. These are important considerations when planning a lifting operation, however, observance of these alone is insufficient. A safe system of work needs to be in place and appropriately supervised.

1.A7.2 SCOPE

This appendix is concerned with those general matters which need to be taken into account when planning a lifting operation. The recommendations however are not exhaustive but are intended to draw attention to the matters which need to be taken into account when assessing and planning a lifting operation. Although primarily concerned with the items of lifting equipment detailed in the various sections of this code, the principles and recommendations given here may be applied to any operation where a load is to be lifted, lowered or suspended.

1.A7.3 DEFINITIONS

Definitions are as stated in section 1.3 DEFINITIONS page 2 of this code but with the addition of the following:

1.A7.3.1 Basic Lifting Operation

Lifting operation where the load characteristics are considered straightforward and there are no significant hazards within the working area or on the access route for the crane to the working area.

1.A7.3.2 Intermediate Lifting Operation

Lifting operation where significant hazards have been identified with the load or with the working area or access route of the crane.

1.A7.3.3 Complex Lifting Operation

Lifting operation where significant hazards have been identified with the load or with the working area or access route of the crane, and the crane is used to lift complex loads or persons, or where two or more cranes are used to lift the load,or where the lifting operation is carried out at a location with exceptional hazards.

1.A7.4 GENERAL CONSIDERATIONS IN ANY LIFTING OPERATION

When lifting any load it is vital that the lifting operation is carried out safely and presents no danger to persons or property. The load must not be damaged by the equipment used to sling or lift it and the equipment must not be damaged by the load. When in the air, the load must remain balanced and stable and be as secure as it was on the ground. Section 1 of this code, together with its appendices, gives general advice applicable to all lifting operations and the product specific sections give advice specific to the equipment.

1.A7.5 PLANNING AND SUPERVISING THE LIFTING OPERATION

All lifting operations, no matter how simple or routine, need to be planned by a person competent for the purpose who has an understanding of the principles involved, the equipment to be used, the nature of the load, the environment in which the lift is to be made and any other factors which may affect the operation. The person planning the lift should be appropriately trained and have the requisite knowledge and expertise of planning lifting operations.

1.A7.5.1 Planning Basic Repetitive Lifting Operations

For the most basic repetitive lifting operation, e.g. repetitive lift on a production line, planning the lifting operation will usually form a part of the considerations of the plant layout and the overall task to be performed. It will

largely be a matter of the initial selection and installation of the lifting equipment, supported by training of operatives to follow a laid down procedure.

1.A7.5.2 Planning Routine Lifting Operations

In the case of routine lifting operations, where simple loads are to be lifted and often transported to a new location, using a limited range of general purpose lifting equipment, planning the operation will normally be a matter for the trained operative, e.g. slinger, who understands the safety procedures to be followed at the particular site. The operative will then follow standard procedures and practices laid down during his training and given in any specific instructions.

1.A7.5.3 Planning Complex Lifting Operations

More complex lifts, e.g. lifting unusual or dangerous loads; lifts performed in difficult locations or hazardous environments; lifts performed in unusual circumstances, lifts requiring more than one lifting appliance or lifts using special purpose lifting equipment, call for greater measures to be taken during the planning. The extent of the measures will depend on the complexity and nature of the operation and of the equipment used. Often this will be a matter of supervision, but in many situations a written plan will need to be prepared.

It is common for complex lifts to require more than one operative. All personnel involved in such an operation should be briefed, their individual duties and responsibilities defined and the overall plan agreed and understood.

1.A7.5.4 Supervision and Monitoring of Lifting Operations

In all cases, supervision is necessary to ensure that the lifting operation is being carried out safely and to monitor the need to amend procedures. The level of supervision will depend on the nature and extent of the operation, the experience and competence of the operatives and the risks involved. Basic repetitive lifting should be monitored to ensure operatives adhere to the work plan and do not adopt bad, or unapproved, practices. It may also be necessary to review the procedures from time to time. Operatives performing routine lifts should be similarly monitored to ensure that they maintain safe systems of work. Refresher training should also be considered to ensure that they remain up to date and this is essential if new equipment or safety procedures are introduced. Complex or unusual lifts call for close monitoring and supervision.

1.A7.6 INFORMATION REQUIRED TO PLAN A LIFTING OPERATION

There are four important matters to consider when planning a lifting operation:

(1) the load;

(2) the task to be performed;

(3) the lifting equipment; and

(4) the site.

These cannot be considered in isolation but are interlinked and must be considered as a whole, as they all affect the choice of lifting equipment and the procedures to be adopted if the operation is to be performed efficiently and safely.

1.A7.6.1 The Load

The initial stage of planning any lifting operation will be to establish the details of the load. In particular the following questions should be considered:

(1) What constitutes the load?

(2) Is the load in one piece or is it likely to fall apart? Are there any parts of the load that need to be removed or secured before the lift is commenced?

(3) Does the load have built in lift points? If not, does it lend itself to being slung in choke or basket hitch? Are there other features that can be utilized, e.g. tapped holes, to connect the lifting accessory to or is it necessary to attach the lifting accessory by other means?

(4) Can the load be lifted using standard equipment or is special lifting equipment necessary?

(5) Is the load strong enough to support itself from the lifting/slinging points or will it need support to be lifted? If it has multi-lift points, is the load capable of withstanding the crushing effect of a multileg sling or is it necessary to use a spreader to ensure a vertical loading condition? If it is to be lifted using a grab with a scissor or gripping action is it liable to crush?

(6) Does the load present any special problems which may affect the choice of lifting accessory or the procedures to be adopted, e.g. is it very hot, very cold, corrosive, is it delicate, does it have surfaces which might be damaged by the lifting accessory or are there sharp edges which might damage the lifting accessory?

(7) What is the weight of the load? (If the weight is in doubt, it must be calculated. It is essential that this is not under estimated - ensure an over estimation is made)

(8) Where is the centre of gravity (C of G)?

(9) Is the load fixed down or free to be lifted?

(10) If it is fixed down, will the load be stable when the fixings are removed/released or will it need supporting?

(11) If the load is free, will it need additional force initially to overcome adhesion, e.g. due to seals or accumulated oil/grease deposits?

(12) Where endless slings are to be joined together then you should not either tie them or use a loop to loop knot. It is good practice when using more than one sling in a single line, to join them with a 'dee' shackle or other suitable connector before placing them onto the hook.

1.A7.6.2 The Task to be Performed

It is essential that the full requirements of the lift are established and understood. In particular the following questions need to be considered:

(1) How high is the load to be lifted? (Loads should not be raised to a greater height than is essential to complete the intended operation)

(2) If the load is only to be raised and suspended, what arrangements are to be made to ensure the safety and security of the load? (Loads should not be suspended for longer periods than is essential. Suspended loads should not be left unattended and should be guarded to prevent persons approaching or walking under the load.)

(3) Is the load to be moved once raised? If so in what direction(s) and over what distance?

(4) Are there persons in the area over which the load is to be moved? (Measures will be necessary to evacuate the immediate area or take other steps to ensure their safety, e.g. use equipment with an enhanced factor of safety)

(5) Does the load have to be turned over or orientated?

1.A7.6.3 The Lifting Equipment

A prime function in planning a lifting operation will be to establish the equipment that will be necessary to sling, lift and move the load. In particular the following questions should be considered:

(1) Is there a suitable lifting machine that can be positioned above the centre of gravity of the load? (To be suitable it must, in particular, be of sufficient capacity and has an operational speed that does not make it difficult to control and position the load and it must permit any sideways movement required)

(2) If there is no suitable lifting machine in place, is there a suitable lift point from which a lifting machine can be attached? (To be suitable it must, in particular, be of sufficient strength bearing in mind any other loads imposed on it, be vertically above the centre of gravity of the load and permit such sideways movement as is required)

(3) If there is neither a suitable lifting machine nor lifting point, is there access for a portable structure or mobile lifting machine that can be positioned over the centre of gravity of the load?

(4) What lifting accessories are available to sling the load and connect to the lifting machine?

(5) Is it necessary to have any special lifting equipment, e.g. spreader beam, manufactured to sling the load?

(6) Is it necessary to use lifting equipment that has been de-rated or which otherwise has an enhanced factor of safety?

1.A7.6.4 The Site

Any restrictions imposed by the site will influence the choice of lifting equipment and the procedure that will be adopted. In particular the following questions should be considered:

(1) Is there sufficient access and working area for the operative, or will the operative need to be remote during the actual lift?

(2) Is there a clear and safe path to the landing site or are there obstructions to be negotiated?

(3) Are persons likely to be exposed to risk during the movement of the load, e.g. by entry through doorways?

(4) Are there any special environmental problems, e.g. very hot, very cold, wet, the presence of fumes, acids, solvents or other chemicals?

(5) If outdoors, is the site liable to be affected by inclement weather, e.g. snow, frost, high winds?

(6) Will it be necessary to manoeuvre the load during movement or before landing, e.g. by turning or orientating, to negotiate obstacles, gangways, etc?

(7) Is the landing site level and strong enough to take the load? (In particular care must be taken to avoid excessive floor loadings, soft ground and hidden weak spots such as ducts and drains.

(8) Has the landing site been prepared, or will it be necessary to provide packing, supports, cradles, tools, etc?

1.A7.7 PLANNING THE PROCEDURE

Having completed the research, the procedure can be considered. There are nine points to be taken into account when setting the procedure to be adopted, as follows:

(1) cooperation and communication with others;

(2) selection and, if necessary, installation or erection of the lifting equipment;

(3) selection of the lifting accessories;

(4) checking the lifting equipment is fit to use;

(5) assembly of the slinging arrangement;

(6) making a trial lift;

(7) lifting and, if necessary, travelling the load;

(8) making a trial landing; and

(9) clearing up.

1.A7.7.1 Cooperation and Communication With Others

In all but the most basic of lifting operations, it will usually be necessary to communicate and enlist the cooperation of others. It will normally be necessary to liaise with personnel responsible for, or working in, the area in which the lifting operation is to be made to ensure that the lifting operation will not conflict with other activities, can be carried out safely without risk to others and, where necessary, the area can be evacuated. The extent to which such discussions and arrangements are necessary will depend on the particular site, the operation and its complexity. The following matters should be considered:

(1) The authority to erect any structure or lifting machine necessary for the lift. It is important that, where building members are to be used to support the lifting machine, e.g. a roof beam, the suitability is confirmed and authorised by a structural engineer, or similarly qualified person, able to make the necessary calculations. Similarly, a check of hard standing areas, e.g. floors, may be necessary. There may also be the need to liaise with and obtain the authority of other trades, e.g. electrical engineer regarding the connection of power supply, civil engineers to check suitability of ground conditions, etc.

(2) The authority and instructions to carry out the lift. The authority of those responsible for the area in which the lift is to be made should be obtained before the lift is made. Steps must be taken to ensure the lifting operation does not conflict with other activities in the area or under the path of the load. The operatives carrying out the lifting operation must be briefed and given the necessary instructions so that they fully understand the procedure to be adopted, their duties and responsibilities. One person should be appointed to take overall responsibility for the operation, and this will include liaison with others who may be affected by the operation, the creation of method statements and risk assessments.

(3) The method of communication and signals. Where more than one operative is involved in the lifting operation, the method of communication and signals to be used must be agreed and understood by all those engaged in the operation. Only one person should be authorised to signal or instruct the crane driver, except in the case of the emergency stop signal.

1.A7.7.2 Selection and Installation of the Lifting Equipment

The correct selection and safe installation of suitable lifting equipment is vital to the safety of the lifting operation. In particular the following matters should be taken into account in the assessment:

(1) Adequate capacity. The lifting equipment should be of adequate capacity for the load to be lifted and any other loads that may be imposed on it during the lifting operation. Where applicable, the capacity of the equipment should make allowance for any de-rating deemed necessary, either by the selection of purposely de-rated equipment (i.e. rated with a higher factor of safety and marked with an appropriately lower SWL) or by the selection of equipment of a higher SWL.

(2) Operation and operating speeds. The operating speed of power operated equipment should not be so fast as to make it difficult to control the movement and positioning of the load. The effort required to be applied by the operative of manual equipment should not be excessive and account should be taken of fatigue where the effort has to be applied for long periods.

(3) Headroom and height of lift. The lifting equipment must have sufficient headroom to allow the attachment of the lifting accessory and provide the required height to lift and manoeuvre the load without reaching any safety limits or stops.

(4) Positioning. The hook of the lifting machine must be able to be positioned over the centre of gravity of the load.

(5) Travel. The lifting equipment must permit any sideways movement (travel) of the load as necessary.

(6) Safe to operate. If equipment has been installed specially for the job, it must be thoroughly examined by a competent person to ensure that it is properly installed and safe to operate. Where appropriate the thorough examination will include a test. Where existing equipment is to be used, it should be covered by a current report of a thorough examination issued by a competent person.

1.A7.7.3 Selection of Lifting Accessories

The nature of the load, the overall task to be performed and the environment will be the main factors influencing the selection of the lifting accessories. The final selection will however to some degree be a matter of personal choice and availability. In particular the following matters should be considered:

(1) Supporting the load. If the load is not strong enough to support itself, additional support will have to be provided. In some cases the method of attaching the lifting accessory and slinging the load, e.g. by using a wide webbing sling in basket hitch, may provide sufficient support.

(2) Containing the load. If the load is made up of more than one part, or if there are loose pieces, where there may be a risk of them separating whenever possible they should be dismantled or removed. Where this is not practicable, they must be contained by the slinging arrangement and/or the use of additional accessories to ensure they cannot fall.

(3) Capacity of lifting accessory. The SWL of the lifting accessory must take account of the weight of the load, any de-rating deemed necessary and the mode of use.

(4) Damage to the load. The lifting accessory and its mode of use must not cause damage to the load, e.g. by crushing, by scoring polished surfaces.

(5) Damage to the lifting accessories. The lifting accessory must not be damaged by the load, e.g. by cutting, by bending, nor should they be damaged by the environment, e.g. by heat, by chemical contact.

(6) Control of the load. The slinging arrangement should enable the load to be controlled in the air, where necessary load manipulation devices should be used.

1.A7.7.4 Checking the Lifting Accessory is Fit to Use

Before assembly, the operative should check that the lifting accessories are fit for use. In particular a check should be made for:

(1) Clear identification and SWL marking.

(2) Freedom from damage, deformation and obvious signs of wear.

(3) Compatibility with other items of lifting gear, accessories and lifting equipment.

1.A7.7.5 Assembly of the Slinging Arrangement

In order to ensure that the load will be balanced when lifted, the hook of the lifting machine should be placed vertically above the centre of gravity of the load. The lifting accessory should then be attached to the load and lifting machine, ensuring that all pieces are free to align correctly. The hook of the lifting machine should then be raised so as to take up the slack and a check made to ensure that the gear is correctly positioned and that the hook of the lifting machine remains vertically over the centre of gravity of the load. Operatives must be aware of the safety procedures to be adopted when taking up the slack, e.g. keeping fingers, toes etc clear to avoid crushing or entrapment.

1.A7.7.6 Making a Trial Lift

Before making the lift, it is essential that a check be made to ensure that the arrangement is satisfactory. This is done by making a trial lift just clear of the ground. It is necessary to ensure that the load is free to be lifted and that it will remain secure, stable and balanced when in the air. If the load does not rise evenly and level, it should be lowered and the lifting accessory repositioned. Further trial lifts will be necessary until a stable and balanced condition is achieved.

1.A7.7.7 Lifting and Travelling the Load

Before commencing the lift, ensure that the landing area has been prepared and that any necessary packing, supports, cradles, etc. or tools are to hand. When lifting and travelling the load, care must be taken to ensure that it remains as safe, e.g. balanced and stable, in the air as it was on the ground. The load should be lifted in a controlled manner to prevent shock loading on the lifting equipment. The speed of movements should be controlled so as not to cause the load to swing. Similarly, when halting the movement, care is necessary to prevent load swing. Swinging loads can become unstable and impose higher, shock, loads on the lifting equipment. Care must be taken to avoid obstacles and people. A warning should be given to exposed persons to clear the area. Wherever possible, loads should be grounded in the event of the operation having to be halted unexpectedly. If, for any reason, it is necessary to halt the operation and leave the load suspended, steps should be taken to cordon off the danger area and prohibit access. In any event, suspended loads should not be left unattended.

1.A7.7.8 Making a Trial Landing

On arrival at the landing site a check should be made as to the position of the load, packers and supports to ensure that the load may be safely lowered into position without trapping the lifting accessory. The load should be lowered gently until landed, but the lifting accessory should not be allowed to go slack. A check should be made to ensure that the load is safe and will remain stable when the lifting accessory is removed and, if not, it must be lifted clear and the supports and packers repositioned until the load can be safely landed. Once the load has been satisfactorily landed, the lifting machine should be lowered sufficiently to slacken off the lifting accessory. Where the weight of the lifting accessory allows, carefully remove it by hand as attempting to drag it clear by pulling with the lifting machine can cause it to become caught and overturn the load and/or cause abrasion damage to the lifting accessory.

1.A7.7.9 Clearing Up

On removal of the lifting accessory, it should be checked and, if necessary, cleaned before returning it to safe storage. Any items found to be contaminated or damaged should not be placed in storage but should be quarantined for subsequent inspection and maintenance by a competent person.

Section 2 – ELECTRIC BRIDGE AND GANTRY CRANES

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2.1 FOREWORD

Electric bridge and gantry cranes are used to lift and move loads within the area covered by the crane. Some cranes may require manual effort to lift, lower, or move the load. However, in most cases, some or all of the crane's movements are powered electrically. This section of the code applies to electric bridge and gantry cranes.

Due to the wide variety of electric bridge and gantry cranes available, the advice provided in this section is general. For specific details about a particular crane, consult the supplier and refer to the manufacturer's instructions.

2.2 SCOPE

This section covers general-purpose electric bridge and gantry cranes that terminate with a hook. The four main types are:

(1) Top running bridge crane

(2) Under-slung bridge crane

(3) Semi-portal gantry crane

(4) Portal gantry crane

For the purpose of this code, these will be referred to as "bridge and gantry cranes" or "cranes."

This section does not cover electric bridge and gantry cranes that are permanently equipped with specialized load-lifting attachments, such as container cranes, ladle cranes, or cranes with vacuum or magnetic lifters. It also does not cover cranes designed for special environments, such as those used in explosive atmospheres.

2.3 DEFINITIONS

2.3.1 Signaller

The person who directs the crane operator. Also known as the Banksman. In simple lifting operations, this role is usually performed by the slinger or rigger.

2.3.2 Crab

The hoisting and cross travel mechanism of a double girder crane.

2.3.3 Crane Bridge

That part of the crane which spans the supporting structure or tracks and carries the crab or hoist.

2.3.4 Crane Supporting Structure

Supporting Structurebe integrated with a building structure or be independent.

2.3.5 Crane Tracks

The supporting structure for a crane which carries the crane and allows it to travel.The term is also used for the ground level supporting structure which allows a portal crane or a semiportal crane to travel longitudinally.

2.3.6 Cross Travel

The movement of the crab or hoist unit across the crane bridge.

2.3.7 End Carriage

The part of the crane bridge which runs on the crane supporting structure or tracks. Also known as a bogie.

2.3.8 Floor to rail dimension

The dimension from the floor or the lowest point the hook must reach to the top of the crane rail.

2.3.9 Headroom

The dimension from the top of a supporting structure rail to the underside of any obstruction such as a roof truss.

2.3.10 Hoist Unit

The hoisting and cross travel mechanism of a single girder crane.

2.3.11 Long Travel

The movement of the crane along the crane supporting structure or tracks.

2.3.12 Side clearance

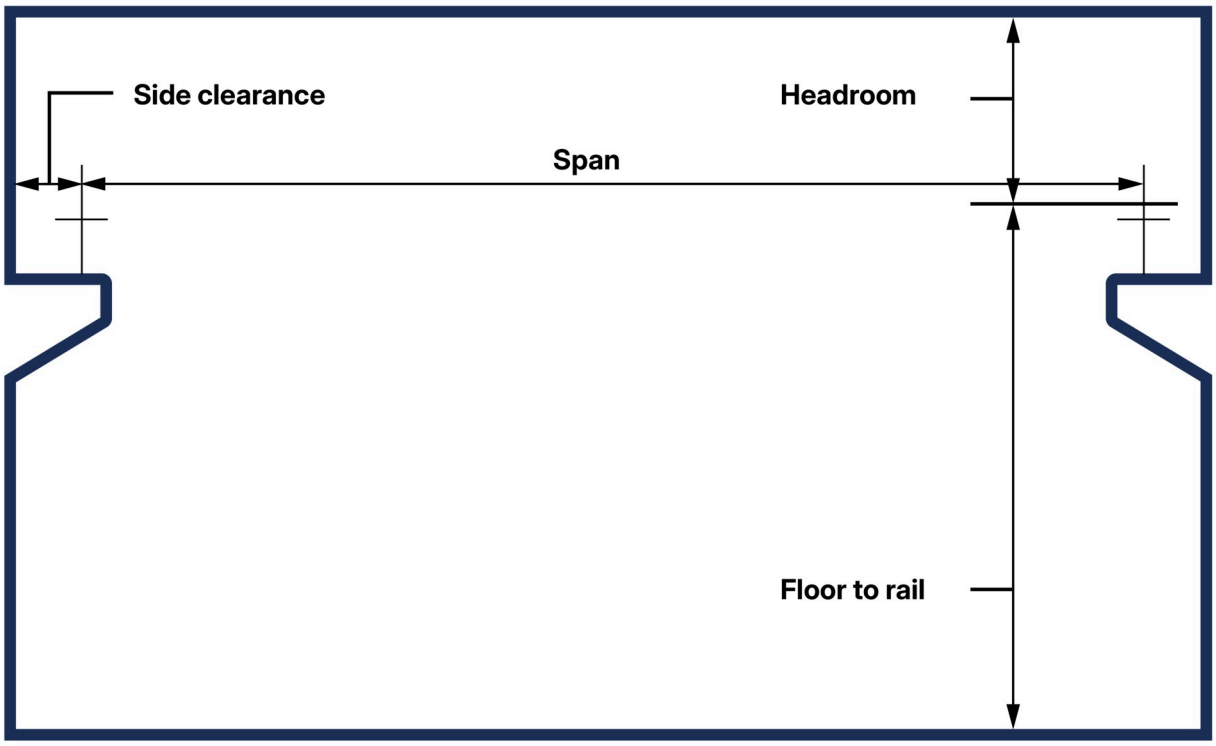
The dimension from the centerline of a supporting structure rail or track to any obstruction such as a building column.

2.3.13 Slinger

The person who attaches the load to the crane hook using slings or other lifting accessories. Also known as a rigger.

2.3.14 Span

The dimension between the rail or track centerlines.



2.4 TYPES OF ELECTRIC BRIDGE AND GANTRY CRANES AND CONTROLS

There are four main types of electric bridge and gantry cranes.

2.4.1 Types of Electric Bridge and Gantry Cranes

2.4.1.1 Top Running Bridge Crane

Top running bridge cranes are distinguished by running on the top of rails which are part of the crane supporting structure.

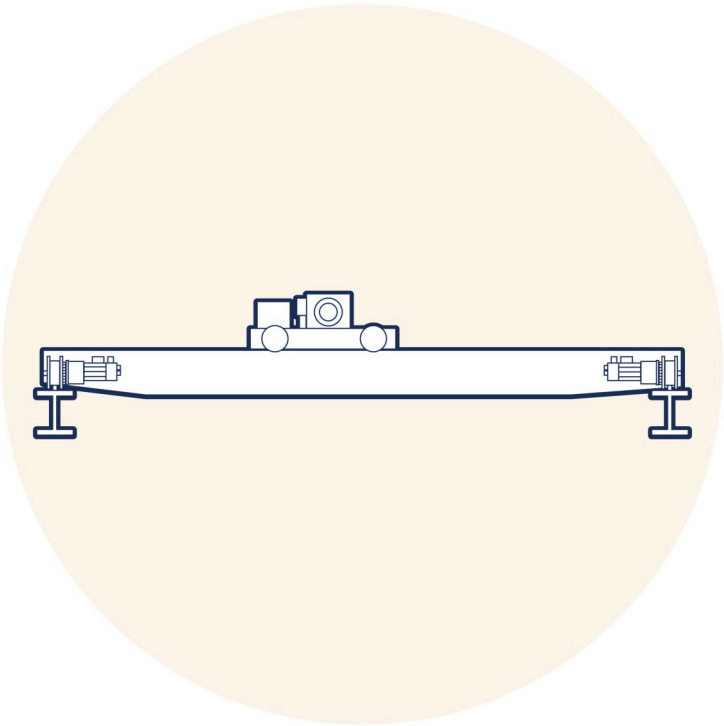


Figure 2.4.1.1-1 Top running bridge crane

2.4.1.2 Under-slung Bridge Crane

Under-slung bridge cranes are distinguished by running on the bottom flanges of the cranes tracks. Because of the under-slung arrangement, the bridge of this type of crane can have a cantilever at one or both ends. Two or more such cranes running on parallel sets of tracks can be fitted with latching mechanisms to facilitate the transfer of loads from one crane to another.

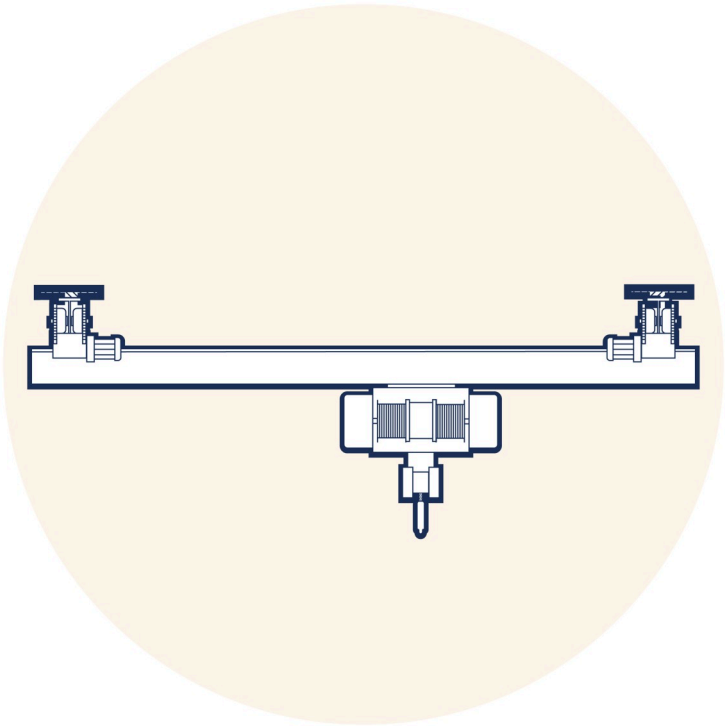


Figure 2.4.1.2-1 Under-slung bridge crane

2.4.1.3 Portal Bridge Crane

Portal bridge cranes are distinguished by running on a low level track, usually at ground level, with the bridge girder or girders supported on legs. The bridge of this type of crane can have a cantilever at one or both ends.

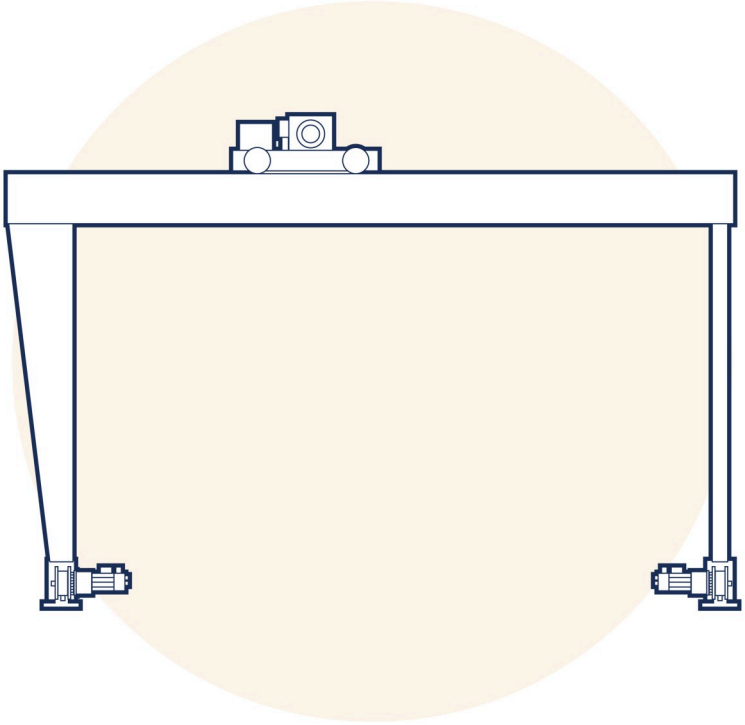


Figure 2.4.1.3-1 Portal Bridge Crane

2.4.1.4 Under-slung Bridge Crane

Under-slung bridge cranes are distinguished by running on the bottom flanges of the cranes tracks. Because of the under-slung arrangement, the bridge of this type of crane can have a cantilever at one or both ends. Two or more such cranes running on parallel sets of tracks can be fitted with latching mechanisms to facilitate the transfer of loads from one crane to another.

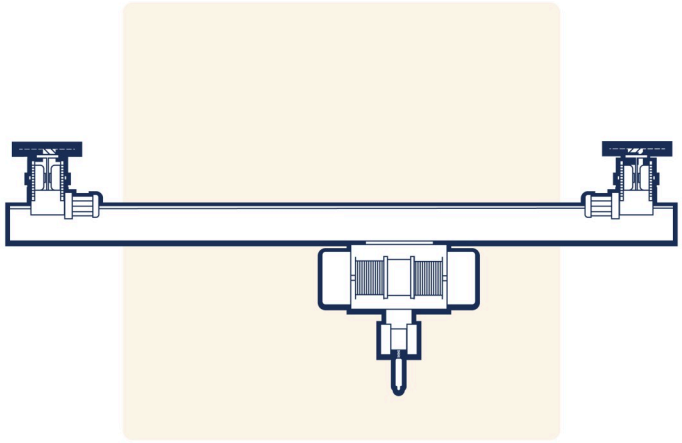


Figure 2.4.1.4-1 Under-slung Bridge Crane

2.4.2 Types of Electric Bridge and Gantry Cranes Controls

2.4.2.1 Cab Control

The crane operator controls the crane from a cab mounted on the crane. This cab is usually fixed at one end of the crane bridge and moves with the bridge. Before modern control systems were developed, most electric bridge and gantry cranes were controlled from the cab. There are still situations where cab control is the best option, especially when the crane is in continuous use or when the operation involves extensive long travel movements. The disadvantage of cab control is the need for the operator to be continuously on duty when use is infrequent.

Another arrangement is where the cab is fixed to the crab and therefore moves with the crab. This has the advantage of giving the operator a view of the load which might otherwise be obscured. A third variation is a cab without controls from which the operator can control the crane using a pendant control or a remote control. This gives the option of cab control when appropriate, such as during a period when the crane is in frequent use yet retains the flexibility of control from other levels.

2.4.2.2 Pendant Control

The crane operator controls the crane from a low level, usually ground level, using a push button box suspended from the crane. The push button box is usually suspended from a track running across the crane bridge and connected by a festoon cable enabling it to be moved to any position. This has the advantage of enabling the operator to choose the best vantage point and also to negotiate any obstacles whilst using the long travel motion.

Less popular arrangements are for the push button box to be suspended from a fixed point on the crane bridgeor from the crab or hoist unit.

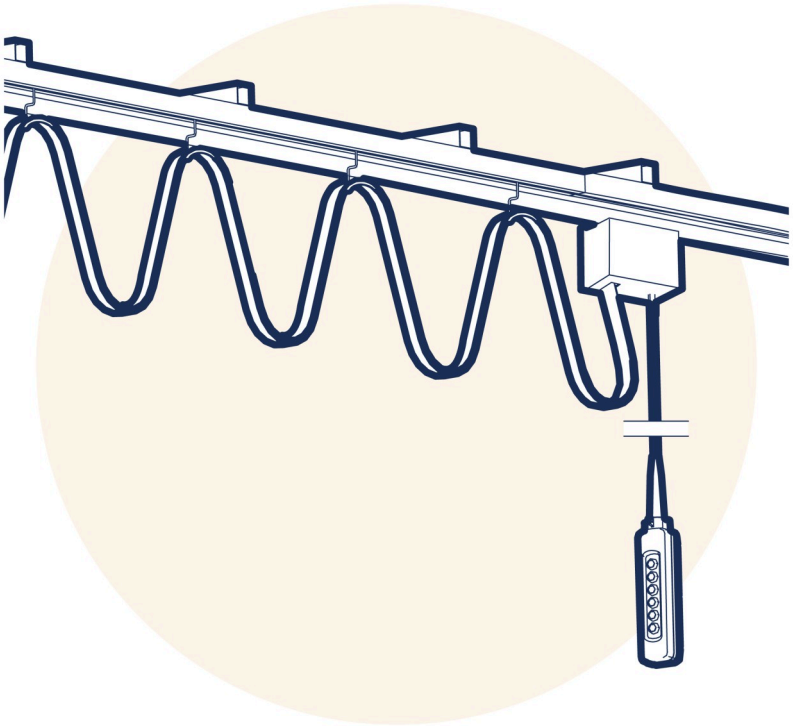


Figure 2.4.2.2-1 Pendant push button box and festoon cable connection

2.4.2.3 Remote Control (Cable-less Controller)

The crane operator controls the crane from a remote operator station without a cable connection to the crane. This has the advantage of enabling the operator to choose the best vantage point with virtually no limitations. Early forms of remote control were of the infra red type similar to the controls used for domestic equipment such as televisions. A significant drawback was the need for a clear line of sight between the controller and the receiver mounted on the crane. These have largely been replaced by radio controls which do not require line of sight.

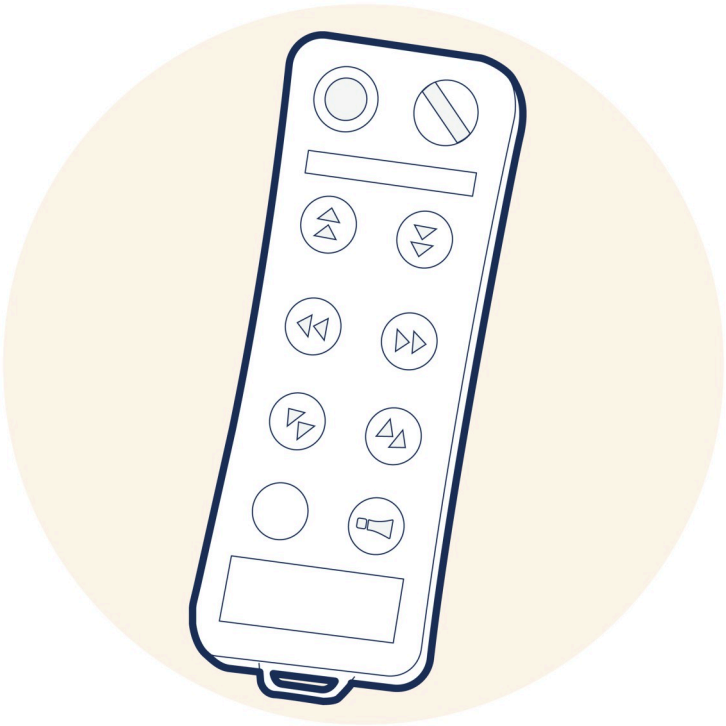


Figure 2.4.2.3-1 Remote control operator station

2.4.3 Types of crane control systems

Older cab-controlled cranes usually have three phase slip ring type motors controlled by drum controllers, so called because of their upright drum shape. A crank rotates contacts within the controller and switches the amount of external resistance in the rotor circuit. This controls the maximum current generated in the rotor and thereby the torque and speed. The motor is started with high resistance giving maximum torque from zero speed. Resistance is reduced as speed builds. This type of control enables a skilled operator to start and stop the crane motions smoothly and control the speed.

When this type of crane was converted to pendant control, timers were required to control the switching of the resistance. This effectively controlled the rotor current but also quickly took the motor up to synchronous speed. In effect, most of the facility to control speed was lost. Also, it was often found that the speeds were too fast particularly that of the long travel motion.

New cranes designed for pendant control often use squirrel cage motors which quickly reach synchronous speed. Therefore, taking the tension at the start of a lift or positioning the load precisely can require rapid and frequent incremental movements by quickly pushing and releasing the appropriate motion button. This is not good for the motor or the control system.

Dual speed hoists offer a better solution and dual speed motors are sometimes fitted to the travel motions. Some dual speed motors have the same rating on both speeds. These are often controlled by separate push buttons; the slow speed being used for precise positioning and the fast for general movement when precision is not required. However, some dual speed motors have a much reduced rating on the slow speed. Its purpose is to provide a transition between being zero speed and fast speed and should not be used for prolonged periods. These are often controlled by a single dual position push button, a half depression giving the slow speed and full depression giving the full speed.

A more recent development is the inverter control system. The speed of an AC squirrel cage motor is controlled by the frequency of the power supply. Inverter control systems rectify the AC supply into DC then invert it back to AC using electronics which allows the frequency, and hence the motor speed, to be controlled. The result is a continuously variable control of the motor speed and the facility to brake through the motor. This system can be used in cab-controlled cranes and also pendant and remote controlled cranes. It works particularly well with remote controls where the operator station can be worn on a strap around the operators neck and incorporate joystick controls.

2.4.4 Types of Power Supply

Power must be supplied to the crane along the length of the supporting structure or track, usually referred to as the down shop supply. It must also be supplied across the crane bridge to the crab or hoist unit. There are

several systems in use, each with variations from different manufacturers. However, they can conveniently be grouped into a few basic types.

- Bare Wire Conductors
- Insulated Conductors
- Festoon Conductors
- Energy chain
- Cable reeling drums

For general guidance on each of the above refer to section 1A6.3 page 41 of this code.

2.5 PRINCIPLES FOR THE SELECTION OF BRIDGE AND GANTRY CRANES

2.5.1 Selecting the Type of Crane

The decision on which type of crane to choose will largely depend on the installation location. There are four main likely situations.

2.5.1.1 An indoor crane for a new building

If the crane is to span the whole width of the building, the most likely choice will be a top running bridge crane and the supporting structure can be designed as an integral part of the building structure.

If the crane is to span only part of the width of the building, there are four options. First an under-slung bridge crane running on tracks suspended from the building. This option keeps the floor area clear of extra supporting structures. Second a semi-portal bridge crane. This option is only suitable if the crane span is to reach one side of the building. Consideration must be given to the possible hazards arising from the crane leg and the floor level track. The third option is a portal bridge crane and again consideration must be given to the possible hazards arising from the crane legs and the floor level tracks. Finally, there is the option of a top running gantry crane with one or both sides supported on a free-standing supporting structure. This has the disadvantage of a permanent supporting structure obstructing part of the floor but may be suitable if only a short travel run is required.

Whichever option is chosen, it is essential that it is decided early in the building design process so that the required capacity, span, travel and height of lift are provided for. The loadings imposed by the crane on the building, supporting structure and ground must be determined and allowed for.

It is essential that the building designer is familiar with designing structures for use with electric bridge and gantry cranes. The design must incorporate the facility to accurately adjust the line, level and span of the supporting structure rails or crane tracks. Many buildings will be subject to movement over time and this will make it necessary to re-align the supporting structure or tracks. The type of building structure is also important. Many modern buildings are of portal frame design. These can flex considerably under the influence of wind, snow and other imposed loads such as internal services, water tanks, etc. This flexing can result in an unacceptable variation of span. It is possible to introduce ties to limit the effect, but this should preferably be done at the design stage.

Consideration must also be given to access for delivery and erection of the crane taking account of whether the crane will be delivered fully assembled or not. The headroom required for a mobile crane to install it may require scheduling the installation for before the roof is completely covered. Similarly, access will be required for load testing the crane and supporting structure. This will involve travelling the crane under load down the length of the supporting structure. It should therefore be scheduled before any plant, machinery or other obstacles are installed in the building.

2.5.1.2 An indoor crane for an existing building

Clearly much will depend upon the design of the building. The options for the type of crane are essentially the same as for a new building but if the building was not designed to accommodate electric bridge and gantry cranes, it is highly unlikely that it will withstand the loads imposed without considerable strengthening or the installation of an independent supporting structure on new foundations. Also, the available headroom may not accommodate a crane of the required capacity spanning the full width of the building. These factors may limit your options.

2.5.1.3 An outdoor crane alongside a new or existing building

The main options are a top running bridge crane and a semi-portal bridge crane. The decision mainly depends upon whether the building will support crane tracks on that side and the length of travel required. For the length

of travel, it is a balance of cost between the more expensive semi-portal crane and the cheaper ground level track. Consideration must be given to the possible hazards arising from the crane leg and the ground level track.

2.5.1.4 An outdoor crane in an open area

The two main options for an outdoor crane are a top-running bridge crane with an independent support structure or a portal bridge crane. The choice depends on the required travel length, practical constraints and balancing the higher cost of the portal crane with the cheaper ground-level track. Hazards from crane legs and tracks must also be considered.

2.5.2 Applications

Cranes designed for use outdoors incorporate features not usually found on those designed for indoor use. They are built with weather protection for critical components, corrosion-resistant materials, and structural elements that may include an additional thickness to account for corrosion over time. Storm anchors are necessary to prevent the crane from being moved along the crane tracks by high winds. These points should be considered when purchasing a second-hand crane for outdoor use or relocating an indoor crane for that purpose.

Important factors to consider in crane selection

- **Duty Rating:** This defines how often the crane will be used and how much load it will handle relative to its maximum capacity. The crane's duty rating must be suitable for the application. A crane that lifts its maximum load continuously during a 24-hour shift does more work and requires a higher duty rating than one used a few times a day and only occasionally lifting near its maximum capacity. It is essential that the current and foreseeable duties of the crane are carefully considered before purchase. If a crane is used beyond its designed duty, it will affect safety, require more frequent inspections and maintenance, and its lifespan will be reduced.
- **Hoist and Travel Speeds:** Variable or slow speeds are needed for precision. Higher speeds may be required for long distances or high lifts.
- **Control System Type:** The choice of control system will depend on the operator's position, movement requirements, and is configured for its environment and application. For long-distance travel, cab control may be the best option. If the operator needs a broader view of the work area or must operate from different levels, remote control may be more appropriate. For tasks where the operator needs to sling the load and wants easy access to controls, pendant control may be the preferred option.

2.5.3 Multi Lifting

Electric bridge and gantry cranes are sometimes used for multi lifting operations where the load is shared between two or more cranes which must operate in unison. The cranes must each have a SWL equal to or in excess of their share of the load taking into account any possible variations of share. They must also be able to operate at the required distance apart, taking account of the load rating of the supporting structure or tracks at that proximity. The speeds of the cranes should be compatible particularly if the operation involves long travel movement in which case the long travel speeds must be matched.

When purchasing new cranes for this application the cranes should be regarded as a single machine. There should be the facility to control all cranes from one control station using a single set of controls. The crane systems should be linked so that when any motion command is given, they communicate to verify that all cranes are executing the same movement. An integrated control system of this type will eliminate the potential risks arising from a malfunction of one of the crane control systems and a lack of coordination between the individual crane operators.

> This is not intended to preclude the cranes having the facility to be used independently.

When using more than one existing crane or purchasing an additional crane to work with an existing one for this application, consider integrating the control systems as described above, especially if the operation is frequent. It is often possible to perform multi-lifting operations with separately controlled cranes, but this requires careful planning, training, and procedures to manage the associated risks.

2.5.4 Multi-hoist cranes

There are two main situations where it may be beneficial for the crane to have more than one hoist unit. Generally, the higher the capacity of the hoist, the slower the hoisting speed. For high capacity cranes, this can result in very slow operations when lifting relatively light loads. A lower capacity, higher speed auxiliary hoist mounted on the same crab frame can facilitate more efficient light load operations.

The second main situation is where the application requires the load to be orientated in some way whilst in the air. An auxiliary hoist or a second crab unit can provide this facility.

2.5.5 Other Features

2.5.5.1 Overload

Protection DevicesIn accordance with most modern legislation cranes manufactured with a rated capacity of 1 tonne or more must be fitted with devices to warn the operative and prevent dangerous movements of the load in the event of overload. However, it should be noted that older equipment may not be fitted with such devices and, if not, consideration should be given to upgrading them.

Overload protection devices take different forms but are usually set to allow a load slightly in excess of the SWL to be raised. This protects the hoist from accidental overload but allows for dynamic loading.

2.5.5.2 Travel Brakes

Older cab-controlled cranes usually had a driver operated foot brake on the long travel motion. These have to be replaced with automatic brakes when the crane is converted to pendant control. The crosstravel motion was slower and below a certain speed there was not usually a brake fitted. This is not always addressed when cranes are converted to pendant control. There may be some of these still in service and if so, their acceptability should be reviewed. Modern cranes should have brakes on both the long and cross travel motions. These are actuated on release of the controls. Unlike the hoist brake, which is designed to arrest the load in the shortest possible distance, travel brakes are designed to stop the motion more gently to minimize load swing.

2.5.5.3 Motion Limits

The hoist motion should always have an upper limit switch to prevent over hoisting. This is a safety device and should not be used as a positional limit switch. If for operational reasons a positional limit is required, a secondary system should be used. Most manufacturers can supply these.

Most modern cranes will also have a lower limit switch to prevent over lowering. Many older cranes did not have a lower limit but relied instead upon having sufficient rope for the bottom hook to reach the floor. This should be borne in mind when relocating such a crane.

Most older cranes were not fitted with limit switches on the long travel and cross travel motions and relied instead on the skill of the operator. The main reason is that simple limit switches can only cut the power supply. Unless this is done at a position which allows for the full speed stopping distance, they will be ineffective. However, positioning them to allow for stopping from full speed will considerably limit the floor area covered by the crane. Modern electronics can provide an effective solution and should be considered if the risk assessment shows that it needs to be addressed.

If more than one crane is operating on the same supporting structure or track, anti-collision control should be considered unless the risk of collision can be controlled by other means. Again, modern electronics can provide a solution.

For portal and semi portal cranes operating in an area where people may be present, anti-collision control to protect personnel should be considered. For further information please refer to the statement in 1. A6.4.8.6.1 Motion limits page 57.

2.5.5.4 Isolator Switch

There should be a lockable isolator switch which can disconnect the power supply to the down shop conductors. This should be mounted in an easily accessible position and clearly identified as the isolator for the crane. There should also be a separate lockable isolator or crane disconnector switch on the crane at the point where the power supply enters the control cabinet.

2.5.5.5 Emergency Stop

All crane controls must incorporate an emergency stop button coloured red on a yellow background. Unlike the other buttons this must not be of the self-resetting type and should require manual resetting once actuated. It must be in a readily accessible position and this will normally be with the crane controls, for example in the operator's cab or in the pendant push button box.

When remote controls are used, the control station should always include a stop button. However, it may also be necessary to have a separate hard-wired emergency stop button to provide functional safety. This addresses the possibility of a malfunction in the control electronics causing a motion to start without an operator command at a time when the control station is unmanned or out of reach. The separate emergency stop button enables anyone in the vicinity to take action.

This approach may not be practical in situations where there is more than one crane on the supporting structure or the supporting structure is very long. However, the problem can also be addressed by good management of the remote-control station. (See section 2.11 SAFE USE OF ELECTRIC BRIDGE AND GANTRY CRANES page 84 dealing with safe use) An additional emergency stop is not required if the following conditions apply:

- It is ensured that a lost remote-control station cannot send any run command
- There are no operator access ways on the crane
- The crane supporting or track has no access facilities

In addition some of the risks arising from an unmanned control station can be addressed as follows:

(1) The control station can be fitted with a neck strap to prevent it being dropped accidentally.

(2) The control station can be fitted with an isolating key lock to prevent unauthorised use. This can be of the 'pull out' type which will automatically de-energise the main contactor. If the key is attached to the operator by a lanyard, this ensures the main contactor is always de-energised before the control station is left unattended. It also gives additional security if the control station is accidentally dropped.

The control station can have a separate 'hold to run' button which holds in the main contactor. This requires two-handed operation but will automatically de-energise the main contactor when the control station is left unattended. If fitted, this facility should have the same level of integrity as the emergency stop, i.e. a single fault shall not lead to loss of safety function and, whenever reasonably practicable, shall be detected at or before the next demand on the safety function.

2.6 INFORMATION TO BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

Bridge and gantry cranes may be used for closely defined applications or for more general applications. It is therefore not always possible to give the designer or supplier precise details of the task to be performed and in some cases the following information can only be provided in terms of maximum and minimum values. When purchasing a crane for a new building the crane designer will need to be intimately involved in the overall design of the facility.

When purchasing a crane for installation into an existing building or for use on an existing supporting structure or tracks, it is essential that the supplier surveys the site of the proposed installation.The required information should include, but is not limited to, the following:

(1) The maximum load to be lifted or the SWL.

(2) The nature of the loads to be lifted.

(3) Whether the application involves multi-lifting.

(4) Whether the application affects the load, e.g., hoisting out of water.

(5) Details of the duty cycle.

(6) The minimum required height of lift.

(7) The required hoisting speed.

(8) The required long travel speed.

(9) The required cross-travel speed.

(10) For an existing supporting structure or tracks, the span.

(11) For an existing supporting structure or tracks, the permitted loadings (if known). If not known, a design check is necessary.

(12) For an existing supporting structure, the available headroom and end clearances.

(13) The preferred type of crane.

(14) The available power supply.

(15) The preferred power supply system.

(16) The preferred crane control system.

(17) The operating environment.

(18) For portal and semi-portal bridge cranes, whether persons may be present in the operating area.

(19) The crane operator's working conditions. For pendant-controlled cranes where the operator follows on foot, the travel motion speed must be limited. For single-speed motion where a clear walkway is

available, limit the speed to a maximum of 1.0 m/s. If there are obstructions in the operator's path, it is recommended to have a selectable speed of 0.75 m/s or less. For pendant and remote-controlled cranes with two or more speeds, including stepless control, higher speeds are allowed, provided that the slowest selectable speed is 0.75 m/s or less.

For an existing supporting structures or tracks, it will be necessary at some stage to have the structure surveyed to determine its condition and accuracy of alignment. It may also be necessary to have the design checked for which purpose the end carriage wheel centers and maximum heel loadings of the intended crane are needed. A load test may also be required. As the costs of repair, strengthening, re-alignment and testing can be considerable, purchasers are advised to have the structure surveyed at an early stage before committing to purchasing the crane.

2.7 LEGAL REQUIREMENTS

Particular attention is drawn to 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

2.7.1 Supply

It is recommended that all cranes are designed and manufactured in accordance with the applicable national standards and legislation.

Many electric bridge and gantry cranes are traded second hand and often modified to suit the new application. This may involve structural modifications and modernised by fitting a new hoist or control systems such as pendant or remote control. In such circumstances there is an element of new manufacture in the finished crane which the supplier must take responsibility for. From a legal point of view, if such modifications are extensive, it may be regarded as a new crane manufactured using some second-hand materials and components. In that case the crane must comply fully with the applicable supply legislation, marked accordingly and supply with new documentation and instructions.

It is not possible to define the point at which the modifications are extensive enough for that to apply but the purchaser is advised to make enquiries in order to be sure about fulfilling the duty placed on an employer, for guidance on this subject reference to LEEA guidance document, LEEA 067 Guide to second hand, modified or refurbished cranes, is recommended. In general, it is recommended that second-hand cranes be updated where necessary. For example, where there is a risk to safety of persons that can be reduced with the integration of modern technology. For older cranes, this is likely to require the fitting of overload protection devices and possibly additional limit switches and brakes.

The supplier should have a technical file containing the drawings and documents which support the modifications and provide the evidence that the finished crane complies with the essential health and safety requirements of the applicable standards and legislation. The supplier should issue a document stating the modifications and provide appropriate information for use and maintenance including, for example, the new or modified wiring diagrams. Any documents supplied with the new equipment fitted should also be provided.

2.7.2 Installation

The safety of electric bridge and gantry cranes depends upon the installation conditions, before it can be used for the first time, therefore it must be thoroughly examined by a Competent Person and a report issued to confirm that it has been correctly installed and is safe to use.

2.7.3 In Service

Electric bridge and gantry cranes must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template documents, retained and cross referenced to the crane’s historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and retuning it to service.

2.7.4 Repair

A thorough examination is required after substantial or significant modification or repair. Any modification which affects the crane's load bearing ability falls into this category. Any repair which involves welding or manufacturing new load bearing parts, such as might occur when manufacturer's parts are not available, also falls into this category.

Many routine repairs involve only the fitting of replacement parts such as the wire rope, sheaves or brake shoes. In such cases, provided that the replacement parts fully comply with the crane manufacturer's specification, a thorough examination is not necessary. However, it is essential that such work is done by someone competent for the purpose and, on completion, it should be inspected to ensure it has been done correctly. It is good practice for the inspection to be made by a person other than the person doing the work. If in doubt or if an independent inspector is not available, the Competent Person should be notified and asked to make a thorough examination.

A record of any modification or repair and subsequent thorough examination or inspection should always be made and cross referenced to the crane's historical records for inspection by the Competent Person or the enforcement authority

2.8 INSTALLATION AND COMMISIONING

2.8.1 Crane supporting structures and Tracks

New supporting structures and or tracks need to be aligned within the required tolerances. Existing supporting structures and tracks need to be surveyed for accuracy of alignment and if necessary adjusted.

Unless otherwise specified by the crane manufacturer, the supporting structure or tracks should meet the criteria specified in the standard to which the crane was made.

Except for existing supporting structures or tracks where appropriate records are available, following the installation of a new crane or significant modification or repair, the supporting structure or tracks should be load tested and a record made and retained.

2.8.2 Cranes

Electric bridge and gantry cranes should be installed by appropriately qualified personnel. Usually, the supplier of the crane will undertake the installation and ensure that all appropriate post-installation tests and checks are carried out and recorded. However, it is the employer's duty to make sure that this is done and to obtain a report of thorough examination stating that it has been properly installed and is safe to use.

The post installation tests and checks will include but may not be limited to:

(1) Assessment of the installation for compliance with the established design criteria, dimensions, etc.

(2) Proving tests of all controls, limit switches and emergency stop controls.

(3) Appropriate electrical safety checks.

(4) Operation of the crane under full load conditions including checking of specified hoist and travel speeds.

(5) Overload testing of the crane and supporting structure.

(6) Compliance with relevant legislation.

The procedure for overload testing and the amount of load to be applied will depend upon the standard to which the crane was manufactured. It is therefore recommended that before testing any crane that you consult with the manufacturer or suitable LEEA member to ensure that the nature and extent of any testing is appropriate.

2.9 MARKING, STORAGE AND HANDLING

2.9.1 Marking

In addition to the information required by the applicable standard and legislation, the following information should be permanently and legibly marked on a suitable part of the crane:

(1) SWL(s). This will usually be on the crane bridge and must be of a size legible from the operating position.

(2) Identification mark.

(3) For pendant and remote-controlled cranes, direction markers corresponding to those on the crane controls.

(4) Name and address of the manufacturer.

(5) Year of manufacture.

2.9.2 Storage and handling

When not in use, electric bridge and gantry cranes should be returned to their parking position and the electrical supply should be switched off by means of the isolator switch. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9of this code and, in addition, it is recommended that:

(1) The parking position is such that it ensures where possible clean, dry conditions which are free from injurious pollution or extremes of temperature. For outdoor cranes storm anchorages are required.

(2) When a bridge and gantry crane has been out of use for more than 12 months, it must always be thoroughly examined by a Competent Person before being returned to service. When it has been out of use for an extended period of less than 12 months, it should be inspected by a suitably qualified and experienced person for any signs of damage or deterioration before being returned to service. Any problems found should be reported to a Competent Person for resolution.

2.10 INSPECTION AND MAINTENANCE

2.10.1 Pre-use Inspection

In addition to the thorough examination, all bridge and gantry cranes should be inspected by a suitably qualified and experienced person prior to use or on a regular basis. For cranes in regular use it is good practice to make the inspection at the start of each shift or working day. For cranes used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. If it does not pass inspection, there should be a procedure to lock off the crane to prevent further use until the problem has been resolved.

The purpose of the inspection is to test the functionality of the crane and make a visual check for any obvious defects and should include but not be limited to the following:

(1) Operation of emergency stop controls.

(2) Operation of all crane motion controls.

(3) Operation of electrical isolator switch.

(4) Operation of motion limit switches.

(5) Operation of any anti-collision devices.

(6) Operation of brakes.

(7) Operation of audible warning devices where fitted.

(8) A check of the general condition of the crane structure and mechanisms paying particular attention to the ropes, sheaves, the hook and any unusual noises or erratic movement during operation.

(9) A visual check on the condition of the control pendant and associated cables or remote-control station.

(10) For portal and semi-portal cranes a check for any debris or other track obstructions.

2.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some cranes will require an interim inspection (s). The number, frequency and extent of interim inspection(s) is based on risk assessment taking into account the possibility of deterioration of components and assemblies based on the conditions of the specific use, to ensure that they are identified before they become a danger to people.

The risk assessment must take into account the manufacturers' literature, crane duty and the actual conditions of use, for example environmental conditions and utilization that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore are not as detailed as the thorough examination. Typically, the interim inspection will be a detailed inspection of one or more of the items listed in 2.10.1 Pre-use Inspection page 83 but may also include components covered by the thorough examination (refer to the Manufacturers literature as guidance for defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance.

2.10.3 Maintenance

The employer has a duty to maintain electric bridge and gantry cranes in good condition and safe for use. The degree of maintenance required will vary dependent on the type and duty of the particular crane. Detailed maintenance information should be provided by the crane manufacturer or supplier. Note that the requirements for maintenance, inspection and examination are separate issues although in some cases they may be carried out concurrently.

A special assessment will need to be made on the crane at regular intervals or following changes in operation to compare the actual utilization of the crane with the design utilization to determine when major modification or overhaul is required. This is particularly important when using second-hand, modified or refurbished cranes.

2.10.4 Thorough examination

The crane must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the crane's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, electrical safety testing, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of cranes, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

2.11 SAFE USE OF ELECTRIC BRIDGE AND GANTRY CRANES

In addition to any specific instructions relating to safe use issued by the manufacturer, the following points should be observed:

(1) All lifting operations should be adequately planned and supervised.

(2) Do not use electric bridge and gantry cranes to lift people without taking the necessary precautions. Lifting people is not within the scope of this code.

(3) Electric bridge and gantry cranes must not be used to raise, lower or suspend a load greater than the marked SWL.

(4) Ensure that the load is directly under the crane. The line of pull should always be vertical, never side lift or drag a load.

(5) The hook should be attached to the load such that no part of the load is in contact with the point of the hook. The sling should be located in the seat of the hook and the safety catch closed.

(6) The hook should not be crowded with terminal fittings of slings. To prevent the hook becoming overcrowded, LEEA recommends that the upper ends of the sling legs are connected by means of a shackle or link of adequate strength.

(7) At the start of the lifting operation, the load should be raised just clear and the lift halted whilst the stability, balance and security of the load is checked. The lift should only proceed if the load is stable, balanced and secure. (See section 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16)

(8) Care should be taken to ensure that the crane is not subjected to shock loading. When using cranes with speed control, commence the lift at slow speed before progressing to full speed.

(9) When travelling, care should be taken to prevent the load swinging unduly.

(10) Avoid running the crab, hoist or crane into the end stops as this will cause the load to swing unsafely, put shock loading on the crane and its supporting structure. End stops are a final safety device only.

(11) It should be borne in mind that all new cranes and many older designs are fitted with some form of overload device designed to protect the crane. This may be mechanical, electrical or thermoelectrical. Should the crane fail to lift the load, it is probable that the load exceeds the SWL and should be checked before resetting the controls.

(12) Never change motions (i.e. lift to lower or vice versa) without first allowing the motor to stop running. Quick reversal of direction causes shock loading and heavy current surges. This will result in burnt contacts and imposes unnecessary strain on transmission shafts and gears.

(13) Avoid unnecessary rapid and frequent incremental movements as this causes burning and pitting of contacts. Excessive rapid and frequent incremental movements could result in burning out of the motor.

(14) Avoid excessive or intentional use of motion limit devices, they are a safety feature intended to protect the crane. Where the operation requires regular approach to the highest and lowest possible hook positions, a positional or working limit should be fitted for this purpose.

(15) Ensure the travel path is clear and free from obstructions before operating the crane. The operative must always have a clear view of the travelling hook path to ensure accidental hook engagement or collisions do not occur. When using a remote control, it may be necessary to stop all motions to allow the operative to re-position to a better vantage point before proceeding.

(16) When using a pendant control in close proximity to the load, the operative should take care to stand clear before initiating a travel motion which might cause the load to trap the operative.

(17) A pendant control should not be placed on the load because the weight of the pendant can operate a push button if the button rests on a small projection on the load. If, for any reason, it is necessary to place the pendant control on the load, it should first be deactivated by pressing the stop button.

(18) Unless essential for the operation, do not operate the long travel and cross travel controls simultaneously.

(19) Ensure the operative and other personnel are fully protected from any hazardous materials which may form part of the load.

(20) Loads should not be left suspended from cranes for any length of time unless absolutely essential. In such cases, or where it is as a result of a breakdown, the operative should ensure that the danger area is cordoned off to prevent personnel from being at risk.

(21) At no time should the operative permit either himself or other personnel to be beneath or on a suspended load.

(22) After use the crane should be returned to its parking position and the hook raised to a height where it will not present a hazard and the electrical supply should be switched off by means of the isolator switch.

(23) No person other than someone competent for the purpose should attempt to carry out maintenance or repairs to the crane.

(24) Never remove guards or protective covers such as weatherproof covers or heat shields without the authority of a Competent Person.

For cranes with remote control, observe the following additional points:

(1) The user must make sure that the system is properly maintained, especially the control station. Wear or damage to the seals around buttons or joysticks, and damage to the casing, can allow dirt, water, and other contaminants to enter, causing false commands.

(2) There must be a designated storage place for the control station when it is not in use.

(3) The user must always press the stop button to de-energize the main contactor before leaving the control station unattended. This includes any time the control station is temporarily set down, such as when the crane operator is also slinging the load.

2.12 TRAINING

Electric bridge and gantry cranes should only be operated by suitably trained personnel.

Training in the safe use of lifting equipment is important, regardless of the type of equipment. The requirements for training are covered in section 1.10 TRAINING page 12 of this code. Carefully consider training requirements. Training should cover the basics of safe lifting, the general use of bridge and gantry cranes, and the specific use of the bridge and gantry crane in its intended operating conditions.

Training should include a practical assessment of the trainee in carrying out a number of tasks designed to test their ability to safely control the crane in all foreseeable circumstances of use. For cranes with remote control, operators must be trained in good practices, particularly in the following areas:

(1) Ensuring that the battery has adequate charge.

(2) Use of the neck strap to prevent accidentally dropping the control station.

(3) Use of the key lock and lanyard if provided.

(4) Ensuring that the main contactor is always de-energised before leaving the control station unattended.

(5) Ensuring that the control station is always returned to the designated storage place when not in use.

In some cases it will be necessary to enlist the services of the manufacturer or supplier of the bridge and gantry crane.

Section 3 - HAND OPERATED CHAIN HOISTS

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3.1 FOREWORD

Despite the labour involved in the use of hand operated chain hoists, they remain in wide use throughout industry. They are preferred to power operated hoists for a number of applications, the main ones being as follows:

(1) Where a permanent installation for infrequent use is required.

(2) Where a temporary installation for erection or maintenance purposes is required.

(3) Where precision location of the load is required.

(4) Where a suitable power supply is not readily available.

It can be seen that there is an emphasis on applications involving either long intervals between use or frequent changes of use, both of which require particular vigilance in the in-service inspection procedures to ensure that no significant deterioration or damage has occurred since last used.

All modern hand operated hoists are fitted with an automatic brake which, when functioning correctly, is capable of arresting and sustaining the load at any position. Whilst this code of practice is directed at such equipment, the user may occasionally still come across older equipment not fitted with a brake. If so, they are reminded of their legal obligations to provide safe systems of work, as it is unlikely that such equipment will meet these requirements.

3.2 SCOPE

This section of the code covers the use of hand operated chain hoists which require the use of a hand chain for both hoisting and lowering. Such hoists are not designed for pulling applications. For pulling, a lever operated machine is more suitable and users are recommended to refer to SECTION 4 page 99 and SECTION 5 page 109.

This section also refers to hoists with built in travelling trolleys but does not provide full guidance for the trolley part. For further information on the safe use of travelling trolleys see SECTION 8 page 161 of the code.

Some manufacturers provide a load chain collecting box as an optional extra for their hoists. The purpose of the box is to collect the loop of slack load chain formed as the load is lifted. Guidance on this item is also included.

Hand chain hoists for people carrying applications are excluded. For such applications, refer to the manufacturer for specific instructions.

3.3 DEFINITIONS

In addition to definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

3.3.1 Suspension Level

In the case of a hoist suspended from a hook, the suspension level is the level of the suspending hook saddle. In the case of a hoist combined with a trolley, it is the level of the surface upon which the trolley runs. In other cases, it is similar appropriate levels. (See Figure 3.3.1-1 page 88)

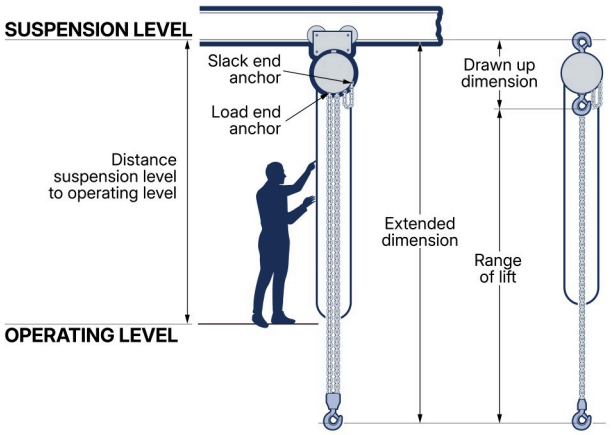


Figure 3.3.1-1

3.3.2 Drawn up Dimension

The drawn-up dimension is the distance between the suspension level and the bottom hook saddle when the bottom hook is in the fully raised position. (See Figure 3.3.1-1 page 88)

3.3.3 Range of Lift

The range of lift is the vertical distance which the bottom hook travels between the extended and highest positions. (See Figure 3.3.1-1 page 88)

3.3.4 Extended Dimension

The extended dimension is the distance between the suspension level and the bottom hook saddle when the bottom hook is in the extended position. It equals the sum of the drawn-up dimensions and the range of lift. (See Figure 3.3.1-1 page 88)

3.3.5 Operating Level

The operating level is the level on which the Operative stands. (See Figure 3.3.1-1 page 88)

3.3.6 Effort

The effort is the pull on the hand chain required to lift a specified load. The specified load is usually the rated capacity of the hoist.

3.4 TYPES OF HAND OPERATED CHAIN HOIST

Owing to the number of different makes of hoists currently available the following information is of a general nature only and may vary from one manufacturer to another.

3.4.1 Method of Attachment

The hoist may be of ‘suspended’ or ‘combined’ unit, many manufacturers producing both options. Suspended types have a top hook, shackle, eyebolt or other fitting by which the hoist is hung and which allows a degree of articulation between the hoist and the supporting structure. (See Figure 3.4.1-1 page 89a) Combined types are usually combined with a purpose made travelling trolley, although a direct connection to the supporting structure may also be possible. (See Figure 3.4.1-1 page 89c) The connection between the hoist and the trolley or structure is usually rigid.

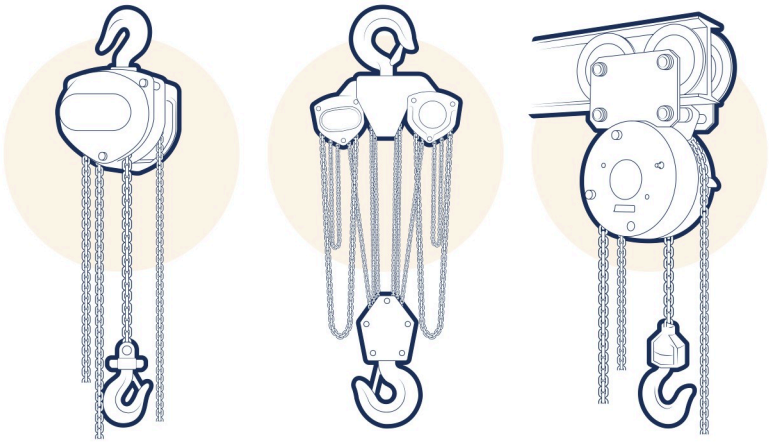


Figure 3.4.1-1 A. Typical single fall hoist, B. Typical multiple fall hoist and C. Typical single fall hoist with built in travelling trolley

3.4.2 Number of Falls of Chain

The lower capacity hoists (e.g. 500kg, 1t) lift the load on a single fall of load chain. (See Figure 3.4.1-1 page 89a and b) Higher capacity hoists may either be of similar design but with a larger frame or may utilise two or more falls of load chain. The very high capacity hoists may utilise a combination of a larger frame and multiple falls of load chain and may even have two or more frames linked by a yoke. (See Figure 3.4.1-1 page 89c)

The various configurations available each have their own advantages and disadvantages with regard to weight size, minimum drawn up dimension and cost.

3.4.3 Grade of Components

Some load bearing components such as chains and hooks are graded according to their performance and may vary between makes and models of hoists. The higher the grade, the smaller and lighter the component will be for a given SWL. According to the conditions of service, some grades may not be suitable for a particular application.

3.4.4 Class of Use

Some manufacturers offer alternative designs of hoist to allow for the intensity of service and service life expected. This should be discussed with the supplier at the time of the information exchange.

3.4.5 Slack Chain Collection

The majority of hand chain hoists are purchased without provision for storing the slack chain, so that when the load hook is in a raised position, the slack chain hangs freely from the hoist forming a loop. In some applications, this can present a hazard, with the risk of the slack chain becoming caught on obstructions or itself becoming a hazard to persons. A condition can also occur where the brake is held open by the weight of the slack chain. Some manufacturers and suppliers are able to offer a collecting box or bag to house the slack chain thereby minimising the risks (see Figure 3.4.5-1 page 90)

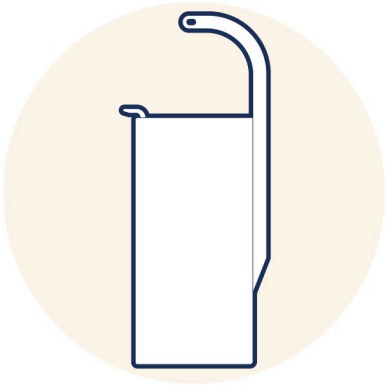


Figure 3.4.5-1 Typical load chain collecting box

3.5 PRINCIPLES FOR THE SELECTION OF HAND OPERATED CHAIN HOISTS

3.5.1 Application of Machines

Hand operated chain hoists are suitable for a variety of purposes. They are frequently used as portable lifting appliances as well as permanent installations. The instructions from some manufacturers state that they are intended for vertical use only while some also allow for use at an angle. However, it is recognised that there are many applications where they are used at an angle to the vertical. In practice this can be done safely within certain parameters provided appropriate precautions are taken. (See 3.11 SAFE USE OF HAND OPERATED CHAIN HOISTS page 96 (10)) If doing so it may be contrary to the manufacturer's instructions and therefore the user must carry out a risk assessment and provide adequate instructions and a safe system of work for the application.

3.5.2 Brake Mechanism

The hoist should be fitted with an automatic brake capable of arresting and sustaining the load. If it is intended to lift a load which is very light, i.e. 10% or less, in relation to the chain hoist's rated capacity, the manufacturer's or supplier's advice should be sought with regard to the performance of the brake. This is because the brake relies upon the hoisting effort for its operation and with a very light load the effort available may be inadequate to operate the brake fully.

3.5.3 Slack Chain Anchorage

Some standards require the slack end anchorage for the load chain to be at least equal in strength to 2.5 times the maximum tension in the load chain when the WLL is being lifted. While others also require the free end of the chain to be fitted with a chain end stop to prevent the chain passing completely through the hoist. This stop must be able to withstand 2.5 times the tension in the chain when the WLL is being lifted. These requirements are an important safety feature and should be considered as the minimum for hoists of all ages. If the user inadvertently runs the chain fully out and the slack end anchorage is not adequate, the chain will easily continue through the hoist and drop the load. It is therefore important to select hoists that have slack end anchorages or chain end stops.

3.5.4 Load Chain Collecting Box

Where a hoist is to be fitted with a load chain collecting box the following points should be borne in mind:

(1) Chain is a load in itself and the uncontrolled fall of a length of chain could inflict serious injury upon any personnel in its path, as well as subjecting the hoist to a high shock load. Where such a risk is identified it should be eliminated through use of a load chain collecting box that is properly designed for the job.

(2) It should be of adequate capacity for all the load chain when the bottom hook is in the highest possible position, i.e. when the hoist is fully drawn up. If the box is of inadequate capacity, the chain will spill over the edge and, rather like a siphon, once this occurs ALL the chain in the box will be pulled out at an accelerating rate.

(3) Where moisture or condensation is likely the box should be provided with a suitable drainage hole to prevent a build-up of water.

3.5.5 General

In addition to the above, consideration should also be given to the following when selecting hand operated chain hoists:

(1) The documentation required by legislation. If this is not on record refer the hoist to a Competent Person for thorough examination.

(2) Length of load chain and hand chain required.

(3) Available headroom.

(4) Degree of portability required.

(5) Operating effort available (particularly for larger capacity hoists)

It is recommended that hooks and other similar devises provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety catches or by the use of 'C' hooks. (See Figure 3.5.5-1 page)

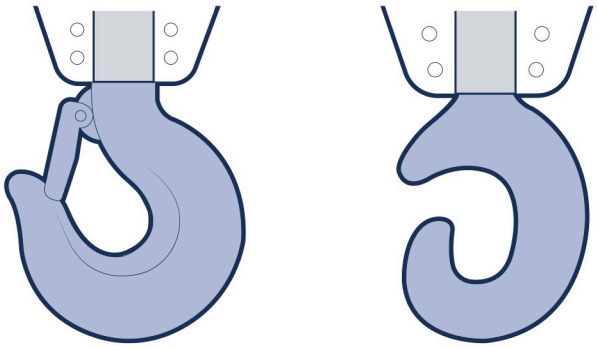


Figure 3.5.5-1 Hook with safety catch and "C" type hook

3.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As hoists are frequently used for miscellaneous lifting purposes, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given and this should include the following information:

(1) The maximum load to be lifted or SWL.

(2) Details of the application that may have a bearing on the load to be lifted, e.g. wind, hoisting out of water, etc.

(3) The maximum extended dimension.

(4) The maximum acceptable drawn up dimension (if headroom is important)

(5) The range of lift.

(6) The distance from the suspension level to the operating level. (This caters for the situation where the hand chain required is shorter than the load chain.)

(7) Whether the hoist is to be used at an angle to the vertical.

(8) The conditions of service and in particular any conditions which the user suspects might be hazardous, e.g. extremes of temperature, high probability of shock loading, uncertainty of weight of load.

(9) The type of suspension i.e. hook suspended or trolley mounted. In the case of trolley mounted hoists, the information required for the trolley is given in SECTION 8 - TRAVELLING GIRDER TROLLEYS page 161.

With larger capacity hoists, the manufacturer may design the gear ratios such that more than one person is required to provide the operating effort. Where the availability of the manpower is likely to be a restriction, the purchaser should also specify the maximum acceptable effort.

3.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

The definitions of lifting equipment and accessories used in this code make it clear that hand operated chain hoists are lifting equipment. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the hoist is put into service. (See section 3.8 INSTALLATION AND COMMISSIONING page 92)

Following repair, hand operated chain hoists must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

New chain hoists should be supplied with comprehensive information for use. Although the method of operation is very simple and similar for all makes and models, the information should include any limitations peculiar to the particular make and model such as operational temperature range, minimum loading and other conditions. Such information should therefore be retained for future reference.

> Although not required by legislation, new chain hoists may be issued with a manufacturer's certificate in addition to, although possibly combined with, the documentation require by the applicable national legislation. This document forms an important part of the record of the hoist. It should be retained and cross referenced to the hoist's other records for inspection by the Competent Person or local enforcing authority.

3.8 INSTALLATION AND COMMISSIONING

3.8.1 Erection of the Equipment

The erection procedure should be carried out in accordance with the manufacturer's instructions paying particular attention to the following:

(1) It is essential to ensure that the structure from which a hoist is suspended is adequate for the load it is intended to carry. This load includes the weight of the hoist itself together with any above hook attachments (i.e. slings, shackles, trolley, etc.) and the operating effort plus a 10% additional allowance on the total to take account of the effects of dynamic loading. Where a travelling trolley of either hook-in or built-in pattern is employed, it is essential that the runway beam, jib arm, etc. is sufficiently level at all loads (up to the maximum for which it is designed) such that the trolley, hoist, etc. will not run away under gravity.

(2) When using a hook suspended hoist, the top hook should be attached to its support in such a manner that the support fits freely into the seat of the hook and does not exert any side thrust upon the point. The top hook should be fitted with a safety catch, but some older hoists made to older standards may not, in which case the hook may be 'moused' to prevent displacement. (See Figure 3.8.1-1 page 92). Where safety catches are not fitted it is recommended that they should be where it is practical to do so.

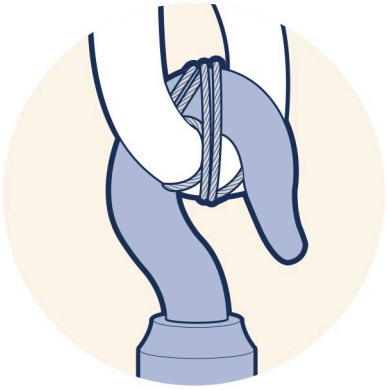


Figure 3.8.1-1 Top hook "moused"

(3) After erection, a check should be made to ensure that the hand and load chains hang freely and are not twisted or knotted. In particular, special care should be taken with multi-fall hoists to ensure that the

bottom block has not been turned over between the falls of chain imparting a twist to the load chain. If this has occurred, the bottom block should be carefully turned back until the twist is removed.

(4) The length of the load chain should be checked to ensure that the bottom hook will reach the lowest point required without running the load chain fully out. If the load chain is permitted to run fully out, an undue stress may be placed on the slack end anchorage. The load chain should not be lengthened beyond its designed limit without guidance from the Competent Person in consultation with the manufacturer.

(1) As the length of the load chain increases, so does its weight and this should be taken account of when assessing the SWL. This also applies to the hand chain.

(2) As a load is lifted, chain is transferred from the 'loaded' side of the load sheave to the 'unloaded' or slack end side. With a long load chain and a light load, the weight of the slack end may counterbalance the load to the extent that once started the load would continue to ascend, thus increasing the weight of chain on the slack end, resulting in an avalanche effect. The fitting of a suitable chain collecting box will prevent this effect.

3.8.2 Installation Pre-use Inspection/Thorough Examination

The extent of pre-use inspection or thorough examination required will to some degree depend on the type of hoist used and the installation conditions. Hand operated chain hoists are commonly used as a portable tool for temporary installation in order to effect a limited lifting operation, e.g. in maintenance applications. Hook suspension hoists are designed and intended for the user to erect onto a suitable suspension point or trolley for use in such applications. It is therefore the user's responsibility to ensure the adequacy and suitability of such suspension arrangements. It will usually be sufficient for a suitably qualified and experienced person to inspect the installation prior to use to ensure the correct attachment of the hoist.

Hand operated chain hoists with built in trolleys are designed and intended for permanent installations, often requiring an amount of dismantling and reassembly, which may call for a higher degree of examination to be made by a Competent Person (See 3.7 LEGAL REQUIREMENTS page 92)

Where the Competent Person deems a proof test is necessary as a part of his thorough examination, the test load applied will be governed by the standard to which the hoist was manufactured and by the requirements for the overall installation, e.g. runway, which form a part of the thorough examination and which may differ from those of the hoist. The proof load for hand operated chain hoists will usually be 150% of the working load limit unless the standard to which the hoist is manufactured to states otherwise. Functional testing at the WLL and a light load test to ensure the integrity of the brake may also form a part of the examination. Test loads should be applied by operating the machine through such a distance as to ensure that all load bearing parts are stressed at least once.

3.9 MARKING, STORAGE AND HANDLING

3.9.1 Marking

In addition to the information required by the applicable legislation and standard being worked to, the following should be permanently and legibly marked on a suitable part of the hoist or plate attached to the hoist:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports.)

(2) SWL (if different from the manufacturers rated capacity mark)

(3) The series or type designation.

(4) Size and grade of the load chain.

(5) Year of manufacture.

(6) Name of manufacturer or supplier.

Some older standards called for the range of lift to be marked on the hoist. This has advantages and it is recommended that this should be considered for all hoists.

3.9.2 Storage and Handling

When not in use, portable hoists should be returned to proper storage. It is recommended that hoists be suspended by their top hooks with both load chain and hand chain clear of the ground in order to prevent

accidental damage. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Equipment which is returned to stores wet and/or dirty should be cleaned and dried. Powerful solvents or cleaning agents should not be used, neither should direct heat. Exposed surfaces liable to corrosion should be suitably protected before going into storage.

(2) In the case of multi-fall hoists, care should be taken during handling to ensure that the bottom block is not turned over within the falls as this will impart a twist to the load chain.

(3) A suitable method of wrapping the load and hand chains is depicted in Figure 3.9.2-1 page 94. The bottom hook or block should be raised to within 350-500 mm (12-18 inches) of its highest position according to the length of chain fitted. (The lower dimension for short lift hoists, the higher dimension for high lift hoists). The slack end loop of load chain should first be wound around the remaining load chain between the hoist body and the bottom hook, followed by the hand chain loop, the ends being secured with suitable twine or wire. Wrapped in this way the hoist is a compact unit for storage or transportation purposes.

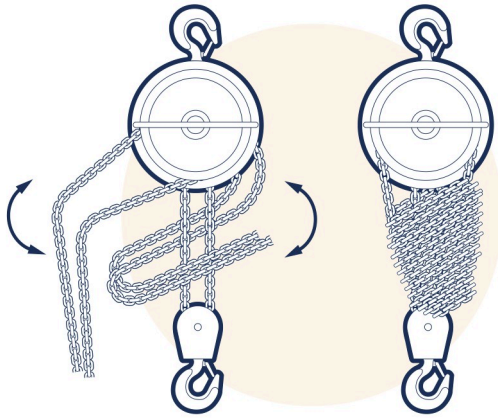


Figure 3.9.2-1 (1) Raise the bottom hook (2) Wrap the load chain (3) Wrap the hand chain (4) Securethe ends

(4) When a hoist has been in storage for any length of time, it should be checked by a Competent Person to ensure that the brake is operating correctly before it is put back into service.

(5) When being handled, hoists should not be dropped or thrown down and when transported, the chains and hooks should not be dragged across the floor surface.

(6) Non-portable hoists used for outdoor applications should be protected from the elements by a suitable protective cover. In addition, steps should be taken to protect the chains from corrosion. It must be stressed, however, that chains and other load bearing parts of the hoist should NEVER be subjected to galvanising or plating processes without the EXPRESS APPROVAL of the manufacturer.

3.10 IN-SERVICE INSPECTION AND MAINTENANCE

3.10.1 Pre-use Inspection

In addition to the thorough examination required under statutory provisions, all chain hoists should be visually inspected by a suitably qualified and experienced person prior to use. For hoists in regular use it is good practice to make the inspection at the start of each shift or working day. For hoists used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be a procedure to quarantine the hoist to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test the functionality of the hoist and make a visual check for any obvious defects and if any of the following faults are present, the hoist shall be withdrawn from service and referred to a competent person.

(1) The load chain is worn or damaged. In particular, attention should be given to the wear which occurs on the bearing surfaces inside of the links and to damage in the form of bent, notched, stretched or corroded links. The chain should articulate freely.

(2) Obvious signs of 'opening out' of hooks, that is any noticeable increase in the throat opening, or any other form of distortion in the hooks or suspension fittings.

(3) Obvious signs of damage to the slack end anchor which connects the load chain to the hoist casing or to the load chain stop where one is fitted.

(4) The hand chain is worn or damaged, particularly on the bearing surfaces on the inside of the links, or is corroded, bearing in mind possible damage to the operative's hands.

(5) When operated under load there is any jumping or excessive noise of either the hand chain or load chain, any undue effort is required or any visible slipping of the brake.

(6) General damage to the hoist body, including any gear covers or chain guides.

(1) The load chain wheel should be checked for debris in the pockets. Any build-up of debris will prevent the load chain from seating correctly and should be removed.

(2) In certain circumstances, very rapid wear of the load chain can develop, which is characterised by a rough appearance on mating surfaces inside of the links. If such circumstances are suspected, then the equipment should be withdrawn from service immediately and referred to a Competent Person.

3.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some hoists will require an interim inspection(s). The number, frequency and extent of the interim inspection(s) is based on risk assessment taking into account the possibility of deterioration of components and assemblies, due to the specific the conditions of use, to ensure that they are identified before they become a danger to persons.

The risk assessment must take into account the manufacturers literature, hoist duty and the actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they are not necessarily as detailed as the thorough examination. Typically the inspection will be a detailed inspection of one or more of the items listed in 3.10.1 Pre-use Inspection page 94, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature and LEEA Lifting Equipment Examiners Handbook for guidance to defined scopes of thorough examination including acceptance and rejection criteria for hand chain hoists).

3.10.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be given to the following points:

(1) Attention should be paid to the lubrication of the load chain. When applying lubricant, care should be taken to ensure that it penetrates between the bearing surfaces on the inside of the links, as failure to do so will considerably reduce the service life of the load chain. Under certain conditions, the use of a wet lubricant may be undesirable because of either (a) the risk of contaminating other goods or products or (b) a dusty atmosphere where dirt is liable to mix with the lubricant and adhere to the chain. In these cases it is possible to use a suitable dry lubricant spray. Details are available from hoist manufacturers or suppliers.

Caution is required when applying lubricant to any hoist as excessive or careless lubrication may lead to lubricant penetrating the brake which can subsequently fail under load.

(2) The brake pawl of a hand chain hoist is normally spring operated and usually has the additional safety feature that in the event of the pawl operating mechanism failing during a vertical lift, gravity will fully operate the pawl so that the load is sustained. The pawl operating spring(s) should therefore be regularly checked to ensure it is still operating.

(3) No person other than a Competent Person or someone under the supervision of a Competent Person should dismantle the hoist or replace the load/hand chain.

3.10.4 Thorough examination

The hand chain hoist must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template documents, retained and cross referenced to the hoist's shistorical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of hand operated chain hoists, except following exceptional and circumstance such as significant modification or repair. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit.

3.11 SAFE USE OF HAND OPERATED CHAIN HOISTS

In addition to any specific instructions relating to the safe use of the hoist issued by the manufacturer, the following points should be observed:

(1) The hoist must not be used to raise, lower or suspend a load that is in excess of the SWL marked upon the hoist.

(2) Do not use the load chain to form a sling, i.e. it must not be wrapped around the load and back hooked, snickled or choke hitched. (See Figure 3.11-1 page 96) This is because doing so will mean that there is no longer a swivel between the load and the hoist and in addition the forces on the links at the point of choke may affect the calibration of the chain.

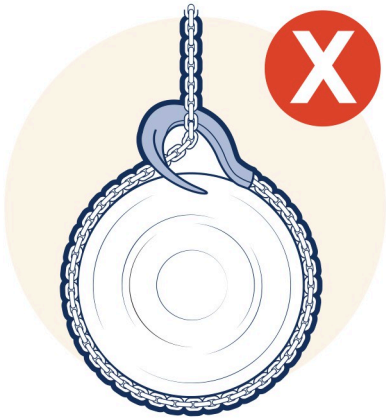


Figure 3.11-1 Never hook a load chain like this

(3) The bottom hook should be attached to the load such that no part of the load is in contact with the point of the hook. (See Figure 3.11-2 page 97)

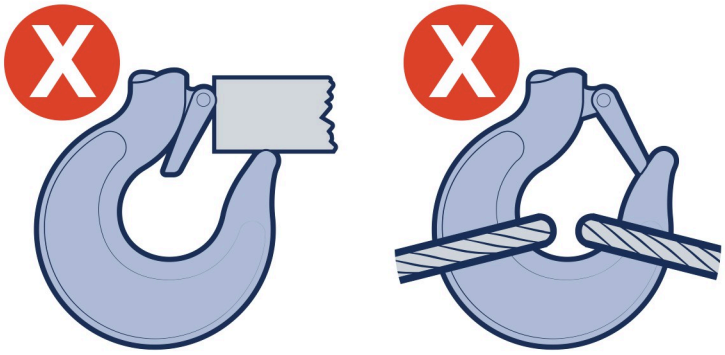


Figure 3.11-2 Never load a hook in this manner, unless permitted and within the limitations instructed by the hoist manufacturer. Always ensure the load is applied through the saddle of the hook.

(4) The bottom hook should not be crowded with the terminal fittings of slings. To prevent the hook becoming overcrowded, LEEA recommends that the upper ends of the sling legs are connected by means of a shackle or link of adequate strength. (See Figure 3.11-3 page 97)

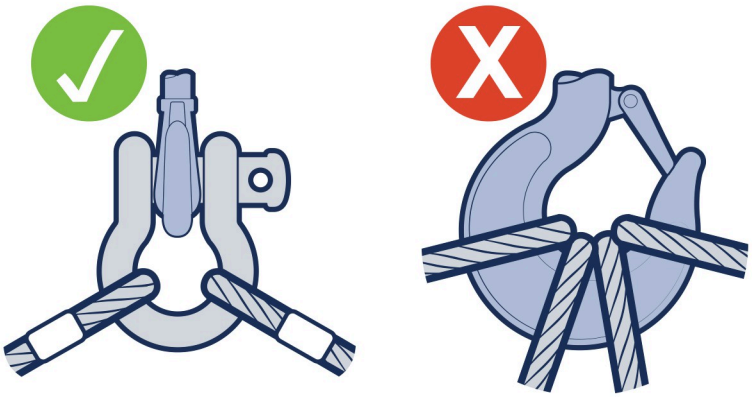


Figure 3.11-3 The right way! To attach two or more slings to the hook use a shackle and The wrong way! Overcrowding the hook is dangerous

(5) It should be borne in mind that the majority of hoists, and especially the lower capacity models, are designed for operation by one person only. If it is found that more than one person is required, it is probable that either: (a) the load exceeds the SWL of the appliance; or (b) the appliance is in need of maintenance; or (c) a combination of (a) and (b) exists. Whichever may be the case, an unduly high operating effort requires investigation before the lift proceeds. This is not intended to preclude the use of two persons to operate the hoist which may in certain applications be found advantageous but is to indicate the degree of operating effort normally required. For larger capacity appliances, the manufacturer will advise on the number of persons normally required to lift maximum capacity.

(6) Care should be taken to ensure that the hoist is not subjected to shock loading.

(7) Hoists should not be used in a position where they are liable to be subjected to adverse conditions unless written approval is given by the manufacturer.

(8) Loads should not be left suspended from hoists for any length of time unless absolutely essential and a safe system or work and/or additional safety measures are provided to reduce the risk to an acceptable minimum. Where it is as a result of a breakdown, the operative should ensure that the danger area beneath the load is cordoned off to prevent personnel from being at a risk in the event of a descending load. At no time should the operative permit either himself or other personnel to be beneath or on a suspended load.

(9) When a hoist is suspended from a crane to facilitate accurate positioning of the load, special precautions should be taken as follows:

a. For use with power operated cranes the SWL of the hoist should be reduced by 15% to allow for the higher dynamic loading.

b. Before hoisting the load with the crane, a short lift should be made with the hand chain hoist to ensure that the brake is locked.

(10) When a hoist is to be used at an angle to the vertical, special precautions should be taken as follows:

a. Only a hook suspended hoist should be used.

b. The suspension point must be suitable for the line of force and of adequate strength.

c. The hoist must be free to align between the seats of the top and bottom hooks.

d. It must be possible to operate the hand chain safely when the hoist is at the required angle(s).

(11) The maximum force on the hoist must be calculated by someone competent for the purpose taking account of the angle(s) and must not exceed the rated capacity.

(12) For high lifts, hoists can be used in series provided that the weight of the lower hoists is taken into account when assessing the SWL required for the hoists above.

(13) Portable hoists (i.e. a hoist that is not regularly suspended from a runway, crane, etc.) should, when no longer required for use, be returned to proper storage.

(14) Care should be taken not to drop a hoist. Any appliance which is accidentally subjected to this treatment should be checked by a Competent Person before further use.

3.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account the manufacturer's instructions for installation and use and also pay particular attention to the following:

(1) In the case of portable hoists, selection of suitable suspension points.

(2) In the case of multi-fall hoists, steps to be taken if the bottom block has been turned over in the falls of chain to remove the twist.

Section 4 - HAND OPERATED CHAIN LEVER HOISTS

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4.1 FOREWORD

Chain lever hoists are widely used in various industries for both lifting and pulling applications. They provide a comparatively lightweight method of moving loads over a short distance and the lever operation allows them to be used in any operating position.

This ability to operate in any attitude makes the chain lever hoist a very versatile tool particularly in rigging applications where it may be used as an adjustable sling leg to enable a load to be balanced or for line adjustment when positioning a load or as a means of restraint to quote just three examples.

Most modern chain lever hoists have a ‘free wheel’ facility, which allows the operative to rapidly extend or take up slack chain under no load conditions.

Two basic types are available, one employing fine tolerance (calibrated) steel short link chain, the other employing roller chain. Some manufacturers offer both types and in addition there may also be a choice between a lightweight aluminium alloy model and a ferrous model.

4.2 SCOPE

This section of the code covers the use of hand operated chain lever hoists where the hoisting effort is applied by means of a built-in lever.

The information contained applies to both the fine tolerance (calibrated) link chain model and the roller chain model unless otherwise stated.

4.3 DEFINITIONS

In addition to definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

4.3.1 Drawn Up Dimension

The drawn-up dimension is the distance between the top and bottom hook saddles when the bottom hook is in the fully raised position. (See Figure 4.3.2-1 page 100)

4.3.2 Range of Lift

The range of lift is the distance which the hook attached to the load chain travels between the extended and the drawn-up positions. (See Figure 4.3.2-1 page 100)

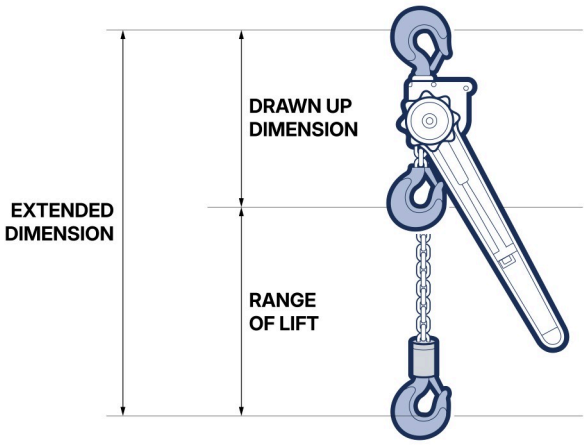


Figure 4.3.2-1

4.3.3 Extended Dimension

The extended dimension is the distance between the hook saddles when the bottom hook is in the fully extended position. It equals the sum of the drawn-up dimension and the range of lift. (See Figure 4.3.2-1 page 100)

4.3.4 Effort

The effort is the force on the lever required to lift a specified load. The specified load is usually the rated capacity of the hoist.

4.4 TYPES OF HAND OPERATED CHAIN LEVER HOISTS

A number of different makes are currently available and some manufacturers produce more than one model. The following information, although of a general nature, gives guidance on the main options.

4.4.1 Type of Chain

The chain lever hoist will be designed to employ one of two types of chain, fine tolerance (calibrated) round steel short link chain or roller chain. (See Figure 4.4.1-1 page 100)

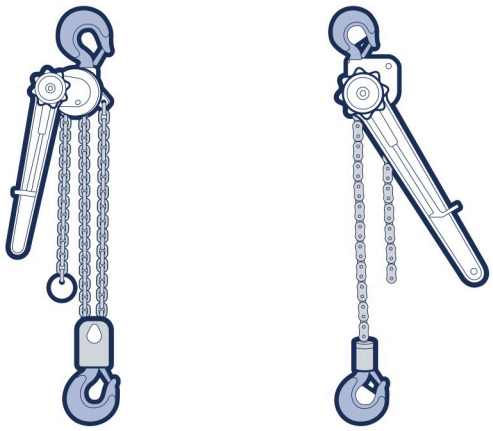


Figure 4.4.1-1 Link type chain - Multi-fall and Roller type chain - Single fall

4.4.2 Material of Manufacture

The standards for chain lever hoists permit manufacturers to use a wide range of materials provided that they possess the necessary strength and physical properties.

In practice, the choice available to the user is limited to the materials from which the hoist body and lever are manufactured. Some models employ light alloys whilst others are all ferrous.

4.4.3 Number of falls

In general, there is no choice available to the user in this respect. The lower capacity models lift the load on a single fall of load chain, the higher capacity models utilising two or more falls. (See Figure 4.4.1-1 page 100)

4.5 PRINCIPLES FOR SELECTION OF CHAIN LEVER HOISTS

4.5.1 Application of Machines

Hand operated chain lever hoists are suitable for a variety of purposes and the braking mechanism is designed for use at any attitude, making them suitable for both lifting and pulling applications.

4.5.2 SWL

Under normal operating conditions, i.e. where there are no hazardous conditions the SWL will be the same as the rated capacity. Due allowance should be made in those cases where the load is not accurately known.

4.5.3 Brake Mechanism

The hoist should be fitted with an automatic brake capable of arresting and sustaining the load. If it is intended to lift a load which is very light, i.e. 10% or less, in relation to the lever hoist's rated capacity, the manufacturer's or supplier's advice should be sought with regard to the performance of the brake. This is because the brake relies upon the hoisting effort for its operation and with a very light load the effort available may be inadequate to operate the brake fully.

4.5.4 Type of Chain

For the majority of applications, there is little to choose between the link chain and roller chain models. It should be noted however that roller chain will only articulate in one plane otherwise such factors as price, weight or drawn up dimension may influence choice of one over the other.

4.5.5 Material of Manufacture

Hoists employing light alloys or steel pressings for the body and/or operating lever offer a significant saving in weight over those using castings and this adds to their value as a portable tool. It should be recognised however that certain alloys may create a spark in contact with steel and should not therefore be used in explosive or potentially explosive atmospheres, e.g. mining.

4.5.6 General

In addition to the above, consideration should also be given to the following when selecting hand operated lever

hoists:

(1) The documentation required by legislation If this is not on record refer the hoist to a Competent Person for thorough examination.

(2) Length of load chain required.

Hooks and other similar devices provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices.

This requirement can be met by the use of hooks with safety catches or by the use of 'C' hooks. (See Figure 4.5.6-1 page 102)

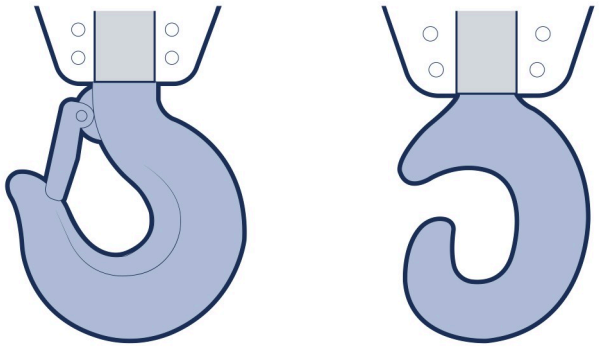


Figure 4.5.6-1 Hook with safety catch and "C" Type hook

4.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As chain lever hoists are frequently used for miscellaneous lifting purposes, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given and this should include the following information:

(1) Intended application e.g. lifting, tensioning or pulling.

(2) The maximum load to be lifted or SWL

(3) Details of the application that may have a bearing on the load to be lifted, e.g. wind, hoisting out of water, etc.

(4) The maximum extended dimension.

(5) The maximum acceptable drawn up dimension if headroom is important.

(6) The range of lift.

(7) The type of chain required.

(8) The conditions of service and in particular any conditions which the user suspects might be hazardous, e.g. extremes of temperature, high probability of shock loading, uncertainty of weight of load.

4.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

The definition of lifting equipment and accessories used in this code make it clear that hand operated chain lever hoists are lifting equipment. Unless a written scheme of examination (refer to LEEA 032 Guidance to written schemes of examination for guidance), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

For some applications it may also be necessary to have the installation thoroughly examined by a Competent

Person before the hoist is put into service. (See 4.8 INSTALLATION AND COMMISSIONING page 103)

Following repair, hand operated chain lever hoists must be re-verified by a Competent Person. The record of the repair and report of the verification should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

New chain lever hoists should be supplied with comprehensive information for use. Although the method of operation is very simple and similar for all makes and models, the information should include any limitations peculiar to the particular make and model such as operational temperature range, minimum loading and other conditions. Such information should therefore be retained for future reference.

> Although not required by legislation, new lever hoists may be issued with a manufacturer's certificate in addition to, although possibly combined with, the documents required by the applicable national legislation, if any, i.e. EC Declaration of Conformity required European legislation. This document forms an important part of the record of the hoist. It should be retained and cross referenced to the hoist's records for inspection by the Competent Person or local enforcing authority.

4.8 INSTALLATION AND COMMISSIONING

4.8.1 The Erection of the Equipment

The erection procedure should be carried out in accordance with the manufacturer's instructions paying particular attention to the following:

(1) It is essential to ensure that the structure from which a lever hoist is suspended is adequate for the load it is intended to carry. This load includes the weight of the lever hoist itself together with any attachments and suspension points, i.e. slings, shackles, trolley, etc. plus a 10% additional allowance on the total to take account of the effects of dynamic loading. (See section 1.A4 APPENDIX 4 - STRUCTURES page 19) Where a travelling trolley is employed, it is essential that the runway beam, jib arm, etc. is sufficiently level at all loads (up to the maximum for which it is designed) such that the trolley, hoist, etc. will not run away under gravity.

(2) The top hook should be attached to its support in such a manner that the support fits freely into the saddle of the hook and does not exert any side thrust upon the point. The top hook should be fitted with a safety catch to prevent accidental displacement.

(3) After erection, a check should be made to ensure that the load chain hangs freely and is not twisted or knotted. In particular, special care should be taken with multi-fall lever hoists to ensure that the bottom block has not been turned over between the falls of chain imparting a twist to the load chain. If this has occurred, the bottom block should be carefully turned back until the twist is removed.

(4) The length of the load chain should be checked to ensure that the bottom hook will reach the lowest point required without running the load chain fully out. If the load chain is permitted to run fully out, an undue stress may be placed on the slack end load chain stop/anchorage.

(5) The lever hoist should not be modified in any way, e.g. the load chain should not be lengthened beyond its designed limit and the length of the operating lever should not be increased, without guidance from the Competent Person in consultation with the manufacturer.

4.8.2 Installation Pre-use Inspection/Thorough Examination

The degree of pre-use inspection or thorough examination required will to some degree depend on the installation conditions. Hand operated chain lever hoists are commonly used as a portable tool for temporary installations in order to effect a limited lifting or moving operation, e.g. in maintenance and plant installation applications. They are designed and intended for the user to erect onto a suitable suspension point or trolley for use in such applications. It is therefore the user's responsibility to ensure the adequacy and suitability of such suspension arrangements. It will usually be sufficient for a suitably qualified and experienced person to inspect the installation without the need for thorough examination prior to use to ensure the correct attachment of the hoist, in many cases this may be the user of the equipment. That is providing that the hoist has a current report of thorough examination and the supporting structure has been verified. Occasionally hand operated chain lever hoists may be used in more complex installations which may call for a higher degree of examination to be made by a Competent Person (See 4.7 LEGAL REQUIREMENTS page 102)

Where the Competent Person deems a proof test is necessary as a part of the thorough examination, the test load applied will be governed by the standard to which the hoist was manufactured and by the requirements for the overall installation, e.g. runway, which form a part of the thorough examination and which may differ from those of the hoist. The proof load for hand operated chain lever hoists will usually be 150% of the working load limit, unless the standard to which the hoist was manufactured states otherwise. (Note some standards only require a dynamic test of 1.1 times the rated capacity) Functional testing at the rated capacity and a light load test to ensure the integrity of the brake may also form a part of the examination. Test loads should be applied by operating the machine through such a distance as to ensure that all load bearing parts are stressed at least once.

4.9 MARKING, STORAGE AND HANDLING

4.9.1 Marking

In addition to the requirements of the applicable national legislation the following information should be permanently and legibly marked on a suitable part of the hoist:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL (if different from the manufacturers rated capacity mark).

(3) The series or type designation.

(4) Size and grade of load chain (in the case of link chain)

(5) Year of manufacture.

(6) Name of manufacturer or supplier.

> Although not required by most standards, it is recommended that the range of lift should be marked on the hoist as this has operational advantages.

4.9.2 Storage and Handling

When not in use, chain lever hoists should be returned to proper storage. It is recommended that chain lever hoists be suspended by their top hooks with the load chain clear of the ground in order to prevent accidental damage. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Equipment which is returned to stores wet and/or dirty should be cleaned and dried. Powerful solvents or cleaning agents should not be used neither should direct heat. Exposed surfaces liable to corrosion should be suitably protected before going into storage.

(2) In the case of multi-fall hoists employing link chain, care should be taken to ensure that the bottom block is not turned over within the falls as this will impart a twist to the load chain.

(3) When a lever hoist has been in storage, it should be checked by a Competent Person to ensure that the brake is operating correctly before it is put back into service.

(4) When handling lever hoists, they should not be dropped or thrown down and when transported the chains and hooks should not be dragged across the floor surface.

(5) When used out of doors for long periods, steps should be taken to protect the hoist from the elements and in particular to prevent the chains from corroding. It must be stressed, however, that chains and other load bearing parts of the hoist should NEVER be subjected to galvanising or plating processes without the EXPRESS APPROVAL of the manufacturer.

4.10 IN-SERVICE INSPECTION AND MAINTENANCE

4.10.1 Pre-Use Inspection

In addition to the thorough examination required under statutory provisions, all chain lever hoists should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis, taking account of the conditions of service. For hoists in regular use it is good practice to make the inspection at the start of each shift or working day. For hoists used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass the inspection, there should be a system a procedure in place to quarantine the hoist to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test the functionality of the hoist and make a visual check for obvious defects and, if any of the following faults are present, the chain lever hoist should be withdrawn from service and referred to a Competent Person:

(1) The load chain is worn or damaged. In particular, attention should be given to the wear which occurs on the bearing surfaces inside of the links and to damage in the form of bent, notched, stretched or corroded links. The chain should articulate freely.

(2) Obvious signs of ‘opening out’ of hooks, that is any noticeable increase in the throat opening, or any other form of distortion in the hooks or suspension fittings.

(3) Obvious signs of damage to the load chain stop or the chain anchor which connects the load chain to the lever hoist casing, whichever is applicable.

(4) When operated under load, there is any jumping or any undue effort is required or there is any visible slipping of the brake.

(5) General damage to the lever hoist body, including any gear covers, breaking of overload protection devices, controls or chain guides, and in particular to the operating lever which could indicate a previous overloading.

(1) In the case of link chain, the load chain wheel should be checked for debris in the pockets and in the case of roller chain, the space between the rollers and the mating sprocket should be checked for a build up of debris. Any build up of debris will prevent the load chain from seating correctly and should be removed.

(2) In certain circumstances, very rapid wear of link type load chain can develop which is characterised by a rough appearance on mating surfaces inside of the links. If such circumstances are suspected, then the equipment should be withdrawn from service immediately and referred to a Competent Person.

4.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some hoist will require an interim inspection(s). the number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, hoist duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 4.9.1 Marking page 103, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

4.10.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be paid to the following points:

(1) Attention should be paid to the lubrication of the load chain. When applying lubricant, care should be taken to ensure that it penetrates between the bearing surfaces on the inside of the links as failure to do so will considerably reduce the service life of the load chain. Under certain conditions, the use of a wet lubricant may be undesirable because of either;

a. the risk of contaminating other goods or products or;

b. dusty atmospheres where dirt is liable to mix with the lubricant and adhere to the chain. In these cases, it is possible to use a suitable dry lubricant spray. Details are available from hoist manufacturers or suppliers.

Caution is required when applying lubricant to any chain hoist as excessive or careless lubrication may lead to lubricant penetrating the brake which can subsequently fail under load.

(2) No person other than a Competent Person or someone under the supervision of a Competent Person should dismantle the hoist or replace the load chain.

4.10.4 Thorough examination

The lever hoist must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template documents, retained and cross referenced to the hoist's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of lever hoists, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

4.11 SAFE USE OF HAND OPERATED CHAIN LEVER HOISTS

In addition to any specific instructions relating to the safe use of the lever hoist issued by the manufacturer, the following points should be observed:

(1) The lever hoist must not be used to raise, lower or sustain a load that is in excess of the SWL marked upon the lever hoist.

(2) Do not use the load chain to form a sling i.e. it must not be wrapped around the load and back hooked, snickled or choke hitched. (See Figure 4.11-1 page 106) This is because doing so will mean that there is no longer a swivel between the load and the hoist and in addition the forces on the links at the point of snickle may affect the calibration of the chain.

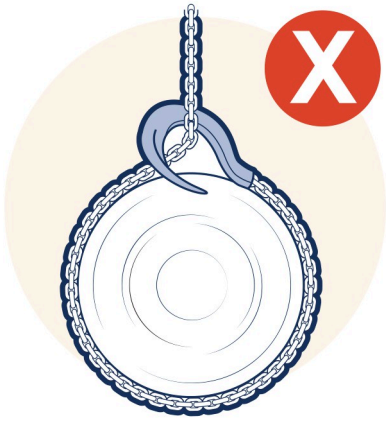


Figure 4.11-1 Never hook back a load chain like this

(3) The bottom hook should be attached to the load such that no part of the load is in contact with the point of the hook. (See Figure 4.11-2 page 106)

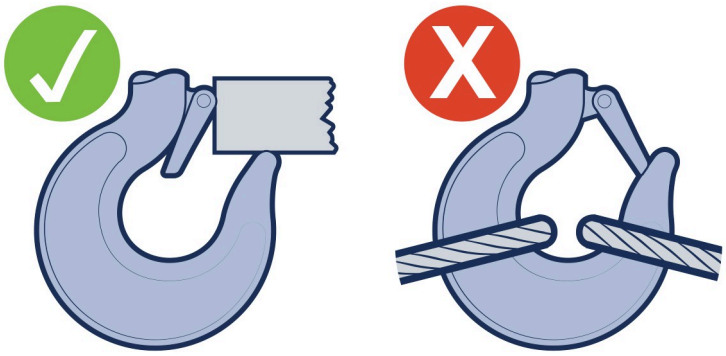


Figure 4.11-2 Never load a hook in this manner, unless permitted and within the limitations instructed by the hoist manufacturer. Always ensure the load is applied through the saddle of the hook.

(4) The bottom hook should not be crowded with the terminal fittings of slings. To prevent the hook becoming overcrowded, LEEA recommends that the upper end of the sling legs are connected by means of a shackle or link of adequate strength. (See Figure 4.11-3 page 107)

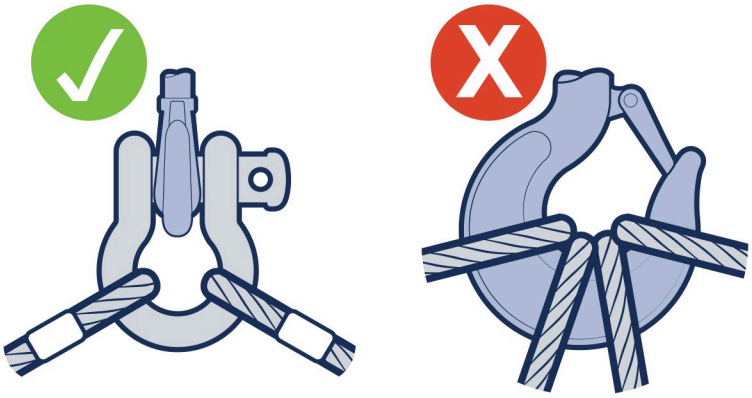


Figure 4.11-3 The right way! To attach two or more slings to the hook use a shackle or link. The wrong way! Overcrowding the hook is dangerous.

(5) The majority of lever hoists and especially the lower capacity models are designed so that one person will be able to operate the machine up to its SWL. This should be borne in mind as if it is found that more than one person is required, it is probable that either;

a. the load exceeds the SWL of the appliance or;

b. the appliance is in need of maintenance or;

c. a combination of (a) and (b) exists.

Whichever may be the case, an unduly high operating effort requires investigation before the lift proceeds. This is not intended to preclude the use of two persons to operate the lever hoist, which may in certain applications be found advantageous, but is to indicate the degree of operating effort normally required.

(6) Care should be taken to ensure that the lever hoist is not subjected to shock loading.

(7) Lever hoists should not be used in a position where they are liable to be subjected to extremes of temperatures beyond the specified manufacturers temperature limits. For example, above a furnace or smith's forge or in severe frost, etc.

(8) Loads should not be left suspended from hoists for any length of time unless absolutely essential and a safe system or work and/or additional safety measures are provided to reduce the risk to an acceptable minimum. Where it is as a result of a breakdown, the operative should ensure that the danger area beneath the load is cordoned off to prevent personnel from being at a risk in the event of a descending load. At no time should the operative permit either himself or other personnel to be beneath or on a suspended load.

(9) When a lever hoist is suspended from a crane, e.g. to facilitate accurate positioning of the load, special precautions should be taken as follows:

a. For use with power operated cranes the SWL of the lever hoist should be reduced by 15% to allow for the higher dynamic loading.

b. Before hoisting the load with the crane, a short lift should be made with the lever hoist to ensure that the brake is locked.

(10) Lever hoists should, when no longer required for use, be returned to proper storage.

(11) Care should be taken not to drop a lever hoist. Any appliance which is accidentally subjected to this treatment should be checked over by a Competent Person before further use.

4.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should include the manufacturer's installation and usage instructions, with specific attention to the following:

(1) The selection of suitable suspension and attachment points.

(2) In the case of multi-fall link chain hoists, steps to be taken if the bottom block has been turned over in the falls of chain to remove the twist.

Section 5 - LIFTING AND PULLING MACHINES USING A GRIPPING ACTION ON THE WIRE ROPE

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5.1 FOREWORD

Lifting and pulling machines, also known as jaw winches, are, by their very nature, versatile pieces of equipment and are widely used throughout industry for both permanent applications and temporary or rigging applications. It is impossible in a document of this nature to cover every such application and so advice in the respect of usage is limited to basic principles. It should be noted however that the manufacturers of this type of machine may permit a lower factor of safety (and therefore a higher SWL) when the machine is used for pulling applications as compared to lifting applications. The advice given is aimed solely at lifting applications or applications involving an element of lifting.

The principles laid down for lifting applications may be applied to pulling applications if so desired, although in some cases they may be found to be excessively restrictive.

5.2 SCOPE

This section deals with the use of lifting and pulling machines using a gripping action on wire ropes when used for lifting and lowering loads.

Although reference is made both to pulling applications and people carrying applications, no specific guidance is offered in respect of these and the manufacturer's instructions and specific guidance should always be sought and strictly followed.

This section of the code does not include any information on wire rope machines where the rope is wound onto a drum. See .

5.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

5.3.1 Lifting Application

A lifting application is any application where, a load is suspended or supported on inclined planes where removal of the lifting force or any failure of the lifting mechanism or lifting medium results in either movement of the load, or a movement that can present a significant hazard.

5.3.2 Pulling Application

A pulling application is any application where, a load supported on level or inclined planes where the removal of the pulling force or a failure of the pulling mechanism or pulling medium results either in no movement of the load, or a movement that cannot result in a significant hazard.

Thus, if for example a load were being 'pulled' up an incline on wheels it would be regarded for the purpose of this section as a lifting application as, in the event of a failure, the load would descend the incline under gravity.

5.4 TYPES OF LIFTING AND PULLING MACHINE

5.4.1 Manually Operated Machines

In manually operated machines (Figure 5.4.1-1 page 110) a hand operated lever activates a mechanism to provide a direct pull on an integral rope which is attached to the load. The pull is applied by means of two pairs of self-energising jaws, which exert a grip on the rope, the distance of travel being limited only by the length of the rope. The initial pressure which causes the jaw to grip the rope and give the self-energising action is provided by powerful springs.

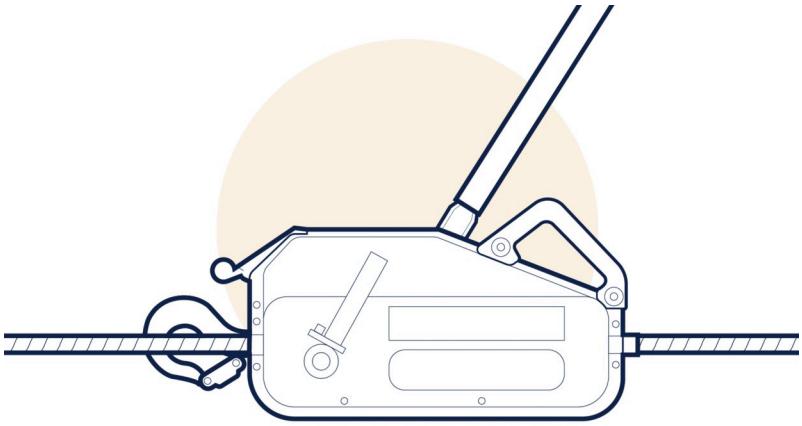


Figure 5.4.1-1 Manually operated lifting and pulling machine

5.4.2 Hydraulically Operated Machines

Hydraulic machines (Figure 5.4.2-1 page 110) are based on the same mechanical principle of operation as the manual type but with the addition of an integral hydraulic mechanism to provide power operation. The hydraulic system is of piston and cylinder design, the piston rods being directly connected to the forward and reverse operating handles. These machines may be used singly or ganged (Figure 5.4.2-2 page 111) with the addition of a purpose designed hydraulic system approved by the Competent Person or manufacturer.

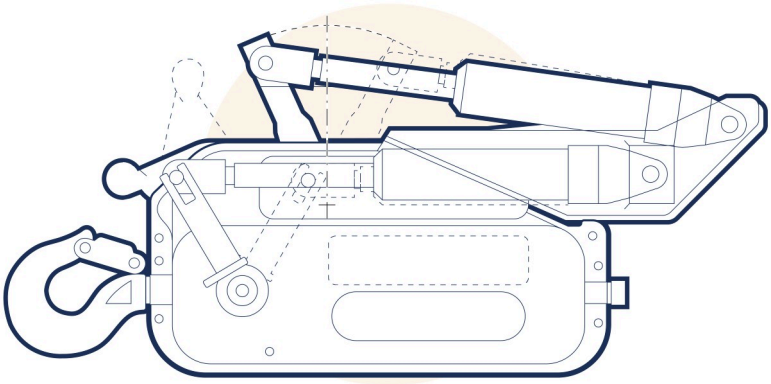


Figure 5.4.2-1 Hydraulically operated lifting and pulling machine

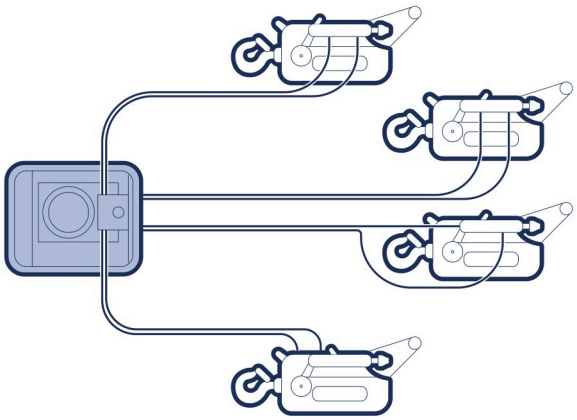


Figure 5.4.2-2 Ganged system

Ensure the pumping unit is specifically supplied for this purpose and compatible with the equipment.

5.5 PRINCIPLES FOR THE SELECTION OF LIFTING AND PULLING MACHINES

5.5.1 Application of Machines

Lifting and pulling machines are suitable for a variety of purposes and can be used over any distance, limited only by the length of rope. They are frequently used where a portable appliance is required as well as for permanent installations. It is also recognised that there are applications where more than one machine is required. They provide a means of tensioning as for example in the guying of towers.

5.5.2 SWL

For lifting applications, under normal operating conditions, i.e. where there are no hazardous conditions the SWL will be the same as the rated capacity. The rated capacity should be based on a minimum factor of safety of 5:1. This applies to the machine, the rope and the terminal fittings.

For pulling applications the manufacturer may permit a lower factor of safety (in the order of 3:1) to give a higher working capacity. Check in the manufacturer's instructions for use.

For people-carrying applications, the factor of safety of the machine, rope and terminal fittings should be increased to a minimum of 10:1, i.e. the SWL should not exceed 50% of the rated capacity. Additional precautions are, however, required. (See 5.5.4 People carrying Applications - Special Requirements page 111)

5.5.3 Rope Construction

The wire rope supplied for use with a lifting and pulling machine should be considered as much an integral part of the mechanism as is the chain of a chain hoist or lever hoist. Some ropes, even those which appear to be of the correct size and which initially the machine may seem to accept, may not be suitable because the efficiency and safety of the friction grip of the machine's jaws around the rope depend entirely upon the rope being of the right diameter and of a construction designed to withstand the immense gripping power of the jaws. It is essential therefore to use only ropes approved by the rope or machine manufacturer and certified by them as suitable for this use.

5.5.4 People carrying Applications - Special Requirements

If the machine is to be used for a people carrying application, reference should be made to the manufacturer for additional safety requirements, e.g. the installation of descent arrestors. As an alternative to adapting a standard lifting and pulling machine for people carrying, the manufacturer may be able to offer a machine purpose designed for such work.

5.5.5 Material of Manufacture

Lifting and pulling machines are available with light alloy or pressed steel casings. Wire rope terminal fittings are attached by ferrule secured eyes using aluminium alloy ferrules as standard. Steel ferrule secured eyes are usually available as an option. It should be recognised that certain alloys may create a spark under certain conditions and should not therefore be used in explosive or potentially explosive atmospheres, e.g. mining.

5.5.6 General

In addition to the above, consideration should also be given to the following when selecting lifting and pulling machines using a gripping action on the wire rope:

(1) The documentation required by legislation. If this is not on record refer the machine and/or rope to a Competent Person for thorough examination.

(2) Length of wire rope required.

(3) Terminal fitting of rope, i.e. hook or shackle.

(4) Storage of the slack rope.

(5) Degree of portability required.

(6) In the case of hydraulically operated machines, the availability of suitable power source to the hydraulic motor.

> Hooks and other similar devices provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety catches or by the use of 'C' hooks.

5.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

The following is the minimum information which should be exchanged between the user and the designer or supplier of a lifting and pulling machine:

(1) Intended application, e.g. lifting, tensioning, pulling or people-carrying.

(2) Total maximum weight of the load to be lifted together with any other forces which may be superimposed on the load.

(3) Frequency of use.

(4) Environmental considerations such as heat or corrosive atmospheres.

(5) Length of rope required.

(6) In the case of hydraulically operated machines, the available power supply.

5.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

5.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used by this code make it clear that lifting and pulling machines using a gripping action on the wire rope are lifting equipment unless their use is restricted to purely pulling operations. Unless a written scheme of examination (refer to LEEA 032 Guidance to written schemes of examination for guidance), drawn up by a Competent person, is in place and operating they must be examined at intervals not exceeding 12 months (6 months in the case of people carrying equipment). Reports of thorough examination should be retained and cross referenced to the machine's historical records for inspection by the Competent Person or local enforcing authority.

5.7.2 Thorough Examination following Installation

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the machine is put into service. (See 5.8 INSTALLATION AND COMMISSIONING page 113)

As these machines are designed and intended for both lifting and pulling operations, unless a machine is installed in such a way that its use is restricted solely to a pulling operation there is always the possibility that they may be used to lift. It is therefore the view of LEEA that machines which are, or could be, used for both lifting and pulling operations should be treated as lifting machines and be subject to the full requirements of this code and applicable national legislation.

5.7.3 Post Repair Verification and Record Keeping

Following repair, lifting and pulling machines must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the machine's historical records for inspection by the Competent Person or local enforcing authority.

5.7.4 Instructions for Use

New lifting and pulling machines should be supplied with comprehensive information for use. The information should include any limitations peculiar to the particular make and model such as rating for lifting and pulling, operational temperature range and other conditions. Such information should therefore be retained for future reference.

Although not required by legislation, new lifting and pulling machines and their ropes will usually be supplied with a manufacturer's certificate in addition to, although possibly combined with, the documents required by the applicable national legislation, if any, i.e. EC Declaration of Conformity required European legislation. These documents form an important part of the record of the machine. They should be retained and cross referenced to the machine's historical records for inspection by the Competent Person or local enforcing authority.

5.8 INSTALLATION AND COMMISSIONING

5.8.1 Erection of the Equipment

The erection procedure should be carried out in accordance with the manufacturer's instructions paying particular attention to the following:

(1) Prior to commencing installation of lifting and pulling machines that have been in storage, a check should be made to ensure that no damage has occurred whilst in store. (See 5.10 IN-SERVICE INSPECTION AND MAINTENANCE page 116)

(2) Lifting and pulling machines may be utilised in many ways. For lifting purposes, they can be used in three different ways as indicated in Figure 5.8.1-1 page 113.

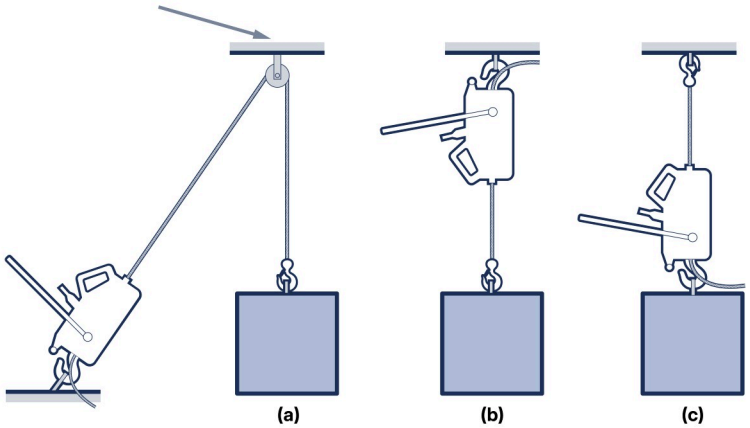


Figure 5.8.1-1 This anchorage must carry 2.08 x load W (see section 1, appendix 1.4)

Figure 5.8.1-1 page 113(a) shows the machine anchored close to the ground with the rope taken over a pulley block fixed directly above the load. Additional pulley blocks may be introduced as required to increase the capacity of the system. This method has the advantage that the operative can stand well away from the load but also has the disadvantage that the load imposed on the overhead anchorage is greater than the load lifted. Figure 5.8.1-1 page 113(b) shows the machine anchored directly to the overhead structure so that the load is lifted towards the machine. One or more pulley blocks can be

introduced into the system in a similar manner to that shown in Figure 5.8.1-1 page 113(a). Figure 5.8.1-1 page 113(c) shows the machine anchored directly to the load so that the rope remains static and the machine and load climb the rope.

(3) Lifting and pulling machines are often used in conjunction with sheaves, as shown above. Owing to the special construction of the rope, the ratio of the sheave diameter to the rope diameter must be higher than for an ordinary pulley block system. It is therefore recommended that the ratio of sheave diameter to rope diameter should be not less than 15:1. Therefore pulley blocks should be selected that have been made to standards that provide for such a ratio in their specification.

(4) It is essential to ensure that the structure from which a lifting and pulling machine or its associated pulley blocks and sheaves are suspended is adequate for the load it is intended to carry. For arrangements other than as figure 5.4(a), this load includes the weight of the machine itself together with any associated pulley blocks and sheaves and above hook attachments (e.g. slings, shackles, etc.) and the operating effort plus a 10% additional allowance on the total to take account of the effects of dynamic loading. In the case of arrangements as figure 5.4(a) the suspension will not carry the weight of the machine but will carry an additional load due to the line pull in the rope. (See section 1 appendix 1.4)

(5) The machine should be free to align itself correctly with the rope and the rope itself should not be allowed to snag, catch or rub on any intermediate obstruction.

5.8.2 Installation Pre-use Inspection/Thorough Examination

The degree of pre-use inspection or thorough examination required will to some degree depend on the type of lifting and pulling machine used and the installation conditions. Lifting and pulling machines are commonly used as a portable tool for temporary installation in order to effect a limited lifting operation, e.g. on construction sites. Some machines are designed and intended for the user to hook or shackle directly onto a suitable suspension point in such applications. It is therefore the users responsibility to ensure the adequacy and suitability of such suspension arrangements. It will usually be sufficient for a suitably qualified and experienced person to inspect simple installations of this type to ensure the correct attachment and alignment of the machine and rope. However, lifting and pulling machines are also used for more complex installations and permanent installations, indeed some machines are specifically designed for such applications. These installations may call for a higher degree of examination to be made by a Competent Person (See 5.7 LEGAL REQUIREMENTS page 112)

Where the Competent Person deems a proof test is necessary as a part of his thorough examination, the test load applied will be governed by the standard to which the lifting and pulling machine was manufactured and by the requirements for the overall installation, e.g. supporting structure, which form a part of the thorough examination and which may differ from those of the machine. The proof load for lifting and pulling machines using a gripping action on the wire rope will usually be 150% of the working load limit, unless the standard to which it was manufactured states otherwise. (BS EN 13157: 2004 only requires a dynamic test of 1.1 times the WLL). This load should be applied by operating the machine and the load should remain steady for a period of not less than 30 seconds without causing any permanent distortion to the equipment or slipping of the rope.

5.9 MARKING, STORAGE AND HANDLING

5.9.1 Marking

In addition to the requirements of the applicable national legislation the following information should be permanently and legibly marked on a suitable part of the machine:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) Series or type designation

(3) Application(s) for which the machine is intended i.e. lifting, pulling, people carrying.

(4) SWL (or loads if machine is intended for more than one application).

(5) The diameter and quality of rope required.

(6) Direction of movement. (Some older lifting and pulling machines may be found which do not include this information, and in such cases the recommendation is to add this information)

(7) Name of manufacturer or supplier.

(8) Year of manufacture.

Wire ropes used with lifting and pulling machines are detachable and, providing the correct specification, i.e. diameter and construction, are interchangeable. The following information should therefore be permanently and legibly marked on the ferrule or terminal fitting of the wire rope:

(1) Identification mark.

(2) SWL.

(3) The length of the rope.

5.9.2 Storage and Handling

After use, the machine and its associated equipment should be returned to safe storage. The storage requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code, i.e. the area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Equipment which is returned to the stores wet and/or dirty should first be cleaned and dried away from direct heat. Special care should be taken with ropes which have been allowed to get wet as internal corrosion may result, considerably reducing the strength of the rope. When in doubt, either consult a Competent Person or replace the rope.

(2) Any ancillary sheaves should be removed from the rope and stored separately.

(3) The rope should be removed from the machine and coiled, or wound onto a purpose designed coiler, care being taken to avoid twists which might lead to kinks. Ropes should always be securely tied in a coil and stored off the floor in such a manner that they are not crushed by other equipment.

(4) When handling ropes, care should be taken to prevent kinks or twists. In particular, when uncoiling the rope it should be 'reeled' off and not pulled from the coil sideways. (See Figure 5.9.2-1 page 115) Improper handling of wire ropes can quickly result in kinking, usually commencing with the formation of a loop as shown in Figure 5.9.2-2 page 115. If this loop is drawn tight the rope will be irreparably damaged.



Figure 5.9.2-1 Correct and incorrect method of uncoiling small coils

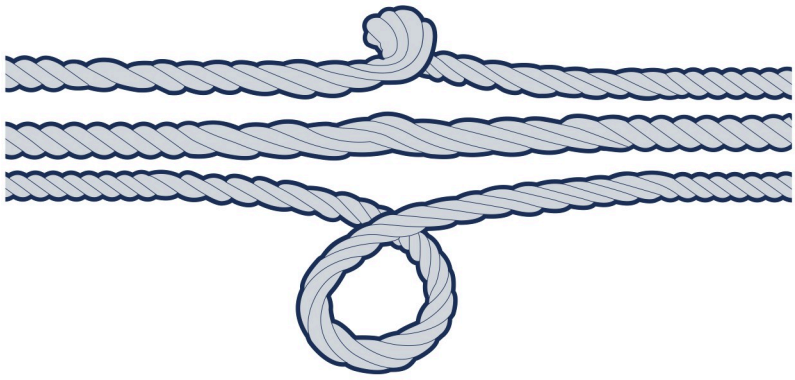


Figure 5.9.2-2

(5) The machine itself should be stored in a position where it is unlikely to suffer physical damage, i.e. preferably off the floor either on a suitable shelf or suspended from a rack by its anchor hook.

(6) Before equipment is put into storage, it should be checked by the Competent Person to ensure that it is in good order. Additionally, equipment which has been in storage for any length of time should be re-checked to ensure that no deterioration has taken place and that it functions correctly

(7) Equipment which is likely to remain in storage for any length of time should be protected from possible corrosion.

(8) As with all lifting equipment, care should be taken to avoid the machine or any of its ancillary equipment being dropped or thrown down.

5.10 IN-SERVICE INSPECTION AND MAINTENANCE

5.10.1 Pre-use Inspection

In addition to the thorough examination required under statutory provisions, all lifting and pulling machines should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis, taking account of the conditions of service. For lifting and pulling machines in regular use it is good practice to make the inspection at the start of each shift or working day. For lifting and pulling machines used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass the inspection, there should be a procedure to quarantine that machine to prevent further use until the problem has been resolved.

The purpose of the pre-use inspection is to test functionality of the machine and check for any obvious defects and, if any of the following faults are present, the machine should be withdrawn from service and referred to a Competent Person:

(1) The SWL and identification markings are illegible.

(2) The shear pins are distorted, indicating overload.

(3) The operating handle is distorted, indicating excessively applied operating effort.

(4) An incorrect wire rope is fitted.

(5) The rope is kinked.

(6) The rope is suffering from obvious wear or corrosion.

(7) The rope has broken wires. (Even one broken wire can cause the rope to jam in the mechanism of the machine. The danger to the operative's hands must also be considered.)

(8) The rope terminations are not intact. (The rope should be fused and tapered at one end with an eye or alternative terminal at the other)

(9) Wear, nicks, cracks and gouges in terminal fittings and hooks. Hooks should also be checked for opening and correct operation of safety catches. In the case of cargo or C hooks safety catches are not required to be fitted.

5.10.2 Additional checks for hydraulic machines

In addition to the above the following checks are required on hydraulically operated machines:

(1) Operating lines should be inspected for wear and possible leakage.

(2) Terminations should be inspected for leakage.

(3) The general condition of all hydraulic components and connections should be checked.

(4) A functional check of the hydraulic system should be made.

5.10.3 Interim Inspection

In addition to the thorough examination and pre-use inspection some lifting and pulling machines will require an interim inspection(s). the number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, machines duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in 5.10.1 Pre-use Inspection page 116 and 5.10.2 Additional checks for hydraulic machines page 116, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

5.10.4 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be paid to the following:

(1) The machine should be lubricated generously before use. It is impossible to over lubricate the machine and an excess of oil will not cause it to slip. A lack of lubricant can result in one jaw locking onto the rope preventing the other jaw from taking over the load. If the operating handle is moved when the machine is in this condition, the rope moves in and out of the machine in sympathy with the handle but does not progress through the machine. Whilst this situation is inconvenient it is not dangerous.

(2) Shear pins, where fitted, should be checked to ensure that they are undamaged and of the correct type and have not been incorrectly replaced with unauthorised substitutes.

(3) The rope should be lubricated with a suitable acid free lubricant at frequent intervals during use and before being placed into storage.

Lubricants containing molybdenum disulphide MUST NOT be used for either the machine or the rope.

5.10.5 Thorough examination

The lifting and pulling machine must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template documents, retained and cross referenced to the machine's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of lifting and pulling machines, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit.

5.11 SAFE USE OF LIFTING AND PULLING MACHINES

In addition to any specific instructions relating to the safe use of lifting and pulling machines issued by the manufacturer, the following points should be observed:

(1) The machine must not be used to raise, lower or suspend a load that is in excess of the SWL marked on the machine. When using multiple units to lift or pull, care must be taken to ensure that the share of the load taken by any one machine does not exceed its SWL

(2) Owing to the action of the machine, kinks, however slight, must not be allowed to form in the rope. Such kinks may be produced by incorrect unreeling, forming the rope into a sling or looped eye, etc. These practices should be prohibited. Similarly, ropes with broken wires should not be used as only one broken wire can jam in the mechanism of the machine rendering it inoperative.

(3) For the manually operated machine, only the handle provided by the manufacturer should be used. Under no circumstances should this be extended by the use of tubing or bars thereby increasing the leverage. In general, one person should be able to operate the machine up to its SWL. This should be borne in mind as if it is found that more than one person is required, it may indicate that the load exceeds the SWL of the machine. This is not intended to preclude the use of two persons to operate the

machine, which may in certain applications be found advantageous, but is to indicate the degree of operating effort normally required.

(4) In addition to the above, it should be noted that it is dangerous to attempt to operate both raising and lowering levers at the same time and no attempt should be made to do this.

(5) Where overload prevention devices are fitted, their integrity must be maintained and under no circumstances are they to be over-ridden. Shear pins in the operating lever, where fitted, are such a safety device and if they fail it is evident that the machine has been overloaded in some manner. It is therefore unsafe to take any measures to interfere with the operation and function of the pins.

5.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account, the manufacturer's instructions for installation and use and also pay particular attention to the following:

(1) Identification of correct wire ropes.

(2) In the case of machines used for temporary installations, selection of suitable suspension or anchor points.

Section 6 - POWER OPERATED HOISTS

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6.1 FOREWORD

Power operated hoists are widely used in industry, often as part of a larger lifting installation, e.g. with an overhead runway, jib crane or overhead travelling crane, or where a permanent lifting facility is required. They may also be used for fixed position lifting applications or where a temporary powered lifting facility is required.

Power operated hoists are readily available with electric or pneumatic operation, but the most common in general use at the present time will be found to be electrically operated. This section of the code therefore has been written on the basis of electric power operated hoists and those matters which are common to all types of power operated hoists. Specific matters relating to pneumatic power operated hoists are then dealt with in an appendix to this section.

Power operated hoists are ideal for heavier or repetitive lifting applications as they offer the following advantages over manually operated chain hoists:

(1) Speed of operation.

(2) Less fatigue for operatives, particularly on long lifts.

(3) Operatives may be remote/away from the load.

Most manufacturers and suppliers offer a range of accessories such as power feed systems, slack chain collecting boxes, weatherproof covers and remote control units.

6.2 SCOPE

This section of the code covers power operated hoists, which may be fitted with short link chain or steel wire rope and which are used for vertical lifting and lowering operations only. It therefore excludes winching or pulling applications.

In the case of chain hoists, it is limited to hoists designed so that the chain passes over a pocketed wheel, the slack chain may then hang freely or be stored in a chain collecting box. In the case of wire rope hoists, it is limited to hoists designed so that the wire rope winds on and off a drum upon which it is stored. Units which employ roller chain drives or wire rope friction drive systems are excluded, although these may have much in common with the items covered by this section.

This section of the code mentions power operated hoists with travelling trolleys. The hoist may be ‘combined’ with the trolley or ‘suspended’ from the trolley by its upper terminal fitting, which may be a hook, eyebolt or similar. No specific guidance is given with regard to trolleys. For information on the safe use of travelling trolleys, see SECTION 8 page 161 of this code.

This section of the code mentions certain accessories, such as slack chain collecting boxes and power feed systems, but no specific guidance is given in respect of these. For further information reference should be made to 1.A6 APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES page 40 of this code.

This section of the code does not cover ‘people carrying’ applications.

6.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

6.3.1 Power Operated Hoist

Power operated hoist is an abbreviated term. More correctly, the term should be power operated chain hoist or power operated wire rope hoist, whichever lifting medium is employed. The term should also be prefixed by the type of power utilized, i.e. electric or pneumatic. This term is further shortened to hoist in some parts of the text where the meaning is obvious.

6.3.2 Suspended Hoist

A suspended hoist has a hook or eye top fitting by which the hoist is mounted to its supporting trolley or suspension point.

6.3.3 Combined Hoist

A combined hoist has an integral travelling trolley and is sometimes referred to as a built-in hoist.

6.3.4 Fixed Suspension Hoist

A fixed suspension hoist has a top mounting by which the hoist may be rigidly suspended from a trolley or permanent structure.

6.3.5 Foot Mounted Hoist

A foot mounted hoist has mounting brackets or feet enabling it to be bolted in a fixed position to a crab or permanent structure.

6.3.6 Support Level

In the case of a suspended hoist, the support level is the level of the seat of the top hook or bearing point of the eye from which the hoist is suspended. In the case of a combined hoist, it is the level of the surface upon which the trolley wheels run. In other cases, it is the appropriate level similar to those stated. (See Figure 6.3.6-1 page 120)

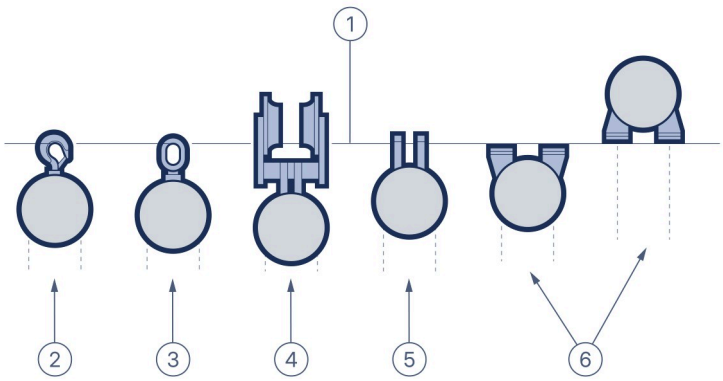


Figure 6.3.6-1 Support level for various types of hoists. 1. Support level, 2. Hook-suspended hoist, 3. Eye-suspended hoist, 4. Combined unit, 5. Fixed suspension hoist, 6. Foot-mounted hoist

6.3.7 Extended Dimension

The extended dimension is the distance between the support level and the bottom hook seat in the extended position. (See Figure 6.3.7-1 page 121)

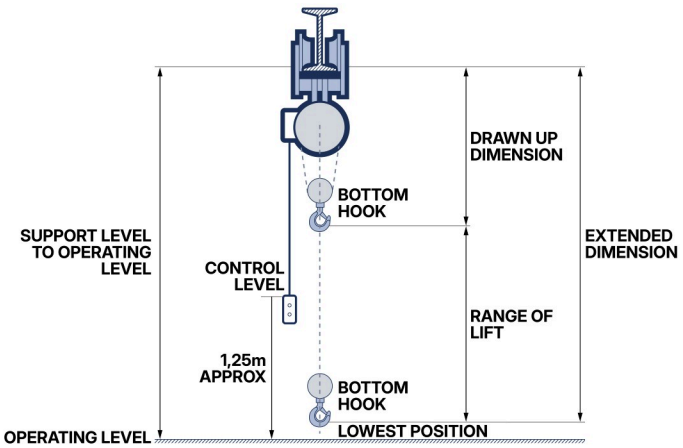


Figure 6.3.7-1

6.3.8 Drawn up Dimension

The drawn up dimension is the distance between the support level and the bottom hook seat when the bottom hook is in the raised position. (See Figure 6.3.7-1 page 121) This is sometimes referred to as the headroom as it is the effective headroom taken up by the hoist. However, the term headroom has not been used as it is sometimes used in everyday language to have other meanings.

6.3.9 Range of Lift

The range of lift is the vertical distance which the bottom hook travels between the extended and drawn up positions. (See Figure 6.3.7-1 page 121)

6.3.10 Operating Level(s)

The operating level(s) is the level(s) at which the operative stands. (See Figure 6.3.7-1 page 121)

6.3.11 Control Level

The control level is the position above the operating level at which the controls are placed or to which the pendant control hangs. (See Figure 6.3.7-1 page 121) Unless otherwise stipulated, this will be approximately 1.25 metres above the operating level.

6.3.12 Limits

Limits are mechanical or electro-mechanical devices which are used to restrict the amount of movement in any motion, i.e. lifting, lowering or travelling.

6.4 TYPES OF ELECTRIC POWER OPERATED HOISTS

In view of the number of manufacturers and models of electric power operated hoists in service, the following information is of a general nature only. Reference to a specific manufacturer's range may show variations to this information.

6.4.1 Electrical Supply

Electric power operated hoists usually require a 3 phase AC supply current. Some of the lower capacity models are available with single phase or low voltage motors.

6.4.2 Low Voltage (LV) Control

Modern electric power operated hoists are normally fitted with low voltage control which is derived internally within the unit by transformer. This is usually in the range of 24 to 50 volts AC or DC and is often known as 'Extra Low Voltage'. Older hoists and special purpose hoists may not have LV control. It should also be noted that it is common in many countries to use mains voltage control However in such cases the recommendation is to have double insulated hand held units or convert to a low voltage control.

6.4.3 Lifting Media

The two principal lifting media used with electric power operated hoists are:

(1) Short link round steel chain.

(2) Steel wire rope.

Each has its own characteristics and the choice of the lifting medium imposes restrictions on the design of the hoist.

In hoists which utilize chain, the chain passes over a pocketed wheel, the slack side of chain hanging loose. A collecting box may be used to house the slack chain, but as this sits below the body of the hoist it restricts the height that certain loads may be lifted.

In hoists which utilize wire rope, the wire rope passes on and off a drum upon which it is stored. The range of lift is limited by the amount of wire rope that the drum can accommodate.

6.4.4 Means of Mounting

Electric power operated hoists are available with various options for suspension or mounting to suit differing applications.

6.4.5 Suspended hoists

Suspended hoists may have a top hook, eye or similar allowing them to be suspended from a range of lifting points or hung on to a travelling trolley load bar. These options allow for temporary installations or where a degree of articulation between the hoist and its support is desirable.

6.4.6 Built in hoists

Built in hoists with integral trolleys are available with a rigid or flexible connection between the hoist and trolley dependent on the hoist design. Three types of built in travelling trolleys are available:

(1) Push-pull, sometimes known as hand pushed.

(2) Hand geared, commonly referred to as geared.

(3) Powered travel.

These permit the hoist to be mounted on runways, jibs and mobile supporting structures.

6.4.6.1 Fixed suspension and foot mounted hoists

Fixed suspension is appropriate where a hoist is to be rigidly mounted to a permanent structure, such as a fixed jib, or be built into a special trolley. In this case, top mountings are provided into which the mounting plate of the supporting structure may be fixed. Similarly, where the hoist is to be permanently mounted to a structure or crab unit, foot mounted hoists are appropriate. In this case, feet which enable the hoist to be directly bolted in position are provided. These may be positioned to allow the hoist to be underslung from a structure, as may be the case over a shaft, or overslung, as may be the case when fitted to a crab unit.

6.4.7 Capacities

Electric power operated chain hoists are generally available in a range of capacities up to 10 tonnes whilst wire rope hoists are generally available in a range of capacities up to 40 tonnes. Both types are available in larger capacities from certain manufacturers and the code is not restrictive in this respect.

In addition to the size of the chain or wire rope used, the capacity of the hoist is governed by the number of falls that support the load. A large proportion of hoists are manufactured with multiple falls. The same basic power unit may therefore be used for two or three capacities of hoist, e.g. 1 tonne single fall, 2 tonne with two falls or 4 tonnes with four falls. (See Figure 6.4.7-1 page 123)

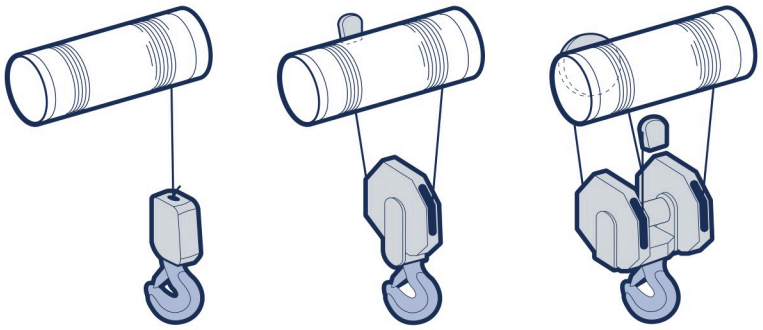


Figure 6.4.7-1

6.4.8 Lifting Heights

The available lifting height, i.e. range of lift, will vary with the power operated hoist design. As a general rule, chain hoists are restricted to 20 metres although longer lifts may be available. This is due to the action of the chain passing over the load wheel which sets up an oscillation in the loaded side of the chain and this can lead to the load swinging. The weight of the chain is also a significant factor which must be taken into account, being heavier than wire rope of the equivalent capacity. Wire rope hoists do not suffer from this oscillation and therefore far greater lifting heights are available. In all cases, it is necessary to consult with the manufacturer to establish the range of extended dimensions available.

6.4.9 Lifting Speeds

Electric power operated hoists may have single, dual or multiple speeds of lifting. These are dependent on the hoist design and standard speeds vary from one manufacturer to another. It should also be remembered that multiple fall hoists will be slower in proportion to the number of falls than the basic unit from which they are constructed. With a dual speed hoist a second speed, often known as creep speed, is provided. This is considerably slower than the standard speed and assists the operative to position the load accurately.

6.4.10 Travel Speeds

As with lifting speeds, hoists that incorporate trolleys may be provided with single, dual or multiple speeds of travel to suit various applications.

6.4.11 Hoisting and Lowering Limits

For safety reasons, to prevent the bottom hook ‘over travelling’ and causing damage to the hoist, a hoisting or upper limit is used. Most power operated hoists are also fitted with a bottom limit to prevent the bottom hook from lowering beyond the designed extended dimension, but it should be noted that this is not always the case, particularly with older hoists. The type of limit used will depend on the hoist design and may be a mechanical device, e.g. a slipping clutch, or an electro mechanical device which uses a mechanical method of actuating a limit switch. Whichever type is employed, hoist limits are not intended for regular use, they must be considered as emergency safety devices. Where positional limits are required, a secondary system should be used, and most manufacturers are able to supply these.

A slipping clutch is generally only used on power operated chain hoists. This is placed between the motor and the final drive. It employs spring loaded discs which will slip when the bottom hook or a stop pushes against the underside of the hoist body framework when hoisting. Similarly, a stop may be fitted to the slack end of the chain to activate the clutch when lowering. It should be noted that the motor keeps running when the clutch is operated and that the operative must release the motion control button to stop the motor and thereby apply the brake.

There are several electro-mechanical methods of actuating a limit which all utilize the movement of the mechanism to disconnect the power to the motor and thereby apply the brake.

In most cases, hoisting and lowering limits are easily reset by reversing the direction of the hoist however in some cases manual resetting may be necessary.

6.4.12 Positional Limits (Working Limits)

Additional limits which control the upper and lower position of the bottom hook, known as positional or working limits may be available. These are used in certain applications, such as on a production line, where the user

may wish to limit the hook movement. Like hoisting limits, working limits automatically reset when the direction of the hoist is reversed. They are however heavy duty to enable them to be regularly used.

6.4.13 Travel Limits and Anti-Collision Devices

Travel limits, which restrict the long travel of hoists with power operated trolleys, are available. These may be used to position the hoist, as may be necessary on a production line, or to prevent the hoist colliding with obstacles or other hoists which may be mounted on the same runway. Various types of limits and devices are available to suit differing applications. These range from simple limit switches and striker plates to infra-red and microwave sensors.

6.4.14 Motion Controls

Various control options are available for electric power operated hoists. By far the most widely used is the pendant control and this is the standard control which is fitted by the manufacturer unless instructed otherwise. This may be suspended direct from the hoist or arranged to run on a separate track feeding to the hoist via a festooned cable. It usually takes the form of a hand held unit with control push buttons which control the various motions and speeds. Additional control functions may also be provided, such as an emergency stop button (as recommended by most standards and legislation), a key switch for isolation of the hoist, etc.

Other control options, such as radio or infra-red controls, enable remote or central control. They are useful in areas where direct access may not be possible. Multi-point controls, usually wall mounted, enable hoists to be controlled from several positions, which is useful in applications such as raising loads through several floor levels. Such arrangements must be suitably inter-locked to prevent more than one control operating at a time. A further essential requirement with this arrangement is the provision of emergency stop buttons to override all control positions until manually reset.

6.4.15 Other Design Options

Other design options are available to suit various environments. These include:

(1) Weather proofed hoists.

(2) Dust proofed hoists.

(3) Spark resistant hoists.

(4) Flame proofed hoists.

(5) Explosion proofed hoists.

It is necessary to consult with the manufacturer or supplier to establish the design options available within their range of equipment. A wide range of accessories is also available for use in specific applications.

6.5 PRINCIPLES FOR THE SELECTION OF ELECTRIC POWER OPERATED HOISTS

6.5.1 Application of Machines

Electric power operated hoists are suitable for a wide variety of purposes. For all applications, initial consideration should be given to the following:

(1) Capacity.

(2) Range of lift.

(3) Speed(s).

(4) Suspension.

(5) Operating level(s).

(6) Availability and suitability of power supply, including protection and isolation facilities.

(7) Service conditions.

(8) Nature of load.

(9) The documentation required by legislation. If this is not on record refer the hoist to a Competent Person for thorough examination.

It should be recognised that power operated hoists are designed to lift in the vertical plane only. The application should be fully discussed with the supplier to ensure that the correct equipment is selected.

6.5.2 Class of Use

A classification system for electric power operated wire rope hoists, which takes into consideration the operating cycles per hour, operating hours per day, magnitude of load and total range of lift, is set out in the standard to which it was made and should be marked on the hoist.

It should be remembered that hoists used frequently for high lifts may approach the limit of their motor rating. The greater the height of lift the longer the motor will run. Incorrect selection can result in extended running times leading to overheating. Single phase hoists are more susceptible to this.

6.5.3 Service Conditions

Standard electric power operated hoists are manufactured to meet normal service conditions and assume:

(1) Use under cover, i.e. not directly exposed to the elements.

(2) Use at ambient temperatures between -10°C and 40°C without high local heating or cooling.

(3) Use in clean air free from excess of humidity, contamination and deposits.

It is therefore necessary to discuss any other service conditions requiring special attention with the supplier to ensure correct selection. Such conditions may be environmental, due to use with hazardous substances or other potential hazards.

6.5.3.1 Environmental Conditions

Examples of environmental conditions requiring special attention are:

(1) Outdoor use.

(2) Salt air.

(3) High humidity.

(4) Ambient temperatures above or below the normal range.

(5) The presence of local heat sources, e.g. furnaces.

(6) Dust/abrasives in the atmosphere.

6.5.3.2 Hazardous substances

Hazardous substances fall into two main groups; those that would harm the hoist or its associated electrical equipment, e.g. corrosives; and those that may be affected by the operation of the hoist, e.g. explosives. Examples of hazardous substances requiring special attention are:

(1) Flammable or explosive gases, vapours or dust.

(2) Corrosive vapours and liquids.

(3) Volatile liquids.

(4) Toxic substances.

(5) Molten metal.

The manufacturer’s or supplier’s specific advice should be sought if power operated hoists are to be operated in an acidic or alkaline environment. Such conditions can cause stress corrosion cracking for example on some types of chain.

6.5.3.3 Other potential hazards

Other potential hazards may arise as the result of the work being carried out in the general location or be caused by the hoist performing lifting and moving operations over the heads of personnel or similar. Examples of such potential hazards requiring special attention are:

(1) Use in mines and quarries.

(2) Use in entertainment

(3) Use in laundries.

(4) Use in galvanizing, pickling and hot dipping processes.

(5) Use in paint shops.

(6) Use over work areas.

(7) Use over walkways and footpaths.

6.5.4 Design Considerations

(1) Electric power operated hoists should be of adequate design taking into account the requirements of the relevant standards for the hoist, trolley, runway or slewing jib and electrics.

(2) The marked SWL should be suitable for the load being handled. At no time must the load applied to the hoist exceed the marked SWL and allowance must be made for any possible shock loading which may occur.

(3) The hoist should be fitted with an automatic brake capable of arresting the mechanism and sustaining the load. Such brakes are mechanically applied and electrically released so that in the event of power failure the brake is automatically applied.

(4) In the case of power operated chain hoists, it should be realised that the action of the chain passing over the pocketed wheel causes an oscillation in the loaded side of chain and on long falls this can cause the load to swing. Manufacturers therefore limit the recommended range of lift for which their models of hoist are suitable.

(5) The hoist should be fitted with positive hoist/lower limits to prevent inadvertent over-hoisting or lowering. Lack of over-lower limit on wire rope hoists can lead to the danger of the rope rewinding on the drum in the reverse direction, resulting in the reversal of control sense and non-function of the over-hoist limits. When it is necessary to restrict the hook movement to suit a particular process or duty, additional working limits must be fitted, hoist limits must not be used for this purpose.

(6) All operating push buttons should be:

a. Shrouded to prevent accidental operation.

b. Of the 'hold to run' type, i.e. motion stops when the button is released.

c. Interlocked to prevent conflicting commands, i.e. only one button will operate at a time.

(7) In the case of power operated hoists with top hook suspension and on all bottom hooks, it is important that hooks and other devices provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety catches or by the use of 'C' hooks. Most hoist manufacturers fit hooks with safety catches as standard.

6.5.5 Power Feed System

Consideration must be given to the power feed system. Not only must the power supply be correct, but also the method of feeding the supply to the hoist must be appropriate for the intended use. Guidance on power feed systems is given in 1.A6 APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES page 40 of this code.

6.5.6 Accessories and Additional Fitments

Consideration must be given to any accessories that are to be used with the hoist. In addition to extra control facilities, such as working limits, a wide range of accessories is available to suit certain applications.

6.5.6.1

In the case of a power operated chain hoist, the slack chain collecting box, bucket or bag is perhaps the most common and important accessory and the following points should be considered:

(1) Without a collecting box the slack chain will hang loose from the hoist. This could be a source of danger as it may catch on the load or other obstructions or strike the operative if allowed to hang freely.

(2) A purpose designed slack chain collecting box may be used to house the chain safely, but it must be of adequate capacity to house all of the chain. If the box is of inadequate capacity, the chain can spill over and, rather like a siphon, once this occurs all the chain will be pulled from the box at an accelerating rate. The uncontrolled fall of the chain could inflict serious injury upon any personnel in its path, as well as subjecting the hoist to a high shock load. Another effect of the box being of inadequate size is that the chain may feed into the hoist with links in the wrong plane causing damage to the hoist and in extreme cases breaking the chain and allowing the load to drop. It should also be noted that a build up of chain

may cause the hoisting limit to operate cutting out the motion. Special care must be taken if the hoist has been re-chained for a greater range of lift than that for which it was originally designed and rated.

(3) The box should be provided with suitable drainage to prevent a build up of moisture which could corrode the chain.

6.5.6.2

When electric power operated hoists are required to operate both inside and outdoor, consideration should be given to the use of a weatherproof cover. This should form a large enough canopy to prevent the hoist being directly exposed to rain, etc.

6.5.6.3

When electric power operated hoists are required to operate over furnaces and quench tanks, etc., the use of a heat shield should be considered. This should be large enough to prevent the hoist being directly exposed to flames.

6.5.6.4

When electric power operated hoists are used in steam-laden atmospheres, such as dye houses and laundries, special precautions are necessary to limit corrosion. Consideration should therefore be given to the use of galvanised wire rope, plated chain and additional lubrication points or specially sealed for life bearings. Sealed body casings to prevent the ingress of moisture are also available. Alternative control methods should also be considered, such as pull cords or remote devices. A wide range of accessories and additional fitments are available to suit these and other severe conditions.

> Electric power operated hoists should only be used outdoors or over furnaces, or other similar environments, with the approval of a Competent Person.

6.5.7 Overload Protection Devices

Hoists which have a rated capacity of 1 tonne or more or which are installed such that there is an overturning moment of 40,000 Nm or more, must be fitted with devices to warn the operative and prevent dangerous movements of the load in the event of overload or of the moments conducive to overturning being exceeded. Older equipment may not be fitted with such devices and we recommend that, if not, the application is assessed and if there is a risk of overload or overturning, that they fitted to the equipment.

Overload protection devices take different forms but may usually be set so that a load up to the proof load can be lifted or to allow a load in excess of the SWL, but less than the proof load to be raised. This protects the hoist from accidental overloading but allows for variations in the imposed load due to dynamic loading.

6.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As electric power operated hoists are frequently used for miscellaneous lifting purposes, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given, and this should include the following information:

(1) Maximum load to be lifted or SWL.

(2) Type of hoist, i.e. chain or wire rope.

(3) Range of lift.

(4) Maximum drawn up dimension.

(5) Maximum extended dimension.

(6) Type of suspension, e.g. hook/eye, push/geared/electric travel trolley, in the case of a trolley suspension, details of the runway beam section and size.

(7) Lifting speed(s).

(8) Power supply, voltage, phase(s) and frequency.

(9) Details of the power feed system if required.

(10) Type of control, e.g. pendant, remote, etc., including pendant length, etc. If unspecified, the manufacturer will assume pendant control and this will be arranged to suit the hoist on the basis of the operating level being at the extended dimension.

(11) Special service conditions or safety requirements which may affect the hoist design, e.g. outdoor use, use in a flammable atmosphere, etc.

(12) Classification if known or details of the state of loading and duty cycle, etc.

(13) Any accessories that may be required, e.g. slack chain collecting box, working limits, etc.

(14) Any other special requirements.

It may subsequently be found that a more detailed exchange of information is necessary to ensure the correct selection. For all but the simplest or repeat installations, a visit by the supplier to survey the site should always be considered as this will minimize the information exchange and reduce the chance of incorrect selection.

Further technical information may be required by the user at the time of installation or for maintenance purposes. It will be contained in the manufacturer's operations and maintenance handbook, which will be supplied with the hoist, and does not otherwise form part of the information exchange.

> Unless instructed otherwise, the supplier will assume the hoist is to be used in normal service conditions and the hoist will be supplied from the manufacturer's standard range of equipment.

6.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

6.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code makes it clear that power operated hoists are lifting equipment. Unless a written scheme of examination (refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

6.7.2 Thorough Examination following Installation

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the hoist is put into service. (See 6.8 INSTALLATION AND COMMISSIONING page 128).

6.7.3 Post Repair Verification and Record Keeping

Following repair, power operated hoists must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

> Although not required by legislation, new power operated hoists will usually be issued with a manufacturer's record of proof load testing in addition to, although possibly combined with, the documentation require by the applicable national legislation. This document forms an important part of the record of the hoist. It should be retained and cross referenced to the hoist's historical records for inspection by the Competent Person or local enforcing authority.

6.8 INSTALLATION AND COMMISSIONING

6.8.1 Erection of the Equipment

The erection procedure should be carried out in accordance with the manufacturer's instructions paying particular attention to the following:

(1) Prior to commencing installation of hoists that have been in storage, a check should be made to ensure that no damage has occurred whilst in store. (See section 6.10 IN-SERVICE INSPECTION AND MAINTENANCE page 131)

(2) Ensure the structure supporting an electric power operated hoist can adequately handle the intended load. This load includes the weight of the hoist itself together with any attachments (i.e. slings, shackles, trolley, etc.) plus a 25% additional allowance on the total to take account of the effect of dynamic loading. If the supporting structure forms part of or is attached to part of the building structure, care must be taken to ensure it is suitable for the intended lifting application. An architect or structural engineer should be consulted, and his written approval kept on file with the lifting equipment records. (See 1. A4 APPENDIX 4 - STRUCTURES page 19)

(3) Runways, suspension points, etc. should be marked with 'SWL - power'. Whilst the use of manual equipment on runways, etc. marked for 'power' is perfectly safe, the reverse is NOT the case and electric power operated hoists must not be used with structures marked for 'manual' use. Where there is no indication or where it is marked for manual use, it may be possible to re-rate the structure for a lower, or in some cases even the same, SWL for power use. A structural engineer should be consulted. His written approval should be passed to the Competent Person to enable him to verify the structure for its new intended use. The approval should be kept on file with the lifting equipment records.

(4) Where a travelling trolley, either hung in or built in, is employed, it is essential that the runway beam, jib arm, etc. is sufficiently level at all loads up to the maximum for which it is designed such that the trolley, hoist, etc. will not run away under gravity.

(5) When erecting onto a runway, jib arm, etc. ensure the trolley is correctly adjusted for the width of beam, that the wheels align, are in full contact with the track and that anti-tilt devices are correctly set. (See for information regarding trolleys). Care must also be taken to ensure that runway end stops are correctly in place, effective and do not make contact with the wheel flanges

(6) When using a hook suspended hoist, the top hook should be fitted with a safety latch to prevent displacement. The hook should be attached to its support in such a manner that the support fits freely into the seat of the hook and does not exert any side thrust upon the point or latch.

(7) After erection, a check should be made to ensure that the load chain or wire rope hangs freely and is not twisted or knotted. In particular, special care should be taken with multi-sheave hoists to ensure that the bottom hook has not been turned over between the falls imparting a twist to the chain or wire rope. In the case of chain, if this has occurred the hook should be turned back carefully until the twist is removed, this will not damage the chain. In the case of wire rope however, great care must be taken as twisting can cause permanent damage to the rope, the rope should be carefully removed and re-reeved.

6.8.2 Connecting the Power Supply

The connection of the power supply should always be carried out by an appropriately qualified electrician or person competent to carry out such work.

(1) The power supply must be taken via fuses, or other protective devices, rated in accordance with the hoist manufacturer's instructions and must include a means of isolating the hoist from the power source.

(2) In the case of an enclosed conductor supply, ensure that the collectors align correctly with the conductors. If spring loaded collectors are fitted, they should be compressed by the conductors to approximately half of their full movement.

(3) In the case of a cable supply, care must be taken to ensure sufficient cable is used so as to allow the hoist to travel to its furthest point from the power source without the cable coming under tension. It is good practice for the earth wire to be longer than the live wires so if there is excessive tension on the cable, which pulls a live wire from its terminal, the earth wire will still be attached.

(4) Before connection of the power supply, insulation resistance, polarity and earth continuity tests should be carried out and care taken not to damage any low voltage circuits or electronic devices.

(5) After connection of the power supply, check the direction of the motions, that is when the 'down' button is depressed - hook hoist lowers, when the 'up' button is depressed - hook hoist rises. This is especially important in the case of plug in connections, as the phasing at the socket is not guaranteed. If the direction of motion is incorrect, disconnect the mains supply and either reverse two phases at the hoist entry terminals or change over two phases at the fuse box. Under no circumstances should any other changes be made. Some hoists may be fitted with phase protection equipment which prevents the hoist operating if the phases are incorrectly connected.

(6) Hoists that incorporate power travel trolleys should be checked in a similar way to ensure that the travel motion is in the selected direction. In the case of hoists controlled by non-conductive controls, it is advisable to mark the hoist clearly with symbols to show the travel control direction, e.g. East - West. The control unit should be marked in an identical way. This is necessary as the operative may be positioned on either side of the unit when operating the travel motion.

6.8.3 Post Installation Checks

(1) On completion of the installation and supply connection to power operated hoists, all functions and motions of the unit should be checked for correct operation.

(2) In the case of an electric power operated chain hoist, care must be taken with the first operation of the hoist/lower motion as the slack chain may have become tangled in transit and erection. The motion should be run allowing the chain to feed out a few inches at a time, any twists or loops being straightened out before the chain enters the body of the unit and, in the case of multi-fall units, before it feeds around idler pulleys in the bottom hook assembly.

(3) The length of chain or wire rope should be checked to ensure that the hook will reach its lowest point without running out fully.

(4) Ensure hoist limits are correctly set and prevent overrun in either the hoist or, where fitted, lower motions.

(5) If a slipping clutch is fitted check this is functioning correctly in accordance with the manufacturer's instructions.

(6) Ensure the brake is operating correctly. Raise and lower a load equal to the marked SWL. The brake should sustain this at any position throughout the range of lift.

(7) Set any working limits to the required top and bottom positions of the hook. Trial run the hoist to ensure the working limits operate correctly.

(8) A similar running check should be made to the powered trolley unit ensuring any travel limits are set to the required positions and operate correctly.

6.8.4 Installation Pre-use Inspection/Thorough Examination

The degree of pre-use inspection or thorough examination required will to some degree depend on the type of hoist used and the installation conditions. Whilst it is recognised that lower capacity hook suspension power operated chain hoists may be used as a portable tool in order to effect a limited lifting operation, the installation of power operated hoists is by nature a more permanent procedure than that of manually operated equipment. For simple, temporary installations of hook suspended hoists onto pre-verified suspension points it may be sufficient for a suitably qualified and experienced person to perform a basic inspection of the installation to ensure the correct attachment of the hoist and its operation. For more complex installations and those requiring an amount of dismantling and reassembly a higher degree of examination by a Competent Person may be called for (See 6.7 LEGAL REQUIREMENTS page 128)

Where the Competent Person deems a proof test is necessary to supplement his thorough examination, the test load applied will take into account the requirements of the overall installation, e.g. runway, which form a part of the thorough examination. The proof load for power operated hoists will usually be 125% of the rated capacity unless the standard to which the hoist is manufactured states otherwise. Functional tests at the rated capacity and other load tests to ensure the integrity of the brake, motion limits and safety devices may also be used to supplement the examination. Test loads should be applied by in accordance with the standard to which the hoist was made or in accordance with the manufacturers instructions.

6.9 MARKING, STORAGE AND HANDLING

6.9.1 Marking

In addition to the information required by the legislation and standards, the following information should be permanently and legibly marked on a suitable part or parts of the electric power operated hoist:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) Rated capacity or SWL.

(3) Name of manufacturer.

(4) Year of manufacturer.

(5) Range of lift.

(6) Power supply, voltage, phase(s) and frequency required.

(7) Motor size(s) in kW and rating.

The following information should always be readily to hand:

(1) Class of use.

(2) Details of lifting medium, e.g. size and grade of chain, size, construction and minimum breaking load of wire rope etc.

(3) IP rating.

(4) Lifting speed or speeds.

(5) Traverse speed or speeds.

(6) Any other marks or references that may identify the model or type.

6.9.2 Storage and Handling

When not in use, electric power operated hoists should be returned to storage or parked in a safe position such as at the end of a runway. When the hoist is parked, the hook should be raised so as not to be a danger to persons who may be walking by or working in the area and to ensure it cannot become accidentally engaged with any items which may be in the vicinity. In the case of chain, the slack chain should be housed in the slack chain collecting box if fitted. Where no slack chain collecting box is fitted, care must be taken to ensure the hanging loop of chain does not present a danger.

When electric power operated hoists are returned to storage, the conditions should meet the requirements for storage recommended in section 1.7.2 Storage and Handling page 9 of this code together with the following additional requirements:

(1) Electric power operated hoists being returned to storage should be clean, dry and protected from corrosion. Beware of cleaning and drying processes which might damage the hoist or its electrical components.

(2) Any specific manufacturer's commissioning or decommissioning instructions should be followed.

(3) All electrical functions of the hoist should be checked prior to storage; in particular hoist limits, brakes and pendant cable control. Attention should be given to all electric cables, particularly where they enter the hoist or pendant control box, to make sure no damage has occurred in use. Plug in cables and pendant cables should be removed and stored separate to the hoist to prevent possible damage. The electric power operated hoist should be labelled to show the date on which it was checked and signifying its readiness for use, but after extended storage or where there may be doubt as to the condition before further use, it is advisable to carry out earth continuity and insulation tests to the main electrical components in addition to the pre-service functional tests detailed in 6.8.3 Post Installation Checks page 130.

(4) Exposed surfaces, including chains and wire ropes, liable to corrosion should be suitably protected before going into storage. In the case of electric power operated wire rope hoists, the bottom hook should be raised to its highest position. In the case of electric power operated chain hoists, if the design and storage arrangements permit, the bottom hook may be raised to its highest position and the slack chain housed in the slack chain collecting box if fitted. Where this is not possible, the hook should be raised to within 350 - 500 mm of its highest position, the slack end of chain then wound around the remaining load chain between the hoist body and hook and secured in place with suitable twine or wire.

(5) It is recommended that electric power operated hoists are stored suspended from the suspension fitting so that the bottom hook and, where applicable, the chain box are clear of the ground thus preventing damage in storage. Where this is not possible, as in the case of larger units with built in trolleys, the hoist should be stored on a purpose built rack or pallet suitably packed so as to keep it clear of the ground.

(6) When being handled, electric power operated hoists should be treated with care. Ensure they are not dropped or thrown down and that the chain or wire rope, bottom hook and pendant cable control are not dragged across the floor.

(7) Whilst being transported and during storage, electric power operated hoists should, if necessary, be covered to prevent the ingress of moisture, dust or other foreign particles.

6.10 IN-SERVICE INSPECTION AND MAINTENANCE

6.10.1 Pre-use Inspection

In addition to the statutory thorough examination by a Competent Person, electric power operated hoists should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For hoists in regular use it is good practice to make the inspection at the start of each shift or each working day. For hoists used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person

making the inspection. In the event that it does not pass the inspection, there should be a procedure to quarantine the hoist to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test functionality of the hoist and make a visual check for any obvious defects. The inspection should include the fixings, suspension points and supporting structures, guidance on the in-service inspection of runways, slewing jib cranes and mobile supporting structures is given in sections , SECTION 10 - SLEWING JIB CRANES page 181 and SECTION 12 page 205 respectively. The inspection should include the following points in addition to any specific checks recommended by the supplier:

(1) State of chain or wire rope.

(2) Correct operation of the brake.

(3) Correct operation of hoist and, where fitted, lower limits.

(4) Correct operation of controls.

(5) A visual check for any obvious defects.

If any of the following faults are found, the hoist should be withdrawn from service and referred to a Competent Person.

6.10.1.1 All power operated hoists

(1) Signs of wear, deformation or damage to hooks, trolleys or other terminal or suspension fittings.

(2) Hook safety latch damaged or inoperative. In the event of the latch appearing to be too short, this is an indication of the hook having opened out and may be the result of the hoist being overloaded.

(3) Signs of wear and fretting corrosion to screw threaded shanks.

(4) Load slips when hoisting or load will not lift although motor is running.

(5) Load stops midway through a lifting cycle. In this case, where possible action must be taken to lower the load. If this cannot be done, the area must be cordoned off to prevent anyone approaching.

(6) Hoist will not operate although power is on.

(7) Spasmodic or erratic lifting operation and similar symptoms on the travel motion.

(8) Trolley slips or skids on the runway.

(9) Damage to any electric cable or cable gland.

(10) Damage to the pendant control hand set including cable, rubber covers, legends or labels and support wire, chain or cord.

(11) Excessive noise or unusual sounds from any part of the hoist, including motor, clutch, gearbox or brake.

(12) Travel and/or hoist motions operate in opposite direction to control indication.

(13) Load continues to travel excessive distance after motion control has been released.

6.10.1.2 Electric power operated chain hoists

(1) Load chain worn or damaged, in particular when wear has occurred on the bearing surfaces inside the links and to damage in the form of bent, notched, stretched or corroded links. In certain circumstances, very rapid wear of the load chain can develop, which is characterised by a rough appearance on the mating surfaces inside the links.

(2) Load chain does not articulate freely.

(3) Signs of damage or distortion to the slack end anchor which connects the load chain to the hoist casing and/or signs of damage or distortion to the load chain stop where one is fitted.

(4) When bottom hook is fully extended to its lowest possible working position, the slack end of the chain pulls tight transmitting the load onto the slack end anchor.

(5) When operating under load, the chain jumps and/or is excessively noisy.

(6) Chain does not hang freely or is twisted over its length.

(7) Chain does not enter or leave the load wheel freely. Chain guide or stripper are worn or damaged.

(8) Chain collecting box is damaged or distorted.

Recommended further guidance on the inspection procedure and rejection criteria for load chain is given in ISO 7592.

6.10.1.3 Electric powered operated rope hoists

(1) Load rope is worn or damaged; in particular any increase or decrease in diameter, opening of strands, kinks or broken wires. Any signs of mechanical damage such as flattening, crushing, cuts, burring and corrosion. Faults are most likely to occur at the terminations and where the rope passes over sheaves and pulleys, in particular compensating sheaves.

(2) Wire rope does not feed onto the drum correctly or winds in the wrong direction in relation to the control direction selected.

(3) Damaged or worn rope guides and bands.

(4) Signs of damage or distortion of the anchorage points or of the wire rope pulling through any clamping devices.

(5) When bottom hook is fully extended to its lowest working position, there are less than 2 full turns of rope remaining on the drum. Under no circumstances must there be less than 2 full turns of rope remaining on the drum but consult the manufacturers instructions as with some units 3 full turns must remain.

(6) Wire rope is cabled, i.e. multiple falls of rope are twisted together.

Recommended further guidance on inspection procedure and rejection criteria for wire rope is given in ISO 4309.

6.10.2 Interim inspection

In addition to the thorough examination and pre-use inspection some hoists will require an interim inspection(s). the number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, hoist duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in 6.10.1 Pre-use Inspection page 131, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see 6.10.3 Maintenance page 133 below.

6.10.3 Maintenance

A routine preventive maintenance programme should be drawn up which can be combined with the maintenance programme that will be necessary for the associated power supply system and control equipment. This should meet the requirements set out in the manufacturer's installation and maintenance instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be given to the following points:

(1) Load chains should fit snugly into the pockets of the load wheel and as the load wheel turns the chain should enter and leave the pockets freely. This action is assisted by a chain guide and stripper which should be checked for correct fitting and operation. The chain should be lubricated in accordance with the manufacturer's instructions. Recommended further guidance on the maintenance of load chains may be found in ISO 7592. (Some examples of chain hoists using roller chain may still exist. These have the limitation that the chain will only articulate in one direction and different maintenance procedures will apply. Such hoists are not covered by this section of the code and the advice of a Competent Person should be sought.)

(2) Wire rope should coil correctly onto the drum. It must move freely on and off the drum in a single layer with no crossing of the strands. The correct number of full turns of rope must remain on the drum when the bottom hook is in its lowest position and the limit has operated. This will vary between 2 and 3 full turns dependent on the hoist design and the manufacturer's instructions must be followed. If any doubt exists ensure 3 full turns remain. Commonly, a rope guide and band is used to assist the rope to coil correctly these should be checked for correct fitting and operation. The wire rope should be lubricated in accordance with the manufacturer's instructions.

(3) The recommended grade of acid free chain or wire rope lubricant should always be used. Care should be taken to ensure it penetrates between the wires of wire rope or the bearing surfaces of the chain. Under certain conditions of use, such as where there is a risk of contaminating other goods or products or in dusty atmospheres where dirt is liable to mix with the lubricant and adhere to the chain or wire rope, a suitable dry lubricant may be used. Details are available from the hoist supplier.

(4) In all but the most special of cases, the bottom terminal fitting will be a swivel hook. They must swivel freely, bearings and swivels should be lubricated in accordance with the manufacturer's instructions. In the case of multi-fall hoists, the pulley sheave or loadwheel must be checked for free movement and the axle pin and bearings should be lubricated in accordance with the manufacturer's instructions. Safety latches should be in good working order and the spring should cause the latch to close completely.

(5) The suspension fitting will vary with the design of the hoist. Hooks, eyes and similar suspension fittings may be fitted with swivels or be arranged to rock in one plane only. They must articulate freely and swivels or rocker pins must be lubricated in accordance with the manufacturer's instructions.

(6) Trolley wheels must movefreely, wheel bearings, axle pinsand drivegears should be lubricated in accordance with the manufacturer's instructions. Anti-tilt devices must be correctly set to the underside of the beam and should be reset if necessary. Further guidance in respect of trolleys is given in of the code.

(7) The pendant cable control should be suspended on a wire, chain or cord internal or external to the cable, which ensures that no load is imposed on the cable, cable glands or terminals. This should be inspected on a regular basis. The cable should be visually checked and if necessary tested to ensure that there has been no deterioration of insulation or breakdown of the cable particularly at gland entries. The control unit should also be checked for its general condition, legibility of legends and correct operation.

(8) Hoisting and travel limits should be checked to ensure that they are correctly set and that the limit mechanism and switches operate freely and correctly. Ensure any necessary lubrication of shafts and linkage points is undertaken.

(9) In the case of any hoist arrangement which incorporates contactors, whether internal to the hoist or as part of the control gear, they should be checked for wear and signs of arcing. They should be cleaned, maintained or replaced in accordance with the manufacturer's instructions.

(10) The slipping clutch, where fitted, is a safety device so its correct operation is essential. It should be checked and if necessary reset in accordance with the manufacturer's instructions.

(11) Various types of gearboxes are used in the construction of electric power operated hoists. Some are filled with oil, which may require regular 'topping up' and occasional draining and replacement. Others are packed with grease and may be sealed for life or require periodic repacking. It is therefore of the utmost importance that lubrication of the gearbox is undertaken strictly in accordance with the manufacturer's instructions. Similarly, various types of bearing may be used. These should be checked for freedom of movement and if necessary lubricated in accordance with the manufacturer's instructions.

(12) Dependent on the application and type of brake fitted, the wear rate will vary. As this item is most critical to the safe operation of the hoist, regular inspection and adjustment in accordance with the manufacturer's instructions are essential. They should be subjected to regular functional checks and any undue noise investigated.

(13) The general condition of the hoist should be maintained in good order. It should be cleaned of any dirt which may have accumulated, paying particular attention to load wheels, pulleys, etc. where such accumulations may impede the correct operation of the hoist. Only cleaning agents recommended by the hoist manufacturer should be used, taking care to follow his instructions.

6.10.4 Thorough examination

The hoist must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the hoist's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, electrical safety testing, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of hoists, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

6.11 SAFE USE OF ELECTRIC POWER OPERATED HOISTS

In addition to any specific instructions relating to the safe use of the hoist issued by the manufacturer, the following points should be observed:

(1) Electric power operated hoists must not be used to raise, lower or suspend a load greater than the marked SWL.

(2) Ensure that the load is directly under the hoist. The line of pull should always be vertical, never side lift or drag a load.

(3) Do not use the load chain or wire rope to form a sling, i.e. it must not be wrapped around the load and back hooked, snickled or choke hitched.

(4) The bottom hook should be attached to the load such that no part of the load is in contact with the point of the hook. The sling should be located in the seat of the hook and the safety catch closed.

(5) The bottom hook should not be crowded with terminal fittings of slings. To prevent the hook becoming overcrowded, LEEA recommends that the upper ends of the sling legs are connected by means of a shackle or link of adequate strength.

(6) Care should be taken to ensure that the hoist is not subjected to shock loading. When using hoists with dual speed, commence the lift in slow speed before progressing to full speed.

(7) It should be borne in mind that the majority of hoists are fitted with some form of overload device designed to protect the hoist. This may be mechanical, electrical or thermo-electrical. Should the hoist fail to lift the load, it is probable that the load exceeds the SWL and should be checked before resetting the controls.

(8) Never change motions (i.e. lift to lower or vice versa) without first allowing the motor to stop running. Quick reversal of direction causes shock loading and heavy current surges. This will result in burnt contacts, and imposes unnecessary strain on transmission shafts and gears.

(9) Avoid unnecessary rapid and frequent incremental movements as this causes burning and pitting of contacts. Excessive rapid and frequent incremental movements could result in burning out of the motor.

(10) Loads should not be left suspended from hoists for any length of time unless absolutely essential and a safe system or work and/or additional safety measures are provided to reduce the risk to an acceptable minimum. Where it is as a result of a breakdown, the operative should ensure that the danger area is cordoned off to prevent personnel from being at risk in the event of a descending load.

(11) At no time should the operative permit either himself or other personnel to be beneath or on a suspended load.

(12) In the case of hoists with push travel trolleys, never attempt to move the hoist by pulling on the pendant cable control. Always pull on the bottom hook of unladen hoists. If a suspended load is to be moved, wherever possible push rather than pull the load. Care must also be taken to ensure the load is not allowed to swing as this may endanger the operative and result in increased loadings on the hoist and its supporting structure.

(13) In the case of hoists with power travel trolleys, care must be taken to prevent the load swinging unduly. If the trolley has dual speed traverse, always start in the slow speed before proceeding to full speed.

(14) Avoid running trolleys into runway end stops as this will cause the load to swing unsafely, put shock loading on the hoist and its supporting runway and structure. End stops are a final safety device only.

(15) Avoid excessive or intentional use of motion limit devices, they are a safety feature intended to protect the hoist. Where the operation requires regular approach to the highest and lowest possible hook positions, a positional or working limit should be fitted for this purpose.

(16) No person other than a Competent Person or someone under the supervision of a Competent Person should attempt to dismantle the hoist or replace the load chain or wire rope.

(17) Never remove guards or protective covers such as weatherproof covers or heat shields without the authority of a Competent Person.

(18) Ensure the travel path is clear and free from obstructions before operating the hoist. This is especially important in the case of unladen hooks or remote control units. The operative must always have a clear vision of the travelling hook path to ensure accidental hook engagement or collisions do not occur.

(19) Ensure the operative and other personnel are fully protected from hazardous materials which may form part of the load.

(20) Before continuing with a lifting operation, the load should be raised just clear and the lift halted to ensure the integrity of the hoist and method of slinging which must sustain the load in any position. Only if the load is stable and balanced should the lift proceed. (See 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16)

6.12 TRAINING

In addition to the training requirements specified in section 6.12 TRAINING page 136 of this code, operative training should take into account the manufacturer's instructions for installation and use and, in particular, operatives must fully understand the controls of the hoist, with special attention being paid to remote controls and emergency stop procedures.

6.A1 APPENDIX 1 - PNEUMATIC POWER OPERATED HOISTS

6.A1.1 FOREWORD

To a large degree, the requirements for the safe use of pneumatic power operated hoists are the same as those for electric power operated hoists. This appendix identifies those areas where special attention is required and outlines the main differences.

Pneumatic power operated hoists tend to be more limited in use than electric power operated hoists, mainly due to the problems associated with the provision of a suitable air supply. However, they offer many advantages over electrically operated equipment and as a result are widely used in industries where air is provided for other purposes or where the safety aspects associated with air operated equipment are a major consideration.

6.A1.2 TYPES OF PNEUMATIC POWER OPERATED HOISTS

Pneumatic power operated hoists utilize both vane and piston air motors to provide the drive. Hoists with vane motors are more compact than those with piston motors but for heavier duties piston motors are better suited. Due to this, the lower capacity units generally utilize vane motors, the resulting hoist being more compact than the equivalent electric power operated hoist. An older type of pneumatic power operated hoist which used a piston cylinder and a system of fixed sheaves to raise a wire rope may still be found in service although these are no longer manufactured.

Pneumatic power operated hoists may use link chain, roller chain or wire rope as the lifting medium.

Due to the wide range of manufacturers and models available, the following is of a general nature only. It is necessary to consult with specific manufacturers to establish the range of designs, capacities and lifts they are able to offer.

6.A1.2.1 Control Options

Three main control options are available for pneumatic power operated hoists:

(1) Cord control. The hoist control valve is fitted with a double lever arm from which rope pull cords are suspended. These normally connect to a common control handle. The raising and lowering motions are obtained by pulling the appropriate cord, opening the valve so that the air flow is in the required direction.

(2) Twist rod control. The hoist control valve is fitted with a suspended twist rod which directly opens the valve, allowing the air to flow in the required direction.

(3) Pendant control. Supply hoses are suspended direct from the motor supply ports. These connect to a hand held control valve unit and by opening the valve in the required direction, air is supplied to the selected motor supply port.

A variation of the pendant control can be used to enable the hoist to be operated from a remote position. This is best suited for use with fixed position hoists which do not incorporate travel motions or where only short distances are to be travelled.

6.A1.2.2 Link Chain Hoists

Modern pneumatic power operated link chain hoists are generally available in a range of capacities from 125 kg. The drive is provided by vane motors whilst the larger capacities, and some older models use piston motors. They are available with top hook suspension or with built-in trolleys for runway mounting. Some models are available with a top lug making them suitable for building into structures for fixed suspension applications or for use in crane crab units. These hoists offer shorter drawn up dimensions than their equivalent electric power operated hoists, making them ideal for use where headroom is restricted. (See Figure 6.A1.2.2-1 page 137)

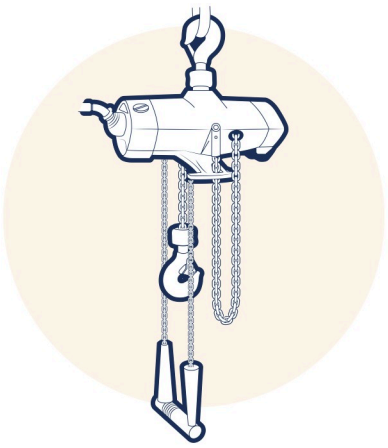


Figure 6.A1.2.2-1

6.A1.2.3 Roller Chain Hoists

Pneumatic power operated roller chain hoists are available in a similar range of designs to those of the link chain models. However, roller chain is only flexible in one plane, limiting the suitability for some applications as storage of the slack chain cannot be achieved in the same way and as a result, heights of lift are more normally limited to 3 metres.

6.A1.2.4 Wire Rope Hoists

Pneumatic power operated wire rope hoists are generally available in a range of capacities from 250kg. Some models may be available with vane motor drives but piston motors are more usually used, particularly for the higher capacity models. A range of low headroom models, usually up to 5 tonnes capacity, is also available. Wire rope hoists are available with built in trolleys or with top lug fittings for fixed suspension. Standard headroom hoists are available with heights of lift up to 50 metres, whilst low headroom units are more normally limited to 15 metres. (See Figure 6.A1.2.4-1 page 137)

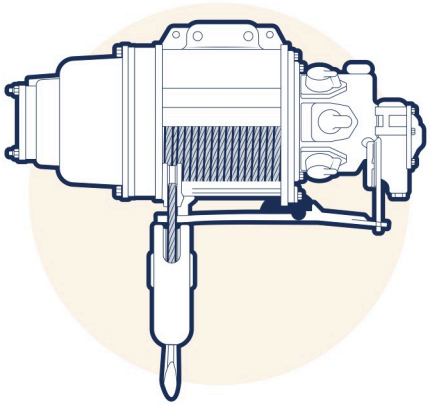


Figure 6.A1.2.4-1

6.A1.2.5 Hoist and Lower Limits

Pneumatic hoists are usually fitted with hoist and lower limits which directly operate the control valve, closing this when the maximum travel position has been reached. These can often be set to any desired position and, unlike electric hoist and lower limits, may be used to position the bottom hook in certain applications.

6.A1.3 THE SELECTION OF PNEUMATIC POWER OPERATED HOISTS

The general requirements for pneumatic power operated hoist selection will be the same as those for electric power operated hoists.

Before considering the selection of the type of pneumatic hoist, it is necessary first to consider why pneumatic equipment is to be selected. As previously stated, pneumatic power operated hoists have many advantages over electric power operated hoists, but the few disadvantages are such that for most general applications electric equipment tends to be the automatic choice. Guidance in this respect is given in 1.A6 APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES page 40 to which reference should be made.

6.A1.3.1 Controls

The choice of the control option will to some extent be a matter of personal choice. The cord control is the most basic and cheapest option. With experience, an operative can learn to control the hoist and lower motion speeds within fine limits, but this is more easily done with the twist rod control. It should be borne in mind that cord control is more easily operated by accident than the other types of control. The pendant control is the most expensive option, but the operative is given two switch type valves clearly defining the direction of operation and these are protected from inadvertent operation by the design of the hand held casing.

6.A1.3.2 Lifting Medium

The choice of the lifting medium will to a large degree be the same as for electric power operated hoists but a third option commonly exists for pneumatic power operated hoists, that of roller chain. This is only flexible in one plane and as a result tends to offer smoother operation with less load oscillation, it is therefore ideal for handling delicate loads. The lack of articulation can be restrictive in use when connecting to loads which do not incorporate flexible slinging arrangements and storage of the slack chain is difficult.

6.A1.3.3 Exhaust

Standard pneumatic power operated hoists exhaust the used air to atmosphere via a series of vents. This can be unduly noisy in some circumstances and the release of air under pressure may also be hazardous in some applications. Noise can be reduced by the provision of a baffled exhaust vent. It is also possible to duct the exhaust air away from the unit. In both cases, it is necessary to discuss this with the supplier as the provision of unsuitable equipment may affect the hoist's performance. Further the design of such equipment will depend to some extent on the particular installation.

6.A1.3.4 Air Supply

A vital consideration when selecting pneumatic power operated hoists is the provision of a suitable air supply. The working capacity and operational speed of the hoist rely on the air supply being at the correct pressure and delivery rate. In the event of the pressure being below that for which the hoist is designed, the actual lifting capacity will be lower than that for which the hoist is rated. Equally, if the pressure is higher than intended, it would be possible to raise a higher load than that for which the hoist is designed. The latter is a danger which must be averted and this can be done by the provision of a pressure regulator in the air line near to the hoist entry port. Manufacturer's specific recommendations should be followed in respect to the supply pressure and delivery rate although these are usually based on 6 bar (90 psi). If the delivery rate of the air supply falls below that for which the hoist is designed, the operating speed will be slower than intended.

Air motors are self purging and as a result, any lubrication is lost with the exhausting air. Oil mist lubricators are available which allow the incoming air to collect lubricant and pass this directly through the motor.

Compressed air is moisture laden. Condensing water will cause corrosion and therefore steps should be taken to prevent this. Similarly, other contaminants should be removed from the air feed. Consideration should therefore be given to the provision of suitable filter/drainers which should be placed in the air line before the oil mist lubricator.

Fixed suspension hoists may be connected directly to the air line with suitable rigid tubing, but it may be desirable to have a short flexible hose and bayonet connector feeding to the hoist to enable it to be readily removed for maintenance or storage purposes. Travelling hoists require flexible hose supply lines, which are usually of a coiled hose design allowing a 3:1 extension. The length of coiled hoses can be restrictive in that the loops of hose occupy considerable space and place a drag on the hoist, which in severe cases can cause the travel to be arrested or even cause the hoist to be pulled backward. A variation of the coiled hose may be suspended

from a festoon wire to allow longer travel distances and hose reeling drum systems may be used for some applications.

However, due to pressure loss in long supply systems the only option for long travel runs is to use a supply line with bayonet connectors at regular intervals and a flexible hose for connection to the hoist. This latter option is restrictive in that the hoist has to be halted at stages throughout the travel operation to enable the supply to be reconnected to the next available supply point.

6.A1.4 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

The exchange of information necessary for pneumatic hoists will generally take the same form as for electric hoists except for the power supply details, these should be given as follows:

(1) Pressure and delivery rate.

(2) Type of supply system, e.g. coiled hose, including any requirements for filters, lubricators and pressure regulators.

(3) Type of control. If hoist has powered trolley, this should include the requirements for the trolley controls.

6.A1.5 INSTALLATION AND COMMISSIONING

(1) The general requirements for installation and commissioning of pneumatic power operated hoists will be the same as those for electric power operated hoists. The connection of the hoist to the air supply should be in accordance with the manufacturer's recommendations and a check should be made of the pressure and delivery rate at the delivery point.

(2) Although air leaks are generally harmless, steps should be taken to seal these as they are inconvenient and in extreme cases may affect the performance of the hoist. The loss of air is also expensive, as the compressor will continue to run whether the appliance is in use or not. It is wise to take the fixed piping of the supply line to a low position, at which filters can be installed to be most effective and drains accessible, before connection to flexible supply hoses. Care must be taken to ensure hoses are positioned so that they are not an obstacle to personnel or liable to cause a hazard to persons or vehicles which may be operating in the area.

(3) On completion of erection, it is advisable to ensure the supply line has been drained of any moisture, etc. which may be present, particularly when the line is an existing installation which has been utilized, and to ensure lubricators are filled to the correct level.

(4) The hoist should be checked to ensure that the chain or wire rope has not become twisted and that it is free of any obstructions. Hoist, and where fitted lower, motion limits should be checked to ensure that they are correctly set. It must be remembered that they are safety devices which are intended to stop the hoist over travelling. Pneumatic power operated hoist limits are usually mechanical devices which directly close the hoist control valve and as such, they are more robust than the limiting devices used on electric power operated hoists.

(5) An operational check should be made to ensure the correct running of the hoist. This should include a check that the control command is in the correct direction. If the 'UP' command results in the hoist lowering, the air supply connection should be corrected. A load equal to the SWL should be raised just clear of the ground and sustained to ensure the correct operation of the brake. Failure of the hoist to raise the load or stalling of the motor during the lift are indications that the air supply pressure is below that for which the hoist was designed.

(6) Prior to taking the hoist into service, the lubrication, including that for the chain or wire rope, should be checked in accordance with the manufacturer's recommendations.

6.A1.6 IN-SERVICE INSPECTION AND MAINTENANCE

6.A1.6.1 In-Service Inspection

The general in-service inspection and maintenance requirements will be the same as for electric power operated hoists. The following faults, which are liable to occur to pneumatic hoists, are additional to those listed for electric power operated hoists. Should any of these faults be found during pre-use inspection or upon the interim inspection by the suitably qualified and experienced person, the hoist should be withdrawn from service and referred to a Competent Person:

(1) Motor exhausts water, becomes very noisy in operation or stalls even with light loads.

(2) Brake fails to sustain the load or load descends slowly.

(3) Air line or supply hoses become damaged, leak or show signs of ice forming at joints.

6.A1.6.2 Maintenance

The maintenance programme should be drawn up in accordance with the manufacturer's instructions and should include the air supply system, at least as far as the filters, lubricators and pressure regulators which are associated with the hoist. The interval between maintenance will depend on the conditions prevailing at the site. Some maintenance functions will only require attention on every other occasion or even longer and the manufacturer's guidance should be followed in this respect. The air supply line and its associated equipment will require attention at regular intervals, dependent on usage, to drain condensation and to top up the oil level in lubricators.

6.A1.6.3 Thorough examination

The general thorough examination requirements are the same as those for electric power operated chain hoists, but taking into account the additional points in section 6.A1.6.1 In-Service Inspection page 139.

6.A1.7 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 and in section 6.12 TRAINING page 136 of this code, operatives should be instructed in the necessity to maintain a clean air supply with sufficient oil mist. They should be shown how to drain condensation and top up oil lubricator levels.

Section 7 - WINCHES USED FOR LIFTING PURPOSES

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7.1 FOREWORD

Winches are versatile lifting and pulling appliances, lending themselves to easy adaptation and are widely used throughout industry for both permanent and temporary rigging applications. The range of designs and capacities is extensive and many are designed for specific applications. They may be power or manually operated.

Although winches provide only a winding mechanism which, if the manufacturer has covered it in the design specification, may be used as a means of raising and lowering loads in lifting operations. They may be fitted or built into structures to enable loads to be moved from one position to another. They may also be used to advantage as a safe method of lifting loads in confined spaces as they can be arranged to occupy less headroom than other lifting appliances and the operative may be remote from the load. This latter feature may also be of benefit in other circumstances.

It is impossible in a document of this nature to cover all of the design and application variations and it is therefore necessary to limit the scope to the more common types and applications. The advice offered in respect of usage is therefore limited to basic principles, although the requirements for other types of winch and applications may have much in common with these.

The use of winches for lifting purposes is always associated with other lifting accessories, guidance on which may be found in the relevant sections of this code, and often the use is in conjunction with pulley blocks. Although some types of winch may be used with fibre ropes, this document has been limited to wire rope applications.

The advice offered in this section of the code is aimed solely at lifting applications or applications involving an element of lifting. The principles laid down may be applied to pulling applications if so desired, although in some cases they may be found to be excessively restrictive.

> There are numerous standards that winches could be manufactured to, but it is important to ensure that the standard to which the winch complies with applies to lifting operations and the manufacturer has designed them for this application.

7.2 SCOPE

The winches covered by this section of the code may be manually operated or power operated using electric, hydraulic, petrol/diesel or pneumatic power, which are fitted with a steel wire rope that winds on and off a drum upon which the rope is stored, and which are used for raising and lowering loads.

This section of the code refers only to winches with a built in brake or other mechanism which is self sustaining by design. It should however be noted that reliance solely on a ratchet and pawl mechanism is not considered acceptable.

Some types of winch are designed to be suitable for people carrying and rescue purposes. Whilst this may be mentioned within the text, no specific guidance is offered in this respect. The manufacturer's instructions and guidance must always be sought and strictly followed in all such applications.

This section of the code excludes winches used for pulling applications although some aspects may be equally applied.

Capstans, on which the rope is passed over a barrel, but is stored elsewhere are excluded, as are winches which are not self sustaining and therefore unsuitable for lifting applications.

7.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

7.3.1 Lifting Application

A lifting application is any application where, a load is suspended or supported on inclined planes where removal of the lifting force or any failure of the lifting mechanism or lifting medium results in either movement of the load, or a movement that can present a significant hazard.

7.3.2 Pulling Application

A pulling application is any application where, a load supported on level or inclined planes where the removal of the pulling force or a failure of the pulling mechanism or pulling medium results either in no movement of the load, or a movement that cannot result in a significant hazard.

Thus, if for example a load were being 'pulled' up an incline on wheels it would be regarded for the purpose of this section as a lifting application as, in the event of a failure, the load would descend the incline under gravity.

7.3.3 SWL/Capacity

The maximum load that can be taken at the drum (first wrap of rope) is sometimes referred to as the line pull of the winch. However, the actual line pull will vary with the number of layers of rope wound onto the drum, i.e. as the number of layers increases so the line pull diminishes. For lifting applications, the SWL of a winch should be based on the line pull when the drum is full of rope or has all of the rope for that application fitted.

7.4 TYPES OF WINCHES

In view of the variety of models of winch in use, the following information is of a general nature only. Reference to a specific manufacturer's product may vary from this information.

7.4.1 Hand Operated Plate Sided Winch

The hand operated plate sided winch, also known as the contractor's winch, is a foot mounting and is designed to be bolted to a firm foundation. This type of winch is used for general lifting and pulling operations and is ideal in situations where no power supply is available.

The design permits the wire rope to be taken off the drum either vertically downward or horizontally. Generally available in a range of capacities up to 10 tonnes, these winches have two operating handles, allowing for two or more operatives. They may have two speeds of operation; the fast speed is not suitable for use under load but allows the rope to be positioned quickly; the slow speed is then used to raise or lower the load. These winches are fitted with a band brake and the drum is also fitted with a ratchet and manual/gravity pawl mechanism. Operation is from the side of the winch. Rope drum storage capacities vary between 80 metres and 150 metres. (See Figure 7.4.1-1 page 143)

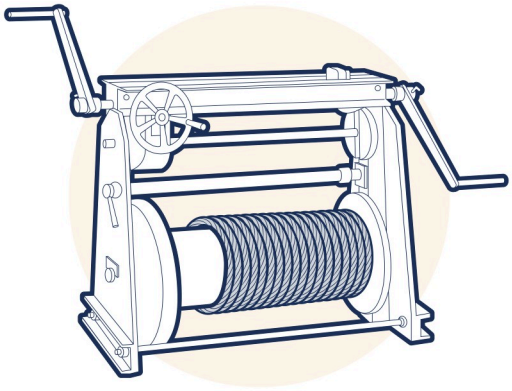


Figure 7.4.1-1

7.4.2 Lorry Winch

The lorry winch is of a similar design to the plate sided winch, but usually smaller in size. It is a foot mounted winch. This type of winch is, as the name suggests, primarily used for mounting on the back of lorries for loading and unloading purposes but can be used for other lifting and pulling operations.

The design permits the wire rope to be taken off the drum horizontally, although in some applications it is possible to take the rope from the drum vertically downwards. This type of winch is usually fitted with a lever operated band brake. Generally available in a range of capacities from 500 kg to 2 tonne, these winches have a single operating handle with operation from the side of the unit. Rope drum storage capacities vary between 30 metres and 50 metres. (See Figure 7.4.2-1 page 143)

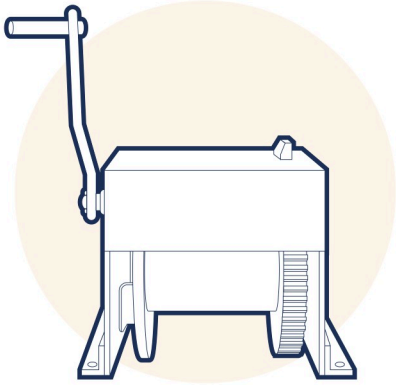


Figure 7.4.2-1

7.4.3 Worm Geared Wall Winch

The worm geared wall winch is designed to be bolted to a wall or other vertical face. This type of winch is used for general lifting operations and is often built into jib cranes, mobile supporting structures and similar structures. Worm geared winches are manually operated from the front of the unit.

The design permits the wire rope to be taken off the drum either vertically upward or horizontally. Generally available in a range of capacities from 250 kg to 2 tonnes, these winches have single speed operation, although some models are available with a no load fast rope reeling facility. Some designs are self sustaining due to the worm/gear wheel ratio whilst others utilize a self sustaining brake with ratchet and pawl. Rope drum storage capacities vary between 20 metres and 60 metres. (See Figure 7.4.3-1 page 144)

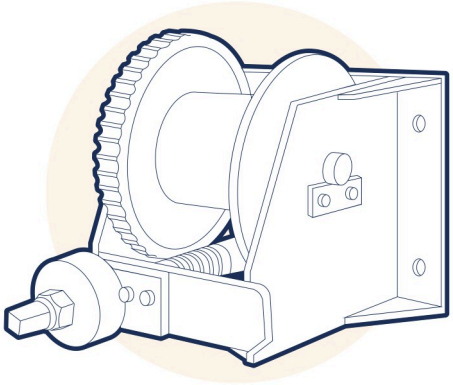


Figure 7.4.3-1

7.4.4 Light Duty Wall Winch

The light duty wall winch is a further design variation suitable for loads from 30kg to 500kg. The mechanism is self sustaining without the need for ratchet or pawl. The design permits the winch to be mounted so that the wire rope may be taken off the drum in any position parallel to the mounting. Rope drum storage capacities vary between 10 metres and 30 metres. (See Figure 7.4.4-1 page 144)

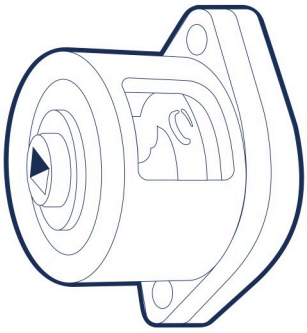


Figure 7.4.4-1

7.4.5 Spur Gear Wall Winch

Spur gear wall winches are used in a similar way to worm gear winches and are available in the same range of capacities. This type of winch is fitted with a self sustaining brake with ratchet and pawl mechanism. Operation may be available from the front or side of the unit, dependent on the arrangement of the spur gear assembly. Rope drum storage capacities vary between 20 metres and 30 metres.

7.4.6 Power Operated Winches

A wide variation of power operated winches is available, which allow for higher capacities and longer rope movements than hand winches. They are used for applications where manual operation is impracticable or undesirable. The motive force may be electric, hydraulic, pneumatic or by petrol/diesel engine, the latter allowing for greater portability. In the case of hydraulic winches, the hydraulic pressure is developed by an integral compressor power pack which itself is driven by electric motor or petrol/diesel engine. Capacity varies with design. Electric winches are generally available with capacities up to 15 tonnes, pneumatic winches up to 25 tonnes and hydraulic winches up to 30 tonnes. However specially manufactured power operated winches may be available to far higher capacities and it is necessary to consult the manufacturer to establish the range of capacities they are able to offer, which may be in excess of 100 tonnes. Figure 7.4.6-1 page 145, Figure 7.4.6-2 page 145 and Figure 7.4.6-3 page 145 illustrate some typical power operated winches.

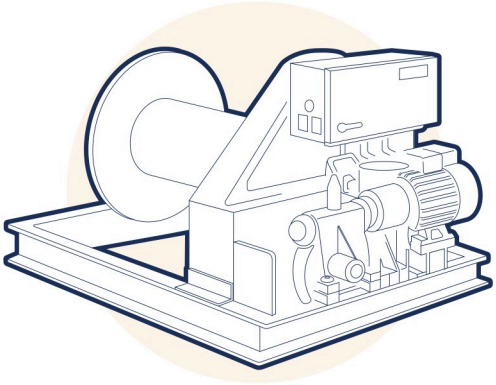


Figure 7.4.6-1

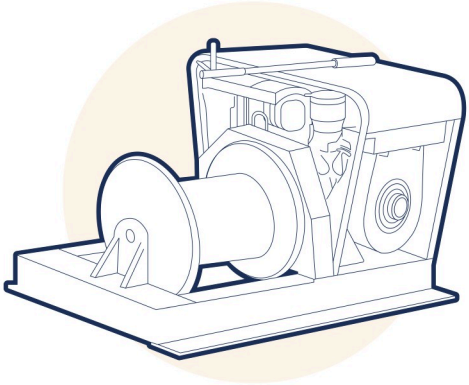


Figure 7.4.6-2

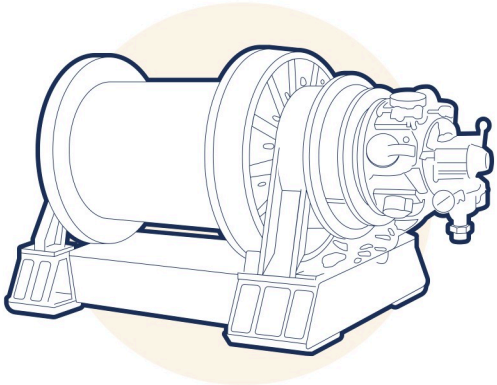


Figure 7.4.6-3

Power operated winches are usually foot mounted for permanent or long term installation, either to a suitable foundation or for building into other structures. Design variations permit the wire rope to be taken off the drum either vertically or horizontally. It is necessary to consult the manufacturer to establish the rope drum storage capacity as these vary greatly and can be several hundred metres and drum sizes can often be varied to suit particular applications.

Operating speeds also vary with design. Power operated winches may be single speed or dual speed and a no load fast rope pay out facility is usually available. Again, it is necessary to consult individual manufacturers to establish the availability due to the wide range of variations possible.

7.4.7 Trailer and Skid Mounted Winches

To allow greater portability, petrol/diesel winches are available either trailer or skid mounted. This allows for applications where a power operated winch is required but no power source is available. In this case, it is

necessary to anchor the trailer or skid unit to a suitable fixing to prevent movement of the winch in use. Trailer mounted winches are normally limited to a maximum of 5 tonnes capacity but rope drum storage can be varied to suit the application.

7.4.8 Battery Operated Winches

Battery operated winches, primarily intended for vehicle mounting, are generally available in a range of capacities up to 500kg; a heavy duty range is available up to 2 tonne capacity. They operate on a 12 volt or 24 volt DC electric supply and are intended to run off the vehicle batteries. The design permits the winch to be mounted in any position and they may therefore be fitted direct to the vehicle, to a jib or other structure mounted on the vehicle, or on a portable structure intended to be used adjacent to the vehicle. They may also be utilized in other situations where a suitable DC supply is available. Rope drum capacities are usually limited to a maximum of 10 metres.

7.4.9 Hoisting and Lowering Limits

For safety purposes, to prevent over-running when the wire rope has reached its maximum extended or retracted position, in most cases a limit can be fitted to the wire rope or winch. In the case of manually operated winches, this is normally in the form of a simple stop. In the case of power operated winches, it is often in the form of a stop and lever operated switch, valve or slipping clutch arrangement. Such arrangements are not however normally supplied as standard and it is advised that for lifting operations they are requested from the supplier.

7.4.10 Overload Protection

Overload protection can and should be built into the winch unit, in particular for power operated types. The most common type of overload protection being the slipping clutch. This can be in the winch winding handle or in the mechanism of the winch. It employs a spring loaded plate which will slip if the applied load exceeds the setting position of the clutch.

Some manually operated winches are fitted with shear pins in the operating handle which will fail if an effort in excess of that designed to operate the winch at SWL is applied. Such arrangements prevent further operation of the winch.

It is a feature of pneumatic motors that they will stall to safety if overloaded, either as the result of the application of a load greater than the maximum design load or if the air supply falls below a level necessary for the motor to operate at the load applied. In certain circumstances, this will result in the motor turning slowly and lowering the load in a controlled manner.

Hydraulic systems are protected by relief valves which prevent the pressure in the system exceeding the design pressure required to lift the SWL.

7.4.11 Other Design Options

As previously stated, winches are versatile machines lending themselves to easy adaptation and a wide range of design options is available, either as standard, as custom built variations, or by the rigging arrangement used. These include:

(1) Low magnetic permeability.

(2) Flame proof.

(3) Explosion proof.

(4) They may be built into other equipment to enable use for other than direct lifting, e.g. built into manually operated fork lift trucks or used to operate platform hoists.

(5) They may be arranged with diverter pulleys to change the direction of the rope run.

(6) They may be arranged with pulley blocks to give multi-falls of wire rope, thus increasing the maximum load the arrangement may lift.

(7) They may be adapted for special purpose use, e.g. as with the suspended winch or pole hoist as discussed in 7.A1 APPENDIX 1 - SUSPENDED WINCHES (POLE HOISTS) page 158 to this section of the code.

7.5 PRINCIPLES FOR THE SELECTION OF WINCHES USED FOR LIFTING

7.5.1 Application

The general application must be fully considered. This must include an appraisal of the intended arrangement including the mounting and rigging details. Due to the extensive range of types of winch, design options and rigging arrangements possible, it is recommended that the application is fully discussed with the supplier to ensure the most suitable equipment is selected.

7.5.2 Capacity

The capacity of the winch to be selected will depend on the maximum load to be lifted and the rigging method to be employed. If the rigging arrangement calls for a single fall of rope, then the SWL of the winch must be at least equal to the maximum load to be lifted. However, if the rigging arrangement utilizes multiple sheaves or blocks, the load will be proportionally shared between the falls of rope. For example, if there are two falls of rope, the load in the rope will be half the total load to be lifted; if there are three falls of rope the load in the rope will be one third the total load to be lifted and so on. (See Figure 7.5.2-1 page 147) In such cases, the SWL of the winch should be at least equal to the load in the rope plus an allowance for the effects of friction. Although the effects of friction will vary, dependent on the type of sheave and bearings, it is normal to assume that this will be 8% per sheave.

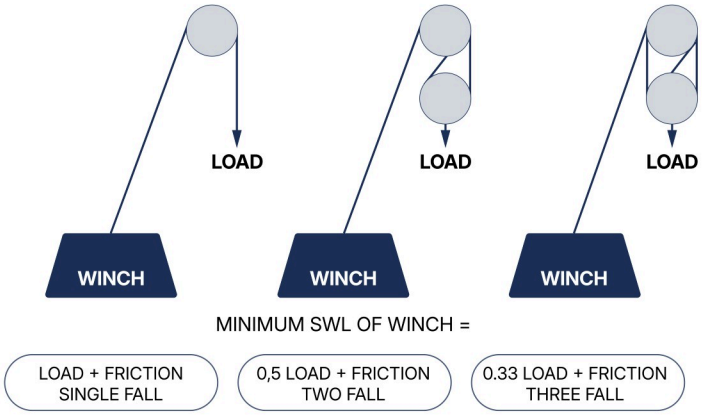


Figure 7.5.2-1 Multi-fall rigging arrangements

7.5.3 Type of Winch

Consider the following when selecting a winch type:

(1) Mounting or suspension details, e.g. wall, floor, built into a structure, etc.

(2) If the installation is to be permanent or temporary. If the arrangement is of a temporary nature and the winch is to be portable, then the self-weight of the winch and the facilities for handling the winch must also be considered.

(3) Method of operation, i.e. manual or power. If power operated, whether electric, pneumatic, hydraulic or petrol/diesel. Consideration must be given to the availability of a suitable power source and any environmental factors affecting the selection.

(4) Where applicable, the type of control and method of brake operation.

7.5.4 Rope Drum Storage Capacity

If the wire rope is to be used in a single fall, then the rope drum must be large enough to store an amount of rope at least equal to the maximum height of lift. However, if the wire rope is to be used with a pulley block arrangement, it must be remembered that the drum will need to accommodate a rope length equal to the height of lift multiplied by the number of falls of rope. Care must be taken to ensure that the rope does not over fill the drum and the manufacturer's recommendations should be followed. When the rope is fully wound onto the drum, the drum flanges should be at least two times the rope diameter higher than the outer coil of rope.

7.5.5 Selection of the Wire Rope

When selecting a wire rope for use on a winch, the following factors should be taken into account:

(1) Required minimum breaking load. Wire rope used for lifting should, in most cases, have a working load limit of not more than one fifth of the wire rope's minimum (or catalogue) breaking load. That is a factor of safety of 5:1, although this figure may be varied by a Competent Person for specific circumstances of use. Hence the factor of safety and load rating of the winch will determine the required wire rope's breaking load, i.e. rope minimum breaking load = load rating multiplied by factor of safety.

(2) Rope construction. The use of wire rope on a winch usually involves wrapping the rope around a drum of a relatively small diameter when compared to other wire rope applications. The choice of a wire rope with sufficient flexibility is therefore important. Ropes with strands comprising a single layer of wire, e.g. 6 x 7 (6/1) are generally unsuitable for winch applications due to their lack of flexibility. Winches also subject the rope to crushing forces, particularly when more than one layer of rope is accommodated on the winch drum. For this reason, ropes with wire cores are to be preferred. In some cases, e.g. when a winch is used as a lifting machine by passing the rope over a pulley such that the load is lifted by a single part of rope, a rotation resistant rope may be required due to the propensity of six stranded ropes to unspin under such conditions. In these circumstances, the advice of the wire rope supplier should be sought.

(3) Corrosion protection. During manufacture of wire rope, the rope maker applies a dressing which acts both as a lubricant and protection against corrosion. In all cases, winch ropes should be adequately protected from the effects of atmospheric corrosion when in use. In severe conditions, this may call for additional dressing to be applied and the manufacturer's advice should be sought. Similarly, advice should be sought and followed with regard to the regular service dressing of the rope. In some cases, for example when it is known that the winch will be working in a wet environment, a galvanised rope should be selected. In special cases, e.g. severely corrosive environments, the use of a stainless steel rope may be appropriate and in such instances the advice of the rope supplier should be sought.

(4) Effective and actual lengths of wire rope. The effective length of wire rope will depend on the manner in which the assembly is rigged. This will be the height of lift multiplied by the number of falls plus the length of the rope run from the drum to the top suspension sheave. The actual length of wire rope required will be longer than the effective length to allow for a number of dead turns to remain on the drum at all times. It is necessary to have a number of dead turns of rope remaining on the drum when the rope is in its fully extended position to provide a frictional grip between the rope and the drum thus preventing the load being imposed on the rope drum anchorage. This will require that at least 2 full turns of rope remain on the drum at all times. However, some manufacturers state that 3 dead turns must remain on their design of winch. The manufacturer's recommendations should therefore be sought and followed, but under no circumstances should less than 2 full turns remain on the drum.



Do not reduce the diameter of the wire rope in order to accommodate a longer length. If the rope storage drum is of insufficient capacity select another winch.

7.5.6 Rigging Arrangement

The rigging arrangement must be given full consideration including the need for diverter pulleys, the use of pulley blocks and suitable anchorages. The diameter of sheaves should ideally be 18 times the diameter of the wire rope, but never less than 12 times, to avoid the rope crushing under load and bending fatigue taking place.

Consideration must also be given to the use of accessories and structures. Temporary arrangements may call for the use of tripods (shearlegs) or davits for winch and/or pulley block suspension.

It should be noted that when pulley blocks are used, the load imposed on the supporting structure is increased by the value of the hoisting effort and the effects of friction. This additional load is also imposed on any equipment used to connect the top hook or eye of the pulley block to the structure. Care should therefore be taken to ensure that the structure, together with all above the hook equipment, e.g. beam clamps, shackles, etc., is of adequate capacity. 3 Number of sheaves page 148 shows the increase in load for various rigging arrangements assuming 8% per sheave for friction.

Table 3 Number of sheaves

Top block	1	1	2	2	3	3
Bottom block	0	1	1	2	2	3

Table 3 Number of sheaves (continued)

Load on top shackle = load lifted x factor	2.08	1.56	1.39	1.3	1.25	1.22
Assuming 8% per sheave for friction						

Where the rigging arrangement calls for a single fall of rope, the rope termination must be considered, e.g. hook or eye and shackle, etc., and steps must be taken to prevent the rope rotating thus unlaying itself, e.g. by the use of a swivel. In some cases, the rope termination may be of insufficient weight to keep the rope under tension. This can result in the rope jumping out of the grooves of pulleys or becoming twisted. To prevent this, a small purpose made weight, sufficient only to keep the rope in tension, may be fitted to the rope immediately above the terminal fittings.

7.5.7 Service Conditions

Generally winches are manufactured to meet normal service conditions and assume:

(1) Use under cover, i.e. not directly exposed to the elements.

(2) Use at ambient temperatures between -10°C and 40°C with no sources of high local heating and cooling.

(3) Use in clean air free from excess of humidity, contamination and deposits.

It should be noted however that some designs of winch may operate successfully in cold or damp conditions. In some other cases, special arrangements are possible to prevent the brake/brake linings being affected by such conditions. It is therefore necessary to discuss any service conditions, other than that deemed to be normal, with the supplier to ensure correct selection.

7.5.7.1 Environmental conditions

Examples of environmental conditions requiring special attention are:

(1) Outdoor use.

(2) Salt air.

(3) High humidity.

(4) Ambient temperatures above or below the normal range.

(5) The presence of local heat sources, e.g. furnaces.

(6) Dust/abrasives in the atmosphere.

7.5.7.2 Hazardous substances

If the winch is to be used in association with hazardous substances, special consideration is necessary. Hazardous substances fall into two main groups; those that would harm the winch and its associated equipment, e.g. corrosives; and those that may be affected by the operation of the winch, e.g. explosives. Examples of hazardous substances requiring special attention are:

(1) Flammable or explosive gases, vapours or dust.

(2) Corrosive vapours and liquids, acids and alkalis.

(3) Volatile liquids.

(4) Toxic substances.

(5) Molten metal.

7.5.7.3 Other potential hazards

Other potential hazards may arise as the result of the work being carried out in the general location or be caused by the winch performing lifting operations over the heads of personnel or similar. Examples of such potential hazards requiring special attention are:

(1) Use in mines and quarries.

(2) Use in laundries.

(3) Use in galvanizing, pickling and hot dipping processes.

(4) Use in paint shops.

(5) Use over work areas.

(6) Use over walkways and footpaths.

7.5.8 SWL

For lifting applications, under normal operating conditions, i.e. where there are no hazardous conditions the SWL will be the same as the rated capacity. The rated capacity of the winch and wire rope should not be more than 20% of the failure load, i.e. there should be a minimum factor of safety of 5:1. For certain terminal fittings this factor may be 4:1.

For people carrying applications, the SWL should not exceed 50% of the rated capacity, i.e. the factor of safety should be increased to a minimum of 10:1. Additional precautions are however required.

7.5.9 People Carrying Applications

Standard winches should not be used for people carrying applications. For such applications, the manufacturer should be consulted as certain winches are purpose designed for this work. Further additional safety requirements will be necessary, e.g. the installation of descent arrestors, and the supplier's recommendations should be sought in this respect and strictly followed.

7.5.10 Other Considerations

Other matters which should be taken into consideration when selecting winches include:

(1) Ease of service and maintenance.

(2) Access for use, service and maintenance.

(3) Braking arrangement, some brake mechanisms only working effectively in one direction. It is therefore important that the winch is rigged to take this into account. Winches are therefore often marked with the direction of rotation for lifting.

(4) Consideration should be given to the facilities for mounting and anchoring the winch and its associated equipment.

(5) If the winch is portable, consideration should be given to the provision of suitable lifting arrangements and transport to handle the winch.

(6) Terminal fitting of rope, e.g. thimble eye, wire rope socket, shackle, hook, and other devices provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety catches or by the use of 'C' hooks.

(7) In the case of power operated winches, the availability and suitability of power supply, including protection and isolation facilities.

(8) The documentation required by legislation for the winch, together with the associated rope, pulley blocks and accessories. If this is not on record refer the equipment to a Competent Person for thorough examination.

7.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND DESIGNER OR SUPPLIER

As winches are frequently used for miscellaneous lifting purposes, precise details of the load to be lifted and rigging arrangement to be used are not always available. In these circumstances, only a general specification can be given, and this should include the following information:

(1) Details of the rigging arrangement in so far as is known, e.g. use of pulley blocks, diverters, etc.

(2) Maximum load to be lifted or line pull required.

(3) Winch mounting details, e.g. wall, floor, built into a structure.

(4) Type of winch, e.g. worm geared, power operated.

(5) Rope drum storage capacity.

(6) Effective and actual length of wire rope required.

(7) Details of wire rope termination, e.g. hook, eye.

(8) Where applicable, operating speed(s).

(9) Where applicable, details of the power source or number of operatives required at full load.

(10) Details of any other lifting equipment and accessories required, e.g. pulley blocks, tripod (shearlegs).

(11) Details of application in so far as is known, e.g. nature of load, duty cycle, whether temporary or permanent installation.

(12) Special service conditions which may affect the winch or its associated equipment, e.g. flammable atmosphere, chemical environment, outdoor use.

(13) Special safety considerations, e.g. positive limits to prevent overwinding, overload protection, use for people carrying applications.

(14) Any special requirements for painting or protective finish.

(15) Any other special requirements.

It may subsequently be found that a more detailed exchange of information is necessary to ensure correct selection. Where the winch is committed to a single purpose use or is a permanent installation, this is not difficult, but similar consideration should be given to units that are to be used for multipurpose or temporary installations. For all but the simplest installations, a visit by the supplier to survey the site should always be considered as this will minimize the information exchange and reduce the chance of incorrect selection.

7.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

7.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that, when used in a lifting application, winches are lifting equipment. Unless a written scheme of examination (refer to LEEA 032 Guidance to written schemes of examination for guidance), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months (6 months in the case of people-carrying equipment). Reports of thorough examination should be retained and cross referenced to the machine's historical records for inspection by the Competent Person or local enforcing authority.

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the winch is put into service. (See 7.8 INSTALLATION AND COMMISSIONING page 152).

(1) As winches are designed and intended for both lifting and pulling operations, unless a winch is installed in such a way that its use is restricted solely to a pulling operation there is always the possibility that they may be used to effect a lift. It is therefore the view of LEEA that winches which are, or could be, used for both lifting and pulling operations should be treated as lifting machines and be subject to the full requirements of lifting equipment legislation.

(2) An important point to be borne in mind is that the winch, its associated wire rope, any fittings and pulley blocks used in the rigging assembly will be deemed to be separate items. In this respect, each item must be thoroughly examined to the appropriate requirements and individual records kept in accordance with the requirements of lifting equipment legislation.

7.7.2 Post Repair Verification and Record Keeping

Following repair, winches must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the machine's historical records for inspection by the Competent Person or local enforcing authority.

7.7.3 Instructions for Use

New winches should be supplied with comprehensive information for use. The information should include any limitations peculiar to the particular make and model such as suitable ropes, operational temperature range and other conditions. Such information should therefore be retained for future reference.

Although not required by the applicable national legislation, new winches will usually be issued with a manufacturer's record of proof load testing in addition to, although possibly combined with, the documents required by the legislation. This document forms an important part of the record of the winch. It should be retained and cross referenced to the winch's historical records for inspection by the Competent Person or local enforcing authority.

7.8 INSTALLATION AND COMMISSIONING

7.8.1 Erection of Equipment

The erection procedure should be carried out in accordance with the manufacturer's instructions paying particular attention to the following:

(1) Before installation, thoroughly check winches and associated equipment from storage to ensure no damage or deterioration has occurred during storage.

(2) Ensure that the foundation, wall, or structure used to mount or suspend the winch is compatible with the fixings and can handle the intended load. Timber bearers are unsuitable and should not be used, indeed they were prohibited by some of the older legislation. If pulley blocks are to form part of the rigging assembly, their suspensions must be adequate for all of the loads that will be imposed. When pulley blocks are used, the load imposed on the supporting structure, connections and fixings is increased by virtue of the hoisting effort and the effects of friction. (See 7.5.6 Rigging Arrangement page 148 and 3 Number of sheaves page 148) The imposed load also includes the weight of the pulley blocks together with any attachments, (e.g. clamps, shackles, slings, etc.) plus an additional allowance for dynamic loading. In the case of manually, operated equipment a dynamic allowance of 10% and in the case of powered equipment a dynamic allowance of 25% should be made.

(3) The winch drum must be positioned so that it is square to the line of pull. If the wire rope runs over a lead block or diverter pulley, an angled pull will result as the rope feeds on and off the drum across its width. This is known as the angle of fleet. It is the recommendation of some winch standards that the first lead block around which the rope passes should be positioned centrally between the drum flanges and not be less than 6 times the length of the drum away from the drum axis. This gives a maximum fleet angle of a little over 4.5°. However, wire rope standards recommend that for optimum rope life the maximum angle of fleet for grooved drums should not exceed 2.5° and for plain drums it should not exceed 1.5°. In practical terms, this means that the distance from the drum axis to the first lead block should be at least 12 for grooved drums and 19 for plain drums. (See Figure 7.8.1-1 page 152)

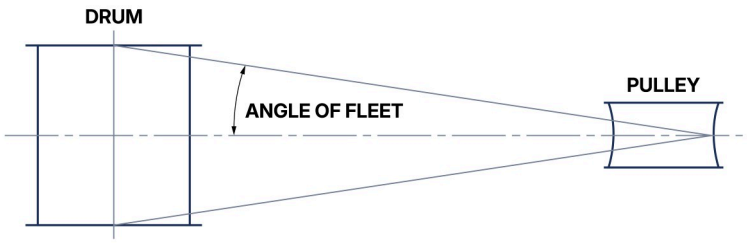


Figure 7.8.1-1

(4) Steps must be taken to ensure that the wire rope is strong enough for the application and long enough to leave at least the minimum number of dead turns on the drum when it is in its fully extended position. The wire rope must not over fill the drum and the width between the outer layer of rope and the outer edge of the flange should not be less than 2 times the rope diameter. The rope must be properly anchored to the drum in such a way that the anchorage does not obstruct the free coiling of the rope onto the drum.

(5) It must be remembered that running ropes and pulleys can be a source of danger, even if they are slow moving. The rigging arrangement should, as far as possible, ensure that these items are installed in such a way that any danger is minimized, either by virtue of their position or by guarding.

(6) After erection, a check should be made to ensure that the wire rope runs and hangs freely and is not twisted or obstructed. Care should be taken when using multi-fall blocks to ensure the bottom block has not been turned over between the rope falls imparting a twist to the rope. Exercise great care when removing such a twist as permanent damage may be caused to the rope by careless handling.

7.8.2 Post Installation Checks

(1) In the case of power operated winches, the power supply system must be checked in accordance with the manufacturer's instructions. Check all winch functions and motions for proper operation before use. Ensure the supply is connected so that the control command is in the correct direction, e.g. that when the 'up' control is operated it results in an upward movement. Ensure any limit switches are operative. (See item 3 below)

(2) The rope should be extended to ensure the hook will reach the lowest point required without the rope running fully out and that at least the necessary number of dead turns remain on the drum.

(3) Where underwind/overwind limits or stops are to be used, ensure that they are correctly set and that they function correctly. A further check should be made if any changes have been made to the power supply.

(4) If a slipping clutch is fitted, check that this functions correctly in accordance with the manufacturer's instructions. Similarly, other types of protective overload devices, e.g. pressure relief valves, must be checked to ensure that they are set and operate correctly. Always follow the manufacturer's instructions and never try to adjust safety devices other than as instructed by the manufacturer.

(5) Ensure that the brake operates effectively. A load equal to the maximum line pull should be raised just clear of the ground and held by the ratchet and pawl where fitted, the load should then be taken by the brake. In all cases of winches used for lifting, the winch brake or mechanism must be capable of sustaining the SWL at any point throughout the range of lift.

7.8.3 Pre-use Inspection/Thorough Examination

The degree of pre-use inspection and thorough examination required will to some degree depend on the type of winch used and the installation conditions. Whilst it is recognised that some winches are designed and intended for simple, temporary, installation by the user, this is generally not the case and more complex installation is usually called for. For complex installations and those requiring an amount of dismantling and reassembly a high degree of examination by a Competent Person may be called for (See 7.7 LEGAL REQUIREMENTS page 151)

Where the Competent Person deems a proof test is necessary to supplement his thorough examination, the test load applied will take into account the requirements of the overall installation, e.g. pulley block support structure, which form a part of the thorough examination. The proof load for the winch may vary with the design and type and reference to standards and/or the manufacturer's instructions will be necessary. These may include both dynamic and static loading. Functional tests at the rated capacity and other load tests to ensure the integrity of the brake or sustaining mechanism, motion limits and safety devices may also form a part of the examination. Dynamic test loads should be applied by operating the machine in accordance with the standard to which the hoist was made or in accordance with the manufacturer's instructions.

7.9 MARKING. STORAGE AND HANDLING

7.9.1 Marking

In addition to the information required by the standard used and the applicable national legislation, the following information should be permanently and legibly marked on a suitable part or parts of the winch:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL.

(3) Name of manufacturer or supplier.

(4) Rope drum storage capacity. Where a winch must be fitted with a specific size and/or construction of steel wire rope, this should also be clearly marked on the winch.

Further information may also be marked on the winch but in any event should be readily to hand. This will vary with the type of winch but some or all of the following information will be necessary:

(1) Model or type.

(2) Year of manufacture.

(3) Lifting speed(s).

(4) Details of power supply; e.g. voltage, phase and frequency; pressure and delivery rate, etc.

(5) Details of operating handle if this may vary. Number of operatives required for operation at full load.

(6) Direction of rotation of drum when lifting.

(7) The minimum number of dead rope turns which must remain on the drum at all times.

It should be noted that the wire rope fitted to the winch, together with any permanent attachments made to the rope, must be considered as individual items. They must therefore carry their own marking in accordance with the individual requirements applicable. Similarly, any pulley blocks used in association with the winch must also be treated as individual items and marked accordingly.

7.9.2 Storage and Handling

The storage and handling requirements will vary with the type of winch and the rigging assembly used.

In the case of permanent installations, when not in use the winch must be left in a safe position so that neither the winch nor its associated lifting accessory presents a hazard. It may be found that pulley blocks, hooks, etc. need to be raised to their highest level to avoid the danger of collision with persons or passing vehicles which may be in the area. In other cases, it may be considered wise to remove any pulley blocks for separate storage and for wire ropes to be fully wound onto the winch drum and lashed in position. Whatever method of storage is adopted, steps must be taken to ensure the winch and its associated equipment are adequately protected from the elements and from accidental damage whilst in store.

In the case of temporary installations, when not in use the winch and its associated equipment should be returned to proper storage. The storage conditions should meet the requirements recommended in section 1.7.2 Storage and Handling page 9 of the code together with the following additional requirements:

(1) Pulley blocks and detachable items used in association with the winch should be removed and stored separately.

(2) The wire rope should be fully wound onto the drum and lashed in position or removed from the winch and wound onto a suitable reel for separate storage.

(3) All functions of the winch should be checked prior to storage, in particular the operation of slipping clutches and brakes. All cables or hoses should be checked to ensure they have not become damaged in use. Where practical, trailing cables, hoses and winding handles should be removed from the winch and stored separately.

(4) When being handled, winches should be treated with care. Ensure they are not dropped or thrown down and that the wire rope and any trailing cables or hoses are not dragged across the floor.

(5) Whilst being transported and during storage, additional protection may be necessary to prevent the ingress of moisture, dust or other foreign particles. Where this is necessary, suitable covering should be provided, in particular to the area of the brake whose operation could be affected by such contamination.

7.10 IN-SERVICE INSPECTION AND MAINTENANCE

7.10.1 Pre-use Inspection

In addition to the statutory thorough examination by a Competent Person, winches should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis, taking account of the conditions of service and statutory requirements. For winches in regular use it is good practice to make the inspection at the start of each shift or working day. For hoists used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use check is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be a procedure to quarantine the winch to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test functionality of the winch and make a visual check for any obvious defects. The inspection should include the fixings, suspension points and supporting structures together with any associated pulley blocks or other equipment used in the rigging assembly. If any of the following faults are present, the winch should be withdrawn from service and referred to a Competent Person:

(1) Winch mounting insecure. missing, loose, damaged or corroded fixing bolts, cracking or crumbling foundation/wall, etc.

(2) Winch frame is corroded, damaged or distorted, guards missing or damaged.

(3) Rope drum damaged, particularly if flanges are chipped or cracked.

(4) Rope anchorages damaged or loose. If rope shows signs of having pulled or slipped in the anchorage or if anchorage bolts are loose, corroded, damaged or missing.

(5) Wire rope does not feed onto the drum correctly and in the case of power operated winches, the rope feeds onto the drum in the wrong direction. The rope should feed onto the drum with each turn sitting comfortably beside the previous turn with no bunching or crossing of turns.

(6) In the case of manually operated winches, the winding handle is bent, damaged or does not fit positively onto the shaft. The handle jams or jumps when turned or the winding gears are damaged, worn or distorted.

(7) In the case of power operated winches, the control lever, push buttons or valves are damaged or do not operate.

(8) The winch distorts under load.

(9) Ratchet teeth and/or pawl are damaged, worn or distorted.

(10) Brake lining worn, impregnated with oil or grease, contaminated with dirt or other particles. If the brake lining is torn, pitted or cracked, also if the brake face of the drum, etc. is damaged, pitted or corroded.

(11) Winch does not hold under load, load slips when lifting or load will not lift.

(12) Winch stops midway through a lifting cycle. (Immediate action will be necessary to secure or lower the load, depending on the winch design. In some cases it will be possible to lower the load in a controlled manner using the winches' own mechanism. In other cases it may be necessary to use a second winch to recover the load. This will call for great care and steps must be taken to ensure no shock loads are imposed to either of the winches or to any slinging arrangements used. Steps should also be taken to prevent access until the load has been safely recovered.)

(13) If there is unexpected vibration or noise during operation, particularly when load is descending at a controlled speed.

(14) Load continues to travel excessive distance after applying the brake or load falls at a faster than expected controlled speed.

(15) The wire rope is worn or damaged, in particular any increase or decrease in diameter, opening of the strands, kinks, broken wires, in addition to any other signs of mechanical damage such as flattening, cuts or corrosion. Faults are most likely to occur at the terminations and where the rope passes over pulleys and sheaves. (Rope damage can be the result of incorrect handling or coiling, particularly when being wound onto the drum in a no load situation. The inspection must therefore be made carefully to ensure that there is no damage to hidden turns on the rope drum, which in turn may cause further damage to other sections of the rope, and that there is no damage as the result of the rope jumping off the drum into the gears, etc.)

(16) Wear, damage or distortion to wire rope terminal fittings. If a swivel is fitted or forms part of the termination, it must operate freely.

(17) Wear, cracks and chips to pulleys and sheaves. Corrosion, seizing or wear to the axle pins of pulleys and sheaves. Where intended, head fittings must swivel freely.

(18) Sliding gear mechanism is too tight or too loose or does not lock positively into the required position.

(19) In the case of power operated winches, the prime mover (e.g. electric motor) must be inspected for any defects, damage or incorrect operation in accordance with the manufacturer's instructions.

7.10.2 Interim inspection

In addition to the thorough examination and pre-use inspection some winches will require an interim inspection (s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, winch duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in 7.10.1 Pre-use Inspection page 154, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see 7.10.3 Maintenance page 156 below.

7.10.3 Maintenance

A routine preventive maintenance programme should be drawn up which, in the case of power operated winches, can be combined with the maintenance programme that will be necessary for the associated power supply system and control equipment. This should meet the requirements set out in the manufacturer's installation and maintenance instructions in addition to any requirements of the particular site due to the conditions of service. In any event, attention should be given to the following points:

(1) The general condition and working order of the winch should be maintained. Cleaning and lubrication should be carried out on a regular basis.

(2) Where fitted, the type of brake will depend upon the design of the winch and intended application. As this is a most critical item in the safe operation of the winch, regular inspection and adjustment is essential and should be in accordance with the manufacturer's instructions. It should be subjected to regular functional checks and any symptoms of incorrect operation investigated, in particular any noise or vibration associated with power operated winch brakes.

(3) The slipping clutch, where fitted, is a safety device so its correct operation is essential. It should be checked in accordance with the manufacturer's instructions and any necessary adjustments made. It should be noted that in some cases the clutch is preset and sealed by the manufacturer. In this case, the winch must be returned to the manufacturer for adjustment and no attempt should be made to adjust this mechanism.

(4) Pressure relief valves and similar overload protection devices should be checked for correct operation and the setting adjusted in accordance with the manufacturer's instructions.

(5) Ensure that any limit stops that may be fitted are correctly positioned and have not moved. In the case of power operated winches fitted with travel limits, limit arms, switches or valves should be checked for correct operation and serviced in accordance with the manufacturer's instructions.

(6) Wire ropes should be lubricated in accordance with the manufacturer's instructions, ensuring the lubricant is acid free in nature. Under certain conditions of use, such as where there is a risk of contaminating other goods or products, or in dusty atmospheres where dirt may mix with the lubricant and adhere to the wire rope, a suitable dry lubricant may be used, details of which are available from the winch supplier or wire rope manufacturer.

(7) Where applicable, rope terminal fittings should swivel freely. Swivels and bearings must be lubricated as necessary. Attention should also be given to hook safety catches to ensure their correct operation and that springs have not become strained.

(8) Pulleys, sheaves and diverters should be checked for freedom of movement and the axle pins and bearings should be lubricated.

(9) In the case of power operated winches, the prime mover (e.g. electric motor) should be maintained in accordance with the manufacturer's instructions.

7.10.4 Thorough examination

The winch must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the winch's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, electrical safety testing, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of winches, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

7.11 SAFE USE OF WINCHES USED FOR LIFTING

In addition to the general requirements for the safe use of lifting equipment given in section 1.9 SAFE USE OF LIFTING EQUIPMENT page 10 and in the appropriate sections of this code relating to the specific equipment in use with the winch, the following recommendations should be followed:

(1) When transporting, handling or lifting a winch, use only the means provided for that purpose. Never attempt to lift by the drum, operating handle or drive shaft, etc.

(2) Ensure the rigging method used is adequate for the load to be lifted so that the winch, its fixings, suspension pulleys and the suspension points of pulley blocks are not overloaded by the imposed loads.

(3) In the case of plate sided winches, never attempt to lift other than light loads in the fast gear as this may place excessive forces on the operating handles and shafts. The higher speed gears should only be used for rope extension/retraction when unloaded. If any doubt exists, use only the slow speed gears.

(4) In the case of dual speed power operated winches, select a speed appropriate to the specific lifting operation in accordance with the manufacturer's instructions.

(5) Ensure that steps are taken to prevent water, oil or other foreign matter coming into contact with lined brakes. Where contamination has occurred, do not use the winch as the brake may have lost its effectiveness.

(6) Where the direction of rotation is indicated on the operating handle, ensure the winch lifts the load when the handle is turned in that direction.

(7) In the case of manually operated winches, ensure that operating handles are correctly fitted and secure before attempting to use the winch.

(8) If the winch is fitted with sliding gears, ensure the gears are correctly in place and that the locking device is correctly applied to prevent the gears disengaging whilst in use.

(9) In the case of winches with a manual gravity pawl, ensure that the pawl is engaged with the ratchet wheel when lifting. It must be out of engagement when lowering and the load controlled by the winding handles and brake. Never try to stop a falling load with the pawl.

(10) Verify brake or sustaining mechanism integrity before lifting. Raise the load just clear of the ground and halt the lift. Ensure the load is sustained with no downward movement before proceeding with the lift.

(11) Prior to operating the winch, ensure the wire rope is not twisted, is correctly positioned in pulleys, etc. and that it is able to move freely between pulleys. Where ropes are in positions which may be dangerous when movement takes place, ensure that they are guarded or that adequate steps are taken to protect personnel or property against any hazard which may arise.

(12) Keep hands, feet, etc. away from ropes, winch drums, pulleys and similar danger areas so as to avoid trapping, laceration or similar injuries when the winch is operated. Remember even slow moving ropes can be dangerous. Stand in a safe place and be sure to keep out of the bight. Beware of flying equipment, particularly the rope, in the event of a failure.

(13) Steps must be taken to ensure inadvertent or accidental operation of the winch cannot occur. Whilst in use, winches should always be attended.

(14) For people carrying applications, use only winches specifically designed and intended for that purpose. Strictly follow the manufacturer's instructions with regard to both the rigging and operation.

(15) Care must be taken to ensure that too much rope is not wound onto or off the winch drum. Where limits or stops are fitted, they are a safety device intended for this purpose and should not be used as working

stops for load positioning. It is more often the case that no such limits are fitted and that the overwind/underwind is controlled by the skill of the operative. In such cases, steps must be taken to ensure the operative is able to assess the rope position, such as colour markings on the rope to indicate when its fully extended or retracted positions are reached.

7.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account the manufacturer's instructions for installation and use and pay particular attention to the following:

(1) If the winch is portable, intended for multipurpose use or the application calls for varying rigging systems to be employed, operatives should be instructed in the selection of suitable equipment, suspension points and anchorages. Emphasis should be given to the effects of rigging methods and the loads that will be imposed by them on supporting structures.

(2) If the winch employs a manual gravity pawl, operatives should be instructed in the correct use of the pawl and made aware of the dangers of misuse. Similarly, if the winch has two speeds of operation, they should understand the purpose of the fast and slow speeds and be instructed in their correct use and the dangers of incorrect use.

(3) Operatives must be made aware of the dangers of overwinding the rope both onto and off the drum.

7.A1 APPENDIX 1 - SUSPENDED WINCHES (POLE HOISTS)

7.A1.1 FOREWORD

The suspended mounting winch, or, as it is commonly known the pole hoist, is a special adaptation of a winch designed to be used only for lifting applications, its use being very similar to that of a hand chain hoist. It is a hand held/steadied winch which combines a suspension sheave unit with a top hook or shackle. The principles and recommendations given in SECTION 7 page 141 of this code will generally apply. This appendix therefore identifies only those areas which may differ or require special attention.

7.A1.2 TYPES OF SUSPENDED WINCHES

With the suspended winch, the winch drum and mechanism is housed in an enclosed casing, which has a built in steadying/carrying handle. Extension tubes, through which the wire rope passes, are fitted to the casing and have a sheave mounted at the top to allow the wire rope to hang vertically downward. They are light in weight and easily portable, making them ideal for applications where light loads are to be lifted in more than one location. The top suspension arrangement allows them to be used with trolleys to move light loads and they are often used on light assembly lines as a means of both lifting and moving components. (See Figure 7.A1.2-1 page 158)

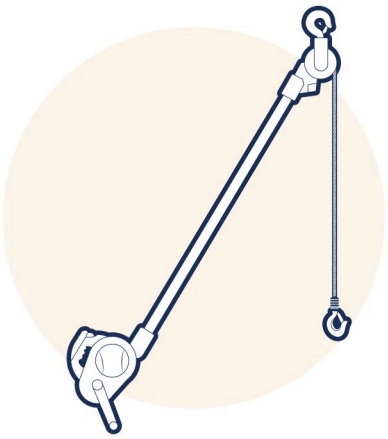


Figure 7.A1.2-1

Varying lengths of extension tubes enable the winch to be used in a variety of locations both for temporary and permanent applications. They are available in capacities from 250 kg to 1270 kg. Suspended winches are available arranged for lifting heights of up to 9 metres. Design variations enable an open drum version with up to 45 metres lifting height to be built into portable lifting structures. Although normally manually operated, a power take off drive unit can be fitted for power operation. Controlled descent is available on some models, obtained by the use of governors in contact with the brake drum which give controlled fall rates.

A variation of this winch design is produced specifically for people carrying purposes and is often used in rescue situations.

7.A1.3 PRINCIPLES FOR THE SELECTION OF SUSPENDED WINCHES

The selection principles will be much the same as for conventional winches except:

(1) The length of the suspension tube(s) must be considered to cope with varying suspension heights.

(2) The top suspension fitting must be considered. Hooks are suitable for attachment to a range of suspension points, including trolleys, and are ideal for temporary applications or those calling for the winch to be moved from one location to another. Shackle suspension is ideal for permanent installations.

7.A1.4 STORAGE AND HANDLING

The general requirements for the storage and handling of suspended winches will be the same as for conventional winches. Due to their design, suspended winches are easily removed and returned to storage when not in use. The lifting hook or bottom block should be fully retracted so as to prevent damage to the wire rope whilst in storage. It is recommended that they are suspended by their top fitting whilst in store.

Where it is necessary or desirable to leave suspended winches in situ whilst not in use, care must be taken to ensure that they do not present a danger to personnel and that hooks cannot become accidentally engaged.

7.A1.5 IN-SERVICE INSPECTION

In addition to the faults which necessitate the withdrawal from service and reference to a Competent Person given for conventional winches, suspended winches should be withdrawn if any of the following faults are found:

(1) Damage, wear, deformation or corrosion to the top suspension fitting. Open or distorted hooks or if safety catch is damaged, missing or does not operate correctly. Shackle distorted, worn, incorrectly fitted pin, etc.

(2) Damage or wear to the suspension sheave, particularly wear to the sides of the sheave groove.

(3) Damage, wear, distortion or corrosion to the suspension sheave/top suspension fitting mounting bracket.

(4) Bent, twisted, cracked or distorted extension tubes.

7.A1.6 SAFE USE OF SUSPENDED WINCHES

The general recommendations for the safe of winches will apply with the addition of the following:

(1) In the case of suspended winches using a top hook suspension, the hook should be fitted with a safety catch. The hook should be attached to its support in such a manner that the support fits freely into the seat of the hook. Care must be taken to ensure the support does not exert any side thrust upon the point of the hook or catch. Care is also needed to keep the axis of the hook cross section square to that of the support.

(2) In the case of suspended winches using a top shackle suspension, similar care is needed. Additionally, it is necessary to ensure that the shackle pin does not work loose. It is recommended that wherever possible bolt and nut pins fitted with cotter retaining pins are used.

(3) When lifting, it is important that the load is directly below the bottom hook so that no side loading occurs as the lift commences. Side loading can result in the wire rope rubbing against the top sheave mounting bracket causing damage both to the rope and the bracket and it can also cause the load to swing.

(4) When using suspended winches in association with trolleys to move suspended loads, care is needed to prevent the load or the winch from swinging. Not only will a swinging load impose greater forces on the equipment but there is also the danger of it striking personnel etc.

Section 8 - TRAVELLING GIRDER TROLLEYS

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8.1 FOREWORD

Girder trolleys are generally used to move a load suspended on a structural section in conjunction with a hand or power-operated lifting appliance. They are therefore commonly used on runways, jib cranes, mobile supporting structures and overhead travelling cranes.

No specific guidance is given in respect of power operated trolleys in this section of the code as it is more usual for them to be 'combined' with their associated hoist and treated as a part of that machine, refer to 1.A6 APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES page 40 and section SECTION 6 - POWER OPERATED HOISTS page 119. However, the general principles given here may also be relevant to their selection and use.

There are a small number of standards dealing specifically with girder trolleys, and as such many are produced to the various manufacturer's own specifications. The user's attention is also drawn to the various sections of this code detailing the structures on which trolleys may be found and with which they must be compatible.

Section SECTION 3 - HAND OPERATED CHAIN HOISTS page 87 of this code refers to the safe use of hand operated chain hoists and section SECTION 6 - POWER OPERATED HOISTS page 119 refers to the safe use of power operated hoists.

8.2 SCOPE

This section of the code refers to manually operated girder trolleys and no specific guidance is given in respect of electrical, pneumatic or hydraulic power operated trolleys as they are usually considered to be an integral part of the lifting appliance which they support, although they have many features in common with manually operated trolleys.

Trolleys with built in pattern chain hoists are referred to but no guidance is given for the chain hoist part. For further information on the safe use of hand operated chain hoists see of this code and for power operated hoists see .

Some types of trolley are designed to run on purpose manufactured track other than on the bottom flange of a standard structural steel section. This section of the code excludes specific guidance on these types since all competent manufacturers and suppliers will provide appropriate design, installation and safe use information.

Trolleys for people-carrying applications are also excluded. For such applications refer to the manufacturer for specific instructions.

8.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

8.3.1 Runway

A runway is any structural section, provided it is suitable for use as a runway beam, i.e. designed for the appropriate load cases and fitted with appropriate safety components such as end stops for example, and is suitably supported. (See 1.A4 APPENDIX 4 - STRUCTURES page 19)

8.3.2 Suspension Level

The suspension level is the level of the surface on which the trolley runs. (See Figure 8.3.3-1 page 162)

8.3.3 Operating Level

The operating level is the level on which the operative stands. (See Figure 8.3.3-1 page 162)

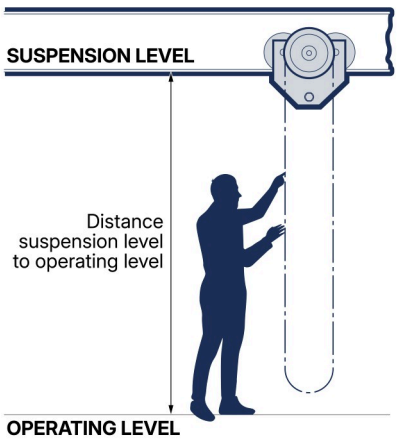


Figure 8.3.3-1

8.3.4 Load Bar

The load bar is that part of the trolley to which the suspended load or lifting appliance is attached. The exact form of the load bar depends on the design of the trolley and may include a hook, eyebolt or similar suspension point. (See Figure 8.3.4-1 page 162)

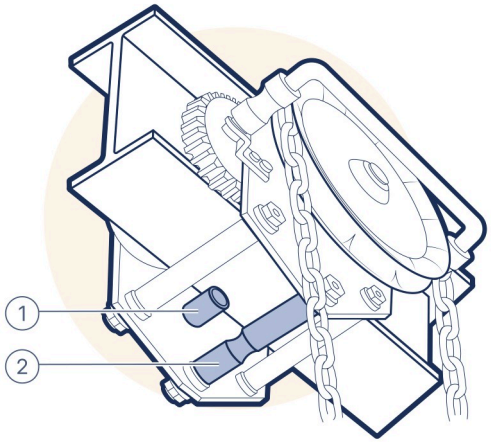


Figure 8.3.4-1 Geared trolley fitted with anti-tilt device

8.3.5 Anti-tilt Device

An anti-tilt device is an adjustable roller or similar device fitted to a gear operated trolley. This operates against the underside of the bottom flange of the runway or other suitable part of the beam section, to prevent the trolley tilting when the hand chain is operated. (See Figure 8.3.4-1 page 162) Certain manufacturers also fit similar devices to hand pushed trolleys.

8.4 TYPES OF GIRDER TROLLEY

Owing to the number of different makes of trolley currently available the following information is of a general nature only and may vary from one manufacturer to another.

8.4.1 Suspension Arrangements

The plain trolley is fitted with a device in the form of a load bar, hook, or eye from which a lifting appliance may be suspended by its head fitting. Other trolleys are designed to have the lifting appliance permanently attached, these are known as 'combined' or 'built in' trolleys. (See Figure 8.4.1-1 page 163)

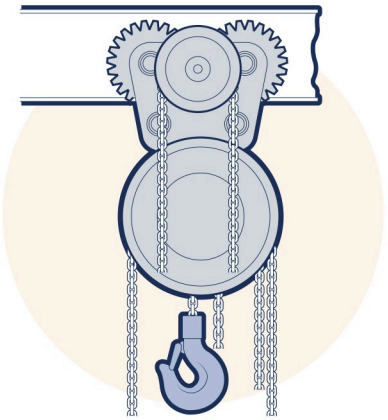


Figure 8.4.1-1 Combined hoist and trolley

8.4.2 Operation

Trolleys are available with a choice of hand push or gear operation. A hand pushed trolley is usually moved by pushing the suspended load. (See Figure 8.4.2-1 page 163) It is however possible to move the trolley by means of a winch or other pulling machine. A geared trolley is provided with geared driving wheels, which are rotated by pulling downwards on a hand chain driving an intermediate gear. (See Figure 8.3.4-1 page 162)

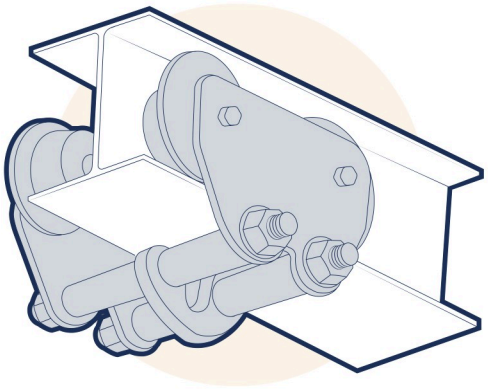


Figure 8.4.2-1 Rigid hand pushed trolley

8.4.3 Wheel Arrangement

The most common types of trolley have a four-wheel arrangement, i.e. two pairs. Two-wheel trolleys are available for certain applications and are usually associated with lighter loads. In certain cases, two or more two wheel or four-wheel trolleys may be connected by a purpose made load bar to provide for a greater rated capacity. (See Figure 8.4.3-1 page 164)

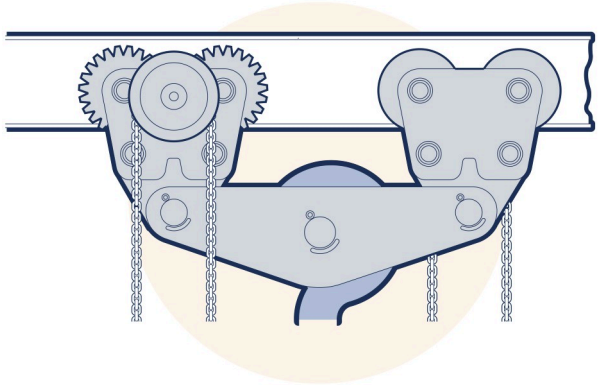


Figure 8.4.3-1 Multiple trolley with hook suspended chain hoist

8.4.4 Types of wheel

Most modern trolleys are fitted with wheels having a tread profile which is suitable to run on any standard constructional section flange or for a specific profiled track section. Older trolleys and those for certain applications may have wheels with tread profiles to suit a specific flange sections, e.g. tapered flange RSJ. The more common trolleys have wheels with a plain bushed bearing. For special applications and for higher loads anti-friction bearings are available.

8.4.5 Rigid or Articulated

The most common forms of four wheeled trolley have the wheels arranged on fixed side plates and are known as rigid trolleys. This makes them suitable for use on straight runway beams or those with a generous radius. Articulated trolleys are also available. These have four or more wheels and are designed so that each pair or set of wheels is free to pivot relative to the others in plan. (See Figure 8.4.5-1 page 164)

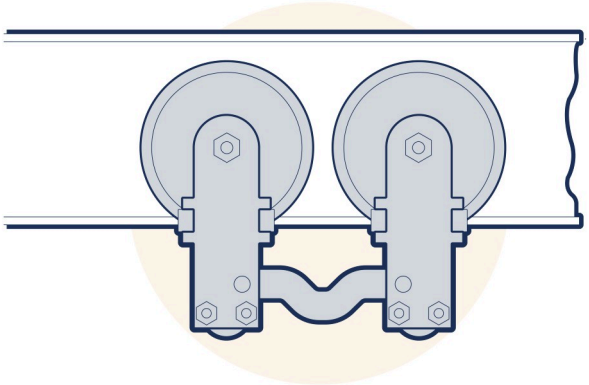


Figure 8.4.5-1 Articulated hand pushed trolley

Trolleys are available to suit a wide range of beam widths. Most modern trolleys are designed to suit a limited range of sizes and must be set to suit the specific beam onto which they are to be mounted. Some types, particularly older trolleys and those for special applications, may be suitable for mounting on one width of beam only.

8.4.6 Demountable Trolley

Combined hoist and trolley appliances are usually used in permanent applications. Similarly, plain trolleys are more commonly used in applications where they will be left in place on the beam, even if the lifting appliance is removed after use. A further design variation of the rigid trolley is available for use in temporary applications, this is known as the demountable trolley and is suitable for use where the trolley has to be frequently moved from one runway beam to another. (See Figure 8.4.6-1 page 165)

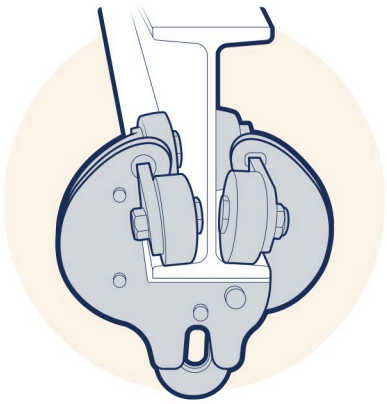


Figure 8.4.6-1 Demountable trolley

8.5 PRINCIPLES FOR THE SELECTION OF TROLLEYS

8.5.1 SWL

The rated capacity of the trolley selected should allow for any additional weight other than the load which is to be suspended from it. In most cases, manufacturers of trolleys take into account the weight of a hoist of their own specification in assessing the rated capacity. If a heavier lifting appliance or one of different duty than that normally specified is to be used, this must be taken into account when establishing the SWL. It is important that the type of lifting appliance to be used (i.e. hand or power operated) is considered.

If a trolley intended for hand operated appliances is to be used with a power operated appliance, then a de-rating of at least 15% should be made. No allowance is necessary if a hand operated appliance is used with a trolley intended for power operated appliances. Account should also be taken of the additional weight of the power operated appliance. In assessing the total load to be lifted, the weight of any lifting equipment or accessories, which will be suspended from the lifting appliance, must also be added to the total load.

8.5.2 Separate Trolley and Hoist or Combined Hoist

The frequency of use of a hoist attached to a trolley will generally determine whether or not a combined hoist and trolley is to be used. Many users find it convenient to leave only the trolley on the runway and use a hook suspended hoist when a lift is required. A combined hoist and trolley will usually take up less headroom than a separate hoist and trolley of the same working load limit and duty.

8.5.3 Hand pushed or Geared Trolley

The particular application will to some degree determine the choice between hand pushed operation or geared operation. Hand gear operated trolleys are generally used for heavier loads and where a greater degree of control is required over the movement of the load. They are also used if the height of lift or distance between the operations level and the suspension level is such that it would be difficult to move the load using a hand pushed trolley.

8.5.4 Wheel Bearings

Wheels fitted with anti-friction bearings greatly reduce the effort required to move the load and these are recommended for heavier loads and frequent operation.

8.5.5 Curved Runway Beams

Difficulty may be experienced in negotiating small radius bends (typically less than 2 or 3 metres). Manufacturers state recommendations on the minimum radius bend their equipment can negotiate. Articulated trolleys will negotiate smaller radii than rigid trolleys with the same wheel centres. A two wheel trolley will negotiate any radius of curve that can be practically manufactured on a runway beam provided the wheel flanges do not foul the beam flange on the inside of the curve.

8.5.6 Beam Width Adjustment

Adjustable width trolleys are available to fit runway beam flanges within limited ranges. These are useful if the trolley is occasionally to be moved from one beam to another, but extreme caution must be observed to ensure that it is properly fitted and adjusted to the correct width.

8.5.7 Temporary Applications

Trolleys which are designed to be readily demountable are available. These are suitable for temporary use when the trolley is to be moved frequently from one runway beam to another. As with the adjustable width trolleys, care must be taken to ensure that this type of trolley is properly fitted and adjusted. Specific installation instructions should be obtained from the manufacturer.

8.5.8 Wheel Tread Profile

Trolleys with wheel tread profiles designed to run on non-standard or old constructional sections may not be suitable for use on on standard beam sections and vice-versa. Most modern trolleys have wheel profiles to suit standard sections and advice should be sought from the manufacturer or supplier on this point.

8.5.9 Documentation

When selecting a trolley, ensure that it is covered by the necessary documentation required by legislation If this is not on record refer the trolley to a Competent Person for thorough examination.

8.5.10 Stops

The trolley buffer stops must be of adequate shape, size and position to engage with the runway end stops.

8.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As girder trolleys are frequently used for miscellaneous lifting applications, precise details of the load to be carried are not always available. In these circumstances, only a general specification can be given, and this should include the following:

(1) Type of trolley required.

(2) Details of the runway beam section to which the trolley is to be fitted. These details must be sufficient to fully identify the particular section or in the case of a fabricated section, the various elements from which it is manufactured. In addition, details of fixing bolts, clips, splices, etc. are required to ensure that they will not foul the load bar, trolley wheels or anti-tilt device where fitted. (See Figure 8.6-1 page 167)

(3) Details of the supporting structure of the runway including clearance dimensions to other structures or items of plant to ensure that there will be no external obstruction to the operation of the trolley and lifting appliance.

(4) The total maximum weight to be lifted.

(5) The type (including whether manual or power operated) and class of use of lifting appliance to be used with the trolley.

(6) Details of the load bar or suspension point of the trolley and the attachment point of the lifting appliance (s) to be fitted.

(7) If a geared trolley is specified, then the suspension and operating levels are required so that the length of hand chain may be determined.

(8) The minimum radius curve, if any, of the runway.

(9) Environmental considerations such as extremes of temperature or corrosive atmospheres.

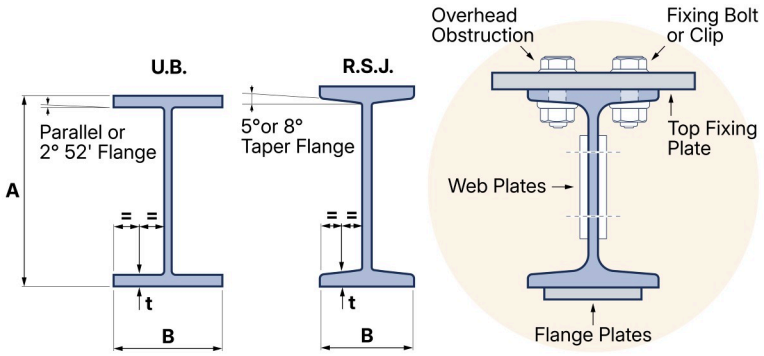


Figure 8.6-1 Types of beam

Indicate whether: parallel flange, tapered flange, fabricated beam, etc. Also indicate end stops, joint plates, etc.

As an example, a trolley may be described as follows:

- 250kg rated capacity:
- Gear operated:
- Four plain bearing wheels:
- Rigid trolley:
- Flange width 150mm parallel flange:
- Suitable for use with hook suspended hand chain hoist.

8.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

8.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code of practice make it clear that trolleys are considered as part of the lifting appliance that they support. Unless a written scheme of examination (refer to LEEA 032 Guide to written schemes of examination for guidance), drawn up by a Competent Person, is in place and operating they must be thoroughly examined at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the trolley's historical records for inspection by the Competent Person or local enforcing authority.

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the trolley is put into service. (See 8.8 INSTALLATION AND COMMISSIONING page 168)

8.7.2 Post Repair Verification and Record Keeping

Following repair, trolleys must be re-verified by a Competent Person. The report of the verification should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

Although not required by legislation, new trolleys will usually be issued with a manufacturer's record of proof load testing in addition to, although possibly combined with, documents required by the national legislation. This document forms an important part of the record of the trolley. It should be retained and cross referenced to the trolley's historical records for inspection by the Competent Person or local enforcing authority.

8.8 INSTALLATION AND COMMISSIONING

8.8.1 Erection of the Equipment

The erection procedure for the trolley should be in accordance with the manufacturer's instructions and take account of the erection and commissioning procedure for the appliance which it is to support. The detail of this procedure will vary depending on the type of trolley used, but in particular attention should be paid to the following:

(1) Prior to commencing installation of trolleys that have been in storage, a check should be made to ensure that no damage has occurred whilst in storage.

(2) It is essential to ensure that the structure on which the trolley is to be erected is adequate for the load it is intended to carry. This load includes the self-weight of the trolley and the weight of the lifting appliance it is to support together with any attachments (i.e. slings, shackles, etc.) plus an allowance on the total to take account of the effect of dynamic loading (10% in the case of manually operated appliances and 25% in the case of powered appliances). If the supporting structure forms part of, or is attached to part of, the building structure, care must be taken to ensure it is suitable for the intended lifting application. An architect or structural engineer should be consulted, and his written approval kept on file with the records for the lifting equipment. (See 1.A4 APPENDIX 4 - STRUCTURES page 19)

(3) Ensure that the trolley is of a suitable type and capacity for the particular operation.

(4) Ensure that the trolley is of the right size for the runway beam to which it is to be fitted.

(5) If the trolley is adjustable width ensure that it is set for the correct beam width, aligned centrally with the beam flange and that the side clearances are in accordance with the manufacturer's recommendations. These are usually of the order of 3mm to 4mm total clearance.

(6) If the trolley is dismantled in order to fit it to the runway, ensure that it is reassembled correctly.

(7) If the runway end stops are removed in order to fit the trolley, ensure that they are refitted securely and correctly.

(8) Ensure that the runway end stops are of a size and in a position to prevent the trolley from passing them. The end stops should not engage onto the wheel flanges.

(9) If an anti-tilt device is fitted, ensure that it is correctly adjusted and that there is no obstruction to its operation on the underside of the runway flange.

(10) Ensure that all fixing bolts and nuts are tight.

(11) If the trolley is to be used with an electrically operated lifting appliance, then the trolley and runway must NOT be used as the earth return. A separate earth conductor should be used. Any electrically operated lifting appliance should be installed in accordance the applicable electrical safety regulations.

8.8.2 Installation Pre-use Inspection/Thorough Examination

The degree of pre-use inspection or thorough examination required will to some degree depend on the type of trolley used and the installation conditions. Demountable trolleys are commonly used as a portable tool for temporary installation in order to suspend a hook suspension hoist to effect a limited lifting and moving operation, e.g. in maintenance applications. Demountable trolleys are designed and intended for the user to erect onto a suitable runway beam for use in such applications. It is therefore the users responsibility to ensure the adequacy and suitability of the beam. It will usually be sufficient for a suitably qualified and experienced person to inspect the installation prior to use to ensure the correct fitting and adjustment, etc. have been made. Other trolley types are designed and intended for more permanent installations, often requiring an amount of dismantling and reassembly, which may call for a higher degree of examination to be made by a Competent Person (See 8.7 LEGAL REQUIREMENTS page 167)

Where the Competent Person deems a proof test is necessary as a part of his thorough examination, the test load applied will be governed by the requirements of the overall installation, e.g. runway, which form a part of the thorough examination and which may differ from those of the trolley. The proof load for trolleys will usually be 150% of the WLL. For trolleys combined with power operated lifting appliances, it is accepted that the proof load will be that of the specific appliance.

8.9 MARKING, STORAGE AND HANDLING

8.9.1 Marking

The following information should be permanently and legibly marked on a suitable part of the trolley:

(1) Identification mark.(If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)

(2) SWL or rated capacity.

(3) An indication as to whether it is suitable for hand or power operated lifting appliances.

(4) The width of the runway beam for which the trolley is designed or, in the case of an adjustable trolley, the range of widths.

(5) Year of manufacture

(6) Name and address of manufacturer.

The marking should be either by means of a suitable metal tab permanently attached or by stamping provided that no mechanical property of the trolley is impaired.

8.9.2 Storage and Handling

When not in use, all trolleys, other than those permanently installed on a runway beam, should be returned to safe storage. The storage requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code.

(1) Trolleys which have been dismantled in order to be removed from a runway should be checked to ensure that all individual parts are the correct ones, that no substitution of components has been made and that they have been properly reassembled.

(2) In the case of geared trolleys, care must be taken to ensure the operating hand chain is stored in such a way as it will not be susceptible to damage whilst in store.

(3) Trolleys which are to be left in-situ should be parked in a position where they will not be liable to damage as the result of other operations which may be taking place in the area, e.g. adjacent to the runway end stop. In the case of geared trolleys, care must be taken to ensure that the hanging loop of hand chain does not present a danger to persons who may be working in the area. In the case of trolleys which are left outdoor, they should be protected from the elements by a suitable protective cover.

(4) When handling trolleys, they should not be dropped or thrown down. All component parts should be reassembled in the correct position after dismantling.

8.10 IN-SERVICE INSPECTION AND MAINTENANCE

8.10.1 Pre-use Inspection

In addition to the thorough examination required under statutory provisions, all trolleys should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For trolleys in regular use it is good practice to make an inspection at the start of each shift or working day. For trolleys used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be a procedure to quarantine the trolleys to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test the functionality of the trolleys and make a visual check for any obvious defects. If any of the following defects are found the trolley should be withdrawn from service and referred to a Competent Person:

(1) Appreciable wear of the trolley wheel treads and bearings or damage to flanges.

(2) Insecurity of the wheels and axle pins.

(3) Distortion, particularly in the side plates and load bar.

(4) Wear on load bearing points.

(5) Cracked or defective welding.

(6) Incorrectly substituted components.

(7) Worn, corroded or damaged hand chain particularly on the bearing surface on the inside of the links but also the outside of the links, bearing in mind possible injury to the operatives' hands.

(8) Illegible SWL or other markings.

8.10.2 Additional Inspection for In-Situ Trolleys

In addition, for trolleys in-situ, if any of the following defects are found the appropriate action should be taken:

(1) Incorrect size of trolley for the runway beam. Replace with correct size of trolley.

(2) Wrongly adjusted trolley. Re-adjust to correct side clearances between the wheel flanges and the toes of beam, usually 3 mm to 4 mm total clearance (the inspector or installer must seek clarification as to the exact dimensions from the manufacturer). Also ensure that the trolley is correctly aligned centrally with the flange of the runway. (See Figure 8.10.2-1 page 170)

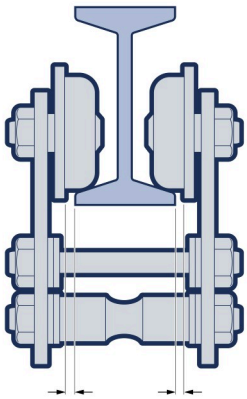


Figure 8.10.2-1 Correct trolley adjustment

(3) Wrongly adjusted anti-tilt device. Re-adjust.

(4) In the case of an incorrect or wrongly fitted hoist, remove and replace or refit as necessary.

8.10.3 Interim Inspection

In addition to the thorough examination and pre-use inspection some trolleys will require an interim inspection (s). the number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, trolley duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in 8.10.1 Pre-use Inspection page 169 and 8.10.2 Additional Inspection for In-Situ Trolleys page 170, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria). Interim inspections are often done at the same time as planned maintenance, see 8.10.4 Maintenance page 170 below.

8.10.4 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. For in-situ trolleys and hoists, this maintenance can be combined with the maintenance programme that will be necessary for the hoist. In any event attention should be given to the following points:

(1) The trolley should be thoroughly cleaned and moving parts lubricated. Particular care must be taken to avoid contamination of the running surfaces of the wheels and the flanges of the runway beam with lubricants.

(2) In the case of in-situ trolleys, if the trolley wheels or runway are contaminated with debris, lubricant or other fluid that could cause wheel slip, the wheels and beam should be cleaned.

(3) If there is any distortion or appreciable wear of the runway beam on which the trolley is fitted, remove the trolley from service and refer to a Competent Person. If the runway end stops are missing, are ineffective or make contact with the trolley wheel flanges they should be replaced.

8.10.5 Thorough examination

The trolley must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the trolley's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, electrical safety testing, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of trolleys, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit.

8.11 SAFE USE OF GIRDER TROLLEYS

In addition to any specific instructions relating to the safe use of the trolley issued by the manufacturer, the following points should be observed:

(1) The trolley must not be used to suspend a total load that is in excess of the SWL marked on the trolley.

(2) Care should be taken to ensure that the trolley is not subjected to shock loading, e.g. vertically by misuse of the lifting appliance or horizontally by side loading or running into the end stops of the runway.

(3) It is essential to note that trolleys are suitable for 'in line' use only and either the load or the trolley must be moved to achieve this, i.e. the line of force must be at right angles to the flange of the runway to which it is fitted (See Figure 8.11-1 page 172). If the load is applied at an angle to the longitudinal axis of the runway the trolley will move along the runway until the line of force is vertical. If the load is applied at an angle to the transverse axis, the load will be transferred onto the wheels and the beam flange on one side of the runway. It is possible to pull a trolley off the runway by loading in this manner. Thus, if the load to be lifted cannot be positioned directly under the runway, some other method of lifting must be devised, i.e. use a moving runway such as a jib.

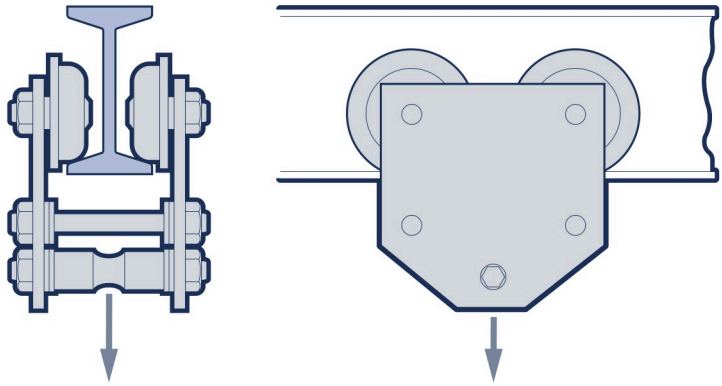


Figure 8.11-1 A girder trolley is intended for "in line" use only

(4) When two or more trolleys are used for one lift, care should be taken to ensure that no one trolley will be subjected to a load greater than its own rated capacity. (See section 1.9.2 Other Requirements page 11 (6))

(5) Trolleys should not be left in a position where they are liable to be subjected to extremes of temperature.

(6) At no time should the operative permit either himself or other personnel to be beneath the suspended load.

8.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account the manufacturer's instructions for installation and use and pay particular attention to the following:

(1) Operatives responsible for erecting trolleys must be trained in proper assembly and fitting.

(2) Operatives should also be made aware of which part of the structures available are suitable for use as runways and what they are capable of supporting.

Section 9 - BEAM CLAMPS

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9.1 FOREWORD

Beam clamps provide a ready means of attaching lifting appliances to suitable structural steelwork. Several standards worldwide address non-fixed load lifting attachments, including various types of clamps. Previous to these, there were no standards dealing specifically with beam clamps and they were normally proprietary items which vary widely in design. It is not therefore possible in a general purpose code to cover every variation and for certain designs special precautions or instructions may apply. The manufacturer's or supplier's instructions should always be sought and followed. Beam clamps can be used either as lifting accessories or as load suspension points and many are supplied for dual purpose applications.

9.2 SCOPE

This section deals with the use of beam clamps intended as a means of suspending lifting appliances from suitable steel sections.

Devices used for attaching to beams to facilitate the lifting and handling of the beam are specifically excluded as are devices which are intended to support a load only and not be used in conjunction with a lifting appliance e.g. pipe support clips, cable support clips.

9.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

9.3.1 Beam Clamp

For the purposes of this code, a beam clamp is a device designed to attach to a suitable steel beam section to provide a means of suspension for a lifting appliance.

9.3.2 Beam

A beam is any structural section provided it is suitable for the purpose of lifting (See 1.A4 APPENDIX 4 - STRUCTURES page 19)

9.4 TYPES OF BEAM CLAMP

9.4.1 Adjustable type Beam Clamps

An adjustable type beam clamp, as the name implies, is adjustable to fit beams of various size. Some, such as the type illustrated in Figure 9.4.1-1 page 174a are self-adjusting whilst others, such as the type shown in Figure 9.4.1-1 page 174b, require the operative to make the adjustment. In addition, there are some designs which,

while not adjustable, will nevertheless accommodate beams of various size and may therefore be conveniently placed in this class, e.g. Figure 9.4.1-1 page 174c.

Depending on the design, adjustable clamps are only capable to adjustment within specific limits and are therefore manufactured in a series of size ranges.

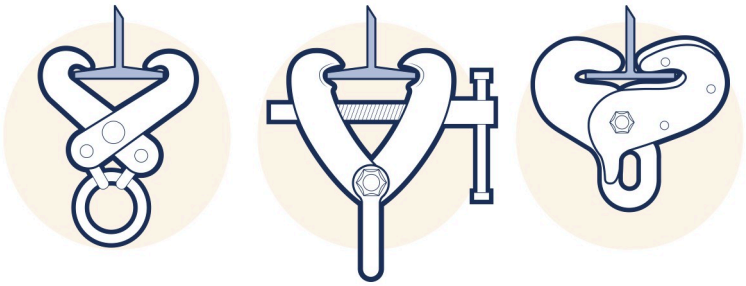


Figure 9.4.1-1

9.4.2 Non-adjustable Type Beam Clamps

A non-adjustable type beam clamp is suitable for one size of beam only. Within this class will be found many of the 'one off' clamps purpose made for a particular beam. A typical example is shown in Figure 9.4.2-1 page 174.

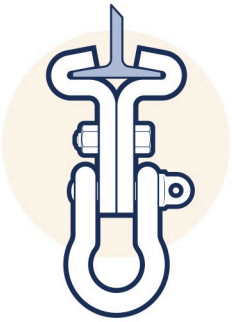


Figure 9.4.2-1

9.5 PRINCIPLES FOR THE SELECTION OF BEAM CLAMPS

9.5.1 SWL

The SWL of the clamp selected should allow for the weight of the lifting appliance and any other tackle which will be suspended from it. Under normal conditions of use, i.e. where there are no hazardous conditions the SWL will be the same as the working load limit. When used in conjunction with sheave blocks, due allowance should be made for the downward pull on the effort rope in establishing the SWL. (See 1.A4 APPENDIX 4 - STRUCTURES page 19)

9.5.2 Contact with the Beam

The clamp should contact the beam in such a manner that the beam flange is not subject to local overload. This applies particularly to beams of light section where the flange is wide and thin.

9.5.3 Temporary Applications

For temporary rigging applications, either an adjustable or non-adjustable clamp may be used providing it is suitable for the particular beam and loading. It is frequently found however that the adjustable type is more convenient as it can be readily attached or detached without tools.

9.5.4 Clamps Left In-Situ

Some clamps rely on the load for clamping force and, if left on the beam without other equipment, may be easily displaced and fall. In addition, some designs rely upon the top hook or shackle of the lifting appliance to lock them in place. Clamps which rely upon other equipment in this way should not be selected for applications when it is intended to leave the clamp in place without the other equipment.

9.5.5 Line of Loading

Many designs of clamp are intended for ‘in line’ use only – i.e. the line of force must be at right angles to the flange of the beam to which it is attached (See Figure 9.5.5-1 page 175) It is therefore important to ensure that for ‘angled’ applications (See Figure 9.5.5-1 page 175) a clamp of suitable design is selected.

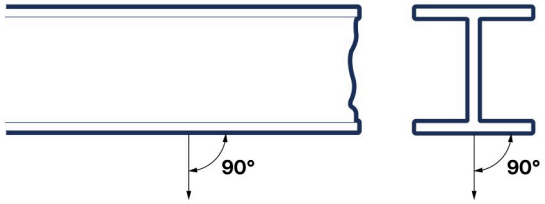


Figure 9.5.5-1 In-line application

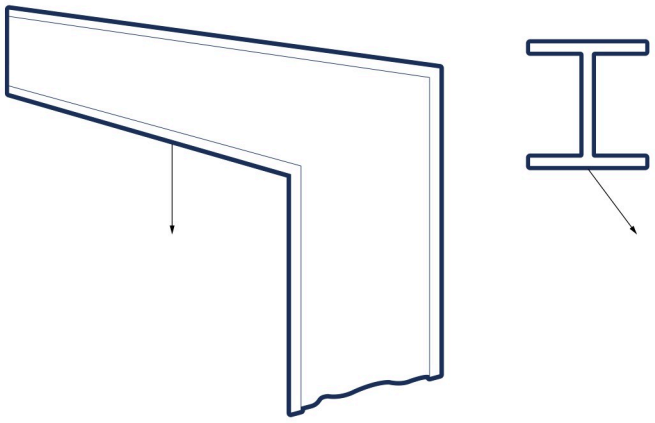


Figure 9.5.5-2 Angled applications

9.5.6 Documentation

When selecting a beam clamp, ensure that it is covered by the necessary documentation required by legislation. If this is not on record refer the clamp to a Competent Person for thorough examination.

9.6 INFORMATION WICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

The following is the minimum amount of information which should be exchanged between the user and the designer or supplier.

(1) Details of the beam to which the clamp is to be attached. These details must be sufficient to fully identify the particular constructional section or, in the case of a fabricated section, the various elements from which it is manufactured. This information is required to ensure that the clamp fits correctly onto the beam. Figure 9.6-1 page 175 indicates the information required.

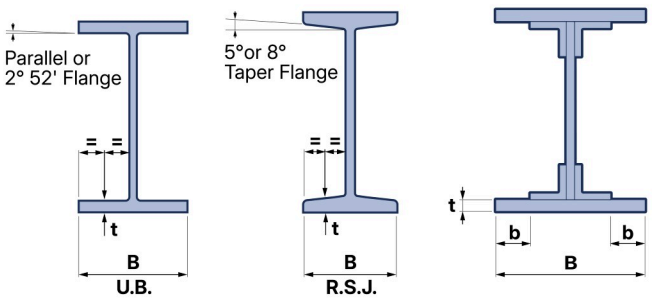


Figure 9.6-1

(2) The maximum weight of the load to be lifted including the weight of the hoist and any other tackle used, together with any other forces which may be superimposed on the load.

(3) The intended application, including information on the angle and plane in which the load is to be applied, and whether the installation is to be temporary or permanent.

(4) Environmental considerations, such as extremes of temperature or corrosive atmospheres.

(5) The type of attachment point required (e.g. shackle, link, etc) or dimensions of the equipment which is to be attached to the beam clamp.

9.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

9.7.1 Statutory Thorough Examination

The definition of lifting equipment used in this code includes 'its attachments used for anchoring, fixing or supporting it'. However, it is the opinion of LEEA that although beam clamps fit this definition they are also supplied and used as lifting accessories. Moreover, their nature and use, particularly those designed for temporary applications, is akin to lifting accessories. It is therefore recommended that they be included in the examination regime as lifting accessories. Unless a written scheme of examination (refer to LEEA 032 Guide to written schemes of examination), drawn up by a Competent Person, is in place and operating they should be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Where adequate controls ensure the equipment is installed for longer periods as a suspension point, then a period not exceeding 12 months is permitted. Reports of thorough examination should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the beam clamp is put into service. (See section 9.8 INSTALLATION AND COMMISSIONING page 176 and section 1.4 GENERAL LEGAL REQUIREMENTS page 6)

9.7.2 Post Repair Verification and Record Keeping

Following repair, beam clamps must be re-verified by a Competent Person. The report of the verification should be retained and cross referenced to the clamp's historical records for inspection by the Competent Person or local enforcing authority.

> Although not required by legislation, new beam clamps will usually be issued with a manufacturer's record of proof load testing in addition to, although possibly combined with, the documents required by the legislation. This document forms an important part of the record of the clamp. It should be retained and cross referenced to the clamp's historical records for inspection by the Competent Person or local enforcing authority.

9.8 INSTALLATION AND COMMISSIONING

9.8.1 Erection of the clamps

(1) It is essential to ensure that the structure from which the clamp(s) is suspended is undamaged and adequate for the load it is intended to carry. The load includes the weight of the clamp(s) together with any attachments.

(2) Ensure that the clamp is of a suitable type for the particular application.

(3) Ensure that the clamp is of the right size for the beam upon which it is to be used.

(4) Ensure that the clamp is seated correctly in accordance with manufacturer's instructions and that all fastenings are secure. It should be noted that different designs of clamp are located in different ways and it is imperative that the clamp is correctly adjusted so that it locates in the correct way. In particular, care should be taken to ensure that the suspension point is correctly located relative to the beam. (See Figure 9.8.1-1 page 177)

(5) Ensure that any ancillary attachments (shackles, etc.) are of suitable dimensions and SWL

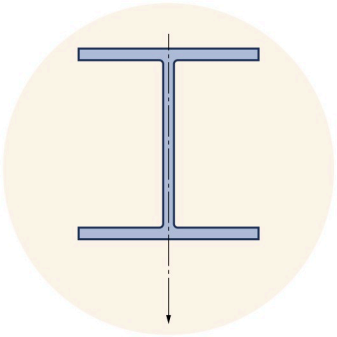


Figure 9.8.1-1

9.8.2 Pre-use Inspection/Thorough Examination

The degree of pre-use inspection or thorough examination required will to some degree depend on the type of clamp used and the installation conditions. Some types of clamp are designed and intended for temporary installation by the user to a suitable beam, e.g. in maintenance applications. It is therefore the user's responsibility to ensure the adequacy and suitability of the beam. It will usually be sufficient for a suitably qualified and experienced person to inspect the installation prior to use to ensure it is correctly fitted. Other types of clamp are designed and intended for more permanent installations, often requiring an amount of dismantling and reassembly, which may call for a higher degree of examination to be made by a Competent Person (See 9.7 LEGAL REQUIREMENTS page 176).

Where the Competent Person deems a proof test is necessary as a part of his thorough examination, the test load applied will be governed by the limitations of the overall installation, the test load for which may differ from that of the clamp, i.e. 125% of the SWL if used with a runway. The proof load for beam clamps is typically twice the WLL, unless specified otherwise by the manufacturer.

9.9 MARKING, STORAGE AND HANDLING

9.9.1 Marking

In addition to information required by the applicable legislation and standard to which the product was made, each beam clamp should be permanently and legibly marked with the following information:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)

(2) Working load limit or SWL.

(3) Width of beam for which the clamp is designed or, in the case of an adjustable clamp, the range of widths and the section of beam if applicable.

(4) Toe thickness of beam if applicable.

(5) Year of manufacture

(6) Name and address of manufacturer

The marking should be either by means of a suitable metal tab permanently attached or by stamping, provided that no mechanical property of the clamp is significantly impaired.

9.9.2 Storage and Handling

All beam clamps other than those fixed permanently in position should, after use, be returned to safe storage. The general requirements are essentially as recommended in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Equipment returned to storage should be checked by a suitably qualified and experienced person to ensure that it is in good order and that all parts of a clamp are present. It is particularly important in the case of clamps which require dismantling for erection or adjustment to ensure that all the individual parts are the correct ones and that substitutions have not been made.

(2) When being handled, clamps should not be dropped or thrown down. Any fasteners used to assemble the clamp should be reassembled immediately after the removal of a clamp from the beam.

9.10 IN-SERVICE INSPECTION AND MAINTENANCE

9.10.1 Pre-use Inspection

In addition to the thorough examination required by statutory provisions, all beam clamps should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For beam clamps in regular use it is good practice to make the inspection at the start of each shift or working day. For beam clamps used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the name and signature of the person making the inspection. In event that it does not pass the inspection, there should be a procedure to quarantine the beam clamp to prevent further use of the equipment until the problem has been resolved

The purpose of the pre-use check is to test functionality of the beam clamp and make a visual check for any obvious defects, and, if any of the following faults are present, the clamp should be withdrawn from service and referred to a Competent Person:

(1) In the case of a clamp in-situ, distortion of beam to which clamp is attached.

(2) Distortion of any part of the clamp.

(3) Cracks especially at bends or changes of section, nicks, gouges and corrosion.

(4) Wear at application and suspension points, pins, pivots and other moving parts.

(5) Insecure locking arrangements including substitute nuts and bolts where used.

(6) Illegible SWL or other markings.

In addition, for clamps in-situ, if either of the following faults are found the appropriate actions should be taken:

(1) Clamp of incorrect profile and/or width for the beam. Replace clamp with one of the correct width and profile.

(2) Incorrect fitting of any hook, shackle, etc., used for attaching other lifting equipment to the clamp. (Other equipment attached to the clamp should be securely retained within the fixing and free to align itself under load). Exchange clamp and/or other lifting equipment for equipment which is compatible, or insert additional linkage of suitable capacity and which will correct the defect.

9.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some beam clamps will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, trolley duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in 9.10.1 Pre-use Inspection page 178, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see 9.10.3 Maintenance page 178 below.

9.10.3 Maintenance

In addition to the inspection work listed above, clamps should at appropriate intervals be thoroughly cleaned and any moving parts lubricated unless manufacturers instructions indicate otherwise.

9.10.4 Thorough examination

The beam clamp must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months (12 months if used for long periods as a suspension point) unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the beam clamp's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of beam clamps, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

9.11 SAFE USE OF BEAM CLAMPS

In addition to any specific instructions relating to the safe use of the clamp issued by the manufacturer, the following points should be observed:

(1) It is essential to note that most beam clamps are only suitable for in line use. Therefore, unless the manufacturer's instructions indicate that loading at other angles is permitted, care should be taken to ensure that only in line loading occurs.

(2) Where two or more clamps are used for one lift, it may be necessary to use them in conjunction with suitable ancillary equipment, e.g. a spreader beam in order to comply with (1) above.

(3) When two or more clamps are used for one lift, care should be taken to ensure that no one clamp will be subjected to a load greater than its own SWL. For guidance on multipoint lifting see section 1.9.2 Other Requirements page 11 (6).

9.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take the manufacturer's instructions for installation and use into account, paying particular attention to the following:

(1) Due to the application for which the beam clamps are used, the operative may frequently be the person who selects and installs the clamp. It is therefore recommended in such cases that all applicable information be available to the operative including this Code of Practice and the manufacturer's instructions. Operatives whose job it is to erect clamps should be trained in the correct method of assembly and fitting the clamp.

(2) Operatives whose job it is to erect such clamps should be made aware of which part of the structures available are suitable for attachment to and what they are capable of supporting.

Section 10 - SLEWING JIB CRANES

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10.1 FOREWORD

Slewing jib cranes are widely used in industry in conjunction with manual or power operated lifting appliances where a permanent facility is required to perform both lifting and limited moving operations. Typical examples of their use being over work benches, in fitting and maintenance shops, over machine tools and in loading and unloading bays.

They offer a wide area of floor coverage within the slewing radius of the jib arm and are ideal where full over-head travelling crane coverage may be either impracticable or uneconomic. They are often used to supplement overhead travelling cranes.

Slewing jib cranes are often designed, supplied and tested without lifting appliances and it must be realised that a slewing jib arm becomes an effective crane only when fitted with a hoist, hoist and trolley or similar lifting appliance.

> ⓘ BS EN 14985:2007 – Cranes - Slewing jib cranes, has a similar title but does apply to the type of crane covered by this section.

10.2 SCOPE

This section of the code covers slewing jib cranes which may be wall mounted, column mounted or free stand-ing in design and manufactured from standard constructional sections or proprietary track sections, used for multi- purposes.

The use of jib cranes is always associated with a lifting appliance, usually a hand chain hoist or power operated hoist and normally includes a trolley. Whilst mentioned in this section, specific guidance on the safe use of these items will be found in the following sections of this code:

(1) Hand chain hoists - .

(2) Power operated hoists - .

(3) Travelling girder trolleys – .

This section of the code excludes derricking (luffing) cranes, lifeboat cranes, cranes used on offshore installa-tions to load and unload vessels and cranes used for people carrying applications.

10.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

10.3.1 Slewing Jib Crane

A slewing jib crane comprises a cantilevered beam or horizontal runway (jib arm) mounted on a king post located in bearing brackets. It may be attached to a suitable existing vertical face (wall or column mounted) or be built into a specially designed individual column (free standing).

10.3.2 Slew

Slew or slewing is the rotary motion of the jib arm about a vertical axis, the angle of slew being the angle of arc described by the jib arm when travelling between its two furthermost positions.

10.3.3 Overbraced

A jib is said to be overbraced when the cantilever runway arm extending from the king post is supported by bracing coming down from above the arm.

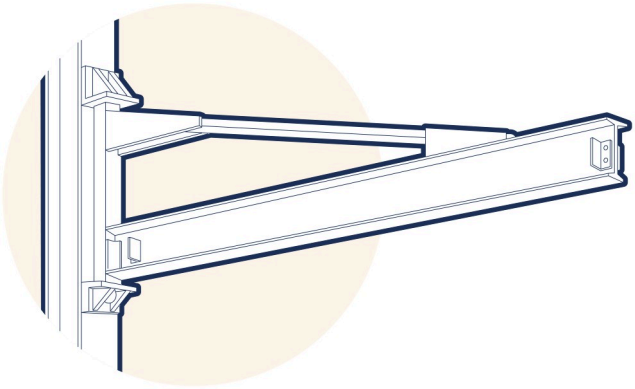


Figure 10.3.3-1 Overbraced slewing jib crane

10.3.4 Underbraced

A jib is said to be underbraced when the cantilever runway arm extending from the king post is supported by bracing coming up from below the arm.

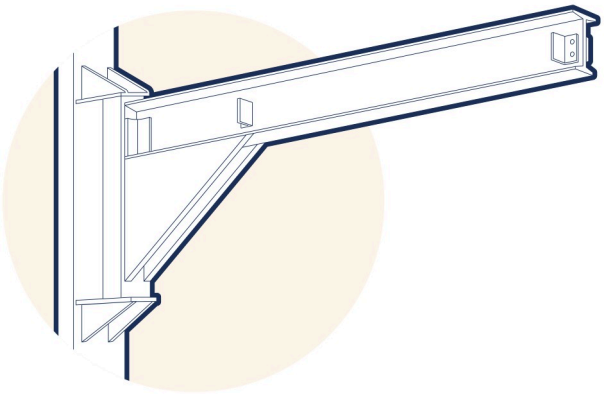


Figure 10.3.4-1 Underbraced slewing jib crane

10.3.5 King Post

The king post is the moving upright part of the structure to which the runway beam and bracing are anchored. It may be in the form of an upright member with journals top and bottom which fit into the bearing brackets and allow the jib to slew (see Figure 10.3.5-1 page 183 a) or in the form of a fabricated section with bearing spigots and rollers which perform a similar function on tubular column free standing jibs. (See Figure 10.3.5-1 page 183 b)

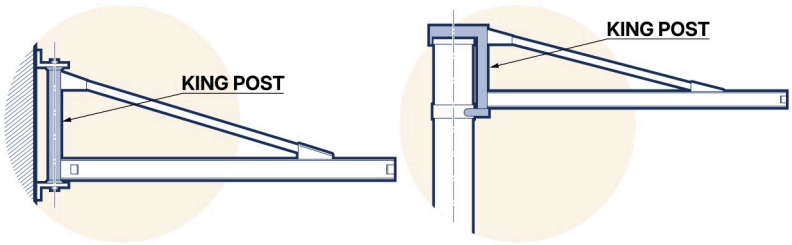


Figure 10.3.5-1 King post

10.3.6 Effective Radius

The effective radius is the horizontal distance between the centre line of rotation and the vertical centre line through the load lifting attachment at the extreme point of outward travel. (See Figure 10.3.6-1 page)

10.3.7 Effective Travel

The effective travel is the distance along the runway which the trolley and hoist may travel between the fixed end stops. (See Figure 10.3.7-1 page)

10.3.8 Height

The height of a jib crane is normally measured from floor to the underside of the jib arm; overall height being from floor to the top of the highest point of the structure. (See Figure 10.3.8-1 page)

10.3.9 Effective Height

The effective height is the distance from the floor level to the seat of the bottom hook of the lifting appliance in its raised position. (See Figure 10.3.8-1 page)

10.4 TYPES OF SLEWING JIB CRANES

There are two basic types of jib crane, Wall or Column Mounted and Free Standing. Both types are available in two styles, over-braced or underbraced.

10.4.1 Wall of Column Mounted

In the case of wall or column mounted jib cranes the jib arm, king post and bracing are assembled as a single unit. They may be over-braced or underbraced, depending on the intended use and installation location. Top and bottom bearing brackets fit onto the king post and these in turn are fixed to the supporting structure.

The design of bearing brackets varies with the intended use and may be provided with drilled bolt holes for wall mounting or clamp fixings for mounting onto or clamping around a column. Figure 10.4.1-1 page 184 (a) shows a wall or column mounted over-braced jib arm and Figure 10.4.1-1 page 184 (b) shows a wall or column mounted underbraced jib arm.

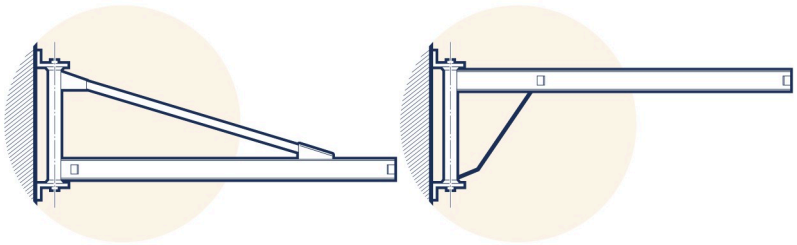


Figure 10.4.1-1 Wall or column mounted jib cranes

The angle of slew is limited dependent on the design of the bearing brackets and the supporting structure onto which they are erected. Wall mounted jibs are usually limited to 180° slew whereas a greater angle of slew may be obtained if the jib is column mounted. The angle of slew may be increased if the length of the bearing brackets is extended and can, in the case of column mounted jibs, be as great as 270°. Stops may be fitted to limit the angle of slew at any position within the arc of travel.

10.4.2 Free Standing

In the case of free-standing jib cranes, the jib arm and supporting column are assembled as a single unit which includes all mountings and bracing. They may be either over-braced or underbraced in design dependent on the intended use and the location of the installation. The supporting column is usually manufactured from square box section, fabricated sections or tube dependent on the required angle of slew. The angle of slew and intended use will also affect the design of the king post and mounting structure.

Free standing jibs are available with a wide variety of slewing angles. They may have a full 360° angle of slew, allowing for continuous rotation if a tubular column is used, or be limited to 270° angle of slew if a square box or similar section column is used. Stops may be fitted to limit the angle of slew at any position within the arc of travel. Where continuous jib rotation is required and electrically operated hoists are to be used, slip ring units are incorporated so that there is no limitation in rotation from the power pick-up. If pneumatic hoists are to be used, the air supply may be piped through the centre of the column and passed along the jib arm via a flexible hose. In this case, slewing stops are necessary to limit the rotation, thus preventing damage to the hose or the loosening of couplings. A similar arrangement may also be used with certain flexible cable electrical supplies.

Two options exist for the foundations of fixing free standing jib cranes. They may be surface mounted; in which case the base of the column is fitted with a base plate drilled to accept anchor bolts. Alternatively, they may be cast into the foundation, in which case the column is extended by a suitable amount to withstand the turning moment imposed. (See Figure 10.4.2-1 page 184)

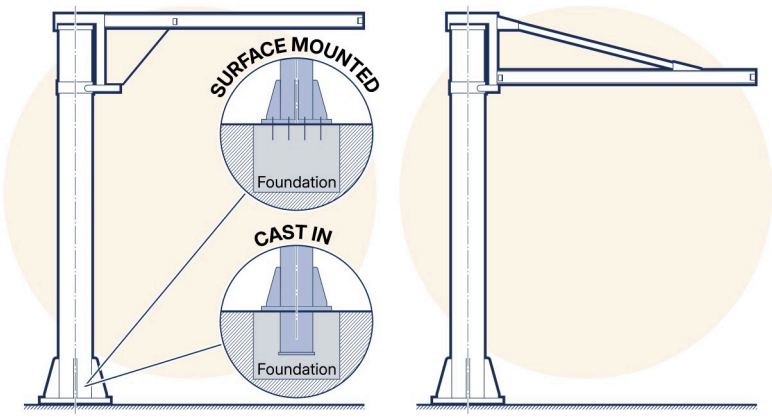


Figure 10.4.2-1 Free standing jib cranes

10.5 PRINCIPLES FOR THE SELECTION OF SLEWING JIB CRANES

10.5.1 Application

Slewing jib cranes are either custom built or made up from a ‘kit’ of standard components. This enables a wide range of designs to be easily manufactured to suit specific applications. Of course, this also affects the cost and performance. Careful consideration must therefore be given and the application should be fully discussed with the supplier.

10.5.2 Selection of Jib Crane

The design of jib crane selected will depend much on its location and the task it is to perform. Careful consideration must be given to its location as relocation may be costly.

(1) If wall or column mounted designs are selected, a qualified engineer must be consulted and approval obtained as to the suitability of the structure to accept the increased loadings that will be imposed on it.

(2) If free standing designs are selected, a prepared foundation will probably prove necessary. This must take into account the type of mounting of the column together with any plating or bracing, i.e. surface mounted or cast in, the turning moments, the permissible soil loadings and the loads that will be imposed. A suitably qualified person should be commissioned to design the foundation.

(3) Consideration must also be given to the style of the jib, i.e. over-braced or underbraced. This must take into account the available overall height, the required effective height, the required length of travel along the jib arm, i.e. the effective travel and the required area of coverage taking into account any obstructions which may impede the facility to slew.

(4) Over-braced jibs give the greatest effective travel and therefore area of coverage, but as the bracing is above the jib arm, they require a lot of clear height. They are therefore unsuitable for use in low buildings or where there are overhead obstructions.

(5) Underbraced jibs give the maximum lifting height, but as the bracing is to the underside of the jib arm, they offer a reduced effective travel and area of coverage. They are therefore unsuitable where the load is to be placed near to the support column or wall.

(6) In order to gain the advantage of lifting height and maximum effective travel, it is possible to have an underbraced jib with the bracing spaced to allow the hoist and trolley to pass between the bracing legs. This has the disadvantage of adding to the width of the jib assembly and can severely restrict the available slewing angle.

10.5.3 Selection of Lifting Appliance

The choice of lifting appliance, e.g. hand chain hoist, electric power operated hoist, pneumatic power operated hoist, etc., will depend on the frequency of use, nature of the load and working environment. Guidance on hand chain hoists will be found in and on power operated hoists in of this code. The lifting appliance must be compatible with the section of the jib arm track. The weight of the appliance and its dimensional bulk must be considered. Consideration must be given to the relative position of the bottom hook and the end approach of the appliance. In the case of power travel trolleys, the necessary clearances for drive motors and balance weights may be greater than for geared or push trolleys and must therefore be taken into account, as should the dynamic effects the appliance may impose on the jib arm.

The capacity of the lifting appliance must be the same as that of the jib crane so as to avoid confusion from differently marked SWLs. In the case of power operated hoists, the type of power feed to be used must also be taken into consideration.

These factors will affect the design of the jib crane and may also restrict load placement. The slewing angle of the jib arm may be affected by the chosen lifting appliance and power feed system and may need to be restricted due to this.

10.5.4 Slewing Facility

The jib arm may be slewed by manual pushing of the load, operation of manual gear or by power operation. Selection will largely depend on the magnitude and nature of the load or nature of the task to be performed.

Small, light loads may be easily slewed by hand, but the following should be borne in mind. Pushing on the load will cause it to swing away from the vertical centre line of the jib. The greater the distance between the load and the jib arm, the more accentuated the swing will become. When the jib arm then moves it will be delayed and then tend to snatch, causing the load to swing back and forth. This could endanger the operative and place excessive loading on the structure.

Ground level obstructions, e.g. machinery, may obstruct the path of the operative when pushing a load or the load may be suspended over a pit, teagle opening or similar. In such cases, a tag line may be fitted to the end of the jib arm to enable the operative to slew the jib.

The size, shape and weight of the load may be such that it is not possible for the operative to slew the jib safely by hand. Similarly, the load may be of a hazardous nature. In such cases, manual geared or power slewing should be considered, these also having the advantage of assisting the operative to position the load accurately.

The location of the slewing jib crane must be given careful consideration taking into account any potential hazards there may be such as the proximity of overhead power systems, nearby structures, machinery and other cranes. These may necessitate restricting the slewing motion of the jib arm to prevent it colliding with them. This may be done by the use of slewing stops.

10.5.5 General Considerations

Other matters which should be taken into consideration when selecting slewing jib cranes include:

(1) If power operated hoists are to be used, the availability of a suitable power source should be considered and this must include provision for isolating the jib crane and hoist from the power supply. It should be noted that most free standing jibs designed for use with power operated hoists will be supplied complete with all necessary power supply systems terminating at an isolator mounted on the column.

(2) The jib arm (runway) must be fitted with positive travel stops to prevent the trolley running off the end or colliding with the bracing or supporting structure. Consideration should be given to the position of the inner stops as it may be desirable to limit the travel of the load in certain applications, such as on a production line, or to prevent the load colliding with ground level obstructions.

(3) The finish and protection of the supporting structure should also be considered, as this will usually be supplied primed and painted as standard. Some further finishing may therefore be necessary to protect the crane due to its environment, e.g. outdoor or high humidity, or to protect the goods being handled, e. g. food products.

(4) The jib crane, together with its associated hoist and trolley, should be covered by the documentation required by legislation. If this is not on record refer the equipment to a Competent Person for thorough examination.

10.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As the variation of design is wide and jib cranes can be made to suit the application within a broad range of standard components, the exchange of information should be as detailed as possible. Wherever possible, a detailed drawing of the intended location, showing any existing installations and possible obstructions such as trunking, ducting and suspended lighting, should be provided by the user. A visit by the supplier to survey the site should always be considered as this will minimise the necessary information exchange and reduce the chance of incorrect selection. The information exchange should therefore include the following:

(1) Type and style of jib crane required i.e. wall/column mounted or free standing, over-braced or underbraced.

(2) Details of the load to be lifted or SWL.

(3) Type of lifting appliance to be used.

(4) Effective radius and minimum radius, thereby giving the effective travel.

(5) Height to underside of arm or effective height required.

(6) Total headroom available for the installation.

(7) Slewing angle required.

(8) Classification of the crane. (See note 2)

(9) If electric power feed equipment is to be supplied, the type required. This should be accompanied with details of the power supply available, including voltage, phase(s) and frequency.

(10) If pneumatic power feed equipment is to be supplied, the type required. This should be accompanied with details of the air supply available, including pressure and rate of delivery.

(11) If free standing jib crane:

a. Size of support column.

b. Fixing details, bolt type, grade and size and PCD.

c. Minimum foundation size (length, breadth and depth).

d. Downward reaction.

e. Turning moment acting on foundation at effective radius.

(12) If wall or column mounting jib crane:

a. Type of bracket and fixing details.

b. Maximum reaction on top bracket.

c. Maximum reaction on bottom bracket.

(13) Environmental conditions, e.g. indoor or outdoor, use within corrosive atmosphere, use in hazardous areas, use with dangerous loads, etc.

(14) Details of finish, e.g. any special paint or protective finish required, taking into account the risks that may require distinctive colours.

(15) Any special conditions or technical requirements, e.g. flame proofed.

(16) Full installation and maintenance instructions.

(1) Items 11 and 12 are given by the supplier to enable the qualified engineer referred to in 10.5.2 Selection of Jib Crane page 185 (1) and (2) to confirm the suitability of fixings and complete the foundation details.

(2) Current standards for jib cranes use a classification system. If the classification is not known, then sufficient information must be given for the supplier to determine the classification. The following is required:

a. Utilization
   i. Number of lifts per hour.
   ii. Operating hours per day.
   iii. Operating hours per month.

b. Loadings
   i. Number of lifts at full load.
   ii. Number of lifts at 75% of full load.
   iii. Number of lifts at 50% of full load.
   iv. Number of lifts at 25% of full load.

c. Weight of lifting appliance if known.

d. Intended design life in years.

Where insufficient detailed information is available, the user should seek the suppliers advice and recommendations as to the most suitable crane. Any restrictions or recommendations on the use must be adhered to.

10.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

10.7.1 Supply Documentation

If supplied without electrics or hoist the purchaser will require documented information about the extent to which the structure complies with any essential health and safety requirements and any standards together with information for use. If supplied a complete crane, then the jib shall be marked and supplied with the documentation required by the applicable legislation for the supply of lifting equipment, and standard used for the design and manufacture.

10.7.2 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that slewing jib cranes, including their attachments used for anchoring, fixing and supporting them, are lifting equipment. Unless a written scheme of examination (for guidance refer to LEEA 032 Guide to written schemes of examinations), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the crane's historical records for inspection by the Competent Person or local enforcing authority.

10.7.3 Thorough Examination and Testing Following Installation

Jib cranes depend on the installation conditions for their safety. Therefore, following installation they must be thoroughly examined by a Competent Person before being put into service for the first time or after installation at a new site or location. (See 10.8 INSTALLATION AND COMMISSIONING page 188) This examination will normally include a proof load test. The report of the thorough examination should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

10.7.4 Post Repair Verification and Record Keeping

Following repair, including repair to the foundation or fixings, jib cranes must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

10.8 INSTALLATION AND COMMISSIONING

10.8.1 Installation of the Equipment

The erection procedure should be carried out in accordance with the manufacturer's instructions, paying particular attention to the following:

(1) The overall stability and safety of a jib crane depends on its foundations or supports. In cases where the jib is attached to an existing structure (wall or column mounted), it is important that the superimposed forces are assessed by a qualified engineer and written approval obtained. Similarly, a free standing jib crane is only safe when rigidly mounted onto the correct foundation capable of resisting the overturning moment of the jib and a suitably qualified person should be consulted. (See 10.5.2 Selection of Jib Crane page 185)

(2) In the case of a jib crane which is to be clamped to an upright structural member, such as a column, using clip or strap type clamps, care must be taken to prevent the clamp fixings, and therefore the crane, from slipping down the column. Suitable positive stops should be fitted to the column directly below the fixings or similar steps taken.

(3) When erecting the trolley onto the jib arm, ensure it is correctly adjusted for the width of beam. (See SECTION 8 page 161 for guidance on trolleys) If it is run on at the end of the track, ensure all bolts are replaced correctly and be sure to replace the end stops.

(4) The erection of the lifting appliance and, where applicable, the power feed system, should be carried out in accordance with the manufacturers instructions. See for guidance on hand chain hoists and for guidance on power operated hoists.

(5) On completion of erection, the structure should be checked to ensure all bolts and fixings are correctly in place and tightened. Any pre-service checks necessary for the power feed system and lifting appliance should also be completed in accordance with the relevant sections of this code. Ensure the jib arm slews freely but has no tendency to move on its own. Ensure any slewing stops and track end stops are correctly positioned.

10.8.2 Pre-use Inspection/Thorough Examination

The installation of jib cranes calls for a thorough examination to be made by a Competent Person before they can be taken into service. Although electrical and mechanical equipment will have been tested in accordance with appropriate Standards at the crane or equipment manufacturer's works, it will usually be necessary for the Competent Person to conduct load tests as a part of the thorough examination. The purpose of this testing is to determine whether the crane is in accordance with standard and specification requirements, correctly installed and to ensure that it is safe to operate.

In addition to the crane structure and fixings, the thorough examination will extend to the lifting appliance and power feed system. Deflection, dynamic and overload (proof load) tests should be carried out in accordance with standard to which it was made. The proof load should be at least 1.25 times the SWL.

The manufacturer is required to specify the maximum permissible deflection to be used and compared with measured deflections obtained in the test. A deviation greater than +/-10% indicates an issue with the installation that needs to be resolved. However, it should be noted that deflections are not the governing criteria for the design and safe operation of slewing jib cranes.

Whilst the maximum allowable deflection must not be exceeded, the vertical deflection of the jib arm must be such that it ensures sufficient stiffness so that:

(1) The trolley on the jib arm will not run out of control when under load.

(2) The slope of the jib arm is not too great so that there is difficulty in travelling the trolley up the gradient.

(3) The jib arm will not slew on its own.

(4) The lifting appliance, and therefore the load, can be accurately positioned.

On satisfactory completion of all tests and the thorough examination, the Competent Person should issue the necessary report of thorough examination, which will include details of the tests he has made. In many cases the lifting appliance will be detachable from the jib arm and may have differing proof testing requirements. If so, a separate report or individually itemised report should be issued for the jib crane, trolley and lifting appliance.

This should be retained with the qualified engineer's written approval and cross referred to the equipment's historical records. (See 10.7 LEGAL REQUIREMENTS page 187)

10.9 MARKING AND STORAGE

10.9.1 Marking

In addition to the information required by the applicable legislation and standard being worked to, the following information should be permanently and legibly marked on a suitable part or parts of the slewing jib crane:

(1) Identification mark. (if the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection report and examination reports)

(2) SWL. This should be marked on both sides of the jib arm in such a way that it is readily legible from the operating level.

(3) Standard number, where applicable.

(4) If supplied without lifting appliance, Maximum hoisting speed for powered hoists or else the words 'Manual Hoist'

(5) Name of manufacturer or supplier.

(6) Classification designation.

(7) Year of manufacture.

Special care must be taken with regard to the SWL of the jib and lifting appliance. The maximum load to be lifted, including the weight of the lifting equipment, should not exceed the marked SWL of the jib or the appliance. This is particularly important in cases where the lifting appliance is regularly removed and replaced as may be the case where the crane is used for maintenance purposes.

10.9.2 Storage

When not in use, the slewing jib arm should be positioned so that it does not present a hazard to persons, goods or vehicles, etc. which may be working or stored in the area. Where practicable, if the crane is not in regular use the lifting appliance should be removed for storage. If this is not possible or desirable, the lifting appliance should be parked where it will not present a hazard, e.g. against the pivot point end stop. It may be necessary to secure the jib arm to prevent movement taking place as the result of winds, etc.

10.10 IN-SERVICE INSPECTION AND MAINTENANCE

10.10.1 Pre-use Inspection

In addition to the statutory thorough examination by a Competent Person, slewing jib cranes should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For jibs in regular use it is good practice to make the inspection at the start of each shift or working day. For jibs used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the jib to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the jib and make a visual check for any obvious defects. The inspection should include the fixings and anchoring devices and extend to the hoist, trolley and any associated power feed system, further guidance for which is given in the appropriate sections of this code.

The following are examples of common defects of the crane and structure which may become apparent in use or during the regular inspection (see also 10.10.2 Interim Inspection page 190). If any of these faults are found the jib crane should be withdrawn from service and referred to a Competent Person.

(1) Any signs of corrosion, damage or deformation of the structure, such as bent or twisted jib arm, distortion of the column, etc.

(2) In the case of wall mounted jibs, any signs of cracking walls or crumbling brickwork, etc.

(3) Damaged or missing end stops. These are safety devices which prevent the trolley, hoist or load colliding with the structure or becoming detached from the jib if travelled to the extremes of the jib arm. Their

effectiveness should be confirmed and they should not make contact with trolley wheel flanges. Bolts securing end stops must all be in place and kept fully tightened.

(4) If bolts are loose, missing, corroded or otherwise damaged. Missing or damaged washers including taper washers where appropriate. All bolts and fixing devices used in the construction of the crane and, in the case of column mounted jibs, for erection onto its supporting structure, should be in place and fully tightened.

(5) If foundation bolts are found to be loose, consult manufacturer's instructions. Some types of foundation bolt require periodic tightening during the initial period of use. If the manufacturer's instructions do not mention periodic tightening or if the problem recurs, withdraw from service and refer to a Competent Person.

(6) Difficulty in slewing the jib arm or if the jib slews on its own with no load.

(7) If push trolleys run to the end of the jib arm with no load.

(8) If the jib slews on its own when loaded or if the load runs away along the jib arm. If there is difficulty in traversing the load along the jib arm. This may be the result of overloading. Lower and check the load, and if the load is found to be excessive, adjust the load or use an alternative means of lifting. The jib crane should be inspected to ensure no damage has occurred prior to continuing the lift.

10.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some jib cranes will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, jib crane duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in 10.9.1 Marking page 189, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see 10.10.3 Maintenance page 190 below.

10.10.3 Maintenance

A routine preventive maintenance programme should be drawn up which can be combined with the maintenance programme that will be necessary for the lifting appliance, trolley and power feed system. It should meet the requirements set out in the manufacturer's installation and maintenance instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be given to the following points:

(1) Lubricate bearings and pivot points. Where the slewing motion is obtained by operation of a manual gear or by power drive, gear wheels and drives must be kept in good order. Gears and bearings should be lubricated and other drives and motors maintained in accordance with the manufacturer's instructions.

(2) The jib arm flange or track face on which the trolley runs should be cleaned of all debris, dust or other substances which may impede the free movement and correct operation of the trolley. Clean the trolley wheels.

(3) The general condition of the jib crane, its fixings and supporting structures should be maintained. Bolts should be checked to ensure that they are tight and re-torqued if necessary. If bolts are missing, they should be replaced with the correct size, type and grade. If these details are unknown do not attempt to replace them but refer to a Competent Person.

(4) Ensure end stops and slewing stops are in good order and that they are correctly positioned.

(5) The types of defect found during the inspection and maintenance of electric conductor systems will vary depending on the type and reference should be made to the manufacturer's instructions. In general, the termination points of electric cables into their respective entry glands are areas of wear due to flexing. With festooned cables, continual flexing and rubbing as they open and close into loops can cause a breakdown of the outer insulation. Similarly, where movement of the jib is permitted by flexible cables, this can cause a breakdown of the outer insulation and fatigue may occur if insufficient slack is allowed. Where power is supplied by slip rings, these should be kept in good order and no carbon or other matter permitted to build up. Brushes or collectors should be checked and renewed as necessary. Collector shoes of enclosed conductor systems are liable to wear and support springs may weaken, and should

be checked for correct fitting. It is advisable to carry out regular insulation and earth continuity tests and keep records of the results.

(6) In the case of pneumatic supply systems, movement of the jib is permitted by flexible hose. Continual flexing and rubbing as the jib arm slews can cause a breakdown of the hose and connectors may become loose. Filters and lubricators should be checked, drained if necessary and lubricator oil levels topped up.

10.10.4 Thorough examination

The jib crane must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months, unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the crane's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of jib cranes, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

10.11 SAFE USE OF SLEWING JIB CRANES

In addition to any specific instructions relating to the safe use of the crane issued by the manufacturer, the

following points should be observed:

(1) The SWL of a crane is the maximum load for which a crane should be used and must not be exceeded. The weight of the lifting appliance should be allowed for in rating the crane. However, it should be noted that the weight of any slings and other lifting equipment form part of the load and hence may reduce the available effective lifting capacity.

(2) SWL's apply only to freely suspended loads. Do not use the crane hook or travelling motion of the crane to drag any load along the ground.

(3) Before lifting the load, ensure the lifting appliance chain or rope is vertically above the load. Failure to do this will result in the jib arm swinging and possibly the trolley whipping when the load begins to rise.

(4) Apply the rules for the safe use of all the lifting equipment employed in the lift as detailed in the relevant sections of this code. In particular, take the weight of the load gently, check to ensure that all lifting attachments are correctly and firmly in place, then complete the lift. Lower the load gently and take care to ensure an unrestricted landing area. Whilst these measures are a necessary part of the trial lift, special care is required as suddenly imposed or removed loads on cantilevers can cause the jib beam to whip.

(5) On all occasions, prior to moving the jib arm, ensure that there are no obstructions in the path of the jib or load. The operative must always have a clear vision of the travel path.

(6) When using a crane and/or trolley which has no manual gearing or powered mechanism for movement, i. e. is hand push, it is preferable to move the load by pushing rather than pulling it.

(7) Care must be taken to avoid the load swinging. This can lead to the danger of the operative becoming pinned or trapped by the load. Another danger is that the load will whip outward thus increasing the effective radius and the resultant loads imposed on the mechanisms and structure.

(8) Avoid shock loads.

(9) Exercise great care when handling partially supported loads, such as when moving work pieces in and out of machine tools or removing chucks from lathes. This type of situation can lead to both swinging loads and shock loads.

(10) Powered equipment may place higher dynamic loading on the structure than manual equipment, so conversion of a jib with hand chain hoist to power operated hoist must take this into account. It should also be realised that the rating of the jib arm made allowance for the weight of the hoist that was originally to be used on the crane. If a heavier hoist is fitted, the crane may no longer be suitable for the marked SWL. If any doubt exists, consult a Competent Person.

10.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives must have good eyesight and be able to judge distances, heights and clearances and the training programme should cover this aspect of the operation.

(2) If the jib crane and/or the associated lifting appliance call for manual effort to push the load the operative should be physically fit for such activity.

Section 11 - RUNWAYS

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11.1 FOREWORD

Runways are widely used in industry to provide a single track upon which a lifting appliance is fitted to allow loads to be raised, lowered and travelled along the path of the runway. Typical areas of usage are in loading bays, adjacent to work benches, in foundries, on production lines, to provide a lifting facility in yards and for loading and unloading from multi-storey buildings by internal runways and external cantilever jibs.

Runways may be manufactured from standard constructional sections or from special track section systems and may be supported from building structures, dedicated free standing structures or a combination of both. They may also be built into machines or the bodywork of service vehicles.

Generally available in capacities up to 10 tonnes, runways offer a cost effective alternative to overhead travelling cranes for lifting and moving loads along a determined path. Their designs range from the basic dedicated runway to lift out a piece of plant to complex production units capable of serving large areas. The most sophisticated systems may include switches, turntables, bends, etc. allowing the movement of the load along alternative routes.

A form of runway is often fitted to high-rise buildings to allow access for external maintenance and window cleaning. Such runways have been excluded from this code. Guidance should be made to the manufacturer's instructions or suitable LEEA member organisation, which should be followed at all times.

A further variation of the runway is the lift shaft lifting beam. Although such beams are usually intended for use with a fixed point lifting arrangement, their design and testing requirements are to the same criteria as runway beams. (For guidance on the verification of lift shaft lifting beams refer to LEEA 076 Guidance to the verification of lift shaft support structures).

It should be remembered that a runway only becomes an effective lifting appliance when fitted with a trolley and hoist or similar lifting appliance which may be either manually or power operated. In the case of power operation on long systems, electric hoists are usually fitted due to the difficulties of providing compressed air over large distances.

11.2 SCOPE

This section of the code covers runways manufactured from standard constructional sections and/or proprietary track systems. They may be built into or supported by building members, free standing structures or a combination of both. The runway track may be supported at each end, at intervals along its length or have a cantilever. The track section follows a level path without change of height.

The use of runways is always associated with a lifting appliance, usually a hand chain hoist or power operated hoist attached to or combined with a trolley. Specific guidance on the safe use of these items can be found in the following sections:

(1) Hand chain hoists - .

(2) Power operated hoists - .

(3) Travelling girder trolleys - .

This section does not cover overhead conveyor systems or specialised motive power systems sometimes referred to as Monorails. Neither does it cover systems with friction drive units which deviate from the horizontal. Runways, either temporary or permanent, used for the suspension of access equipment are also excluded from this code.

Although mentioned in this section, no guidance is given in respect of retractable jibs, runway switches or turntables. Where these form part of a runway installation, the manufacturer's specific guidance and recommendations should be sought and followed.

11.3 DEFINITIONS

The definitions are as stated in section 1.3 DEFINITIONS page 2 of this code, whilst others are adequately explained in the text or accompanying illustrations.

11.4 TYPES OF RUNWAYS

The most basic form of runway is the building member specifically intended for the purpose or approved for use as a runway. Two further common variations of this type are the built in (or encastre) and those suspended from the building structure. Free standing structures may be used to support runways in applications where no suitable building member exists or their use is undesirable. For many applications, a combination of support from the building and a free standing member is not uncommon. Runway tracks may be supported at each end, have supports at intervals along their length or have cantilevered sections. For some special applications, they may be fitted with retractable jib sections, which allow the load to be moved outside of the supporting structure, or with runway switches and turntables, which permit the load to be transferred from one runway track to another. Providing adequate support is given, there is no limit to the length of track and they may include bends or be made in a continuous loop.

11.4.1 Built in (Encastre)

Runways may be built directly into suitable walls. Figure 11.4.1-1 page 194 a shows a cantilever runway built directly into a concrete structure. A runway, built into a brick structure, is shown in Figure 11.4.1-1 page 194 b, and is considered to be a simply supported beam. In this case, note the padstones distributing the resulting crushing loads imposed on the bricks at the bearing points.

> When designing runways which are supported at each end, it is normal to base the calculations on the assumption that the beam is simply supported.

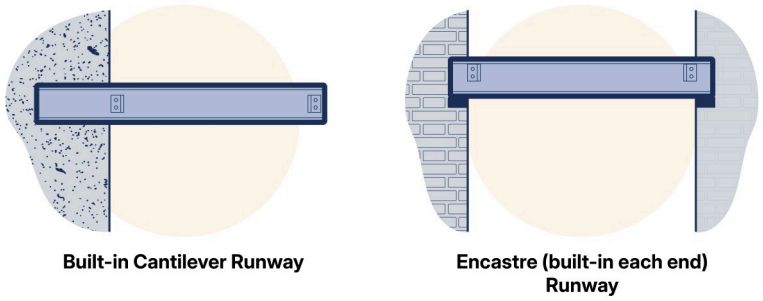


Figure 11.4.1-1

11.4.2 Free Standing

Where runways are used in locations that do not provide suitable supporting structures, free standing runway structures are common. Supporting structures may vary to suit the application and location of the runway. Figure 11.4.2-1 page 195 shows two typical free standing runway structures, suitably braced to withstand the dynamic loading and imposing the resultant loads through the column bases only.

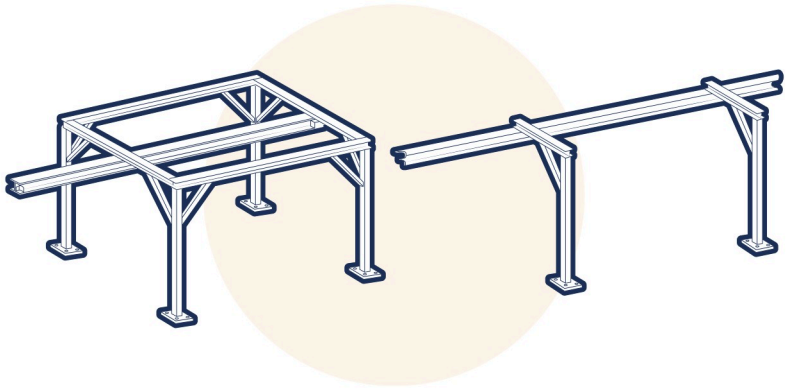


Figure 11.4.2-1 Free standing runway gantry structures

11.4.3 Suspended

Runways are commonly suspended from suitable roof members or beams built into the building structure. Figure 11.4.3-1 page 195 shows a typical runway, with a cantilever section, suspended from roof beams and a runway supported each end.

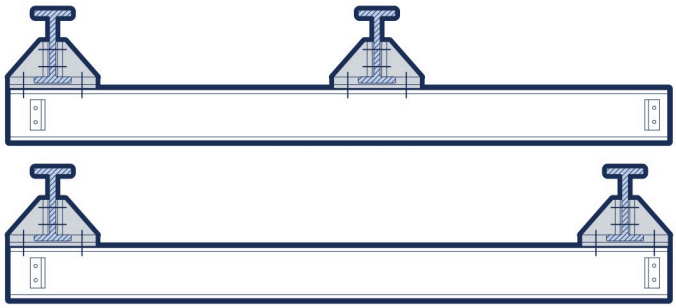


Figure 11.4.3-1 Suspended runway sections

11.4.4 Special Track Sections

The previous illustrations all show runways which are constructed from standard constructional sections, but runways may also be manufactured from special track sections. Figure 11.4.4-1 page 195 shows a range of typical mountings and support brackets for a special track system. These allow the runway to be suspended from building members or free-standing structures.

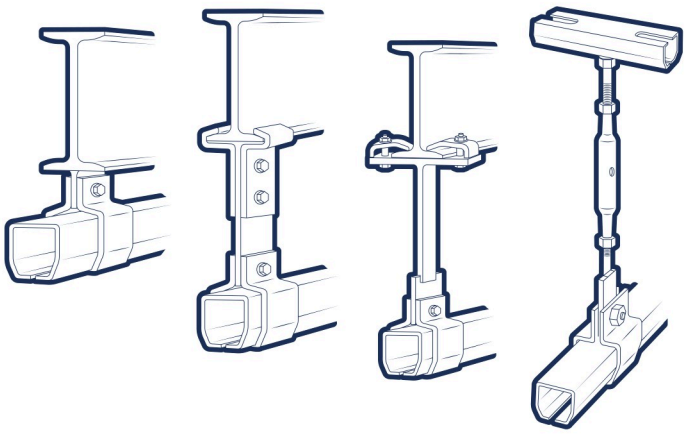


Figure 11.4.4-1 Special track section supports

11.4.5 Runway Switch

The use of a runway switch, as shown in Figure 11.4.5-1 page 196, allows the lifting appliance to be diverted from one runway system to another adjacent system.

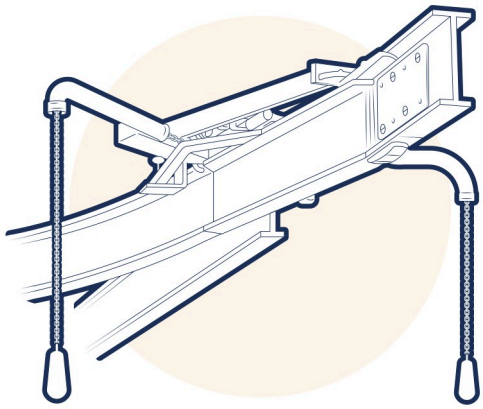


Figure 11.4.5-1 Typical runway switch

11.4.6 Runway Turntable

In both complex and simple runway systems, turntables can be utilized to transfer the lifting appliance from one runway system to another. Figure 11.4.6-1 page 196 shows a typical runway turntable.

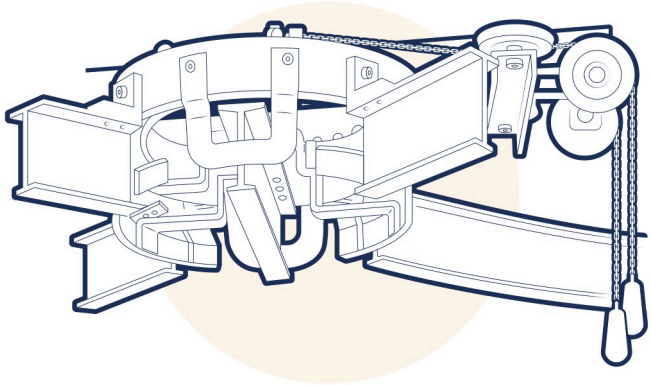


Figure 11.4.6-1 Typical runway turntable

11.5 PRINCIPLES FOR THE SELECTION OF RUNWAYS

11.5.1 Application

Runways may be custom built from standard structural steel sections, special track sections or made up from a 'kit' of standard components, enabling a wide range of designs to be achieved to satisfy specific applications.

The application, design requirements, and installation details should be fully discussed with the supplier, and their recommendations followed. This should include an appraisal of the overall handling requirement and, where possible, a review of the probable future needs. The path the track is to follow should be carefully assessed as must the need for supplementary tracks and the use of turntables or switches. Where the track includes bends, their radii will be governed, at least in part, by the type and dimensions of the lifting appliance and trolley selected. A visit by the supplier to survey the site should always be considered as this will minimize the risk of incorrect selection.

11.5.2 Selection of Runway

The choice of runway depends on the location, task requirements, and the type of lifting appliance used. This should be given careful consideration as subsequent alteration and/or relocation may be very costly or prove impossible.

The choice of a runway of standard constructional section or special track will to a large degree also be influenced by the application and chosen lifting appliance.

The resulting loads imposed on the building structure or foundations are almost always in addition to those for which the building has been designed. A theoretical check should therefore be made by a structural engineer or other suitably qualified person and written confirmation of the adequacy obtained and kept with the lifting

equipment records. (See section 1 1.A4 APPENDIX 4 - STRUCTURES page 19 and 1.A6 APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES page 40)

The loads imposed on the support points will comprise the load to be lifted, any slings and equipment used to attach the load to the lifting appliance, the weight of the appliance and trolley, a proportion of the runway and fixings self-weight and a dynamic allowance defined in the applicable design standard.

11.5.3 Selection of Lifting Appliance

The choice of lifting appliance, e.g. hand chain hoist or power operated hoist, will depend on the frequency of use, nature of the load and working environment. Guidance on the selection of hand chain hoists can be found in section of this code; power operated hoists in section and trolleys in section . The design of the runway will be affected by the lifting appliance chosen.

Careful consideration must be given to the capacity both of the lifting appliance, complete with its connecting device, and of the runway. The marked capacity of the lifting appliance must not exceed that of the runway so as to avoid confusion from differently marked SWLs. In the case of multi-point lifting using two or more appliances, the marked capacity of the runway is the maximum capacity and the total capacity of the appliances must not exceed this. For example, a runway marked 2t SWL may be fitted with 1 x 2t SWL hoist OR 2 x 1t SWL hoists.

Further consideration is necessary in the case of multi-point lifting. Steps must be taken to ensure that no one appliance carries more than its share of the total load and that the load imposed on the runway does not exceed that stated for any single span or given load centre.

In the case of power operated lifting appliances, consideration must also be given to the availability of a suitable power source and the type of power feed system to be employed. Provision must be made for isolating the runway conductor system and lifting appliance from the power source.

11.5.4 General Considerations

Other matters which should be taken into consideration when selecting runways include:

(1) The runway must be fitted with positive end stops to prevent the trolley and lifting appliance running off the end or colliding with any supporting structure. Further stops may be utilized to arrest the load at a specific location, e.g. over a production line. These stops may take one of several forms, and may be adjustable, movable or electro-mechanical in operation. The end stops should be assessed to ensure adequacy of engagement with the type of trolley being used.

(2) The finish and protection of the structure should also be considered as it will usually be supplied primed and painted as standard. Some further finishing may therefore be required to protect the runway due to its environment, e.g. outdoors or high humidity, or to protect the goods being handled where hygiene is important.

(3) In certain applications, particularly outdoors, consideration must be given to the provision of a covered section on the runway in which a lifting appliance may be ‘parked’ protected from the elements. There are indoor applications where a similar shielded area is needed for protection against humidity or heat.

(4) That the runway, together with its associated hoist and trolley, are covered by the necessary documentation required by the applicable legislation. If this is not on record refer the equipment to a Competent Person for thorough examination.

11.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND DESIGNER OR SUPPLIER

For dedicated runways, information exchange should be as detailed as possible. Where the runway is to be used for miscellaneous lifting duties, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given and this should include the following information:

(1) Type and style of runway, e.g. free standing, built into the building or suspended from the building structure, including the track section, suspension and fixing details and details of any cantilevered sections. Normally a layout drawing will be provided.

(2) Type of appliance and trolley to be used, e.g. manual or power operated, including the lifting medium, e.g. wire rope or chain. In the case of power operated equipment, this should include details of the power source, isolation and supply system, etc. and voltage, phase(s) and frequency or pressure and delivery rate. If more than one appliance is to be fitted, details of the number permitted in a single span or the minimum load centres at which they are to operate.

(3) SWL or maximum load to be lifted. In the case of a dedicated runway, full details of the load including weight and dimensions and the slinging method to be used.

(4) Details of the supporting structure and/or building to which the runway is to be installed. This should include details of any obstructions which may affect the design or operation of the runway.

(5) If the runway is to be attached to the building or an existing structure, details of attachment brackets and any additional supporting structures, columns, etc. that may be necessary and the position of any stiffening brace members. This should include details of the resultant loads at the attachment points and column bases.

(6) If the runway is to be free standing, details of the supporting structure, including the size and position of supporting structures, columns and foundation base plates, etc. This should include details of the loads imposed on the building floor or foundation.

(7) Minimum headroom required or height to underside of runway. In the case of free standing structures, the overall height should also be given.

(8) Effective lifting height of the appliance.

(9) Environmental conditions, e.g. indoor or outdoor, use within corrosive atmosphere, use in hazardous area, use with dangerous loads, etc.

(10) Details of finish, e.g. special painted or protective finish.

(11) Any special conditions or technical requirements, e.g. flame proofed.

(12) Details of access to the location of the proposed runway for erection and testing purposes. Full installation and maintenance instructions.

This usually calls for an initial site visit by the supplier to survey the area and assess the practicality of the project. In the majority of cases, this type of installation will be carried out by the supplier who will require the structural engineer's confirmation of the acceptability of the proposed attachment and/or foundation details. The information exchanged should therefore include sufficient details to enable full loading calculations to be made.

11.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

11.7.1 Supply Documentation

If supplied without electrics and hoist the purchaser will require documented information about the extent to which the runway track complies with any essential health and safety requirements and any standards together with information for use. If supplied complete it is classified as a crane system and the complete system shall be marked and supplied with the documentation required by the applicable legislation and standard used for the design and manufacture.

11.7.2 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that runways, including their attachments used for anchoring, fixing and supporting them, are lifting equipment. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the runway's historical records for inspection by the Competent Person or local enforcing authority.

11.7.3 Thorough Examination and Testing Following Installation

Runways depend on the installation conditions for their safety. Therefore, following installation they must be thoroughly examined by a Competent Person before being put into service for the first time or after installation at a new site or location. (See section 11.8 INSTALLATION AND COMMISSIONING page 199). This examination will normally include a proof load test. The report of the thorough examination should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

11.7.4 Post Repair Verification and Record Keeping

Following repair or modification, including repair to the fixings, runways must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

Users who manufacture and install runways for their own use are reminded that it is they and not the test organisation who are responsible for complying with the requirements of the applicable national legislation. The result and reports of the test are retained by them, and they have the responsibility for issuing any applicable documentation required by this legislation.

11.8 INSTALLATION AND COMMISSIONING

11.8.1 Installation of the Equipment

The security and rigidity of a runway depends largely on its fixings and foundations. When a runway is built into or attached to an existing structure, a structural engineer or other qualified person must assess the superimposed forces. A certificate of approval should be obtained and kept with the lifting equipment records. Similarly, a free standing runway and structure is only safe when rigidly mounted onto a correct foundation which has been approved by a qualified person.

It is usually the case that the supplier will undertake the installation and commissioning of all but the simplest of runway systems. The following recommendations are offered for those occasions where the user may be installing a simple runway or moving an existing runway to a new location.

(1) It is important that proprietary items, e.g. fixings and special track sections, should be fitted fully in accordance with the manufacturer's instructions.

(2) The track should be level both along and across the track and the running surface on which trolley wheels sit should be even, with no steps which will impede the movement of the wheels. Suitable packing pieces and shims should therefore be used to ensure this condition. They should be securely fitted so that they are unable to work loose or be accidentally removed.

(3) All bolts and fixings must be secured with necessary washers, including taper washers if needed, and locking devices.

(4) When erecting the lifting appliance trolley onto the beam, ensure it is correctly adjusted for the width of the beam or track in accordance with the manufacturer's instructions.

(5) Positive end stops must be securely fitted so as to prevent the lifting appliance becoming detached from the runway or colliding with the supporting structure.

(6) The erection of the lifting appliance and, where necessary, the power feed system must be carried out in accordance with the manufacturer's instructions. Reference should also be made to the following sections of this code for further guidance:

a. SECTION 1 - APPENDIX 6 - PRINCIPLES FOR THE SELECTION AND USE OF LIFTING APPLIANCES page 40.

b. SECTION 3 - HAND OPERATED CHAIN HOISTS page 87

c. SECTION 6 - POWER OPERATED HOISTS page 119

d. SECTION 8 - TRAVELLING GIRDER TROLLEYS page 161

(7) On completion of erection, the fixings and all structural bolted connections should be checked for correct alignment and tightness. Foundation bolts and fixings should be checked for correct fitting and security. End stops should be checked to ensure that they are correctly in place, secure and that they do not contact the trolley wheel flanges. Working stops should be checked for correct positioning and operation.

(8) Any pre-service checks necessary for the power feed system and lifting appliance(s) should be completed in accordance with the manufacturer's instructions and the relevant sections of this code.

11.8.2 Pre-use Inspection/Thorough Examination

The installation of runways calls for a thorough examination to be made by a Competent Person before they can be taken into service. Although the lifting appliance and electrical equipment will have been tested at the manufacturer's works, it will usually be necessary for the Competent Person to conduct load tests as a part of the thorough examination of the complete installation. The purpose of this testing is to determine whether the runway is in accordance with standard and specification requirements, correctly installed and to ensure it is safe to operate.

In addition to the runway, supporting structures, fixings and fittings, the thorough examination will extend to the lifting appliance and power feed system. Deflection, dynamic and proof load tests will be carried out in accordance with the applicable national standards. The proof load should be at least 1.25 times the SWL.

The manufacturer is required to specify the maximum permissible deflection to be used and compared with measured deflections obtained in the test. A deviation greater than +/-10% indicates an issue with the installation that needs to be resolved. However, it should be noted that deflections in most cases are not the only criteria for the design and safe operation of runways. Further, it should be noted that the permissible deflections of the building structure may be greater than those of the runway. The cumulative effect of all allowable deflections must be such that:

(1) The trolley or any moving part of the runway will not run out of control under load.

(2) The slope at any point is not too great so that there is difficulty travelling the trolley up the gradient.

It should be noted that in the case of proprietary runway systems, the deflection criteria may differ from those of standard constructional sections. The manufacturer's recommendations should be adhered to and duly recorded.

On satisfactory completion of the thorough examination and the supplementary tests, the Competent Person will issue the necessary report of thorough examination, which will include details of the tests he has made. In many cases the lifting appliance will be detachable from the runway and may have differing proof testing requirements. If so, a separate report or individually itemised report should be issued for the runway, trolley and lifting appliance. This should be retained with the qualified engineer's written approval and cross referenced to the equipment's historical records.

11.9 MARKING AND STORAGE

11.9.1 Marking

The following information should be permanently and legibly marked on the runway to give maximum visibility to the operative. In certain instances, it is recommended that the SWL should be marked in more than one place.

(1) Identification mark(s). (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL. This should be marked on both sides of the runway in such a way that it is readily legible from the operating position.

(3) Any limiting conditions marked on the runway must be clearly visible. (i.e. reduced capacity towards the end of a cantilever).

(4) Maximum hoisting speed for powered hoists or else the words 'Manual Hoist'.

(5) Year of manufacture and installation.

(6) Name of manufacturer or supplier.

Special care must be taken with regard to the SWL of the runway and lifting appliance(s). The maximum load to be lifted, including the weight of the equipment, should not exceed the marked SWL of the runway. This is particularly important in cases where the lifting appliance is regularly removed and replaced, as may be the case in maintenance applications, or where more than one lifting appliance is being used, i.e. multi-point lifting.

11.9.2 Storage

When not in use, the recommendations given for storage of the lifting appliance in the relevant sections of this code should be followed. If the appliance is left on the runway, it should be parked where it creates the least hazard. The hand chain or pendant control, as applicable, should be tied back to the appliance to prevent entanglement and possible damage.

11.10 IN-SERVICE INSPECTION AND MAINTENANCE

11.10.1 Pre-use Inspection

In addition to the thorough examination by a Competent Person necessary under legal requirements, all runways and their associated lifting appliances should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For runways in regular use it is good practice to make the inspection at the start of each shift or working day. For runways used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the runway to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the runway and make a visual check for any obvious defects. Guidance on pre-use inspection of lifting appliances will be found in the relevant sections of this code. The following are examples of the common defects which may become apparent in use or during the regular inspection of runways. If any of these defects are found the runway should be withdrawn from service and referred to a Competent Person:

(1) Damage or deformation to the track, such as cracks, bent or twisted flanges, wear to the running face of the track etc. Also twisted, bent or 'turned down' cantilever jib sections.

(2) Damage or deformation to supporting steel structures, such as cracks, distorted columns, bent or twisted flanges, damaged or distorted stools, packers and fixings, bent or distorted base plates.

(3) Corrosion of any of the structural members or track.

(4) Loose, missing or distorted bolts, nuts or clamps. All washers, including taper washers where appropriate, and locking devices must be in place. (In the case of missing bolts, nuts or washers, they must be replaced by ones of the correct size, grade and type. If any doubt exists withdraw from service and refer to a Competent Person.)

(5) Insecure, cracked or undercut welds.

(6) Loose foundation bolts. (It may be necessary to consult the manufacturer's instructions as certain types of foundation bolt require periodic re-torquing during the initial period of use. Where the manufacturer's instructions do not mention this or if the problem recurs, withdraw from service immediately and refer to a Competent Person.)

(7) Damaged, loose or missing end stops. End stops are safety devices which prevent the trolley, hoist or load colliding with the structure or running off the end of the track. Their correct fitting is of vital importance to the safe use of the runway. They must be set so that they mate with the wheel tread and do not contact the flanges of the trolley wheels.

(8) In the case of runways which are built into stone or brick walls, cracking or crumbling of the wall.

(9) Trolley lacks traction or all of the wheels are not in full contact with the track. In the case of hand geared trolleys, trolley tilts when effort is applied to the hand chain. (If the trolley slips or slides on the track, this may be due to dirt or debris. The running face of the track and trolley wheel treads should be cleaned of all contamination which may impede the free movement and correct operation of the trolley. If the problem persists, withdraw from service and refer to a Competent Person.)

11.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some runways will require an interim inspection (s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, runway duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 11.10.1 Pre-use Inspection page 200, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 11.10.3 Maintenance page 201 below.

11.10.3 Maintenance

A routine preventive maintenance programme should be drawn up. This may be combined with the maintenance programme that will be necessary for the lifting appliance and, where applicable, the power feed system. Guidance for the requirements concerning lifting appliances and power feed systems are given in the relevant section of this code. The maintenance programme for the runway should include the following:

(1) The general condition of the track and supporting structures should be maintained in good order. Where necessary, the paint work should be rubbed down and repainted. The running face of the track should be kept clean and free of any debris or contamination which may impede the correct operation of the trolley.

(2) All bolts and fixings should be correctly fitted and tightened.

(3) End stops must be in place and correctly set.

(4) The identification marks and SWL markings should be legible and re-marked in such a way that enables the operative to see them from any position he may be required to take during the operation.

11.10.4 Thorough examination

The runway must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the runway's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of runways, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

11.11 SAFE USE OF RUNWAYS

In addition to any specific instructions relating to the safe use of the runway issued by the manufacturer, the following points should be observed:

(1) The SWL of a runway is the maximum allowable load and must not be exceeded. The weight of the lifting appliance(s) should be allowed for in the rating of the runway, but it should be noted that the weight of any slings and other lifting equipment used form a part of the load and thereby reduce the effective lifting capacity.

(2) Before lifting, ensure that the lifting appliance is positioned vertically above the load. Failure to do this places undue stress on the trolley wheels and the lifting appliance chain or rope guides, thus promoting wear or in extreme cases failure, in addition to causing excessive torsional stress in the runway track. A further danger is that the load may swing when raised causing possible shock load to the runway and lifting appliance and being a possible source of danger to the operative.

(3) Never attempt to use the lifting appliance hook or travel motion to drag loads along the ground. The marked SWLs apply to freely suspended loads only.

(4) Apply the rules for the safe use of all lifting equipment employed in the lift as detailed in the relevant sections of this code. In particular, check to ensure that all lifting attachments are correctly and firmly in place, take the weight of the load gently and then complete the lift. Lower loads gently taking care to ensure an unrestricted landing area.

(5) Before moving the trolley, ensure there are no obstructions in the load's path. This is particularly important when lowering from runways in multi-storey applications and it is necessary for the operative to move into a position that enables him to have a clear view of the load path. It is important in applications where more than one operative is required, e.g. loading and unloading vehicles, that all assisting with the lift are aware of the correct signals for lifting, lowering and emergency stop. Equally, it is important that anyone assisting clearly understands the correct slinging procedures to be adopted.

(6) When using hand push travel trolleys, it is preferable to move the load by pushing and not by pulling it. Care must be taken to avoid the risk of swinging loads. In some applications, e.g. lowering loads over apertures, the use of an extended arm fitted to the trolley is recommended.

(7) When lowering loads through apertures or over the edge of buildings etc., edge protection should be placed across the opening once the load has been moved clear of the building. This enables the operative to safely stand close to the opening in order to look down the load path and to communicate with the assistance below. A load should never be lowered to another level without someone being in attendance at the lower level to handle the load and give instruction to the operative.

(8) Care must be taken to avoid the load swinging. Swinging loads may strike supporting structures, or when operating in multi-storey applications, the building, not only causing damage to them or the load but also affecting the safe slinging of the load. Excessive swinging can result in increased loads being imposed on the lifting appliance, runway or cantilever. Danger also exists to personnel who may be struck or pinned by swinging loads.

(9) Avoid shock loading the runway or lifting appliance. This is particularly important where loads are being moved clear of buildings, etc., or where raised loads are being added to, e.g. using a container to clear debris from an upper floor of a building, etc.

(10) In some cases, a runway may be fitted with more than one lifting appliance. Where this is the case, follow the recommendations given in 1.8.2 Competency and Control of Interim Inspections page 9 (6) of this code. In particular care must be taken to avoid collision. Further, the permitted loading in any one span of the runway track or the appliance lifting centres may be restricted and care must be taken to ensure that this is not exceeded by the approach of other appliances.

(11) It is generally accepted that the use of powered equipment places higher dynamic loading on a structure than manual equipment. Allowance for this is made in the design of runways. A runway fitted with hand operated lifting appliances should never be converted to power operated appliances without the express approval of a Competent Person.

(12) Multiple runway systems often employ switches or turntables to allow the appliance and load to be transferred from one track to another. Such systems are usually fitted with gate type end stops, which may be automatic or manually operated and care must be taken to ensure that they are in the correct position before continuing with the operation. All such systems must be operated in accordance with the manufacturer's instructions as well as the recommendations given in this section of the code.

(13) In some applications, e.g. for raising and lowering loads over the sides of buildings, the runway system may include a retractable section of track or the complete runway may be of a retractable design. Reference should be made to the manufacturer's operating instructions and these should be strictly followed.

(14) In the case of curved runway tracks or those that include bends, care must be taken when replacing trolleys onto the track. The trolley may be such that it only negotiates the bends when mounted on the track in a certain direction. The trolley manufacturer's instructions should therefore be sought and followed.

(15) Never attach additional steelwork to or suspend pipes, cables or similar items from runways. On no account should the runway or its supporting members be modified without the express approval of a Competent Person.

11.12 TRAINING

In addition to the training recommendations specified in section 1.10.1 Operative Training page 12of this code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

Operatives must have good eyesight and be able to judge distances, heights and clearances and the training programme should cover this aspect of the operation. If associated lifting appliance calls for manual effort to push the load the operative should be physically fit for such activity.

Section 12 - MOBILE SUPPORTING STRUCTURES

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12.1 FOREWORD

Mobile supporting structures are widely used in industry in conjunction with hand or power operated lifting appliances where a temporary runway structure is required to perform both lifting and linear moving operations. They represent a cost effective method of providing a lifting structure where the purchase of a permanent installation cannot be justified or where the load cannot be positioned under a fixed structure. Their portability allows convenient use in multiple locations, but also imposes certain restrictions on use. They are usually available up to 5 tonne capacity, although higher capacities can be manufactured and the code is not restrictive in this respect.

Mobile supporting structures are not intended for movement under load. They are mobile supporting structures which may be moved from one place to another to enable the runway to be positioned over the point of lift. The only intended movement of the raised load is along the runway.

It should be noted that special mobile supporting structures can be manufactured which are suitable for movement under load, but are uncommon due to their high cost compared to other methods of handling and moving loads. Caution must be exercised as such designs are often visually indistinguishable from standard mobile supporting structures designs. Unless explicitly confirmed by the manufacturer, assume the mobile supporting structure is of standard design. Such special mobile supporting structures are not covered by this section of the code and their use must be strictly in accordance with the manufacturer's written instructions.

Typical examples of the use of mobile supporting structures are loading and unloading in yards and open areas, the installation/removal of plant and equipment and periodic maintenance purposes; in fact any application where a lifting point, runway or crane cannot conveniently or economically be permanently installed. There are currently only a small number of standards that cover mobile supporting structures, but those that do generally classify them as manually operated light cranes. As a mobile supporting structure is essentially a movable runway structure, it should be designed, manufactured and tested in accordance with those standards relevant to runways and manual light cranes as applicable.

It must be realised that a mobile supporting structure cannot on its own be used for lifting operations, or classed as a light crane, and only becomes an effective lifting structure when fitted with a hoist, hoist and trolley or similar lifting appliance.

12.2 SCOPE

This section of the code covers manually re-locatable mobile supporting structures for static use only. They may be manufactured from standard constructional sections or proprietary track sections and will usually be

mounted on wheels or castors but may have free standing feet. The range of designs and intended use covers all common types including demountable, fold away and self-erecting mobile supporting structures.

The use of mobile supporting structures is always associated with a lifting appliance, usually a hand chain hoist or power operated hoist and normally includes a trolley. In certain circumstances, winch and pulley block arrangements are used and fixed lifting points achieved by the use of beam clamps. Whilst mentioned in this section, specific guidance on the safe use of these items will be found in the following sections of this code:

(1) Hand chain hoists - .

(2) Hand operated chain lever hoists - SECTION 4 - HAND OPERATED CHAIN LEVER HOISTS page 99.

(3) Lifting and pulling machines using a gripping action on the wire rope - SECTION 5 - LIFTING AND PULLING MACHINES USING A GRIPPING ACTION ON THE WIRE ROPE page 109 .

(4) Power operated hoists - .

(5) Travelling girder trolleys - .

(6) Beam clamps - SECTION 9 - BEAM CLAMPS page 173.

This section of the code excludes mobile supporting structures with cantilever runways, tubular shear legs (tripods), mobile supporting structures designed for manual movement under load, power operated travelling portal cranes, straddle carriers and support structures on fixed foundations, although the latter may have features in common with the mobile type. Mobile supporting structures used for people carrying applications are also excluded.

12.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of the code, the following should be noted:

12.3.1 Mobile Supporting Structure (Mobile Gantry)

A mobile supporting structure is a free standing structure comprising (but not limited to) a runway beam and two supports or A-frames assembled in a goalpost-like configuration. The supports are usually mounted on wheels or castors to enable the structure to be relocated by man power only; they may however be mounted on free standing feet requiring the structure to be dismantled for transportation.

12.3.2 Bracing

Bracing is used to give support, rigidity and longitudinal stability to the runway. There are four common methods

of bracing:

(1) External bracing - A mobile supporting structure is said to be externally braced when the runway is given rigidity by a diagonal bracing member positioned from the support to the runway on the outside of the goalpost arrangement.

(2) Internal bracing - A mobile supporting structure is said to be internally braced when the runway is given rigidity by a diagonal bracing member from the support to the runway on the inside of the goalpost structure.

(3) Box bracing - A mobile supporting structure is said to be box braced when the runway is given rigidity by the box-like design of the supports.

(4) Rigid or splice bracing - A mobile supporting structure is said to be rigid or splice braced when the runway is given rigidity by the design of the joint or splice between the supporting member and the runway.

Figure 12.3.2-1 page 206 shows examples of external and internal methods of bracing and Figure 12.3.2-2 page 207 shows box bracing and rigid or splice bracing.

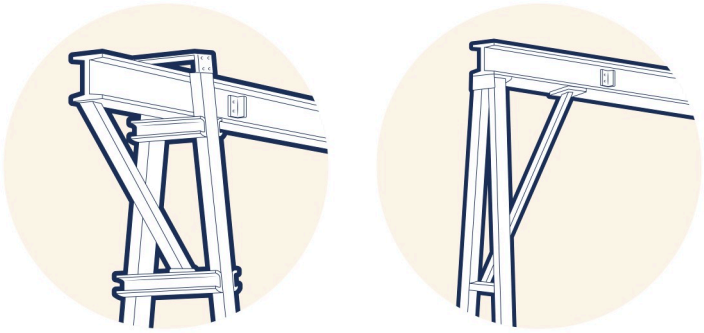


Figure 12.3.2-1 External and internal brace

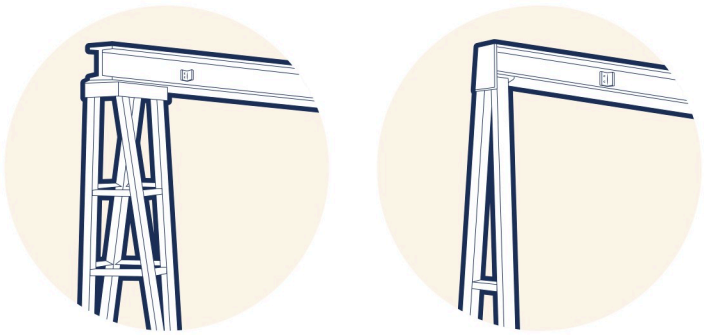


Figure 12.3.2-2 Box brace and rigid or splice brace

12.3.3 Height

The height of a mobile supporting structure is normally measured from the floor to the underside of the runway beam. The overall height is measured from the floor to the top of highest point of the structure.

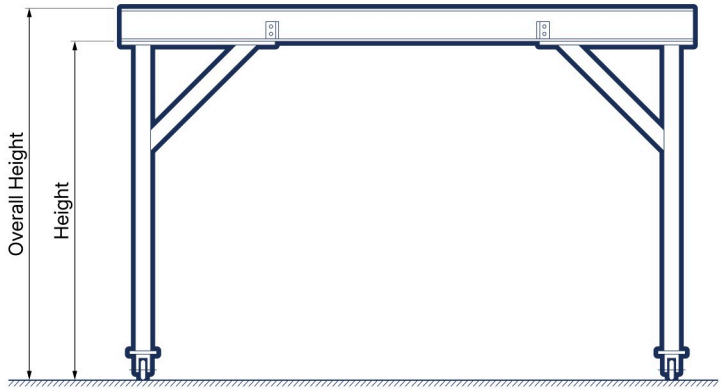


Figure 12.3.3-1 Height measurements

12.3.4 Span

The span of a mobile supporting structure is normally measured between the wheel centres along the line of the runway (longitudinally).

The clear span is the clear distance between any internal structural members and represents the maximum width of any item over which the mobile supporting structure may be positioned or passed.

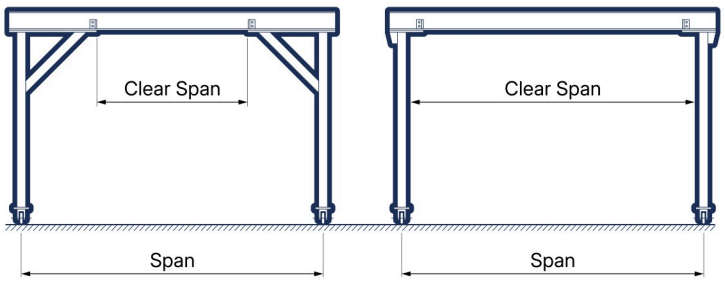


Figure 12.3.4-1 Span measurements

12.3.5 Effective Length

The effective length of a mobile supporting structure is the distance the lifting appliance and trolley may travel along the runway between the end (travel) stops.

Overall length is the distance between the extremities of the structure measured along the line of the runway (longitudinally) and represents the minimum width through which the mobile supporting structure may pass when an allowance is added for clearance.

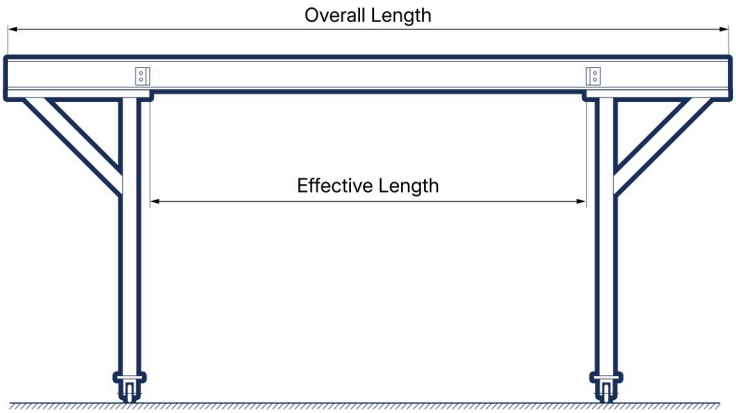


Figure 12.3.5-1 Length measurements

12.3.6 Width

The width of the mobile supporting structure is measured across the base member of the support.

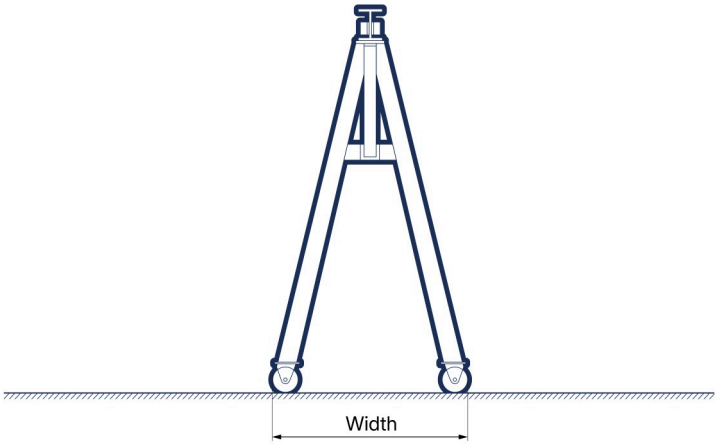


Figure 12.3.6-1 Width measurement

12.3.7 Duty Classification

There is no formal duty classification for supporting structures, but manufacturers commonly refer to light duty and heavy duty or similar terms to indicate the intended duty as follows:

(1) Light duty - infrequent use, manually operated lifting appliance, loads usually below the marked SWL. Also commonly known as economy, junior or lightweight.

(2) Heavy duty - frequent use, manual or power operated lifting appliance, high proportion of loads up to the marked SWL, applications where a more robust structure is required. Also commonly known as colossus, robust or senior.

12.4 TYPES OF MOBILE SUPPORTING STRUCTURES

Mobile supporting structures are available in a wide range of designs and varying facilities may be provided to suit a particular site or application. Mobile supporting structures are usually mounted on castors for complete mobility of the unladen structure, however they are available with fixed wheels or with freestanding feet for certain applications.

12.4.1 Goalpost Mobile Supporting Structure

The simplest form of mobile supporting structure is the goalpost type. This comprises a runway beam, often of proprietary track section, with single column supports. Lateral stability is provided by a base member on which the column is mounted. This design is limited to light loads, usually up to 500kg, and light duty applications. (See Figure 12.4.1-1 page 209)

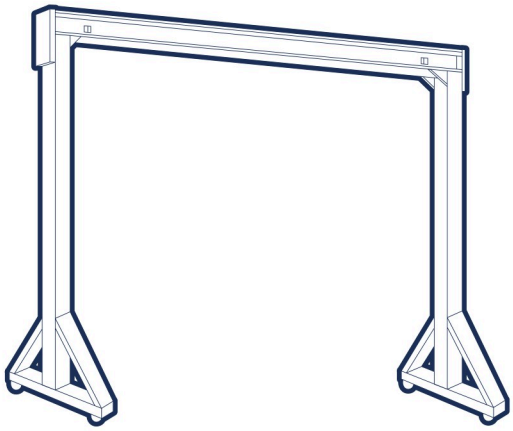


Figure 12.4.1-1 Goalpost mobile supporting structure

12.4.2 ‘A’ Frame Mobile Supporting Structure

The ‘A’ frame mobile supporting structure is the most common type of mobile supporting structure. This comprises a runway beam, usually of standard rolled steel section, with supports in the form of an ‘A’. Lateral stability is given to the structure by the shape of the supports. This design is available in all capacities, usually up to 5 tonnes. (See Figure 12.4.2-1 page 209)



Figure 12.4.2-1 ‘A’ frame mobile supporting structure

12.4.3 Adjustable Height Mobile Supporting Structure

To provide limited variations to the erected height of the runway, an adjustable height mobile supporting structure has telescopic supports enabling the runway to be raised or lowered to suit differing site conditions. This facility is not intended for use under load but is to allow for varying lifting height requirements only. This design is available in all capacities, usually up to 5 tonnes. (See Figure 12.4.3-1 page 210)

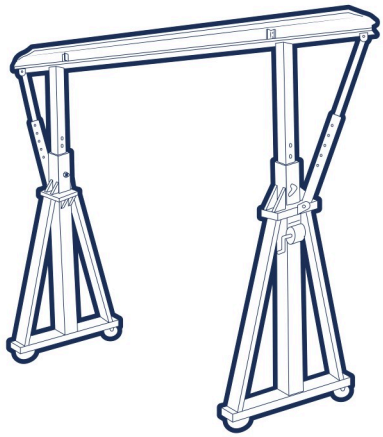


Figure 12.4.3-1 Adjustable height mobile supporting structure

12.4.4 Foldaway Mobile Supporting Structure

Foldaway mobile supporting structures are designed for easy dismantling and storage. They are intended for applications where regular dismantling and transportation is necessary or where the usage is such that long periods of storage occur. This design is usually limited to loads of up to 2 tonnes. (See Figure 12.4.4-1 page 210)

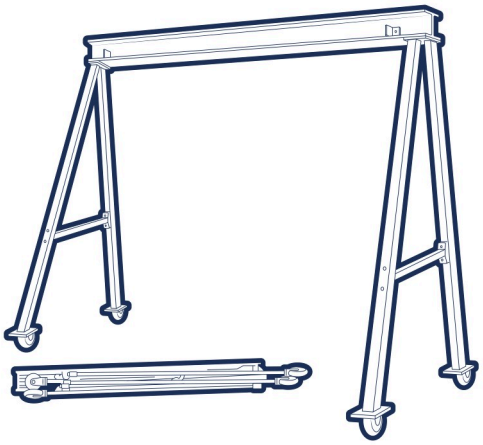


Figure 12.4.4-1 Foldaway mobile supporting structure

12.4.5 Self-Erecting Mobile Supporting Structure

Self-erecting mobile supporting structure are designed with the provision of hand winching mechanisms which allow the structure to be assembled horizontally on the floor. Operation of the winches pulls the side members of the ‘A’ frame supports together until the mobile supporting structure is in its operating position. Additional locking structural components are then inserted makingthe structurerigid. This design isusually available in the highercapacities from 2 tonnes upward. (See Figure 12.4.5-1 page 211)



Figure 12.4.5-1 Self erecting mobile supporting structure

12.4.6 Demountable Mobile Supporting Structure

Demountable mobile supporting structures are a further design variation which permits the structure to be dismantled for relocation. The construction is fully bolted, although some joints may utilise locking pins, which enables the structure to be dismantled and erected using other lifting facilities to assist in the operation. Demountable mobile supporting structures are intended for applications where long periods of service with occasional dismantling for storage or transportation is necessary. This design is available in all capacities, usually up to 5 tonnes.

12.4.7 Bracing Options

To obtain longitudinal stability and rigidity one of the following bracing options is used:

(1) Internal bracing.

(2) External bracing.

(3) Box bracing.

(4) Rigid or splice bracing.

Although any of the above options may be applied to any design of supporting structure, due to the function of self-erecting mobile supporting structures, these are usually boxed braced. The light duty, lower capacity 'A' frame and goalpost mobile supporting structures designs are usually rigid or splice braced.

12.4.8 Castors and Wheels

Castor wheels may be metallic, non-metallic, tyred, swivel or fixed to suit various site conditions. Two classes of castors are generally used:

(1) Light duty - These are suitable for carrying the weight of the mobile supporting structure only but are NOT capable of taking the weight of the load. Light duty castors must always be used in conjunction with jacks.

(2) Medium duty - These are suitable for carrying the weight of the mobile supporting structure and, when static, sustaining the weight of the load. Medium duty castors may be provided with brakes and/or rotational locking devices to prevent accidental movement of the structure when lifting.

(1) Heavy duty castors are not generally used for standard mobile supporting structure. They may be used for special purposes, such as movement under load and are therefore outside the scope of this section of the code.

(2) A supporting structure without castors or wheels can still be considered to be mobile if it is designed to be free standing and be easily dismantled or moved.

12.4.9 Jacks

Mobile supporting structure may be fitted with jacks which are intended to make the structure more permanent by taking the load off the castors. This is essential in the case of light duty castors. Some jacks are also designed to be used for levelling the structure and runway track. (See section 12.8.1 Installation of the Equipment

page 216 and section 12.11 SAFE USE OF MOBILE SUPPORTING STRUCTURES page 219) It should be noted that jacks intended for parking purposes, i.e. preventing movement by removing the weight off the wheels, may not be suitable for levelling purposes.

12.5 PRINCIPLES FOR THE SELECTION OF MOBILE SUPPORTING STRUCTURES

12.5.1 Application

Mobile supporting structures may be custom built or made up from standard components. This enables a wide range of designs and features to be manufactured to suit specific applications. This of course also affects the cost and performance. Carefully consider the selection and fully discuss the application with the supplier. (See section 12.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER page 214)

An essential part of these considerations will be the dimensions. The overall length, height and width of the mobile supporting structure must take into account any obstructions that may limit these. Equally the internal dimensions of the mobile supporting structure, i.e. span and effective length, must take into account the size and nature of the load as well as the requirements for lifting and placement of the load.

12.5.2 Selection of Mobile Supporting Structure

Consideration must be given to the type of mobile supporting structure to be selected together with any special features that may be required. Whilst not an exhaustive list, the following covers the main aspects.

12.5.2.1 Types of Mobile Supporting Structures

Goalpost mobile supporting structures are intended for light duty and are ideal for occasional maintenance work or similar applications. Their structure is less bulky than other designs, allowing the operative more freedom of movement around the structure than with other designs. The structure is however less robust than 'A' frame designs. They should not be considered where regular or heavy duty lifts are to be made.

For light duty applications which require regular dismantling of the mobile supporting structure, either for storage or for transportation from site to site, a foldaway mobile supporting structure should be considered.

'A' frame mobile supporting structures are intended for heavier duty work and applications where the structure will be left in its erected condition. They are ideal for applications which regularly require a mobile lifting facility such as loading and unloading in yards and open areas or for use in workshops. The structure is more robust than goalpost designs. They should be considered for all general purpose applications.

For heavier duty applications which require the mobile supporting structure to be dismantled between periods of use and where no other lifting aids are available to assist in the erection of the mobile supporting structure and sufficient space is available, a self-erecting mobile supporting structure should be considered.

For applications where limited variation of the height of the runway beam is required, an adjustable height mobile supporting structure should be considered. Designs vary and it should be noted that in some cases additional stays or guys are necessary to provide stability. Consideration must be given to the space occupied by such stays.

For applications where the structure will be left in its erected condition for long periods of service, but occasional dismantling for transportation or storage is required, a demountable mobile supporting structure should be considered. Consideration must also be given to other lifting facilities that will be necessary to assist in the dismantling and erection operations.

12.5.2.2 Duty

Heavy duty mobile supporting structures should be considered for applications where:

(1) A high proportion of the loads will be up to the marked SWL.

(2) Manual or power operated lifting appliances are to be used.

(3) High utilization is expected.

(4) A more robust structure is desirable.

Light duty mobile supporting structures may be considered for applications where:

(1) The majority of loads will be below the marked SWL.

(2) Manual lifting appliances are to be used.

(3) Low utilization is expected.

(4) A less robust structure is acceptable.

12.5.2.3 Type of bracing

The selection of the bracing method will largely depend on the application.

For applications which require maximum internal clearance dimensions and where there are no external obstructions, external bracing should be considered. This option allows for the maximum amount of travel along the runway or for wide loads to be lifted to the maximum height.

For applications where external obstructions exist, such as use over gangways or between machines, internal bracing should be considered. This option limits the amount of travel along the runway.

For applications where the maximum travel along the runway is required but external clearances are limited, a box braced, rigid or spliced braced mobile supporting structure should be considered. It should be borne in mind that in addition to providing rigidity to the structure, bracing may also be used to give support to the runway beam, enabling a smaller section of beam to be used. This is important in areas of limited clearances where maximum lifting height is required.

Variations in the design of the bracing and method of attachment are possible in some cases to suit particular applications. An example of this would be an internally braced mobile supporting structure where the trolley and hoist is required to travel up to the supporting member. This may be done using twin bracing members suitably spaced either side of the runway beam.

Where special bracing requirements exist, they should be fully discussed with the supplier and his advice sought.

12.5.2.4 Types of castors

The selection of the type of castor will largely depend on the surface on which the mobile supporting structure is to be moved and the duty for which it is intended. Careful consideration must also be given to the need for the wheels to be fitted with brakes and for castors to be fitted with rotational locks.

12.5.2.5 Jacks

Consideration should be given to the need for jacks. In the case of mobile supporting structures fitted with light duty castors, jacks are essential to ensure the load is not supported on the castors. They should also be considered for applications where the mobile supporting structure is to be used in one position for long periods of time. Jacks should also be considered for runway levelling purposes.

Careful consideration must be given to the type of jack to be selected to ensure it is suitable for the purpose for which it is intended. Jacks intended for parking purposes, i.e. preventing movement and taking the weight off the wheels, may not be suitable for levelling purposes.

12.5.2.6 Brakes and locking devices

The use of brakes, wheel locks and castor rotational locks should always be considered where inadvertent movement might occur, e.g. outdoor due to high winds. They may be fitted to most types of mobile supporting structures and used in addition to, or as an alternative to, jacks to prevent movement.

12.5.3 Selection of Lifting Appliance

The choice of lifting appliance, e.g. hand chain hoist, electric power operated hoist or pneumatic power operated hoist, etc., will depend on the frequency of use, nature of load and working environment. Guidance on hand chain hoists will be found in section and on power operated hoists in section of this code. For some applications, fixed point lifting is desirable as a permanent feature. This can be achieved so that the operative is on the outside of the mobile supporting structure using built-in winch and pulley arrangements.

In all cases consideration must also be given to the means of connecting the lifting appliance to the runway beam. This may be achieved by the use of trolleys, beam clamps, fixed eyes or built-in pulleys dependent on the application, type of lifting appliance and design of the mobile supporting structure. It is important that such devices are compatible with the section of beam. Guidance on travelling girder trolleys will be found in section of this code and beam clamps in section SECTION 9 - BEAM CLAMPS page 173.

In the case of power operated hoists, the type of power feed to be used must be taken into consideration together with the availability of a suitable power source. The power source must include provision for isolating the mobile supporting structure and hoist from the power supply and a ready means of disconnecting the supply when movement of the mobile supporting structure is necessary, e.g. plug and socket in the case of electrics or valve and quick release connector in the case of pneumatics. Electric power feeds must be provided

with an integral earth line and under no circumstances should the mobile supporting structure itself be used for earthing purposes. Steps must be taken to avoid hazards that may exist or be caused by the selected power feed, e.g. trailing leads or hoses. Movement of the mobile supporting structure must be restricted so that no tension is placed on the power feed. (See section 12.11 SAFE USE OF MOBILE SUPPORTING STRUCTURES page 219)

Careful consideration must be given to the capacity; both of the lifting appliance complete with its connecting device and of the mobile supporting structure. The marked capacity of the lifting appliance must not exceed that of the mobile supporting structure, so as to avoid confusion from differently marked SWLs. In the case of multi-point lifting using two or more appliances, the marked capacity of the mobile supporting structure is the maximum capacity and the total capacity of the appliances must not exceed this. For example, a mobile supporting structure marked 2 tonne SWL may be fitted with 1 x 2 tonne SWL hoist or 2 x 1 tonne SWL hoists.

Further consideration is necessary in the case of multi-point lifting. Steps must be taken to ensure that no one appliance carries more than its share of the total load.

Care must be taken if pulley block and winch arrangements, other than those built into the mobile supporting structure, are to be used. The mobile supporting structure capacity must take into account both the effects of the effort and of friction which will, in addition to the load, act on the mobile supporting structure. (See section 1 1.A4 APPENDIX 4 - STRUCTURES page 19).

12.5.4 General Considerations

Other matters which should be taken into consideration when selecting mobile supporting structures include:

(1) The runway beam must be fitted with positive travel stops (end stops) to prevent the trolley or load colliding with the supporting structure.

(2) The finish and protection of the structure should also be considered as this will usually be supplied primed and painted or self-colour as standard. Some further finishing may therefore be necessary to protect the mobile supporting structure due to its environment, e.g. outdoor or high humidity, or to protect the goods being handled, e.g. food products.

(3) In the case of mobile supporting structures which are to be exposed to the elements or where similar conditions apply, consideration should also be given to the provision of weather guards to prevent corrosion of the runway track and to offer protection to the lifting appliance.

(4) Movement and location of the mobile supporting structure must be considered. Although the surface over which the mobile supporting structure is to be moved will have been taken into account when selecting the castors or wheels, it must be remembered that small objects, e.g. stones or metal offcuts, can wedge under wheels. Steps must be taken to avoid such hazards. Similarly, floor loadings must be considered. The floor must be capable of sustaining the point loadings that will be imposed through wheels, jacks, etc. Account must be taken of hidden hazards such as underground pipes and cables which may affect this. Consideration must therefore be given to the use of floor spreader plates.

(5) As previously stated, mobile supporting structures are not intended for movement under load. Should this be necessary, a standard mobile supporting structure should not be selected. The manufacturer should be consulted and the requirements discussed in detail. Any special mobile supporting structure supplied for movement under load must be used strictly in accordance with the manufacturer's written instructions and is excluded from this section of the code.

(6) The mobile supporting structure, together with its associated hoist and trolley, should be covered by the documentation required by legislation. If this is not on record refer the equipment to a Competent Person for thorough examination.

12.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

Mobile supporting structures are readily available in a wide range of designs, sizes and duty classifications, and may of course be purpose built to suit a particular application or include various special features. The exchange of information should be as detailed as possible. As by their nature mobile supporting structures are often moved from site to site and used to handle a wide variety of loads, precise details are not always available. In these cases, only a general specification can be given. In many cases, the requirements will be basic and the information easily exchanged. Where special site conditions apply or where special circumstances exist, a visit by the supplier to survey the site should be considered as this will minimize the necessary exchange of information. In all cases, the following minimum information should be exchanged.

(1) SWL. Where possible, full details of the load to be lifted, including dimensions and weight.

(2) Type of mobile supporting structure, (e.g. goalpost, adjustable, self-erecting), including maximum wheel and/or jack loadings.

(3) Duty type, i.e. heavy duty or light duty.

(4) Details of working dimensions, e.g. height, span, effective length, etc, including any necessary clearances. This information should also include the details of any obstructions which may affect the design of the structure. Outline drawings may be used for this purpose.

(5) Details of bracing, e.g. internal.

(6) Type of lifting appliance to be used, including its connecting device.

(7) If electric power feed equipment is to be supplied, the type required, which must include provision of earth leads. This should be accompanied by details of the power supply available, including voltage, phase(s), frequency and details of the method of connection to the power source.

(8) If pneumatic power feed equipment is to be supplied, the type required. This should be accompanied with details of the air supply available, including pressure, rate of delivery and method of connection to the air supply.

(9) Type of castors, including details of the floor conditions and any other factors affecting the choice of type.

(10) If jacks are required, the type and details of permissible loading duties.

(11) If wheel brakes and /or rotational locks are required, the type.

(12) Environmental conditions, e.g. indoor or outdoor use, use with corrosive atmosphere, use in hazardous areas, use with dangerous loads.

(13) Details of finish, including any special paint or protective finish required taking account of standards or legislative requirements with regard to the use of distinctive colours.

(14) Weight of the structure.

(15) Any special features or technical requirements, including if the mobile supporting structure is to be moved under load.

(16) Full erection, operational and maintenance instructions.

12.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1 section 9.7 LEGAL REQUIREMENTS page 176 of this code.

12.7.1 Supply Documentation

If supplied without electrics and hoist the purchaser will require documented information about the extent to which the structure complies with the essential health and safety requirements and any standards together with information for use. If supplied complete it is classified as a crane system and the complete system shall be marked and supplied with documentation required by the applicable legislation and standard used for the design and manufacture.

12.7.2 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that mobile supporting structures are lifting equipment. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the mobile supporting structure's historical records for inspection by the Competent Person or local enforcing authority.

For some applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the mobile supporting structure is put into service. (See section 12.8 INSTALLATION AND COMMISSIONING page 216)

12.7.3 Repair Verification and Record Keeping

Following repair, mobile supporting structures must be re-verified by a Competent Person. The record of the repair and report of the verification should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

Although not required by legislation, new mobile supporting structures will usually be supplied with a manufacturer's record of proof load testing in addition to, although possibly combined with, the documentation required by the applicable national legislation. These documents form an important part of the record of the mobile supporting structures. They should be retained and cross referenced to the gantry's historical records for inspection by the Competent Person or local enforcing authority.

12.8 INSTALLATION AND COMMISSIONING

12.8.1 Installation of the Equipment

(1) The mobile supporting structures should be assembled and erected fully in accordance with the manufacturer's instructions, which may vary dependent on the design. Any departure from the recommended procedure should be approved by the manufacturer. Always pay due attention to safety and avoid dangerous practices. (See section 12.11 SAFE USE OF MOBILE SUPPORTING STRUCTURES page 219)

(2) Great care must be taken to ensure only components to the manufacturer's original specification are used. This is especially important in the case of self-erecting and foldaway designs as with regular dismantling and reassembly parts are more liable to be mislaid.

(3) The overall stability of the mobile supporting structures depends on a suitable floor, capable of supporting the concentrated point loads of the castors or jacks without movement. Mobile supporting structuress should never be used on slopes or inclines; the surface must be level and even; jacks may be used for minor levelling adjustments only. Caution must be exercised to avoid hidden dangers such as buried cables, pipes and ducts which may affect the load bearing capability of the floor on which the mobile supporting structures is to be used. This may be achieved using floor plates to arrive at an acceptable ground loading.

(4) The floor should be level so that the centre line of the supports is vertical and the runway beam is level. Jacks may be used to achieve this, but these should not be raised higher than is necessary and the manufacturer's specific instructions regarding their use should be obtained and observed.

(5) The erection of the lifting appliance, and where necessary the power feed system, should be carried out in accordance with the manufacturer's instructions. See also section , and , of this code for further guidance.

(6) On completion of erection, the structure should be checked to ensure all bolts and fixings are correctly in place and tightened. All pre-service checks necessary for the power feed system and lifting appliance should also be completed in accordance with the relevant sections of this code and the manufacturer's instructions. Ensure that the runway beam is level before use and that the appropriate support point at each corner is in full contact with the floor.

12.8.2 Pre-use Inspection/Thorough Examination

The degree of pre-use inspection or thorough examination required will to some degree depend on the type of mobile supporting structures used and the installation conditions. Mobile supporting structures are generally proof load tested and thoroughly examined on completion at the manufacturer's works, they are then dismantled ready for transportation to site. Further load testing after erection on site is not usually required as the manufacturer's test record remains valid, providing the erection has been carried out fully in accordance with his instructions using his original components.

Some types of mobile supporting structures are designed and intended for the user to dismantle and re-erect, e.g. foldaway and self-erecting mobile supporting structures. In such cases it may be sufficient for a suitably qualified and experienced person to inspect the installation to ensure the correct assembly and attachment of the lifting appliance. For more complex installations and those requiring a high degree of dismantling and reassembly a higher degree of examination by a Competent Person may be called for. (See section 12.7 LEGAL REQUIREMENTS page 215)

Where the Competent Person deems a proof test is necessary as a part of his thorough examination, e.g. if the mobile supporting structures has been supplied without a test certificate or following an exceptional circumstance such as a structural repair, the proof load should be at least 1.25 times the SWL. The testing will usually include deflection, dynamic and overload tests. Deflection limits shall be in accordance with the manufacturers specifications or standard to which the equipment was made.

On satisfactory completion of the thorough examination and supplementary testing, the Competent Person will issue the necessary report of thorough examination, which will include details of the tests he has made. As with the manufacturer's original documentation, this should give details of the support points, i.e. 'on jacks' or 'on castors'. As in the majority of cases the lifting appliance will be detachable from the mobile supporting structures and may have differing proof load requirements, an individually detailed or a separate report should be issued for the mobile supporting structures, the connecting device, e.g. trolley, beam clamp, etc., and the lifting appliance. These should be retained and cross referenced to the equipment's historical records.

12.9 MARKING AND STORAGE

12.9.1 Marking

In addition to the requirements of the applicable national legislation the following information should be permanently and legibly marked on a suitable part or parts of the mobile supporting structures:

(1) Identification mark(s). (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)

(2) SWL. This should be marked on both sides of the mobile supporting structures in such a way that it is readily legible from the operating position.

(3) Name of manufacturer or supplier.

(4) Year of manufacture.

(5) Maximum hoisting speed for powered hoists or else the words 'Manual Hoist', where different hoist could be fitted.

In addition, it is advisable that the weight of the structure is marked or otherwise made readily available.

Special care must be taken with regard to the SWL of the mobile mobile supporting structures and lifting appliance(s). The maximum load to be lifted, including the weight of the equipment, should not exceed the marked SWL of the mobile supporting structures. This is particularly important in cases where the lifting appliance is regularly removed and replaced as may be the case with self-erecting or foldaway mobile supporting structures, or where more than one lifting appliance is being used, i.e. multi-point lifting.

12.9.2 Storage

The choice of storage method will depend on several factors which will vary from site to site and will be related to the application, design, site conditions and utilization. The selected storage arrangements should therefore be reviewed from time to time to ensure they remain applicable to the site. There are two principal cases of storage:

(1) Mobile supporting structures which are left in their erected condition for storage.

(2) Mobile supporting structures which are dismantled for storage.

12.9.3 Storage of erected mobile supporting structures

(1) When not in use, the mobile supporting structure should be positioned so that it does not present a hazard to persons, goods or vehicles, etc. which may be working or stored in the area.

(2) Where practicable, if the mobile supporting structure is not in regular use the lifting appliance should be removed for storage. If this is not possible or desirable, the lifting appliance should be parked where it will not present a hazard. This may be found to be against an end stop adjacent to one of the supports. Where appropriate, the lifting appliance should be disconnected from the power source and offered suitable protection from weather, etc.

(3) It is advisable that, when not in use, the mobile supporting structure is parked with the jacks taking the weight off the castors to prevent accidental movement. This should be done whether the castors are fitted with brakes or not as certain types of wheels and tyres may develop flats on the treads if left supporting a weight for long periods. Mobile supporting structures which are not fitted with jacks or wheel brakes should be given special attention to ensure that they cannot be accidentally moved, e.g. by winds.

12.9.4 Storage of dismantled mobile supporting structures

(1) The storage area should meet the general requirements given in section 1.7.2 Storage and Handling page 9 of this code.

(2) When not in use, mobile supporting structures which have been dismantled for storage should be packed and stored in such a way that all the components and structural members are kept together with no danger of loss or risk of later substitution of incorrect items.

(3) Prior to placing in store, the Operative should check to ensure that all the components are present and undamaged.

12.10 IN-SERVICE INSPECTION AND MAINTENANCE

12.10.1 Pre-use Inspection

In addition to the periodic thorough examination required under statutory provisions, all mobile supporting structures should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For mobile supporting structures used infrequently it should be done before use on each day of use.

A formal pre-use inspection system should be implemented, with a written record noting the inspection date, result, and the name and signature of the inspector. In the event that it does not pass the inspection, there should be a procedure to quarantine the mobile supporting structure to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test the functionality of the equipment and make a visual check for any obvious defects and if any of the following faults are present, the mobile supporting structure shall be withdrawn from service and referred to a Competent Person.

(1) Structural defects; signs of damage, distortion or deformation of the supporting members, bracing, tie bars and lateral stiffening members. Missing structural members. Cracked welds. Distorted, loose or missing bolts and fixings. Missing locking devices and washers, in particular spring and taper washers. The overall condition of the structure should be sound with no signs of corrosion.

(2) Deformation or damage to the runway; bent or twisted beam, damaged or distorted flanges, twisted web. The surface on which the trolley runs should be clean, un-lubricated and even and there should be no corrosion.

(3) Damaged or missing end stops; distorted contact face, loose or missing fixing bolts.

(4) Damaged locking and pivot pins; bent, distorted or burred pins. Missing or damaged retaining devices. Particular attention should be paid to pins on which structural members pivot, e.g. on self-erecting mobile supporting structures; there should be no signs of scoring, burring or excessive wear.

(5) Damaged wheels and castors; chipped wheel treads, damaged tyres, bent axles, seized bearings, collapsed housing, missing or distorted fixing bolts. If brakes are fitted, they should be in good order; attention should be given to their operation which should prevent movement of the wheel. Similarly, rotational locks must prevent the castor from swivelling.

(6) Damaged jacks; bent screw shanks, burred threads, seized threads, bent, distorted or missing feet.



Any damage or defect to the wheels, castors or jacks should be viewed seriously as this may affect the stability of the structure and may give rise to the mobile supporting structure overturning.

For guidance on the defects affecting lifting appliances requiring withdrawal from service, reference should be made to the following sections of this code:

- Section 3 - Hand operated chain hoists.
- Section 4 - Hand operated chain lever hoists.
- Section 5 - Lifting and pulling machines using a gripping action on the wire rope.
- Section 6 - Power operated hoists.
- Section 8 - Travelling girder trolleys.

12.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some mobile supporting structures will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, runway duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 12.10.1 Pre-use Inspection page 218, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 12.10.3 Maintenance page 219below.

12.10.3 Maintenance

A routine preventive maintenance programme should be drawn up. This can be combined with the maintenance programme that will be necessary for the lifting appliance. It should meet the requirements set out in the manufacturer's installation and maintenance instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be given to the following points:

(1) In particular, attention should be given to the lubrication of wheel and castor bearings, which should turn and swivel freely.

(2) Screw jack threads should be cleaned, free of any debris and lubricated; ball joints should also be lubricated as necessary.

(3) The general condition of the structure should be maintained in good order. Where necessary, paint work should be rubbed down and repainted.

(4) The face of the runway track on which the trolley runs must be cleared of all debris or other matter which may impede the smooth operation of the trolley. The track face should not be lubricated or painted as this may cause the trolley wheels to slip or skid.

12.10.4 Thorough examination

The mobile supporting structure must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the mobile supporting structure's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of mobile supporting structures, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

12.11 SAFE USE OF MOBILE SUPPORTING STRUCTURES

In addition to any specific instructions relating to the safe use of the mobile supporting structure issued by the manufacturer, the following points should be observed:

(1) When erecting mobile supporting structures, never force or hammer bolts or locking pins into place. Ensure bolt holes align; use only tools designed for this purpose and never place fingers in holes to check alignment, etc. Damaged or lost nuts, bolts, washers, etc., must only be replaced with identical items of the same size and grade. In the case of fold away and self-erecting supporting structure, do not place hands near to pivoting components which may have a scissor action. Similar attention is also necessary during dismantling operations.

(2) Ensure the site will take the weight. The floor must be capable of sustaining the imposed point loads of the castors or jacks without movement. Where necessary, floor plates should be positioned under the mobile supporting structure to achieve these conditions. Caution must be exercised to avoid hidden

dangers such as buried cables, pipes and ducts which may affect the load bearing capability of the floor on which the mobile supporting structure is to be used. In considering the point loads that will be imposed, due allowance must be made for the weight of the mobile supporting structure and its associated lifting equipment in addition to the load being lifted.

(3) Ensure the surface is level and even. Jacks intended for the purpose may be used for minor levelling adjustments, but mobile supporting structure must not be used on slopes or inclines. Mobile supporting structures are usually fitted with light duty castors designed to sustain the load imposed by moving the mobile supporting structures only. They are unsuitable for sustaining any further load that may be imposed by the weight of the load or lifting operation. It is essential with such supporting structure that suitable jacks are used on every occasion of lift. Failure to observe these recommendations may result in the structure becoming unstable and the mobile supporting structure overturning.

(4) Ensure the mobile supporting structure remains stable during the lifting operation. Steps must be taken to prevent inadvertent movement as this may endanger the operative or lead to the structure becoming unstable and overturning. If jacks are fitted, they should be in contact with the floor. If the wheels are fitted with brakes, these should be locked on prior to commencing the lifting operation. Similarly, rotational locks that may be fitted to castors should be in position to prevent the castor from swivelling.

(5) The SWL of a mobile supporting structure is the maximum load for which it should be used and must not be exceeded. The weight of the lifting appliance should be allowed for in rating the mobile supporting structure. However, it should be noted that the weight of any slings and other lifting equipment form part of the load and hence may reduce the available effective lifting capacity.

(6) Do not use the hoist hook to drag any load along the ground. Before lifting the load, ensure the lifting appliance chain or rope is vertically above the load. Failure to do this will result in the mobile mobile supporting structure moving and possibly overturning.

(7) Never move a mobile supporting structure while lifting or suspending a load unless it is specifically designed for this purpose. They are usually designed for static use and the only permitted movement of the load is longitudinally along the runway via a suitable travelling trolley. The wheels and castors are fitted to facilitate positioning of the structure only. Attention to this point is important in operations such as loading and unloading vehicles. Unless the runway is long enough to allow unloading to the side then, after the load has been lifted clear, the vehicle should be moved to allow the load to be lowered and, if necessary, moved by another means. If further items are to be unloaded, the mobile supporting structure and vehicle should be repositioned for another lift to be made. Special mobile supporting structure can be manufactured that are suitable for movement under load, but they are comparatively uncommon. Unless the manufacturer confirms the mobile supporting structure is suitable for this purpose it should be assumed that it not. Such special mobile supporting structure are not covered by this section of the code and their use must be strictly in accordance with the manufacturer's written instructions.

(8) Exercise great care when handling partially suspended loads, such as when moving work pieces in and out of machine tools or removing chucks from lathes. This type of situation can lead to both swinging loads and shock loads and not only do these present a direct danger to the operative, but they can cause the mobile supporting structure to become unstable and possibly overturn.

(9) Care must be taken when rotating loads suspended from mobile supporting structure. This should only be attempted when it can be guaranteed that the centre of gravity of the load will remain directly on the vertical centre line of the runway beam. Failure to observe this recommendation may result in load swing, shock load or the structure becoming unstable and possibly overturning.

(10) Powered equipment may place higher dynamic loading on the structure than manual equipment, so conversion of a mobile supporting structure with hand chain hoist must take this into account. It should also be realised that the rating of the mobile supporting structure made allowance for this and for the weight of the hoist that was originally to be used on the mobile supporting structure. If a heavier hoist is fitted the mobile supporting structure may no longer be suitable for the marked SWL. If any doubt exists, consult a Competent Person.

(11) In the case of multi-point lifting, either using two appliances on one mobile supporting structure or two separate mobile supporting structure, follow the recommendations given in section 1.9.2 Other Requirements page 11 (6) of this code, paying regard to the stability of the structure.

(12) Prior to moving the mobile supporting structure, ensure any power supply systems are disconnected. The trailing ends of cables or hoses should be tied back to the structure so as not to be a hazard during the moving operation and to prevent them becoming damaged. Care must also be taken to ensure no danger arises from swinging hooks, chains or ropes.

(13) When moving the unladen mobile supporting structure on its castors or wheels, use manual power only. Ensure the floor surface is clear of any particles or objects which may prevent the wheels from turning, e.g. stones or metal offcuts, as sudden or unexpected resistance to the movement may cause the structure to overturn. Ensure the moving operation pays due regard to any hazards and obstructions that may be present on the site, e.g. overhead cables. Ensure the structure is moved in such a way that it remains in a stable condition at all times. Jacks must be clear of the ground. Brakes or rotational locks should be released, though it is accepted that these may be used to assist with changes of direction.

(14) Keep feet clear of wheels during the moving operation and away from jack bases when these are being lowered.

(15) Never place ladders or climb on unrestrained mobile supporting structure as they may move and cause the ladder to topple. Great care must be taken to ensure the mobile supporting structure is not overturned during the erection or dismantling of lifting appliances, etc.

12.12 TRAINING

In addition to the training recommendations specified in section 1.10 TRAINING page 12of this code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) In the case of fold away mobile supporting structure, self-erecting mobile supporting structure or other designs which require regular dismantling and re-erection, the operative should be trained in the correct procedure applicable to the specific design. The training programme should pay due attention to safe systems of work.

(2) Operatives should be instructed in the correct use of the mobile supporting structure. Emphasis should be given to the aspects of movement, stability and the danger of overturning when considering dangerous practices.

(3) Operatives must have good eyesight and be able to judge distances, heights and clearances and the training programme should cover this aspect of the operation. If the use of the mobile supporting structure and its associated lifting appliance calls for manual effort to push the mobile supporting structure into position, or to push/pull the load, the operative should be physically fit for such activity.

Section 13 - JACKS

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13.1 FOREWORD

Jacks are widely used in industry where loads need to be raised or lowered a limited distance. They are often used to afford access for other means of handling or lifting equipment and for levelling purposes. Their versatility of use and portability make them ideal for many maintenance functions. As a result, jacks have often been mistakenly considered as tools rather than lifting appliances.

Jacks are hydraulically or mechanically motivated by manual or power systems. The range of designs, sizes and capacities is almost limitless, and many manufacturers produce as standard jacks designed for a specific function, e.g. re-railing locomotives. This document focuses on common manually operated jacks, although excluded types may share similar requirements.

There are several modern standards throughout the world covering a wide range of mobile or movable jacks for various applications. The range includes hydraulically-operated, pneumatically- operated, electrically-operated and manually-operated jacks and jacks for road vehicles. However, prior to these there were very few standards for general purpose jacks and, as a result, many manufacturers produced, and continue to do so, a range of jacks to their own specifications.

Hydraulic cylinders (rams), with independent pumps connected by hoses, are often used in jacking applications. Although no specific guidance is given, the principles set out in this section of the code may be equally applied to certain cylinders when they are used for jacking purposes.

13.2 SCOPE

This section covers manually operated hydraulic or mechanical jacks used to raise or lower loads vertically, supported on either the head or toe. The principles set out in this section of the code may also be applied to independent hydraulic cylinder (ram) and pump units when they are used for vertical jacking operations.

This section of the code excludes jacks designed so that the supporting head moves through an arc when raising or lowering, jacks designed for a specific function such as re-railing locomotives, jacks with traversing bases, trolley jacks, pit-prop or scaffold jacks, drawbar jacks, aircraft tripod jacks, vehicle jacks, pole jacks and jacks used for raising and lowering portable buildings and containers. The use of hydraulic cylinder (ram) and independent pump units for purposes other than vertical jacking operations is also excluded. It is however acknowledged that these items may have much in common with the jacks described in this section of the code and the recommendations may be equally applied to them when they are used in certain applications.

13.3 DEFINITIONS

The definitions given in section 1.3 DEFINITIONS page 2 of this code apply. Other terminology applying to jacks is adequately explained by the text or by the illustrations contained within the text.

13.4 TYPES OF JACK

Jacks are available in a wide range of designs to suit various applications and duties. They are manually operated, utilizing hydraulic or mechanical means to facilitate the lifting motion and in some cases the lowering motion, but most hydraulic jacks rely on gravity for lowering.

13.4.1 Hydraulic Jacks

Hydraulic jacks use oil as the lifting medium, the body of the jack acting as a reservoir for the oil. When the jack is operated, oil is passed under pressure through a system of non-return valves to the base of the ram chamber. As more oil is delivered with each stroke of the operating lever, and as the oil cannot be compressed, it forces the ram out of the chamber providing a lifting motion. Lowering is achieved by releasing a valve which allows the oil to return to the reservoir. The operation of the release valve may be by depressing a lever, turning a screw or opening the valve directly. The ram is then returned by gravity, although in some cases this may be spring assisted.

The controlled use of hydraulics, where known pressures are applied over known areas, enables jacks to be used for load weighing purposes. Calibrated gauges may be fitted to some models to enable them to be used for this purpose.

Hydraulic jack bodies are commonly manufactured from aluminium, steel or cast iron. The material used affects the design, size, self-weight and capacity of the jack.

13.4.2 Aluminium Constructions

Jacks constructed of aluminium tend to be of robust design and are used for high capacity, heavy duty jacking operations. They are generally available in a range of capacities up to 150 tonnes, although other capacities may be available. Lifting rams used in this construction of jack are normally single stage giving a range of run-outs (lifts) of 152mm, 305mm or 457mm. The profile of the base is usually rectangular and the body casting incorporates a carrying handle. Operation of the jack is commonly from the back of the unit and the front face of the body is flat to allow the use of a claw attachment.



Figure 13.4.2-1 Aluminium Jack

The use of a claw attachment provides the means of supporting the load on the head of the jack or on a toe. It should however be noted that the maximum load permitted on the toe of the claw attachment is considerably less than on the head, usually only 40% of the head load. Further it should also be noted that only jacks with extended bases can be used in conjunction with claw attachments as these prevent the jack from overturning.



Figure 13.4.2-2 Jack with claw attachment

Some models are available with a screwed locking collar. In this case the lifting ram has a robust male thread along its length and a screwed collar is fitted to this. This enables a raised ram to be locked in position against the base of the jack. Should there then be any loss of pressure within the hydraulic system, the load will be supported by the collar against the base, preventing the ram from creeping down.

13.4.2.1 Tubular steel construction

Jacks constructed from steel tube or tubular form steel pressings tend to be of basic design and are used for low to medium capacity, light to medium duty jacking operations. Within this type of design falls the increasingly popular continental style of jack, generally available in a range of capacities up to 20 tonnes, although larger capacities may be available. Lifting rams used in this construction of jack are normally single stage giving a range of runouts (lifts) varying between 85mm and 160mm. The profile of the base is usually square and there is no special provision made for carrying the jack. Operation of the jack may be from the side or back of the unit.

Some models are available with telescopic lifting rams allowing for greater runouts from low profiled bodies. It must be remembered however that the reservoir, and therefore the jack body, must be large enough to accommodate sufficient oil to fully extend the lifting ram. This results in the outer diameter of the body being larger than for single stage rams.



Figure 13.4.2.1-1 Tubular steel jack

13.4.2.2 Cast iron construction

Jacks constructed from cast iron tend to be sturdy in design and are used for medium capacity, general duty jacking operations. The popularity of this design has declined in favour of the continental style of jack in recent years as the self-weight of the cast iron unit is greater than that of the tubular steel jack. They are generally available in a range of capacities up to 12 tonnes. Lifting rams used in this construction of jack may be single stage or telescopic with runouts (lifts) varying between 150mm and 200mm. The profile of the base is usually circular, and the design incorporates a carrying handle. Operation of the jack is usually from the side of the unit.

Some models are available with an adjustable height head. This is achieved by using a tubular lifting ram with a female thread form, the head of the jack being mounted on a male threaded shank which is screwed into the ram. This allows the height of the head to be raised by up to 130mm prior to commencing the jacking operation but cannot itself be used to raise the load.

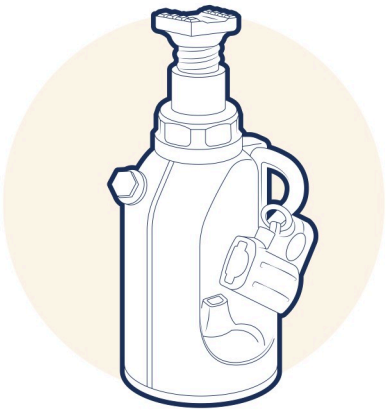


Figure 13.4.2.2-1 Cast iron with adjustable head

13.4.2.3 Other designs of hydraulic jacks

As already stated, the range of design, size and capacity of hydraulic jacks is extremely extensive, and it is not possible in a document of this nature to detail all of the available types of jack. Over the years, each manufacturer has tended to specialise, developing their own particular design range and it is often necessary to consult several manufacturers to ascertain the availability of suitable jacks for specific duties. Three of the more common types of specialist hydraulic jack which are generally available are:

(1) Low profile jacks. These offer low closed heights with very restricted ram runouts (lifts). They are available in a wide range of capacities. This type of jack is used for such duties as bridge jacking to allow bearing replacement. (See Figure 13.4.2.3-1 page 226)

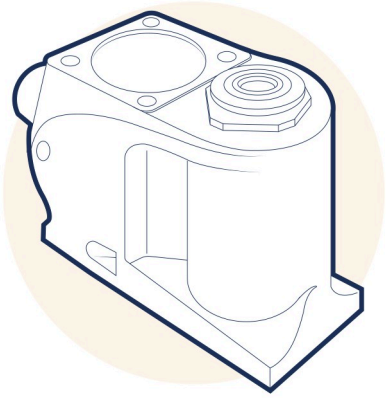


Figure 13.4.2.3-1 Low profile jack

(2) Ship jacks. A variation of the low profile jack, but very much larger, is known as the ship jack. These offer high capacities of 1000 tonnes or more. They were, as the name suggests, originally developed for the shipbuilding industry.

(3) Claw jacks. These have toes built into the rams and offer the same capacity on the head or toe, usually limited to 5 tonnes. Although originally developed for the mining industry and produced in all ferrous metal, they are extensively used for general purposes. (See Figure 13.4.2.3-2 page 227)

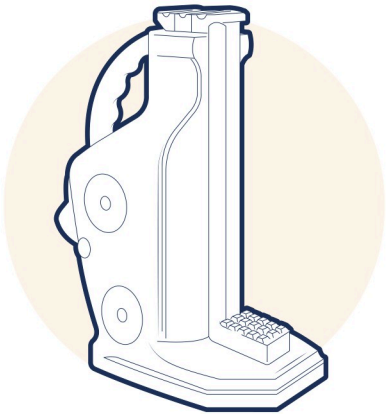


Figure 13.4.2.3-2 Claw jack

13.4.3 Mechanical Jacks

Mechanical jacks use ratchet, screw or gear mechanisms as the lifting medium. Reversal of the mechanism is used to lower the jack.

Mechanical jacks are usually manufactured from cast ferrous materials although some models are available manufactured from aluminium.

13.4.3.1 Ratchet jacks

Currently the most popular type of mechanical jack is the ratchet jack. The body of the jack contains a pair of pawls which engage in a rack. Operation of the jack causes the pawls to raise or lower the rack, which is fitted with a lifting head and toe, providing alternative positions for supporting the load. Ratchet jacks are available in a range of capacities up to 20 tonnes and, in most cases, the full rated load may be supported on the head or toe. The movement of the rack (lift) varies between 175mm and 450mm. The profile of the base is rectangular, extending beyond the toe so as to give stability to the jack when the toe is in use.

During the jacking operation the operative effectively carries the load via the operating lever. At the end of each stroke the load is sustained by a pawl. Due to the high effort required some models are designed for more than one operative. Further, for the same reason, it is not always possible to raise the full rated load, but it is possible to lower the rated load. This type of ratchet jack is therefore commonly referred to as a lowering jack. To enable the rack to be positioned quickly a rack release mechanism is incorporated, which holds the operating pawls away from the rack, so arranged as to prevent its free fall under load.

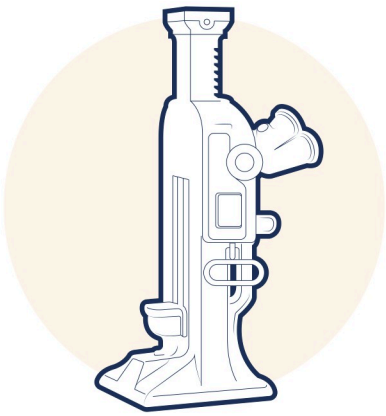


Figure 13.4.3.1-1 Ratchet lowering jack

13.4.3.2 Screw jacks

The screw jack is perhaps the oldest form of jacking device known. The base consists of a single hollow casting with a square form female thread into which fits a male screwed shank. A swivel head is fitted to the shank to support the load. Directly turning the screwed shank causes it to raise or lower. Screw jacks are available in a range of capacities up to 24 tonne, with screw movements (lifts) from 50mm to 320mm. The profile of the base is usually circular.

Although operation is normally by tommy-bar directly through the screwed shank some models are available with ratchet lever or gear operated screws.

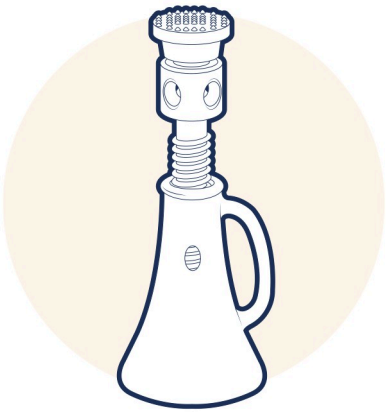


Figure 13.4.3.2-1 Screw jack

13.4.3.3 Journal jacks

The journal jack consists of a cast body which houses a bevel gear and screw mechanism. Operation of a ratchet lever turns the gears which drive a screwed shank. This in turn drives a running nut which is captive in the lifting journal and therefore causes the journal to raise or lower. Journal jacks are generally available in a range of sizes up to 50 tonnes capacity with a journal runout (lift) of 100mm to 150mm. The profile of the base is usually circular.

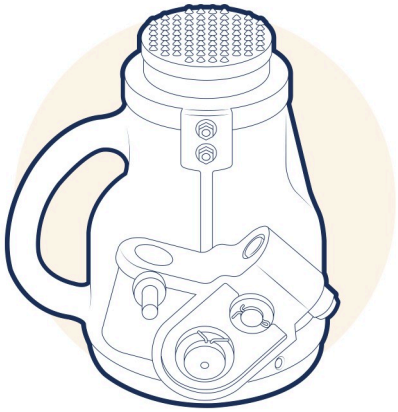


Figure 13.4.3.3-1 Journal jack

13.5 PRINCIPLES FOR THE SELECTION OF JACKS

13.5.1 Application

Many factors influence the selection of the correct jack, and supplier advice should be sought for the most suitable option. For some applications it may be beneficial to use an independent cylinder and pump arrangement. These are available in a wide range of sizes and capacities. It is possible to arrange several cylinders to operate from a single pump and the operative can be remote from the load. Whilst no specific guidance is given for their selection, many of the principles will be the same as for jacks. The following general points should always be considered when selecting jacks.

13.5.2 Capacity

The selected jack's capacity should always exceed the maximum load it will carry. Jacks are seldom used singly but tend to be used in multiples resulting in one jack taking more than its share of the load. The selected jacks must take full account of this as in the worst case the full load may act on one jack only. (See section 13.10 SAFE USE OF JACKS page 233)

13.5.3 Operating Features

There is a wide choice of jack designs, each with its own operational advantages and disadvantages for certain applications. The operating features should be carefully considered when selecting the type of jack to be used.

Hydraulic jacks offer low to very high lifting capacities with comparatively low operator effort. During the lifting operation, the ram may be stopped accurately at any position, whilst lowering is normally by gravity and relies on the skill of the operative to control descending loads. A valve is manipulated to control the descent and must be completely shut when the required position is reached.

It must also be remembered that any loss of pressure within the hydraulic system will cause the ram to sink and even well maintained jacks in good order are liable to creep downward. A screwed ram with locking collar may be used to assist in accurate downward placement of the load and to sustain the load in position, but it is necessary to raise the ram to release the collar when the jack is to be removed.

Ratchet jacks offer medium lifting capacities, but operator effort can be very high, some operations needing more than one operative. The raising and lowering motions can only be halted after one complete stroke of the operating lever giving a height variation equal to one pitch of the rack teeth. They do however offer greater distances of travel than other types of jack. When lowering the load, the mechanism raises the load a short distance before it descends on each stroke of the operating lever.

Screw jacks offer medium lifting capacities but operator effort can be very high, some operations needing more than one operative. The raising and lowering motions can be accurately halted and the load sustained in any position. Lower operator effort can be achieved and placement of the load can be accurately controlled if a journal jack is selected.

13.5.4 Closed Height

Consideration must be given to the closed height of the jack, which should be such that the jack will pass freely into position directly below the jacking point. It must also be remembered that the lifting distance, i.e. movement, will be considerably less than the closed height of the jack. For loads with low jacking points, the use of a jack with toe or a claw attachment should be considered.

13.5.5 Extended Height/Packing

The extended height, and therefore the movement of the load, will be governed by the jack design. Where the load is to be raised a greater amount than the design of the jack will permit in a single lift, the use of suitable packing material will be necessary, both to rest the load on once the maximum jack movement has been achieved and to seat the jack on in order to allow a second lift to be made. Careful consideration must be given to the initial jack selection and to the selection of suitable packing material. (See section 13.10 SAFE USE OF JACKS page 233)

13.5.6 Floor Loadings

The full weight carried by the jack will act on the floor through the base of the jack and often this is a much smaller area than the load itself presented to the floor. The floor must be capable of sustaining the point loads that will be imposed by the jacks. Account must be taken of hidden hazards such as underground pipes and cables which may affect this. Consideration should therefore be given to the use of floor spreader plates. (See section 13.10 SAFE USE OF JACKS page 233)

13.5.7 Operating Access/Clearance

When considering the type of jack to be selected, account must be taken of the access and clearances available to the operative. Jacks which operate from the back allow the jack to be placed further under the load than those with side operation. Jacks with tommy-bar operation may necessitate the operative reaching under the load, a practice which must be avoided, or large clearances to enable the bar to be turned freely. In order to keep operator effort to an acceptable level, the operating levers of ratchet jacks tend to be longer than those of other types of jack, requiring greater clearances to allow full movement. It is a feature of ratchet jacks that in order to allow the holding pawl to engage, the operating lever must make a full stroke, which is not the case with other types of jack.

13.5.8 Jacking Points

Some items will be provided with purpose made jacking points and where this is the case, they should always be used. In other cases, the load must be carefully assessed and suitable jacking points selected. Care must be taken to ensure the jacking points selected are capable of taking the full load that will be imposed on them and that their use will not damage or deform the load. The flexibility of the load must also form part of the considerations in selecting jacking points.

13.5.9 Pressure/Load Measurement

Where hydraulic jacks are to be used for load measurement or weighing purposes, consideration should be given to the gauge calibration, which is available in units of pressure, force or mass. The correct gauge for the jack and the intended use should be selected.

13.5.10 Load support

Attention should be given to other accessories which may be required. If hydraulic jacks are to be used to sustain the load for long periods, the use of jacks with screwed rams and locking collars should be considered. Where this is not possible or where other types of jack are used, suitable packing, axle stands, trestles or other means of positive support should be considered. Loads should not be supported by jacks alone and under no circumstances should any attempt be made to work on items supported by jacks.

13.5.11 Classified Atmospheres

Due to the possibility of sparking, the use of aluminium is restricted in certain classified atmospheres, e.g. in mines. Care must therefore be taken when selecting jacks for use in such areas so as to avoid the use of aluminium jacks or jacks with aluminium components.

13.5.12 Documentation

The jack should be covered by the documentation required by the applicable legislation. If this is not on record refer the jack to a Competent Person for thorough examination.

13.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

Jacks are readily available in a wide range of designs, sizes and capacities, some including special features making them suitable for certain applications. The exchange of information should therefore be as detailed as possible. As by their nature jacks are often moved from site to site and used to handle a wide variety of loads, precise details are not always available and in these cases only a general specification can be given. In many cases, the requirements will be basic and the information easily exchanged. In all other cases the following minimum information should be exchanged:

(1) Capacity. Where possible, full details of the load to be lifted, including dimensions, weight and details of jacking points.

(2) Type of jack, i.e. hydraulic, ratchet, screw or journal.

(3) Details of working dimensions, e.g. closed height, extended height, size of head of jack, height and size of toe, etc.

(4) Details of the intended use, including utilization and required accuracy of load placement. Where the jack is required for general purpose use, it may be necessary to impose limits on the use. The manufacturer's instructions should therefore be sought and their recommendations followed.

(5) Environmental conditions, e.g. outdoor or indoor use, use in corrosive atmospheres, use in hazardous areas, use with dangerous loads, etc.

(6) Details of finish, including any special paint or protective finish.

(7) Any special features or optional fittings such as claw attachment, gauges, etc.

(8) Any other technical requirements.

(9) Operational and maintenance instructions, including limitations of use.

13.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

13.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in code makes it clear that jacks are lifting equipment. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a

Competent Person at intervals not exceeding 12 months. Reports of thorough examination should be retained and cross referenced to the jack's historical records for inspection by the Competent Person or local enforcing authority.

13.7.2 Post Repair Verification and Record Keeping

Following repair, jacks must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the jack's historical records for inspection by the Competent Person or local enforcing authority.

13.8 MARKING AND STORAGE

13.8.1 Marking

In addition to the information required by the applicable legislation and standard being worked to the following information should be permanently and legibly marked on a suitable part or parts of the jack:

(1) Identification mark(s). (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) Capacity, i.e. maximum load to be lifted on head and/or toe.

(3) Name of manufacturer or supplier.

(4) Year of manufacture.

13.8.2 Storage

Jacks should always be stored upright. When not in use, they should be returned to a designated storage area and not be left laying about work areas. The storage area should meet the general requirements given in section 1.7.2 Storage and Handling page 9 of this code, in addition to which the following recommendations are made:

(1) In the case of hydraulic jacks, the ram should be lowered prior to storage, thus protecting the face of the ram from damage. Some hydraulic jack designs incorporate leather cup washers. In this case, the jack should be given a single stroke of the operating handle and the release valve kept closed whilst in storage to ensure the cup washers will remain expanded. In other cases, the release valve should be left open to keep the system pressure free. In case of doubt, seek the supplier's recommendations on storage which should be followed. Operating levers should be removed, identified and stored separately from the jacks.

> ⓘ During storage, seepage of oil may occur and such leaks should be investigated and if necessary, the jack should be overhauled.

(2) Prior to storage, mechanical jacks should be lubricated and greased to protect the teeth of racks, pawls and screw threads from corrosion. The jack should be stored in its lowest position to protect the teeth of racks and screw threads from damage. The operating lever or tommy-bar should be removed from the jack, identified and stored separately from the jack.

> ⓘ Care is needed when lubricating ratchet jacks as research has shown that excessive grease can cause the holding pawl to stick and not engage with the rack to sustain the load. The holding pawl has a fall back action which is vital to the safe use of the jack and any delay to this action can result in the load being dropped.

13.9 IN-SERVICE INSPECTION AND MAINTENANCE

13.9.1 Pre-use inspection

In addition to the recommended periodic examination by a Competent Person, jacks should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For jacks used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person

making the inspection. In the event that it does not pass the inspection, there should be a procedure to quarantine the jack to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to test the functionality of the equipment and make a visual check for any obvious defects and if any of the following faults are present, the jack shall be withdrawn from service and referred to a Competent Person.

In the case of hydraulic jacks:

(1) Jack fails to lift. The jack will not raise the load or after a short period of movement the load rises and falls (pumps) with each stroke of the lever.

(2) Jack fails to sustain the load. When lifting operation ceases the load begins to lower on its own.

(3) Oil leaks, particularly during the operation of the jack.

(4) The ram is scored, nicked or otherwise damaged .

(5) Ram fails to lower, lowering is jerky or fails to fully retract. The ram may appear to lower in stages or move at varying speeds during lowering and in some cases stop moving altogether.

> Hydraulic rams usually retract by gravity, so once the load is fully lowered, the movement of the ram will slow considerably or even stop. This is normal and if pressure is applied to the ram, it will continue to lower.

(6) Release valve is difficult to operate or fails to release the load.

(7) Cracks, dents or other mechanical damage to the jack body.

(8) Base of the jack is twisted or bent preventing the jack from sitting solidly on the floor.

(9) Claw attachment will not sit correctly on head of jack or the claw is cracked, distorted or otherwise damaged.

In the case of mechanical jacks:

(1) Jack fails to lift or load slips back after each stroke of the operating lever.

(2) Jack fails to lower load.

> It is a feature of ratchet jacks that the load will rise a short distance prior to lowering, the load will then be lowered the distance of the pitch of one tooth on the rack. This process is repeated with each stroke of the operating lever.

(3) The teeth of the rack are chipped, worn, corroded or otherwise damaged.

(4) The screw is chipped, worn, corroded or otherwise damaged.

(5) The body or main frame of the jack is bent, cracked or otherwise damaged.

(6) Swivel heads are seized or do not turn freely.

(7) The rack, including the toe, is bent, cracked or otherwise damaged.

(8) The base of the jack is twisted or bent preventing the jack from sitting solidly on the floor, or the base is cracked.

13.9.2 Interim inspection

In addition to the thorough examination and pre-use inspection some jacks will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature, jack duty and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 13.9.1 Pre-use inspection page 231, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 13.9.3 Maintenance page 233 below.

13.9.3 Maintenance

A routine preventive maintenance programme should be drawn up. This should meet the requirements set out in the manufacturer's maintenance instructions in addition to any requirements of the particular site due to the conditions of service. In any event attention should be given to the following points:

(1) In particular, attention should be given to the lubrication of the rack or screw mechanisms of mechanical jacks.

(2) In the case of ratchet jacks, regular cleaning and occasional adjustment of the lowering spring mechanism may be necessary. Care is necessary as the excessive use of grease can cause the holding pawl to stick or become retarded in its operation. If the holding pawl does not fall into place correctly, the rack will become free and will fall thus dropping the load. A similar condition can arise from the incorrect fitting of the mechanism or the use of incorrect parts. It is imperative that only the original manufacturer's approved spare parts are fitted and that this is done strictly in accordance with their instructions.

(3) Oil levels of hydraulic jacks may require occasional topping up or the oil may require periodic draining and replacement. It is essential to the correct operation that the oil level is maintained and that the oil is clean and free of any dirt or debris. Only oil recommended by the manufacturer should be used.

(4) In all cases, jacks should be cleaned regularly to remove any dirt or debris, paying particular attention to the racks and screws of mechanical jacks and to the area around the top ram seals of hydraulic jacks, which may interfere with the correct operation or otherwise cause damage to the jack mechanism.

13.9.4 Thorough examination

The jack must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 12 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the jack's historical records for inspection by the Competent Person or the local enforcing authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, functional testing, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of jacks, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

13.10 SAFE USE OF JACKS

In addition to any specific instructions relating to the safe use of the jack issued by the manufacturer, the following points should be observed:

(1) Most jacking operations involve multiple jacks, requiring special care since it is not possible to raise or lower them in perfect unison. This results in an uneven loading condition with the weight distribution being transferred from one jack to another. Any one jack can therefore be carrying a greater load than the other jacks in the arrangement at any time. The capacity of the jacks should be adequate to account for this and the operation must be supervised in such a way that this condition is limited. (See note at end of this subsection)

(2) In many cases, it will not be possible for the operatives to see all of the load and it will be necessary to have a Responsible Person in charge of the operation to ensure the load is kept level and that each jack carries its correct share of the load within the limits of operation. An agreed system of instruction and signals should be used so as to avoid any confusion between the operatives.

(3) The floor must withstand the load imposed by the jacks. Use floor plates if necessary to distribute the load over a wider area. Caution must be exercised to avoid hidden dangers such as buried cables, pipes and ducts which may affect the load bearing capability of the floor on which the jacks are to be used.

(4) The surface on which the jack is to be placed should be level and even, allowing the base of the jack to sit firmly without any tendency to rock or tilt. If necessary, suitable floor plates or packers should be used to ensure this condition.

(5) The jacking point on the load must be carefully selected so as to ensure the jacking operation does not damage the load. Precautions must be taken to ensure the head of the jack is in full, firm contact with the jacking point and to prevent the head of the jack slipping. If necessary, suitable packing should be placed between the jack head and the load.

(6) Never raise a load higher than is necessary. Use suitable packers to ensure the load will not tilt or fall in the event of a jack failure. A process of lifting and packing in short stages may be necessary to ensure that in the event of a jack slipping or failing the load will only drop a short distance onto the packing. Where fitted, screwed collars should be regularly adjusted for this purpose.

(7) Never leave a load supported entirely by jacks; ensure the load is supported by suitable packing or by the use of screwed collars. In some cases, purpose made axle stands or trestle supports may be used to advantage.

(8) Only use packing which is capable of withstanding the crushing effect of the load and which itself will not kick out or topple due to the downward thrust of the load.

(9) Care must be taken to prevent the jack kicking out or toppling due to an oblique thrust caused by incorrect packing, unstable load, uneven operation or unsuitable mounting. Special care is necessary if one jack only is being used.

(10) In cases where independent cylinders and pumps are employed, additional measures may be necessary to ensure stability. Cylinders tend to be of small diameter with no enlarged base so the stability of the arrangement must be guaranteed before commencing the operation.

(11) Jacking operations are often carried out in confined spaces as no other means of lifting can gain easy access. Care must be taken to ensure operatives do not become trapped or pinned by the movement of the load and that they always have a clear exit.

(12) Never reach, or allow anyone else to reach, under a load supported by jacks. Keep fingers and toes clear at all times, taking special care when placing or removing packing, or when positioning machinery skates, slings or other lifting or handling equipment.

(13) Under no circumstances should anyone be permitted to work or climb on a load which is supported by jacks.

(14) Never over-extend a jack. It is unwise to use any jack in its fully extended position. In the case of hydraulic jacks, many are fitted with a mechanical stop which prevents the ram from extending too far. Others are merely marked with an indicator when the maximum ram extension is achieved. Continued operation will result in the ram being ejected from the body causing the load to fall. Screw jacks are provided with a viewing port in the body so that the operative is able to monitor the screw movement. The screw must be visible through the port at all times or the screw may be ejected from the body thus dropping the load. On some models, the screw may be pegged or spot welded to prevent it being raised too far. Continued operation can cause this to nip and lock the screw making lowering difficult. In the case of ratchet and journal jacks, racks and journals are usually captive within the body. Continued operation after the jack has reached its maximum extension may cause excessive strain on the mechanisms and in severe cases may result in them becoming jammed or failing.

(15) In the case of ratchet jacks, whilst in operation the load is carried by the operative via the operating lever. At the end of each stroke of the lever, the load is sustained by a pawl. On no account should any attempt be made to balance and hold the load by applying effort to the operating lever.

(1) In all operations care must be taken to ensure that the jack is not overloaded inadvertently, as may occur if the load tips shifting the balance of the load. In some cases, the equipment may have built-in overload protection or the operational features may limit the ability to lift loads greater than the rated capacity. Even so, damage or failure may still be caused by overloading due to shifting loads. Whilst this can occur during the lifting operation, a greater danger exists when loads are being lowered and this is particularly the case with hydraulic jacks. Lowering is controlled by the skill of the operative opening a valve allowing the jack to retract by gravity. In multiple jack applications, it is very difficult to maintain even control when lowering. (See section 13.5.3 Operating Features page 228)

(2) In the case of hydraulic jacks, a pressure relief valve may be fitted in the system so that once a predetermined pressure is achieved, the valve will open preventing a further increase in pressure. Alternatively, the system may be designed so that it is impossible to exceed a predetermined pressure by normal operation. However, to ensure the jacks operate correctly up to and including their rated capacity this maximum pressure will be in excess of the normal working pressure. If dirt is present in the oil or if the oil has become emulsified, relief valves and non-return valves may not function correctly. In these circumstances, excessive pressure may be developed, this can lead to failure of seals or damage to the hydraulic system, allowing the load to fall.

(3) In the case of mechanical jacks, operating levers may be fitted with shear pins so that if a greater effort is applied than that for which the mechanism is designed, the pins will shear preventing further operation. However, in the majority of cases, mechanical jacks are limited only by the length of lever and the effort that the operative can apply. The use of longer levers or more than the recommended number of operatives can result in the mechanism becoming over-stressed and failing, allowing the load to drop.

(4) Whilst the above measures will protect the equipment if attempts are made to raise loads greater than the design maximum, if a greater load is accidentally placed on a raised jack, e.g. as a result of the load tipping, the jack will fail thus dropping the load.

13.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be instructed in the correct use of the jack, in particular they should be made aware of the operational limits of the specific jack design. Emphasis should be given to the dangers of attempting to raise the jack beyond its intended maximum height, allowing the load to tilt and jacking on unsuitable surfaces.

(2) Operatives should be instructed in the selection and correct use of suitable spreader plates and packing. They should be made aware of the dangers that can arise from incorrect selection and use.

(3) Operatives should be instructed in the selection of suitable jacking points and in the consequences of incorrect selection.

(4) The training programme should pay due attention to safe systems of work. Emphasis should be given to multiple jacking operations and the need to understand the procedure and instruction system to be employed.

Section 14 - CHAIN SLINGS

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14.1 FOREWORD

Although chain slings represent a highly versatile, durable and safe means of connecting loads to lifting appliances, they should only be used in the correct manner if dangerous lifting practices and service damage are to be avoided. Historically, this has not always been the case and many slings have been subjected to great abuse in service. The comments and recommendations contained in this section of the code are intended to provide guidance on the correct usage of chain slings.

14.2 SCOPE

This section of the code defines the correct selection, in-service inspection, usage and storage of chain slings constructed from the various grades of chain conforming to the common national and international chain standards.

Wrought iron chain slings are obsolete and no longer available. Similarly, mild steel chain slings were rendered obsolete in the early 1980's following the publication of newer standards which specifically exclude the use of this grade of chain for lifting applications. However, it is possible that examples of wrought iron and mild steel chain slings may occasionally be found in service, but their continued use is not recommended by LEEA and they are therefore outside the scope of this code.

A brief history of chain grades;

'The history of material grades is rather complex. They are not in fact material grades but rather product grades. The origin is chain, and the grade is the breaking strength of the chain expressed as grade x chain diameter squared. It only works in imperial units so a 1" grade 40 chain broke at 40 x 12 = 40 tons. A ½" grade 80 breaks at 80 x ½ 2 = 20 tons.

When chain went metric some companies started using letter grades to make the distinction. Others used an abbreviated number e.g. 4 instead of 40.

Coincidentally the mean stress at failure when expressed in N/mm2 is almost 10 x the breaking strength in tons derived from the above formula. So imperial grade 80 has a mean stress at failure of approximately 800 N/mm2. The mean stress is now used to define the grade. So grade 40 became M or 4, 60 became S or 6 and 80 became T or 8. This has continued with grade 100 being V or 10.

There were a few variations along the way. The original BS grade 40 was used at a factor of safety of 5:1 and because of that, it could either be in the normalised condition or hardened and tempered. To make the distinction the mark 04 was used for normalised and 40 for hardened and tempered. Later the factor of safety was reduced to 4:1 so it had to be hardened and tempered and again to make the distinction, grade M was used. So all three have the same breaking strength but the heat treatment and rating varied.

Once all grades of chain were hardened and tempered, the letters and numbers became interchangeable and expressed as M(4), S(6) and T(8). However when the European standards programme in the late 1980s, it was agreed to use the number grades for medium tolerance chain for chain slings and the letter grades for fine tolerance chain for hoists. At the same time we started using the terms 'medium tolerance' and 'fine tolerance'. Previously chain for hoists was termed 'calibrated' to make the distinction but in practice all machine made chain is calibrated as part of the manufacturing process, the distinction is one of accuracy.

The European separation of number and letter grades was then adopted in ISO. There are also a few other variations. Chain for use in hand operated hoists is through hardened but for power operation it is surface

hardened to improve the wear hence we have grade T (Types T, DAT and DT) the types DAT and DT being surface hardened. Also in ISO there are grades TH and VH these being through hardened and grades T and V for hand operated hoists.

When applied to components other than chain, the grades are not defined strictly by stress levels, rather by being compatible with the same grade of chain so whilst the maximum stress levels may be of similar order, it is the manufacturer who decides on most of the dimensions (within the confines of the dimensional envelope) and therefore the stress level. Hence some manufacturers can use the same components for grades 8 and 10.'

At the present time, the majority of chain slings in service are grade 8 or grade 80 (or T – See note below about the use of letter grades in older standards). Other grades, notably 40, M, 4 and, to a lesser degree, 60, S, 6, of welded construction may also be found in service and are therefore covered by this code of practice. Grades 8, 80 and T have a breaking load twice that of grades 40, M, 4 and are therefore lighter for the same strength.

Although not yet standardised in many parts of the world, grade 10, or higher, chain slings are available and gaining in popularity.

> Older national and international standards permitted the use of either letters or numbers to indicate the grade of chain irrespective of its intended use. However, most modern standards now reserve the use of numbers to indicate the grade of medium tolerance chain for chain slings and the use of letters to indicate the grade of fine tolerance chain for lifting appliances.

14.3 DEFINITIONS

The definitions given in section 1.3 DEFINITIONS page 2 of this code apply. Other terminology applying to chain slings is adequately explained by the text or by illustrations contained within the text.

14.4 TYPES OF CHAIN SLING

14.4.1 Common Sling Assemblies

This subsection illustrates the most commonly used chain sling assemblies. Other special assemblies may be devised for lifting specific unusually shaped loads. Although the upper terminal fittings illustrated are links, rings were also permitted in some standards, but LEEA does not recommend their use.

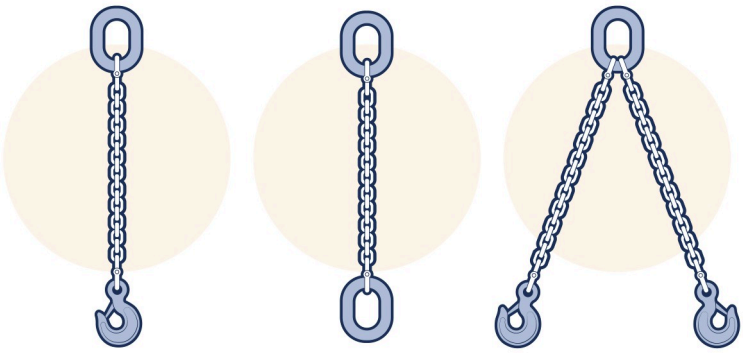


Figure 14.4.1-1 A. Single leg sling. B. Collar sling (If one end will pass through the other, this is known as a reevable collar sling). C. Two leg sling.

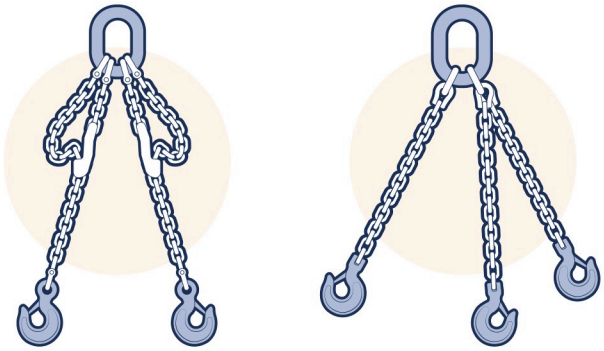


Figure 14.4.1-2 A. Adjustable two leg sling. B. Three leg sling.

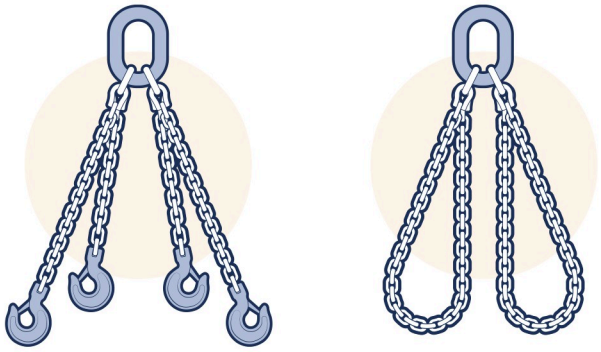


Figure 14.4.1-3 A. Four leg sling. B. Double basket sling.

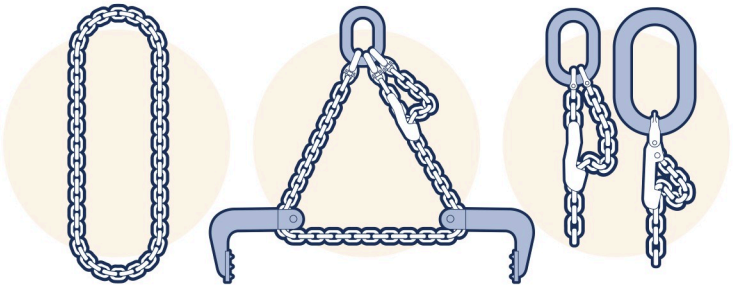


Figure 14.4.1-4 A. Endless sling. B. Case sling. C. Shortening clutches.

14.4.2 Leg Length Adjustment

Any sling can be made adjustable using a shortening device. (See Figure 14.4.1-2 page 239a and Figure 14.4.1-4 page 239 c)

14.4.3 Sling Construction

Chain sling assemblies are manufactured in various material/heat-treatment combinations to produce the different grades and to suit differing service conditions. The end fittings are attached to the chain by means of:

(1) one or more welded joiner links (See Figure 14.4.3-1 page 240 a) or

(2) a mechanical joining device (See Figure 14.4.3-1 page 240 b)

All grades are available in welded construction but only grades 8 (or 80), 10 (or 100) and 12 (or 120) are available constructed with mechanical joining devices.

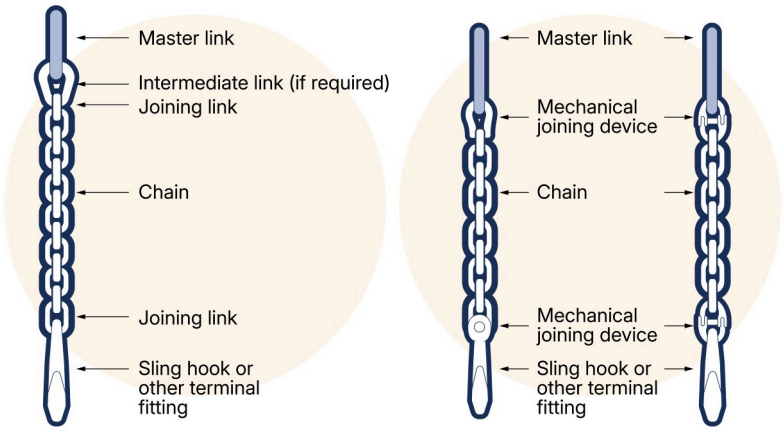


Figure 14.4.3-1 A. Typical single leg sling of welded construction. B. Typical single leg sling with mechanical joining devices.

14.5 PRINCIPLES FOR THE SELECTION OF CHAIN SLINGS

14.5.1 Working Load Limit/SWL

Consideration must be given to the working load limit of the sling and the SWL with which it is then attributed for the particular service conditions so as to ensure that no part of the sling is overloaded by the method of use. The working load limit of a sling depends upon the following three factors:

(1) The size and grade of chain selected. It will be noted that as the grade of chain sling selected increases from 4 (or M) to 6 (or S) to 8 (or T) progressively smaller chain slings can be used to achieve equivalent strength, e.g. a Grade 8 (or T) sling will have twice the lifting capacity of a Grade 4 (or M) sling of the same size.

(2) The geometry of the sling: i.e. the number of chain legs and, in the case of multi-leg slings, the angle of the legs to the vertical and the disposition of the legs in plan. Angles should be assessed as shown in figures 14.13 to 14.15 inclusive. The angle to the vertical = β ('included angle' = 2β).

(3) The method of rating, this may be either the uniform load method or the trigonometric method, dependent on the application. It should be noted that the uniform load method is the only method of rating multipurpose slings used in Harmonised European standards. For an explanation of these two methods, refer to section 1 1.A5.4.3 Methods of Rating Lifting Slings page 25.

> The maximum angle of inclination at which the sling may be rated is 60° (120° included angle) but it may only be rated for use at 45° (90° included angle)

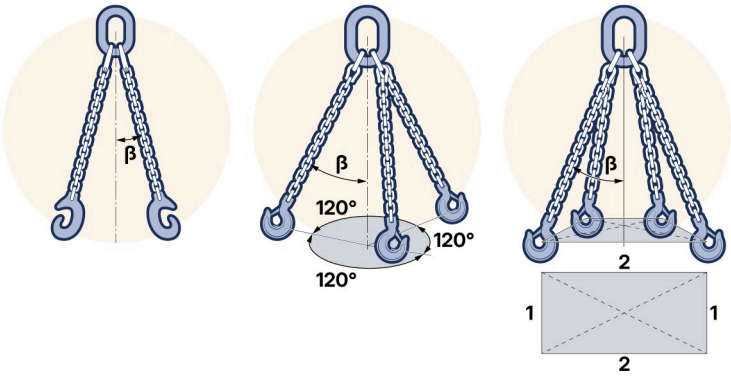


Figure 14.5.1-1 A. Two leg sling. B. Three leg sling. C. Four leg sling.

The SWL to be marked on the sling should be assessed by a Competent Person and will be the same as the working load limit in normal conditions or less than the working load limit under special conditions. The SWL of the sling selected must be at least equal to the maximum load to be lifted. The maximum load that can be lifted by a sling may also vary from the marked SWL depending upon the method of use. The most commonly used methods are dealt with in section 14.5.2 Method of Use page 241 below. Where it is proposed to use slings in some other way the operative should consult a Competent Person.

14.5.2 Method of Use

The factors to be considered fall into three main groups:

(1) Those dealing with the way the sling is attached to the load.

(2) Those dealing with the geometry of the sling, i.e. the angle of the legs to the vertical and the disposition of the legs in plan.

(3) Those dealing with the number of legs in use.

The amount of load that will be carried by an individual leg will depend on the angle between each of the legs and the vertical, the disposition of the legs in plan view and the total load being lifted.

The reduced ratings for slings when used in choke hitch take account of higher stresses at the point where the choking hook or link bears upon the chain.

The following examples are based on slings which have been rated and marked to the uniform load method. The SWL marked on uniform load rated multi-leg chain slings is for a range of angles from 0- 45° to the vertical (0- 90° included angle) and, if requested by the purchaser, an additional mark showing the reduced SWL for angles of 45°-60° (90°-120°). This assumes that the legs are equally disposed about the vertical and symmetrically disposed in plan. (See section 1 1.A5.5.2 Rating Assumptions page 28) If a tilt occurs due to the centre of gravity being misjudged or if unequal angles to the vertical are formed, then the leg with the smaller angle to the vertical will have a larger share of the load imposed upon it.

14.5.2.1 Single leg sling in straight lift

When a single leg sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling. (See Figure 14.5.2.2-1 page 241 a)

14.5.2.2 Single leg sling in choke hitch

When a single leg sling is used in a choke hitch, the maximum load to be lifted must not exceed 0.8 x the SWL marked on the sling. (See Figure 14.5.2.2-1 page 241 b)

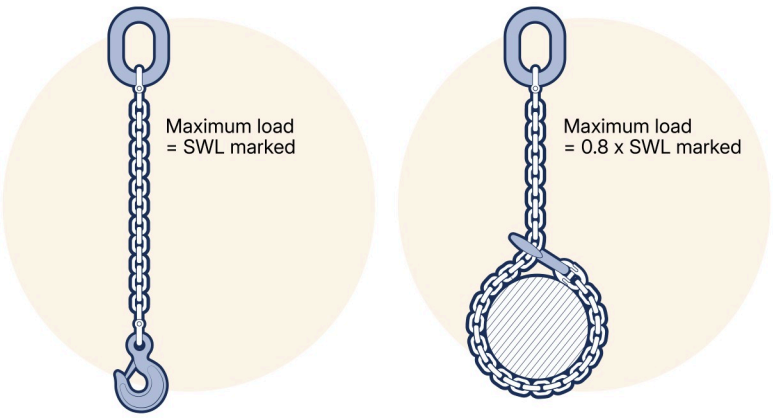


Figure 14.5.2.2-1 A. Single leg sling in straight lift. B. Single leg sling in choke hitch.

14.5.2.3 Single leg sling in basket hitch

When a single leg sling is used in basket hitch by hooking back to the master link, with the parts of chain inclined at angles between 0-45° to the vertical (0-90° between the parts of chain), the maximum load to be lifted must not exceed the SWL marked on the sling as in this arrangement the full load is taken by the master link. (See Figure 14.5.2.3-1 page 242 a)

When a single leg sling has master links at each end and is used in basket hitch with both links on the hook and with the parts of the chain inclined at angles between 0-45° to the vertical (disposed at an included angle of 0-90°), the maximum load to be lifted must not exceed 1.4 x the SWL marked on the sling. In this arrangement, the load is shared between the master links. (See Figure 14.5.2.3-1 page 242 b)

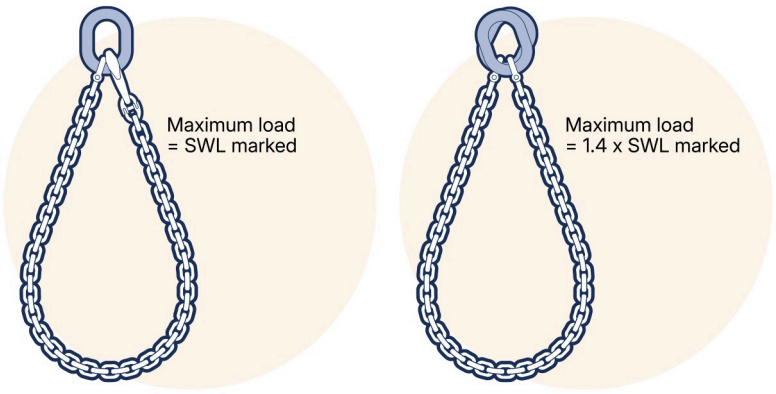


Figure 14.5.2.3-1 A. Single leg sling in basket hitch hooked back to master link. B. Single leg sling in basket hitch with both master links to hook.

14.5.2.4 Two leg sling in straight lift

When a two leg sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. (See Figure 14.5.2.4-1 page)

When two single leg slings, of the same length and SWL, are used for a straight lift, the maximum load to be lifted must not exceed 1.4 x the SWL marked on a single sling when the legs are inclined at angles between 0-45° to the vertical (included angle between the legs is in the range 0-90°). The use of two single slings at angles to the vertical of greater than 45° (included angle greater than 90°) is not recommended. (See Figure 14.5.2.4-2 page)

14.5.2.5 Two leg sling in choke hitch

When a two leg sling is used in a choke hitch, the maximum load to be lifted must not exceed 0.8 x the SWL marked on the sling for the appropriate range of angles. (See Figure 14.5.2.5-1 page 242 a)

When two single leg slings, of the same length and SWL, are used in a choke hitch, the maximum load to be lifted must not exceed 0.8 x the maximum load rating obtained for straight lift as in 14.5.2.4 Two leg sling in straight lift page 242 when the legs are inclined at angles between 0-45° to the vertical (0-90° included angle). The use of two single slings at angles to the vertical of greater than 45° (included angle greater than 90°) is not recommended. (See Figure 14.5.2.5-1 page 242 b)

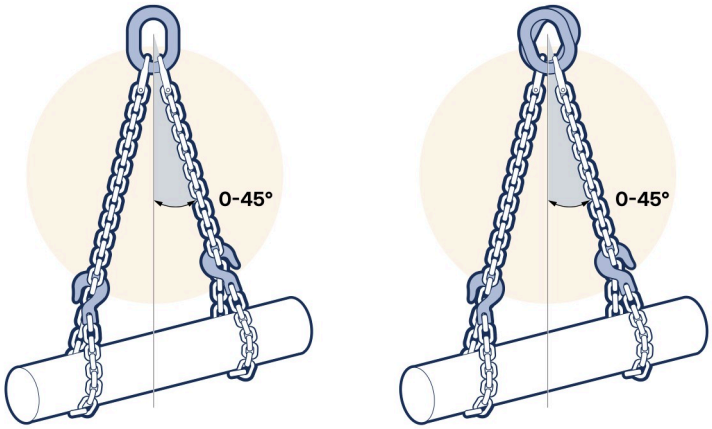


Figure 14.5.2.5-1

14.5.2.6 Two leg sling in basket hitch

When a two leg sling is used in basket hitch the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. In this case the angle between the vertical or included angle formed between any two parts of chain must not be in excess of that permitted by the appropriate range. (See Figure 14.5.2.6-1 page 243 a)

When two single leg slings, of the same length and SWL, are used in basket hitch, the maximum load to be lifted must not exceed 1.4 x the SWL marked on a single sling when the legs are inclined at angles between 0-45° to the vertical (0-90° included angle) The use of two single slings at angles to the vertical of greater than 45° (included angle greater than 90° is not recommended. (See Figure 14.5.2.6-1 page 243 b)

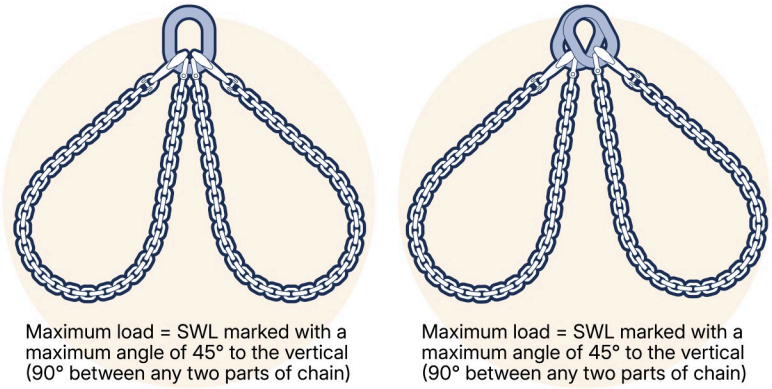


Figure 14.5.2.6-1 A. Two leg sling in basket hitch. B. Two single leg slings i basket hitch.

> To prevent the hook of the lifting appliance becoming overcrowded, LEEA recommends that the upper ends of the sling legs are connected by a shackle of adequate strength.

14.5.2.7 Three leg sling in straight lift

When a three leg sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. Where this is given for the included angle it should be taken as twice the angle between the sling leg and the vertical i.e. 2 x β. (See Figure 14.5.2.7-1 page 243)

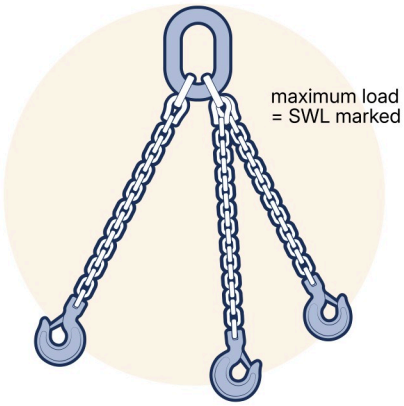


Figure 14.5.2.7-1

14.5.2.8 Three leg sling in choke hitch

When a three leg sling is used in a choke hitch, the maximum load to be lifted must not exceed 0.8 x the SWL marked on the sling for the appropriate range of included angles. The included angle should be taken as twice the angle between the sling leg and the vertical i.e. 2 x β.

14.5.2.9 Three leg sling in basket hitch

When a three leg sling is used in a basket hitch, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of included angles. In this case, the included angle, i.e. 2β, between any two parts of chain must not be in excess of that permitted by the appropriate range.

14.5.2.10 Four leg sling in straight lift

When a four leg sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. The included angle, i.e. 2 x β, should be measured between diagonally opposite legs. (See Figure 14.5.2.13-1 page 244 a)

14.5.2.11 Four leg sling in choke hitch

When a four leg sling is used in a choke hitch, the maximum load to be lifted must not exceed 0.8 x the SWL marked on the sling for the appropriate range of angles. The included angle, i.e. 2 x β, should be measured between diagonally opposite legs.

14.5.2.12 Four leg sling in basket hitch

When a four leg sling is used in basket hitch, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. In this case, the included angle, i.e. 2 x β, between any two parts of chain must not be in excess of that permitted by the appropriate range.

14.5.2.13 Double basket sling

When a double basket sling is being used, the maximum load to be lifted for the appropriate range of angles must not exceed the SWL marked on the sling. The included angles should be measured between any diagonally opposite parts of chain. (See Figure 14.5.2.13-1 page 244 b)

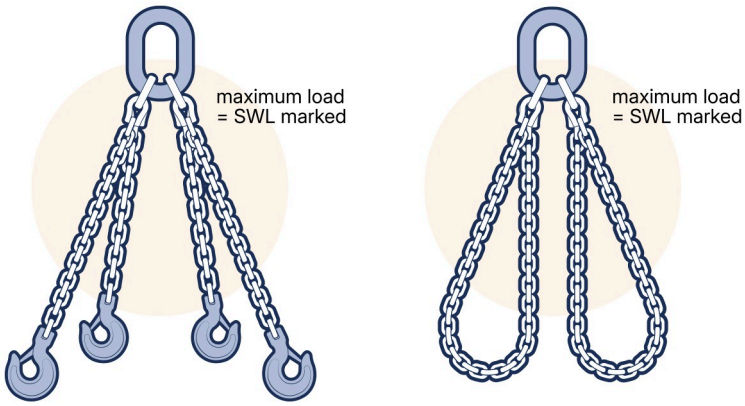


Figure 14.5.2.13-1

14.5.2.14 Endless sling

An endless sling should be used only in the configuration shown in figure Figure 14.5.2.14-1 page 244. The maximum load to be lifted must not exceed the SWL marked on the sling.

In the case of a sling with a mechanical joining device, the device should be positioned in one of the straight sections, away from the load, bight or appliance hook.



Figure 14.5.2.14-1 Endless sling

14.5.2.15 Adjustable slings

Most manufacturers can incorporate shortening devices into all sling assemblies rendering them adjustable. (See section 14.4 TYPES OF CHAIN SLING page 238) Shortening clutches are the preferred devices for adjusting leg length as they maintain the correct 'in line loading' of the chain so that the rating is not affected. The use of hooks that lock onto a link of the chain, commonly known as grab hooks, is not recommended for this purpose as they involve a transverse or oblique loading on the chain. If a manufacturer provides grab hooks for shortening purposes, their recommendations on de-rating must be sought and followed. Another, more appropriate, type of grab hook that is sometimes used is the cradle type and again if using these the manufacturer's instructions must be strictly adhered to.

Shortening devices in multi-leg slings will adjust the leg length, but care must be taken to ensure that no one leg is overloaded as a result. Bear in mind that if the legs are not equally disposed about the vertical, the leg making the smaller angle to the vertical will carry a larger share of the load. Such shortening devices MUST be used correctly with the load bearing chain always leading out from the bottom of the device. (See Figure 14.5.2.15-1 page 245 for illustrations of correct and incorrect usage)

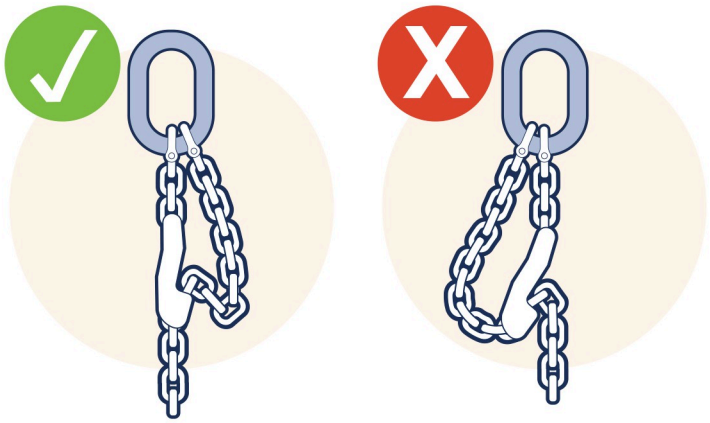


Figure 14.5.2.15-1 Use of shortening clutches in adjustable slings. Note that the loaded end of the chain must come out of the bottom of the clutch.

14.5.2.16 The use of multi-leg slings with less than the total number of legs in use

Occasionally, it may be necessary to use a multi-leg sling with less than the total number of legs employed in the lift. With care this may be done safely.

The reduced SWL for multi-leg slings with less than the full number of legs in use may be calculated exactly. This however requires several factors to be taken into account and the calculation may become complex. A simple method requiring the minimum of calculation has been devised which can be safely applied to any sling.

Care must be taken to ensure the rules of rating slings for different slinging methods are also applied to any multi-leg sling used this way. That is to say, for example, a four leg sling with only two legs in use must be treated as a two leg sling, the reduced SWL being subjected to any further reduction factors applicable to two leg slings due to the method of use.

To calculate the maximum load that can be lifted by any combination of legs, simply multiply the marked SWL by the number of legs in use expressed as a fraction of the total number of legs in the sling. For example, a two leg sling with only one leg in use can lift = 1/2 x SWL marked on sling.

4 Reduction factors for multi-leg slings when less than the full number of legs are in use page 246 gives the simplified reduction factors which should be applied to the marked SWLs of multileg slings when less than the full number of legs are in use.

Table 4 Reduction factors for multi-leg slings when less than the full number of legs are in use

Total number of legs in sling	Number of legs in use		
	1	2	3
2	½	1	-
3	⅓	⅔	1
4	¼	½	¾

The reduced SWL calculated by this method will ensure that the sling is never overloaded. The adoption of the above method means that in some cases the sling will be under utilised, although this is unlikely to hinder the user unduly. If, however, the maximum utilisation is required, reference should be made to a Competent Person who understands the factors involved and who can perform the necessary calculations.

14.5.3 Adverse Environments

In adverse environments, the SWL must be reduced from a value equal to the working load limit in accordance with the following recommendations.

14.5.3.1 High temperature conditions

As the temperature which a sling attains in service increases, its strength decreases. Care must be taken to account for the maximum temperature which can be reached by the sling in service. This may be difficult to determine in practice, but under-estimation of the temperature involved must be avoided. The effect of increasing temperature on the strength of the various grades of slings is indicated in 5 Reduction of sling strength with increase in temperature page 246.

Table 5 Reduction of sling strength with increase in temperature

Grades 60, S, T, 8 **Temperature of Sling**	**Strength of Sling**
Up to 200º C	Nominal strength rating
*200º to 300º C	90% of strength rating
*300º to 400º C	75% of strength rating
Over 400º C	Not recommended – refer to manufacturer
Grades 40, M, 4 **Temperature of Sling**	**Strength of Sling**
Up to 300º C	Nominal strength rating
*300º to 350º C	85% of strength rating
*350º to 400º C	75% of strength rating
*400º to 475º C	50% of strength rating
Over 475º C	Not recommended – refer to manufacturer

*For grades not listed refer to the manufacturers specific instructions

The use of a sling within these temperature ranges does not imply any permanent reduction in strength when the sling is returned to normal temperatures. If slings are accidentally exposed to temperatures in excess of the maximum permissible temperatures indicated above, they should be withdrawn from service and referred to a Competent Person and/or the manufacturer.

14.5.3.2 Low temperature conditions

Chain slings covered by most standards will not be adversely affected by temperatures down to minus 40°C (see note below) and no reduction from working load limit is therefore necessary on this account. Where slings are to be used at temperatures below minus 40°C, the manufacturer should be consulted.

Depending on the manufacturing processes some grades of chain can only be used as low as minus 20°C. Care must therefore be taken to ensure the correct chain is selected and advice sought from a Competent Person and manufacturers literature.

14.5.3.3 Acidic conditions

Chain slings manufactured to Grades S, T, 8 (or 80), 10 (or 100) and 12 (or 120) should not be used either immersed in acid solutions or exposed to acid fumes, as this can cause and phenomena known as hydrogen embrittlement or hydrogen cracking, that can seriously reduce the ductility and loadbearing capacity, cause cracking and catastrophic brittle failures at stresses below the yield stress of sling material.

Attention is drawn to the fact that certain coating processes, i.e. galvanizing, give rise to these conditions. Slings of Grade S, T, 8 (or 80), 10 (or 100) and 12 (or 120) should not therefore be used in such an environment nor should they be subjected to such processes themselves without the express approval in writing from the manufacturers.

Chain slings of Grade 40, M or 4 may be used in such an environment subject to the following precautions:

(1) The SWL of such a sling should not be greater than 50% of the working load limit.

(2) The sling should be thoroughly washed in clean water immediately after use.

(3) The sling should be given a thorough examination by a Competent Person prior to use each day.

In other conditions in which the sling is likely to be subjected to chemical attack, the manufacturer should be consulted.

14.5.4 Gripping Force

Multi-leg slings exert a gripping or clamping force on the load which increases as the included angle between the legs is increased. (See Figure 14.5.4-1 page 247) The magnitude of this gripping force must be taken into account, bearing in mind the nature of the load to be lifted.

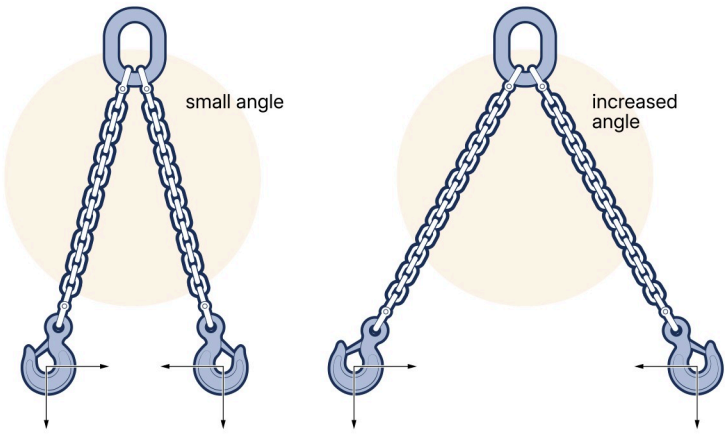


Figure 14.5.4-1

This force is much increased in the type of sling where the lower terminal fittings are threaded on a loop of chain (e.g. case/drum slings) and so the maximum included angle between the parts of chain in this type of application should not exceed 60°. (See Figure 14.5.4-2 page 248)

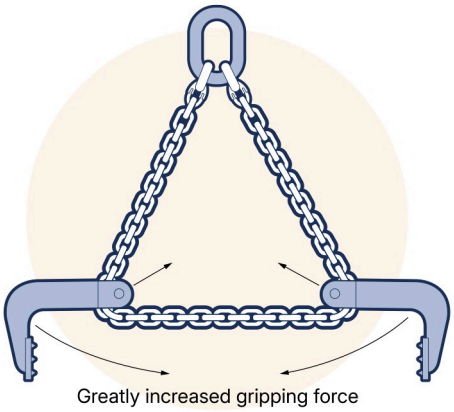


Figure 14.5.4-2

14.5.5 Documentation

Ensure the selected sling is covered by the documentation required by the applicable national legislation. If this is not on record refer the sling to a Competent Person for thorough examination.

14.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

In the case of multipurpose slings, only a general specification can be given, whereas for dedicated single purpose slings a more detailed exchange of information is necessary. In either case, the following is the minimum information which should be exchanged between the user and designer or supplier of equipment:

14.6.1 Multipurpose Slings

(1) Details of the sling required, i.e. single leg, two leg, etc., maximum load to be lifted, length of leg(s).

(2) Slinging conditions, if the sling is to be used in choke hitch, if the sling is to be used at 0-45º or 45º-60º as well and the maximum load to be lifted in any of these conditions.

(3) If shortening devices are required for sling adjustment.

(4) The environmental conditions, including extremes of temperature and details of possible chemical attack.

(5) The conditions of loading, including being subject to shock loads, if the nature of the load is inherently dangerous, e.g. hot metal or acids, if the load is to be transported over areas involving high risk, e.g. work areas.

(6) Details of the largest and smallest crane hook onto which it is intended to place the upper terminal fitting.

(7) Other technical requirements or any special requirements applicable on the site(s) where the sling is to be used.

14.6.2 Single Purpose Slings

(1) All details of the load to be lifted, including the gross weight and dimensions together with the position of the centre of gravity and details of any permanently built in lifting points.

(2) The environmental conditions, including extremes of temperature and details of possible chemical attack.

(3) The conditions of loading, including being subject to shock loads, if the nature of the load is inherently dangerous, e.g. hot metal or acid, if the load is to be transported over areas involving high risk, e.g. work areas.

(4) Details of the crane hook onto which the upper terminal fitting will be placed.

(5) The headroom available.

(6) Other technical requirements or special requirements applicable on the site(s) where the sling is to be used.

14.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

14.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that chain slings fall under the heading of lifting accessories. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

14.7.2 Post Repair Verification and Record Keeping

Following a repair, chain slings must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

(1) In the case of slings of welded construction, heat treatment will be required following a repair. In this case the repaired sling will usually be verified by way of a proof test and thorough examination. In the case of slings with mechanical joining devices, a repair will consist simply of fitting a manufacturer's certified spare part and heat treatment is therefore not necessary. In this case the repaired sling will usually be verified by way of a thorough examination. The records of the sling should be amended taking account of the replacement parts fitted.

(2) New slings manufactured to the most common current standards will be issued with a Manufacturer's Certificate in addition to, although possibly combined with, any documentation required by the applicable national legislation, giving details of the sling and its WLL. However, slings to other standards will usually be accompanied by a manufacturer's record of proof load testing. These documents form an important part of the record of the sling. They should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

(3) Hooks and other similar devices provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety devices or by the use of 'C' hooks.

14.8 MARKING, STORAGE AND HANDLING

14.8.1 Marking

In addition to the information required by the applicable legislation and standard the following information should be permanently and legibly marked:

(1) Identification mark, (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL.

(3) Material grade.

(4) Year of manufacture

(5) Name and address of manufacturer or unique identification mark/symbol

(6) Any other information called for by the standard being worked to or by legislation.

The marking should be either on a substantial metal tag permanently attached to the master link or to a link immediately adjacent to it; or on the master link, provided that the mechanical properties of the link are not significantly impaired:

Where such information is on a metal tag it is recommended that the identification marks should also appear on the master link or secondary tag to enable the sling's historical records, and thus the rest of the information to be recovered in the event of the tag being lost.

Particular attention is drawn to section 1 1.A5.4.3 Methods of Rating Lifting Slings page 25 as the method of marking will depend on the rating method adopted and the style of expressing this. The SWL marking for multi-leg slings should be in one of the following forms as appropriate:

(1) For uniform load rated slings, or slings which have otherwise been rated to express the SWL in terms of the inclination angle: SWL Ut 0-45º plus optionally Vt 45º-60º Additionally, or as an alternative, the rating angles and SWL may be shown by a pictograph on the identification tag similar to that shown in Figure 14.8.1-1 page 250

(2) For uniform load rated slings to other standards expressing the rating at the included angle: SWL Wt 0-90º plus optionally SWL Xt 90º-120º Users of slings rated by the uniform load method and marked at the 'included angle' may wish to consider a programme of re-marking to show the SWL in terms of the angle to the vertical, see section 1 1.A5.4.3.7 Re-Marking and Training for Rating Methods page 27. For example, a sling with SWL of say 16t would be re-marked SWL 16t 0-45º instead of SWL 16t 0-90º.

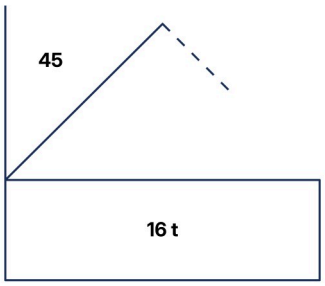


Figure 14.8.1-1

(3) For single purpose trigonometrically rated slings which express the SWL in terms of the angle to the vertical: SWL Xt @ 45º

(4) For single purpose trigonometrically rated slings which express the SWL in terms of the included angle: SWL Zt @ 90°

14.8.2 Storage and Handling

When not in use, chain slings should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Chain slings should normally be kept on a properly designed rack. They should not be left lying on the ground after use, where they may be damaged or lost.

(2) If the slings are expected to be out of use for some time, they should be cleaned, dried and protected from corrosion. Advice on suitable products for this purpose is available from LEEA members.

(3) When being handled, chain slings should not be dropped or thrown down and when being transported they should not be dragged across the floor surface.

(4) Care must be taken with chain slings which are left on crane hooks to ensure that they do not present a danger to persons or property and do not become accidentally engaged.

(5) When one or more legs of a multi-leg sling are not being used, ensure that they are hooked back to the master link or an intermediate link out of harms way.

14.9 IN SERVICE INSPECTION AND MAINTENANCE

14.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all chain slings should be visually inspected by a suitably qualified and experienced person prior to use. For chain slings in regular use it is good practice to make the inspection at the start of each shift or working day. For chain slings used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the sling to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the chain sling and make a visual check for any obvious defects. This inspection must be carried out with the sling in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of chain slings and if any are present, the sling should be withdrawn from service and referred to a Competent Person:

(1) Illegible markings; i.e. the sling identification mark and the SWL including the angle or range of angles of use.

(2) Distortion of the top terminal fittings.

(3) Stretched chain; if the outside length of the chain links is noticeably increased or if there is any lack of free articulation between the links.

(4) Bent or twisted links; slings used in choke hitch should be inspected more frequently paying particular attention to the point of choke.

(5) Wear; most common at the interlink seats.

(6) 'Opening out' of hooks (i.e. any noticeable increase in the throat opening) or any other form of distortion in the lower terminal fittings.

(7) Ineffective safety catches where fitted.

(8) Cuts, nicks, gouges, cracks, excessive corrosion, heat discolouration, or any other defects in chain or fittings.

(9) Incorrect assembly of the mechanical joining devices (refer to manufacturer's instructions).

14.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some chain slings will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use and ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 14.9.1 Pre-use inspection page 250, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 14.9.3 Maintenance and Repair page 251 below.

14.9.3 Maintenance and Repair

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. The chain sling should be thoroughly cleaned, and components lubricated in accordance with the manufacturer's instructions.

Repairs may be carried out to chain slings with the following (but not limited to) considered:

- Repairs should be carried out by a suitably qualified competent person
- It is advisable to check the root cause of the damage, to determine if the chain sling is suitable for its intended purpose.
- Check the Manufacturers Certificate/Declaration of Conformity for the components used damaged components should be replaced with only those that are on the list.
- Check the manufacturer's instructions for component assembly instructions
- If any chain link within the leg of a chain sling is required to be replaced then the whole of the chain within that leg should be renewed
- Mechanical coupling links or low carbon steel repair links shall not be used to repair broken lengths of chain
- Chain should be cut to length using appropriate methods e.g. chain cutters either hydraulic or mechanical, Cutting discs and heat sources should be avoided
- Components that are cracked, visibly distorted or twisted, severely corroded or have deposits which cannot be removed should be discarded and replaced
- Minor damage such as nicks and gouges may be removed by careful grinding or filing. The surface should blend smoothly into the adjacent material without abrupt change of section. The complete removal of the damage should not reduce the thickness of the section at that point to less than the manufacturers specified minimum dimensions or by more than 10% of nominal thickness of the section

- When exchanging chains or components use new load and retaining pins only
- Details of the repair should be made in the chain maintenance log
- Where components are used from other system manufacturer's the chain sling should be assembled as above, in addition referred to a competent person to be thoroughly examined before returning to service

14.9.4 Thorough examination

The chain sling must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the sling's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of slings, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

For repairs using mechanically assembled components testing is not necessary if the components have been individually tested. Inspection to check for correct assembly is all that will be required.

14.10 SAFE USE OF CHAIN SLINGS

In addition to any specific instructions relating to the safe use of the chain sling issued by the manufacturer, the following points should be observed:

(1) The sling must not be used to lift a load that is in excess of the SWL marked upon the sling, taking account of the slinging mode. In addition to selecting a suitable sling, ensure that the lifting machine or appliance is adequate to lift the load.

(2) Several different grades of material are used for lifting equipment and in particular it will be found that slings, crane hooks, shackles, etc. vary considerably in size for a given capacity. Care must therefore be taken to ensure the compatibility of the ancillary equipment used to sling the load, both in size and capacity. Where necessary, an intermediate link or shackle should be used to ensure this.

(3) Ensure the sling hook is compatible with the lifting point. The load should be seated well down in the sling hook, never on the point, nor wedged in the throat; the hook should be free to align in any direction so as to avoid bending. Safety catches, where fitted, must be free to operate. Ensure the sling is compatible with the crane hook. The master link of the sling should be seated in the crane hook, never on the point, nor wedged in the throat. The master link should be free to articulate at all times so as to avoid deformation of the master link or the crane hook. Safety catches, where fitted, must be free to operate.

(4) Ensure that the load, including any lifting points, will withstand the lifting operation. In particular, attention is drawn to the gripping or clamping force generated by multi-leg slings. Ensure all loose items are removed from the load or contained in such a way that they are secure with no possibility of them falling.

(5) Chain is designed to support a load in a straight line. Therefore, chain should never be loaded when twisted or worse, knotted. Where chain is tensioned across an edge or corner, adequate packing must be used. (See section 1 1.A5.5.7 Control of Lifting Equipment, Storage, Handling and Inspection page 39)

(6) Care must be taken to ensure the load will remain stable throughout the lift. A load will be inherently stable if the slings are attached above the centre of gravity and properly disposed around it. Where this is not possible, the selection of suitable slings and their attachment to the load must be carefully considered, for guidance on this see section 1 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16.

(7) Sling hooks of multi-leg slings should be positioned so that they face outward from the load. In the case of a four-leg sling, the length/width ratio of the rectangle formed by the hooks in plan should not exceed 2:1. (See Figure 14.5.1-1 page 240 c)

(8) When used in basket hitch, single-leg slings should only be used in pairs with a spreader beam, unless the chain passes through the load making it captive. Multi-leg slings may be used in basket hitch provided there is some positive means to prevent the legs from closing, e.g. a shoulder on the load.

(9) When back hooking the sling hook onto the master link or intermediate link to form a basket hitch, care must be taken to ensure the link is large enough to accept the hook freely without binding or overcrowding the components already attached to the link.

(10) The sling should be arranged with the centre of gravity of the load directly below the master link of the sling so that the load is balanced with no change of attitude when the lift is made. (See section 1 1.A3 APPENDIX 3 - LOAD SECURITY - BALANCE AND STABILITY page 16) A trial lift should be made prior to the full lifting operation. If the load is not balanced, it should be lowered and the slings repositioned or adjusted using shortening devices. Never reposition chain slings by hammering, either to bring an unequally balanced load into balance or, in the case of choke hitch, to tighten the bight. (See Figure 14.10-1 page 253) When used in choke hitch, the bight should be allowed to assume its own position, i.e. the three parts being approximately 120° apart.



Figure 14.10-1

(11) Great care should be taken to avoid shock loading as it effectively increases the weight of a load and could result in the lifting equipment being grossly overloaded.

(12) It is recommended that when lifting long loads, a rope or 'tag line' should be attached to one or both ends of the load so that rotational movement may be controlled. Tag lines should be of such a length so as to ensure that operatives need not stand under the load during the lift. Under no circumstances must a tag line be used to balance the load, or for any other purpose than controlling the rotation of the load.

(13) Always prepare the site where the load is to be landed in advance of the lifting operation and lower the load carefully, taking precautions to ensure that the sling is not trapped by the load in such a way as to prevent easy removal by hand. Only remove the sling by hand so as to ensure it does not become accidentally engaged or caught on the load, as this could cause the load to become unstable and overturn and/or result in overloading the sling and other lifting equipment.

(14) Where endless slings are to be joined together then you should not either tie them or use a loop to loop knot. It is good practice when using more than one sling in a single line, to join them with a 'dee' shackle or other suitable connector before placing them onto the hook.

14.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be familiar with the methods of marking slings and with estimating angles of inclination and included angles in order to establish that the sling is being used within its marked range of angles.

(2) Operatives should be familiar with slinging conditions and methods which necessitate a reduction from the marked SWL and should be able to apply the rating factors given in section 14.5.2 Method of Use page 241.

(3) Operatives should be familiar with the conditions which might necessitate a SWL lower than the working load limit, e.g. adverse environmental conditions as detailed in section 14.5.3 Adverse Environments page 246.

Section 15 - WIRE ROPE SLINGS

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15.1 FOREWORD

Wire rope slings are a versatile and safe way to connect loads to lifting appliances, as long as they are used correctly to avoid dangerous practices and damage. In many cases the use of a wire rope sling in preference to, for example, a chain sling is a matter of the personal choice of the user. There are however applications where wire rope slings are to be preferred to other types of sling and similarly there are applications where other types of slings may be preferable to wire rope slings.

15.2 SCOPE

This section of the code defines the correct selection, in-service inspection, usage and storage of wire rope slings.

The scope of this section has been extended to include slings rated by the uniform load and trigonometric methods, which are excluded from some national standards, i.e. in Europe only the uniform load method is used. It also includes endless slings, which were excluded from older standards. The reason for this is that all may be found service.

15.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

15.3.1 Single Part Leg

A single part leg is the leg of a sling formed by a single part of wire rope. (See Figure 15.3.1-1 page 255)

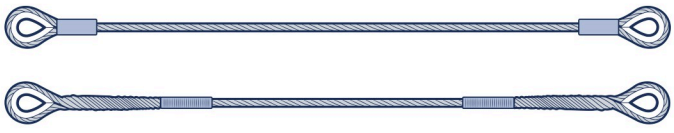


Figure 15.3.1-1 Single part leg

15.3.2 Double Part Leg

A double part leg is the leg of a sling formed by two parts of wire rope when constructed as a grommet, spliced endless or ferrule secured endless with the two parts in parallel contact having a thimble seized at each end. (See Figure 15.3.2-1 page 256)

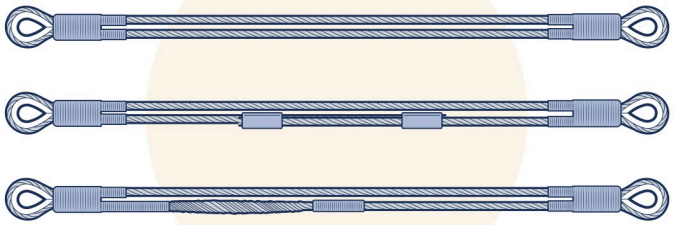


Figure 15.3.2-1 Double part leg

15.3.3 Thimble

A thimble is a protective insert which is fitted to the eye of a sling leg at the time of manufacture. Thimbles are fitted where it is desirable to protect the eye from the worst effects of abrasion and point loading. Two common types of thimble are used in the construction of slings. The heart shaped thimble, which is used where sling legs are to attach to other fittings, and the reeving thimble, which is designed to permit the passage of one eye through the other so that the sling may be used in choke hitch. A similar protective inset, known as the stirrup or half thimble, is designed to protect the wire rope of a soft eye when the sling is used in choke hitch. (See Figure 15.3.5-1 page 256)

15.3.4 Soft Eye

A soft eye is an eye formed at the end of a sling leg comprising a loop made in the wire rope which is then secured by either a ferrule or by hand splicing, having no protective attachments, i.e. thimbles. (See Figure 15.3.5-1 page 256)

15.3.5 Ferrule Secured Eye

A ferrule secured eye is an eye formed at the end of a sling and secured by a hollow metal ferrule which is passed over and then pressed onto the rope. (See Figure 15.3.5-1 page 256) This eye may be formed by the ‘turn back loop’ or ‘flemish eye’ method of construction.

A turn back loop is formed by bending the rope to form an eye which is then secured by a ferrule. The strength of the eye is entirely reliant on the ferrule. A flemish eye is formed by opening the strands of the rope in the form of a letter ‘Y’. The open rope tails are laid back into one another meeting the standing rope at the throat of the ‘Y’ thus forming the eye which is secured by a ferrule. In this case the strength of the eye is not solely reliant on the ferrule.

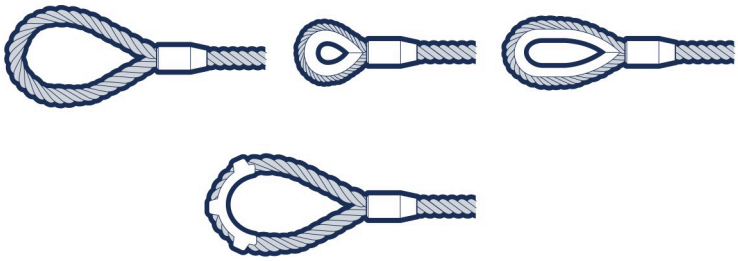


Figure 15.3.5-1 Ferrule secured eye terminations

15.3.6 Hand Spliced Eye

A hand spliced eye is an eye formed at the end of a sling by the traditional method of threading the individual strands of the rope back along the main body of the rope in a prescribed pattern.

Whilst this type of eye is now less popular than the more modern ferrule secured eye, it is still available and preferred by some users. (See Figure 15.3.6-1 page 257)

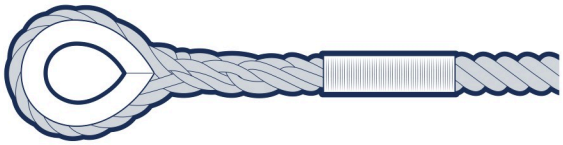


Figure 15.3.6-1 Hand spliced eye

15.3.7 Rope Lay

Rope lay refers to the way in which the wires are laid together to form the individual strands and the way in which the strands are laid together to form the rope. There are two types of lay, ordinary lay, also known as regular lay, and Lang's lay.

(1) Ordinary lay. The wires in the strands are laid in the opposite direction of lay to the strands in the rope. This gives the appearance of the individual wires running along the length of the rope. (See Figure 15.3.7-1 page 257 a) Six strand and eight strand ordinary lay ropes are suitable for the manufacture of wire rope sling legs.

(2) Lang's lay. The wires in the strands are laid in the same direction of lay as the strands in the rope. This gives the appearance of the individual wires running across the diameter of the rope. (See Figure 15.3.7-1 page 257 b) Lang's lay ropes are NOT suitable for the manufacture of wire rope sling legs as the rope has a tendency to unwind when subjected to a load unless it is prevented from doing so, as in the case of a multi-fall rope block, by being fixed at both ends.

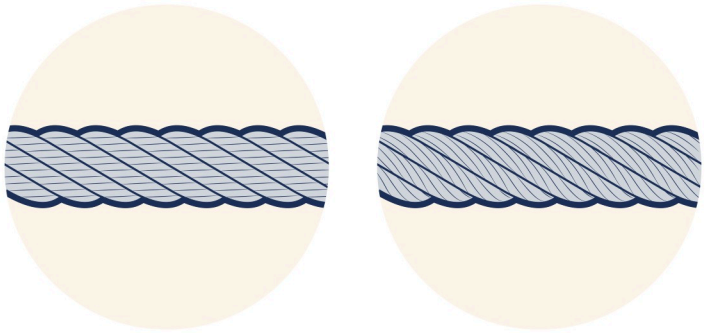


Figure 15.3.7-1 Rope lay

15.4 TYPES OF WIRE ROPE SLING

15.4.1 Common Sling Assemblies

This subsection illustrates the most common wire rope sling assemblies.. Other special assemblies may be devised for lifting specific unusually shaped loads. Sling legs may be single part or double part with hand spliced or ferrule secured eyes.



Figure 15.4.1-1 Endless sling

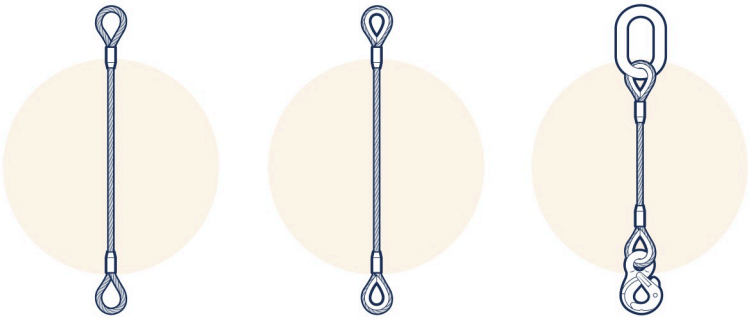


Figure 15.4.1-2 Various single leg slings

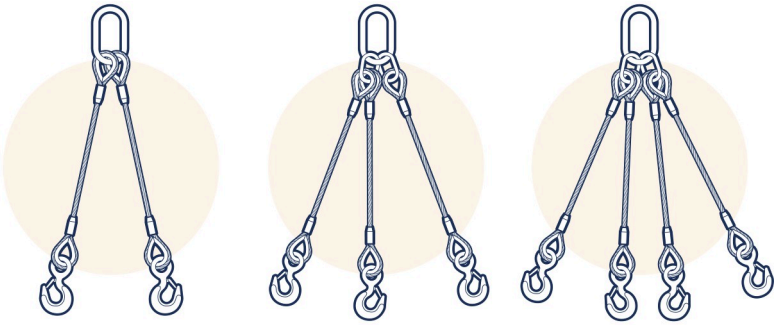


Figure 15.4.1-3 Two leg sling, three leg sling, four leg sling

15.4.2 Fittings

A range of lower terminal fittings may be used with wire rope slings, the most common are illustrated in Figure 15.4.2-1 page 258.

In the case of multi-leg slings, links are used as the upper terminal fitting. End fittings are attached to the slings during the process of forming the eyes and are therefore not removable, except in the case of some shackles which can be made removable if required.



Figure 15.4.2-1 Typical lower terminal fittings

15.4.3 Rope Construction

The construction of the rope from which the sling is made is within reason unimportant provided that the rope has adequate flexibility and an adequate minimum breaking load (from which the SWL of the sling is calculated). The rope should be ordinary lay and may be six or eight strand having a fibre or a wire core.

15.5 PRINCIPLES FOR THE SELECTION OF WIRE ROPE SLINGS

15.5.1 Working Load Limit/SWL

Consideration must be given to the WLL of the sling and the SWL with which it is then attributed for the particular service conditions so as to ensure that no part of the sling is overloaded by the method of use. In the case of some older standards, the WLL of a wire rope sling was based on the minimum breaking load of the rope from which the sling is made, divided by a factor of safety of 5:1. For slings manufactured to modern standards, the minimum breaking load of the rope is first multiplied by a factor which allows for the efficiency of the termination before the factor of safety is applied. For ferrule secured eyes the efficiency factor is 0.9 and for hand spliced eyes the efficiency factor is 0.8. The terminal fittings of a wire rope sling may well be rated at a different factor of safety e.g. 4:1. Ensure that the rope and fittings are matched based on their working load limits, not their safety factors. The working load limit of a wire rope sling depends upon the following factors:

(1) The size and tensile strength of the rope. It will be noted that different but similar constructions of rope of equal tensile strength have the same minimum breaking loads.

(2) The core of the rope. A rope with a steel core will have a marginally higher breaking load than a similar rope with a fibre core. It will at the same time be slightly less flexible and more resistant to crushing.

(3) The number of parts of wire rope (single or double) per sling leg. For some applications double part legs are preferable as they give more flexibility than the equivalent capacity single part leg. They are however more costly and therefore normally only used for large capacities in order to utilize smaller diameter wire rope whilst offering a greater bearing area to the load.

(4) The geometry of the sling, i.e. the number of legs and, in the case of multi-leg slings, the angles between the legs and the vertical and their disposition in plan.

(5) The method of rating, this may be either the uniform load method or the trigonometric method, dependent on the application. Whilst slings may be found in service rated by either method, the uniform load method is the preferred method for rating multipurpose slings. For an explanation of these two methods, refer to section 1 1.A5.4.3 Methods of Rating Lifting Slings page 25.

> The maximum angle of inclination at which the sling may be rated is 60° (120° included angle) but it may only be rated for use at 45° (90° included angle). The SWL to be marked on the sling should be assessed by a Competent Person and will be the same as the WLL in normal conditions or less than the WLL under special conditions. The SWL of the sling selected must be at least equal to the maximum load to be lifted. The maximum load that can be lifted by a sling may also vary from the marked SWL depending upon the method of use. The most commonly used methods are dealt with in section 15.5.2 Method of Use page 259.

15.5.2 Method of Use

There are numerous methods of slinging, many of which affect the load carrying capacity of the sling. The most commonly used methods for effectively balanced loads are illustrated in this subsection. Where it is proposed to use wire rope slings in some other way the operative should consult a Competent Person.

The factors to be considered fall into three main groups:

(1) Those dealing with the way the sling is attached to the load.

(2) Those dealing with the geometry of the sling, i.e. the angles between the various legs of the sling and also between the legs and the vertical.

(3) Those dealing with the number of legs in use.

The amount of load that will be carried by an individual leg will depend on the angle between each of the legs and the vertical, the distribution of the legs in plan view and the total load being lifted.

The following examples are based on slings which have been rated and marked to the uniform load method. The SWL marked on uniform load rated multi-leg wire rope slings is for the legs to be inclined to the vertical over a range of angles between 0-45° (0-90° included angle) or additionally 45°-60° (90°- 120° included angle) and assumes that the legs are equally disposed about the vertical. If a tilt occurs due to the centre of gravity being misjudged, or if unequal angles to the vertical are formed, then the leg with the smaller angle to the vertical will have a larger share of the load imposed upon it.

15.5.2.1 Single leg sling in straight lift or in choke hitch

When the sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling. When using a wire rope sling in choke hitch, the maximum load lifted should not be more than 0.8 x the marked SWL. (See Figure 15.5.2.1-1 page 260). The practice of reducing the SWL of wire rope slings when used in choke hitch is a modern requirement. Previously no reduction was made and the resulting factor of

safety in choke hitch was approximately 4:1. Newer standards require a minimum of 5:1, hence the need for a reduction. For the benefit of the user, the same factor as is used for chain and textile slings has been adopted.

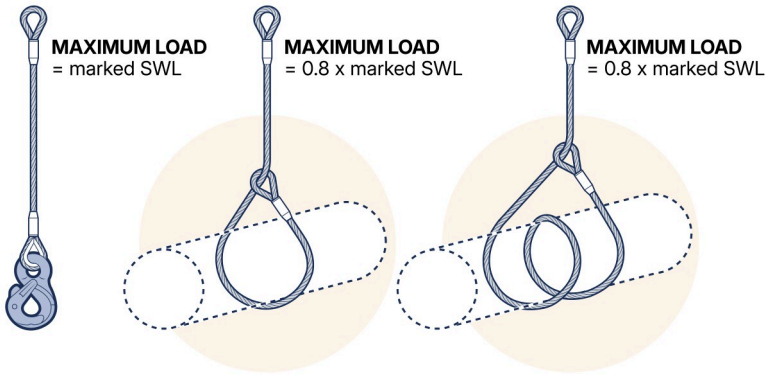


Figure 15.5.2.1-1 A. Single leg sling in straight lift. B. Single leg sling in choke hitch. C. Single leg sling in double wrapped choke hitch.

15.5.2.2 Single leg sling in double and choke hitch

When the sling is used in double and choke hitch (halshed), the maximum load to be lifted must not exceed 1.6 x the SWL marked on the sling. (See Figure 15.5.2.2-1 page 260)

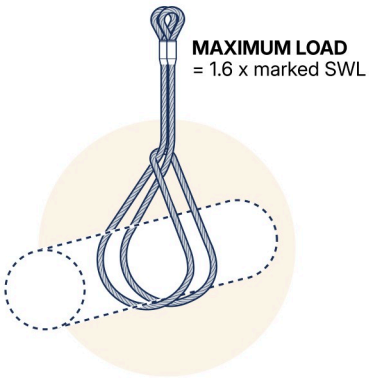


Figure 15.5.2.2-1 Single leg sling in double and choke hitch

15.5.2.3 Single leg sling in basket hitch

When a single leg sling is used in basket hitch by hooking back to the master link, with the parts of rope inclined at angles between 0-45° to the vertical (0-90° between the parts of rope), the maximum load to be lifted must not exceed the SWL marked on the sling as in this arrangement the full load is taken by the master link. (See Figure 15.5.2.3-1 page 261 a)

When a single leg sling is used in basket hitch with both ends onto the hook, or connected by a suitable shackle, and with the parts of rope disposed at angles between 0-45° to the vertical (disposed at an included angle of 0-90°), the maximum load to be lifted must not exceed 1.4 x the SWL marked on the sling. (See Figure 15.5.2.3-1 page 261 b)

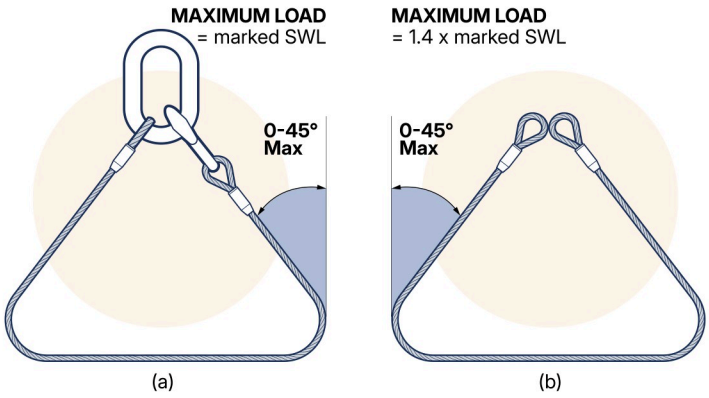


Figure 15.5.2.3-1 Single leg sling in basket hitch

15.5.2.4 Two leg sling in straight lift

When the sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. (See Figure 15.5.2.4-1 page 261)

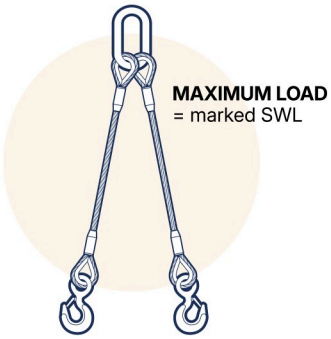


Figure 15.5.2.4-1 Two leg sling in straight lift

When two single leg slings, of the same length and SWL, are used for a straight lift, the maximum load to be lifted must not exceed 1.4 x the SWL marked on a single sling when the legs are inclined at angles between 0-45° to the vertical (included angle between the legs is in the range 0-90°). The use of two single slings at angles to the vertical greater than 45° (included angle greater than 90°) is not recommended. (See Figure 15.5.2.4-2 page 261)

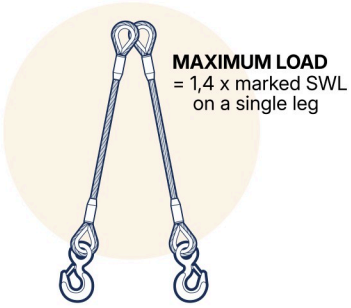


Figure 15.5.2.4-2 Two single legs in straight lift

> To prevent the hook of the lifting appliance becoming overcrowded, LEEA recommends that the upper ends of the sling legs are connected by means of a shackle or link of adequate strength.

15.5.2.5 Two leg sling in choke hitch

When a two leg sling is used in choke, the maximum load to be lifted must not exceed 0.8 x SWL marked on the sling for the range of angles shown. The angle must not exceed the maximum angle shown. (See Figure 15.5.2.5-1 page 262)

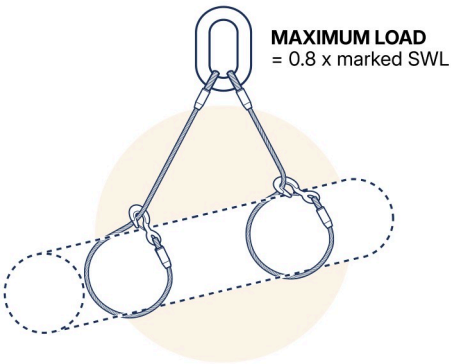


Figure 15.5.2.5-1 Two leg sling in choke hitch

When two single leg slings, of the same size and SWL, are used in choke hitch, the maximum load to be lifted must not exceed 0.8 x 1.4 x the SWL marked on a single sling when the legs are inclined at angles between 0-45° to the vertical (0-90° included angle). The use of two single slings at angles to the vertical of greater than 45° (included angle greater than 90°) is not recommended. (See Figure 15.5.2.5-2 page 262)

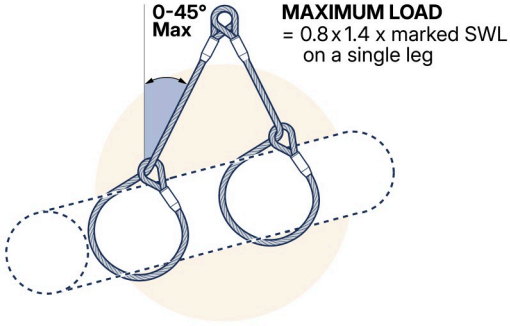


Figure 15.5.2.5-2 Two single legs in choke hitch

15.5.2.6 Two leg sling in basket hitch

When a two leg sling is used in basket hitch, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. In this case, the angle between the vertical or included angle formed between any two parts of rope must not be in excess of that permitted by the appropriate range. (See Figure 15.5.2.6-1 page 262)

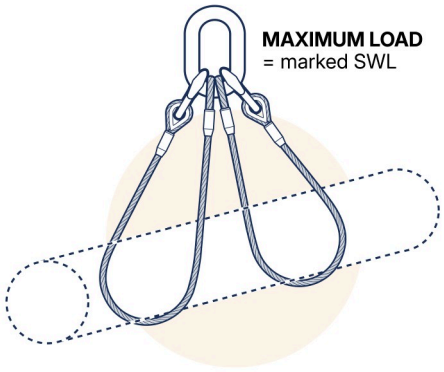


Figure 15.5.2.6-1 Two leg sling in basket hitch

When two single leg slings, of the same length and SWL, are used in basket hitch with the ends of the slings connected to the hook by suitable shackles, the maximum load to be lifted must not exceed 2.1 x the SWL marked on a single sling when the legs are inclined at angles between 0-45° to the vertical (included angle between any two parts of rope is in the range 0-90°). No attempt should be made to use two single slings at an included angle greater than 90°. (See Figure 15.5.2.6-2 page 263)

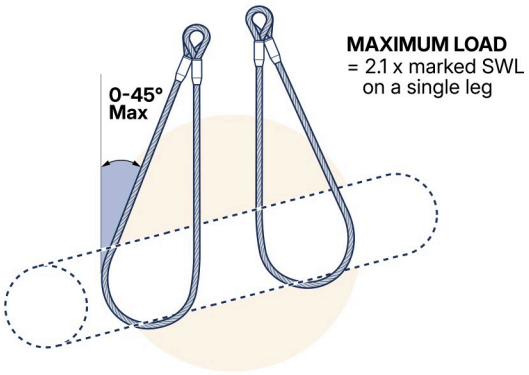


Figure 15.5.2.6-2 Two single leg slings in basket hitch

15.5.2.7 Three leg sling in straight lift

When a three leg sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. Where this is given as the included angle it should be taken as twice the angle between the sling leg and the vertical. (See Figure 15.5.2.7-1 page 263) It is assumed that viewed in plan the legs are at 120° to each other. If two of the legs are closer than that, the third leg will receive a greater share of the load.

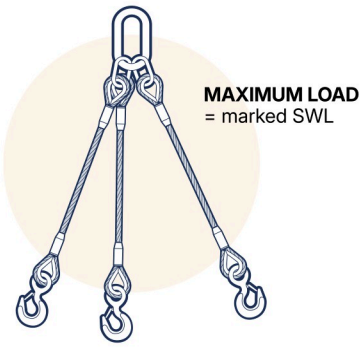


Figure 15.5.2.7-1 Three leg sling in straight lift

15.5.2.8 Three leg sling in choke hitch or basket hitch

The use of three leg slings in either choke or basket hitch is uncommon and if used in these modes, care must be taken to ensure that all legs are carrying an equal share of the load. When used in choke hitch, the maximum load to be lifted must not exceed 0.8 times the SWL marked on the sling for the appropriate range of angles. When used in basket hitch, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. The included angle should be taken as twice the angle to the vertical of any part of any leg.

15.5.2.9 Four leg slings in straight lift

When a four leg sling is used for a straight lift, the maximum load to be lifted must not exceed the SWL marked on the sling for the appropriate range of angles. The 'included angle' should be measured between diagonally opposite legs. (See Figure 15.5.2.9-1 page 264) It is assumed that viewed in plan the legs are symmetrically disposed, the lower attachment points making the corners of a rectangle. Ideally, the nearer the rectangle is to a square the better, but if the proportions of the sides exceed 2 to 1 the sling should be de-rated to the capacity of a two leg sling.

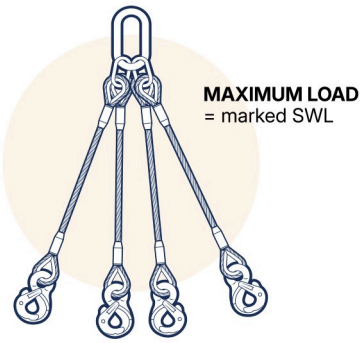


Figure 15.5.2.9-1 Four leg sling in straight lift

15.5.2.10 Four leg sling in choke hitch or basket hitch

The use of four leg slings in either choke or basket hitch is uncommon and if used in these modes, care must be taken to ensure that all legs are carrying an equal share of the load. Subject to this consideration, the load to be lifted in basket hitch must not exceed the SWL marked on the sling for the appropriate range of angles. When a four leg sling is used in choke hitch, the maximum load to be lifted must not exceed 0.8 x the SWL marked on the sling for the appropriate range of angles. The 'included angle' should be taken as twice the angle to the vertical of any part of any leg.

15.5.2.11 Endless sling

Endless wire rope slings are uncommon nowadays, but not unheard of. They should be used in choke hitch as shown below and they are rated on the assumption that this will be the case. The use of endless slings in other modes, e.g. in line lifting, is not preferred. Care must be taken to position any splice or ferrule connections in the standing section of rope away from the load, the hook and the choke. The maximum load to be lifted must not exceed the SWL marking on the sling. (See Figure 15.5.2.11-1 page 264)

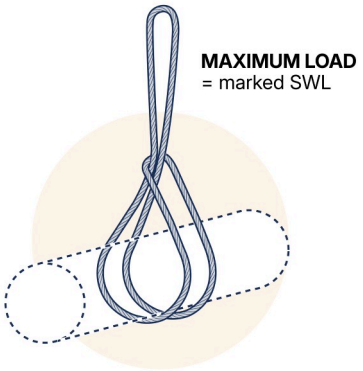


Figure 15.5.2.11-1 Endless sling

15.5.2.12 Adjustment

Unlike chain slings, wire rope slings do not lend themselves to adjustment of the length of the legs and no attempts should be made to shorten the length by knotting or by any other means.

15.5.2.13 The use of multi-leg slings with less than the total number of legs in use

Occasionally, it may be necessary to use a multi-leg sling with less than the total number of legs in use. With care, this can be done safely.

Whilst the reduced SWL applicable to a sling used in this way may be precisely calculated, the adoption of the following simple rules will ensure that the sling is never overloaded. The marked SWL should be multiplied by the appropriate factor as shown in the following table.

Total number of legs in sling	Number of legs in use		
	1	2	3
2	½	1	-
3	⅓	⅔	1
4	¼	½	¾

The adoption of the above method means that in some cases the sling will be under utilised, although this is unlikely to hinder the user unduly. If the maximum utilisation is required, reference should be made to a Competent Person who understands the factors involved and who can perform the necessary calculations.

15.5.3 Adverse Conditions

In adverse environments, the SWL must be reduced from a value equal to the working load limit in accordance with the following recommendations.

15.5.3.1 High temperature conditions

Wire rope slings with WIRE CORES and ALUMINIUM FERRULE SECURED EYES should not be used above 150°C. Such slings which have accidentally been subjected to temperatures in excess of 150°C should be withdrawn from service.

Slings made from wire rope with a FIBRE CORE should not be used at temperatures exceeding 100°C. Such slings which have accidentally been subjected to temperatures in excess of 100°C should be withdrawn from service.

The use of wire rope with a WIRE CORE to produce slings with either HAND SPLICED OR STEEL FERRULE SECURED EYES enables them to be used at temperatures up to 400°C. However, a reduction in strength occurs necessitating a reduction in SWL as shown in the following table.

Table 6 Reduction in SWL due to temperature applicable to wire ropes with hand spliced or steel ferrule secured eyes

Temperature	Reduction in SWL
Up to 100°C	No reduction
100 to 200°C	10%
200 to 300°C	25%
300 to 400°C	35%
Over 400°C	Not recommended

Provided that the sling is subjected to temperatures no greater than 400°C, there will be no permanent loss of strength, i.e. the strength of the sling will return to normal at room temperature. Beyond 400°C, a permanent loss of strength will occur and slings exposed to such temperatures should be withdrawn from service.

15.5.3.2 Low temperature conditions

Wire rope slings will not be adversely affected by temperatures down to minus 40°C and no reduction from working load limit is therefore necessary on this account. Where slings are to be used at temperatures below minus 40°C, the manufacturer should be consulted.

15.5.3.3 Acidic and chemical conditions

The use of wire rope slings in acidic conditions is not recommended. In other conditions which may present a possibility of chemical attack, the manufacturer should be consulted.

15.5.3.4 Classified atmospheres

Due to the possibility of sparking, the use of aluminium is restricted in certain classified atmospheres. Care must therefore be taken when selecting wire rope slings with ferrule secured eyes for use in such areas to ensure the suitability of the ferrule material.

15.5.4 Terminations

For certain special applications, it may be desirable to use wire rope sling legs which do not have hand spliced or ferrule secured eye terminations. Various fittings, such as sockets and fork ends, may be used which are fitted to the rope by a compression process or by a white-metal or resin bonding process. These are outside the scope of this document and the supplier's advice should always be sought and followed where their use is intended.

The use of gripping devices, commonly known as bulldog grips, which clamp the wire to form temporary eyes is not recommended for the manufacture of slings. The reason for this is that tests have showed that these grips did not give an acceptable or consistent level of safety.

In the case of hand splices, these should be made with five tucks against the lay of the rope. The type of splice where the tucks are made with the lay of rope, should not be used as this has a tendency to undo if the rope rotates in use and is effectively banned.

Two types of ferrule are commonly available for aluminium ferrule secured eyes, the tapered ferrule and the plain (square ended) ferrule. In the case of the tapered ferrule, the tail ends of the rope are concealed in the taper, thereby protecting the operative from protruding barbs. In the case of the plain ferrule it is necessary for the tail ends of the rope to protrude from the ferrule.

15.5.5 Finish

Wire rope is available in self colour (bright) or galvanised finish. The selection of the finish will to some extent depend on the application. In most circumstances, galvanised wire rope will be more resistant to corrosion and in this respect offer a longer service life. Although in most cases the selection will be a matter of personal choice, the supplier's advice should be sought where any doubt exists.

15.5.6 Gripping Force

Multi-leg slings exert a gripping or clamping force on the load which is proportional to the angle between the legs and increases as the included angle increases.

The magnitude of this gripping force must be taken into account bearing in mind the nature of the load to be lifted. Consideration must therefore be given to the intended slinging method. In the case of fragile/crushable loads it may be preferable to select a lifting method which utilizes a spreader beam so that the slings act vertically on the load rather than use a multi-leg sling.

15.5.7 Documentation

Ensure the selected sling is covered by the documentation required by the applicable national legislation. If this is not on record refer the sling to a Competent Person for thorough examination.

15.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As wire rope slings are frequently used for multi-purpose lifting applications, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given but should, as far as possible, include the following information:

(1) The maximum load to be lifted and, if available, dimensions of the load together with details of any permanently built-in lifting points.

(2) The number of sling legs required and length.

(3) If multi-leg, the range of angles for which the sling is to be rated (i.e. 0-45° or additionally 45°- 60°).

(4) The upper and lower terminal fittings required (if any) or type of eye, e.g. soft eye, thimbles.

(5) Information on any adverse environmental conditions, e.g. exposure to chemical atmospheres, high or low temperatures, exposure to the elements, etc.

(6) The conditions of loading, including whether the sling is likely to be subjected to a shock load, whether the load to be lifted is inherently dangerous, e.g. hot metal or acid, whether the load is to be transported over areas involving high risk e.g. work areas.

(7) The extent of the headroom available if known.

(8) Other technical requirements or any special requirements applicable on the site(s) where the sling is to be used.

15.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

15.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that wire rope slings fall under the heading of lifting accessories. Unless a written scheme of examination, (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

15.7.2 Post Repair Verification and Record Keeping

Following a repair, wire rope slings must be re-verified by a Competent Person. The record of the repair and the report of the verification should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

(1) Although not required by legislation, new slings should be issued with a manufacturer's certificate in addition to, although possibly combined with, the documentation required by the applicable legislation. These documents form an important part of the record of the sling. They should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

(2) Attention is drawn to the fact that hooks and other similar devices provided for lifting should be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety catches or by the use of 'C' hooks.

15.8 MARKING, STORAGE AND HANDLING

15.8.1 Marking

In addition to the information required by the applicable legislation and standard wire rope slings should bear identification and SWL markings as detailed in Section 1 1.7.1 Marking page 8.

Where such information is on a metal tab or label, it is recommended that the identification marking should also appear on the master link (if fitted) or a ferrule to enable the historical records of the sling, and thus the rest of the information, to be recovered if the tab or label is lost.

15.8.2 Storage and Handling

When not in use, wire rope slings should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Wire rope slings should be hung from suitable pegs or stored on a proper rack. They should not be left lying on the ground after use where they may sustain damage or be lost.

(2) If wire rope slings are to be out of use for some time, they should be cleaned by brushing if necessary (do not use solvents) and protected from corrosion. Advice on suitable products for this purpose is available from the manufacturers, but under no circumstances must lubricants, etc. contain acids or be of an acidic nature.

Wire rope slings must NOT be galvanised or subjected to any other plating process although they may be manufactured from galvanised wire rope in the first instance.

(3) When being handled, wire rope slings should not be dropped or thrown down and when being transported they should not be dragged across the floor surface.

(4) If further use is required and the sling is left suspended from a crane hook, the lower terminals should be 'hooked back' to the crane hook if necessary to avoid causing an obstruction to passers by and to avoid the risk of accidental hook engagement. It should however be remembered that wire rope has a degree of stiffness and will form a noose, care must be taken to ensure that this does not present a danger to personnel.

15.9 IN-SERVICE INSPECTION AND MAINTENANCE

15.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all wire rope slings should be visually inspected by a suitably qualified and experienced person prior to use. For wire rope slings in regular use it is good practice to make the inspection at the start of each shift or working day. For wire rope slings used infrequently it should be done before use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the sling to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the wire rope sling and make a visual check for any obvious defects. This inspection must be carried out with the sling in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of wire rope slings and if any are present, the sling should be withdrawn from service and referred to a Competent Person:

(1) Illegible markings, i.e. the sling identification mark and the SWL including the range of angles for which the sling is rated.

(2) Damage or wear to any of the terminal fittings including protective thimbles.

(3) Mechanical damage to the rope, fittings, hand splice (if any) or the ferrules, including any indication of cracking or slippage.

(4) Broken wires.

(5) Ineffective safety catches on hooks.

(6) Corrosion or drying out of lubricant.

(7) Kinks or other permanent set in the wire rope.

(8) Disturbance to the position of wires in the strands or strands in the rope or protrusion of the core.

(9) Evidence of heat damage, e.g. melted lubricant, blueing of wires, contamination by weld splatter, evidence of arcing, etc.

(10) Opening out of hooks, i.e. noticeable increase in the throat opening, or any other form of distortion in the terminal fittings, including thimbles.

15.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some wire rope slings will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 15.9.1 Pre-use inspection page 268, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 15.9.3 Maintenance page 269below.

15.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. The wire rope sling should be thoroughly cleaned, and components lubricated in accordance with the manufacturer's instructions.

15.9.4 Thorough examination

The wire rope sling must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the sling's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of slings, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- Defects such as fatigue cracking can be made worse by overload testing but may still not be identified by the test.
- If equipment fails during testing it could be dangerous and will certainly be expensive
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

15.10 SAFE USE OF WIRE ROPE SLINGS

In addition to any specific instructions relating to the safe use of the wire rope sling issued by the manufacturer, the following points should be observed:

(1) The sling must not be used to lift a load that is in excess of the SWL marked upon the sling, taking account of the slinging mode. In addition to selecting a suitable sling, ensure that the lifting machine or appliance is adequate to lift the load.

(2) Care must be taken to ensure the compatibility of any ancillary equipment used to sling the load, both in size and capacity. Where more than one sling is used to lift the load, each sling should be adequate for the share of the load imposed on it taking into account the slinging method.

(3) As far as is reasonably practicable, the effective diameters of pins, hooks or other components over which soft eyes are used should not be less than twice the diameter of the rope in the case of single part slings or four times the diameter of the rope in the case of double part slings. Where necessary, an intermediate component of adequate size should be used to ensure this.

(4) The upper terminal of the sling should be seated in the bowl of the crane hook, never on the point, nor wedged in the throat. Master links should be free to articulate at all times so as to avoid deformation of the master link or the crane hook. Safety catches, where fitted, must be free to operate. It is good practice when using more than one sling to join them with a shackle before placing them onto the hook.

(5) The joining together of wire rope slings made from rope of different lay directions must never be considered since this may cause the ropes to unlay, thus seriously affecting the capacity of the slings.

(6) Wire rope slings have very different stretch characteristics to those of other lifting media such as webbing slings. Their use in parallel with such slings to form multi-leg assemblies should therefore be avoided as the unequal stretch of the legs can lead to load instability. However, this is not intended to

preclude their use combined in series as a means of connecting a sling to the load which can be advantageous in some circumstances. For example, a webbing sling can be wrapped and choked onto a polished surface then hooked into a wire rope sling thus gaining the advantage of the webbing protecting an easily damaged surface.

(7) Care must be taken to position the slings correctly. Wire rope performs best when it supports a load in a straight line. It is however a flexible medium and may be used to wrap, either fully or in part, around loads as in choke hitch or basket hitch. Where this is the case, the rope should form as large a radius as possible having a smooth curve. In any circumstances, the radius formed should never be less than four times the diameter of the rope. Use packing protection, e.g. old tyres, to prevent cutting damage to the sling, this will also help the rope to form smooth curves. (See Figure 15.10-1 page 270) Attention to these points will prolong the service life and avoid permanent kinking of the rope.

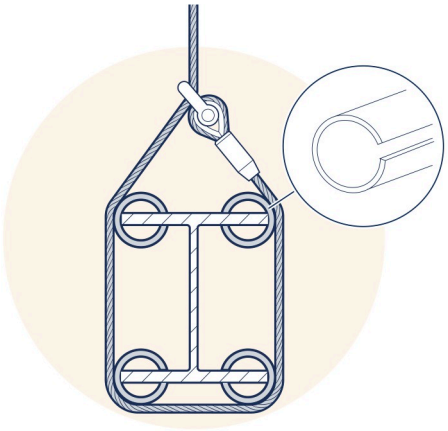


Figure 15.10-1

(8) When positioning endless slings, care must be taken to ensure splices and ferrules are kept away from the load, the hook and the choke. They should be placed in the freestanding part of the rope.

(9) Sling hooks of multi-leg slings should be positioned so that they face outward from the load, without inducing a twist in the rope. In the case of a four leg sling, the length/width ratio of the rectangle formed by the hooks in plan should not exceed 2:1.

(10) If during the trial lift the load is found to be out of balance, it should be lowered and the slings repositioned. Never reposition wire rope slings by hammering, either to bring an out of balance load into balance or, in the case of choke hitch, to tighten the bight. When used in choke hitch, the bight should be positioned so as to assume the natural position, i.e. the three parts of rope being 120° apart. Unlike chain slings with clutches, wire rope slings cannot be adjusted, so in some cases it may be necessary to change the slings for ones of another length or to select another slinging method.

(11) When used in basket hitch, single leg slings should preferably be used in pairs with a spreader beam, unless the rope passes through the load making it captive as shown in Figure 15.10-2 page 270. Multileg slings used in basket hitch without a spreader may be prone to slippage and consequent imbalance or dropping of the load.



Figure 15.10-2

(12) Great care should be taken to avoid shock loading as it effectively increases the weight of a load and could result in the lifting equipment being grossly overloaded. In the case of wire rope, this can result in internal, and therefore unseen, damage.

(13) Wire rope slings which have been in service for long periods of repetitive lifting around loads, e.g. in choke hitch, may become bent or set. To some degree, this is unavoidable and may have no detrimental effect on the use of the sling. However such slings may become difficult to handle and further deterioration will take place. These slings call for careful handling and a more detailed inspection prior to each lift. If any of the faults or defects given in section 15.8 MARKING, STORAGE AND HANDLING page 267 are found, difficulty of handling is experienced or any doubt exists as to the condition, the sling should not be used without reference to a Competent Person.

(14) A small number of well distributed broken wires is acceptable in many cases and will have no effect on the capacity of the sling, but they do present a danger to the operative when handling the sling if they protrude. Similarly, the necessary tail of exposed wire ends from square ferrules can also present a hazard to the operative. Wire rope slings should therefore be handled with care and it is advisable that suitable protective gloves are worn at all times. When protruding barbs of broken wires are found, the sling should be referred to the Competent Person for attention.

(15) Where endless slings are to be joined together then you should not either tie them or use a loop to loop knot. It is good practice when using more than one sling in a single line, to join them with a 'dee' shackle or other suitable connector before placing them onto the hook.

15.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be familiar with the methods of marking slings and with estimating angles of inclination and included angles in order to establish that the sling is being used within its marked range of angles.

(2) Operatives should be familiar with slinging conditions and methods which necessitate a reduction from the marked SWL and should be able to apply the rating factors given in section 15.5.2 Method of Use page 259.

(3) Operatives should be familiar with the conditions which might necessitate a SWL lower than the working load limit, e.g. adverse environmental conditions as detailed in section 15.5.3 Adverse Conditions page 265.

Section 16 - FLAT WOVEN WEBBING SLINGS

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16.1 FOREWORD

Flat woven webbing slings, also commonly known as belt slings, are used for a variety of lifting purposes. They are a form of textile sling which is soft and easy to handle whilst offering rigidity across their width. These qualities make them ideal for handling loads which require some support when being lifted as the load is spread across the full width of the webbing, thus avoiding point contact as is the case with chains or ropes. They are therefore less liable to damage finished surfaces than rope, wire rope or chain slings. However, they are less robust and more easily damaged than equivalent capacity wire rope and chain slings.

> The unfamiliar reader is advised to pay particular attention to section 16.3 DEFINITIONS page 274. For historical reasons, some of the terminology applied to textile slings is different from, or applied in a different way, to other lifting equipment.

16.2 SCOPE

This section of the code covers flat woven webbing slings for multi-purposes, made of Polyamide (Nylon), Polyester or Polypropylene. These may be endless or in the form of single or multi-leg slings which may terminate with soft eyes or metal terminal fittings.

Whilst multi-leg slings are included in this section, their terminal and connecting fittings, such as shackles, are excluded and reference should be made to the appropriate section(s) of this code for specific guidance on their safe use, if required.

This section does not cover special slings or slings used for certain applications, the following are therefore excluded:

(1) Bag slings or the lifting straps which form part of flexible intermediate bulk containers.

(2) Nets, i.e. consisting of several crossed webbings stitched together, or fibre rope cargo nets.

(3) Webbings used for the securing or lashing of cargoes to each other on pallets and platforms or in vehicles.

(4) Adjustable slings, e.g. with intermediate buckles stitched along the webbing.

(5) Slings consisting of webbing with a nominal width of less than 25mm or more than 450mm, or with a nominal thickness of less than 1.2mm.

(6) Slings made from webbing woven from mono-filament yarns.

(7) Slings of tubular webbing.

(8) Slings formed from strips of cut fabric.

(9) Disposable or ‘one trip’ slings used for pre-slung cargo and not reused.

16.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

16.3.1 Effective Length

The effective length is the distance between the bearing points of the sling when stretched out by hand, without noticeable tension, on a flat surface. (See Figure 16.3.1-1 page 274)

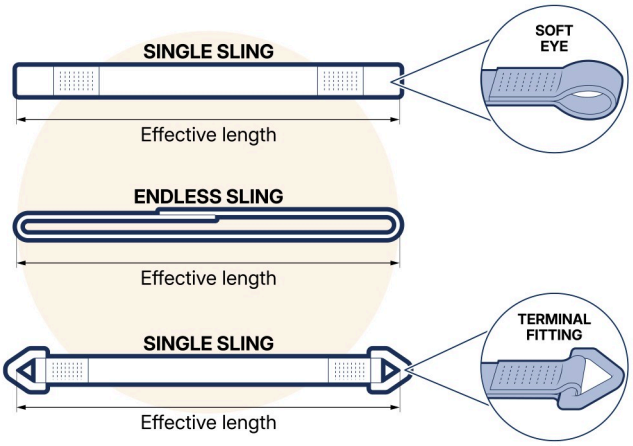


Figure 16.3.1-1

16.3.2 Sewn Webbing Component

The sewn webbing component is that part of the sling comprising woven webbing only including the stitching, i. e. an endless sling, a single sling with soft eyes or a single sling excluding its terminal fittings if any.

16.3.3 Working Load Limit

The working load limit marked on the sewn webbing component and indicated by any colour codes or stripe markings is the maximum load that the sewn webbing component may sustain when it is in straight pull.

> For use in normal conditions the SWL of a single leg sling in straight pull, or an endless sling in straight pull, will be equal to the working load limit.

16.3.4 Mode Factor

The mode factor is a numerical value which is applied to the marked working load limit of a sewn webbing component to determine the maximum load which the sling may lift according to the mode of use and assembly, e.g. choke hitch, basket hitch, single or multiple slinging.

16.3.5 Protective Sleeve

A protective sleeve is a tubular sleeve, either fixed or movable, which may be of leather, woven fabric or other material placed over the webbing to provide extra protection to the webbing. It has no effect on the strength of the sling. Similar protection may also be given to soft eyes.

16.3.6 Soft Eye

A soft eye may be used to terminate a sling leg. It is formed by folding the webbing back on itself in the form of a loop, the free end of which is then sewn back to the body of the webbing so forming an eye.

16.3.7 Eye Protection

A piece of reinforcing material sewn into a soft eye so as to give protection to the material of the eye when placed on the hook of a lifting appliance, connected to other lifting accessories or used in choke hitch.

The fitting of such eye protection is recommended by this code and is a requirement of some standards.

16.3.8 Selvedge

The selvedge (sometimes spelt selvage) of webbing is the natural woven edge of the material produced by the weaving process and which therefore is free of cutting, folding and stitching.

16.3.9 Manufacturer's Certificate, Statement of Conformity / Test Record

Flat woven webbing slings are not subject to proof load testing, as this could be detrimental to the sling and will not reveal any additional information. They are however subject to strength tests made on representative slings during manufacture. A manufacturer's certificate or statement of conformity is supplied with each sling. This confirms compliance with the manufacturing standard and certifies that such manufacturing and sampling tests as are required have been completed. In the case of slings with integral fittings, this will also contain details of the verification of the fittings.

16.4 TYPES OF FLAT WOVEN WEBBING SLINGS

There are a wide range of flat woven webbing slings, which may be manufactured in (a) Polyamide (Nylon); (b) Polyester; (c) Polypropylene in a range of widths from 25mm to 450mm.

Webbing slings are available as single leg, endless or multiple leg slings with a choice of terminations. They may have soft eyes or be fitted with metal 'D' links/plates or similar fittings. These may allow for one end to be reeved through the other or require both to be placed on the hook of the lifting appliance or be coupled together with a coupling component such as a shackle.

In practice, single leg slings are the most popular. They are found to be the most versatile for general purposes as they may be used as a single leg sling or be coupled together to form multi-leg assemblies. Endless slings are uncommon nowadays, having been replaced by the more adaptable roundsling (see SECTION 17 - MAN-MADE FIBRE ROUNDSLINGS page 285 of this code) for everyday use. They are however still used to form the leg of multi-leg sling arrangements.

Whilst individual manufacturers and suppliers may keep a stock of popular lengths, slings can be made to any reasonable length to suit the particular application.

The capacity is related to the width and thickness of the webbing. In order to provide a fuller range of capacities or allow a narrower sling, duplex or multi-layer slings are available, although it must be realised that this results in some loss of flexibility.

16.5 PRINCIPLES FOR THE SELECTION OF FLAT WOVEN WEBBING SLINGS

16.5.1 Working Load Limit

Consideration must be given to the WLL of the sling for the particular service conditions so as to ensure that no part of the sling is overloaded by the method of use. The following should be considered:

(1) The WLL of a webbing sling is based on the minimum breaking load of the sewn webbing component and is calculated on the basis of a factor of safety, which is specified in the applicable national legislation or standard. The terminal fittings of a webbing sling may well be rated at a different factor of safety. It is important to ensure that the webbing and fittings are matched on the basis of their working load limits and not their factors of safety.

(2) Colour coding is often used in standards to relate the WLL of the sewn webbing component . However, standards prior to these permitted, but did not require colour coding. As a result many manufacturers adopted their own systems of colour coding, which were not universal. Care must therefore be exercised in the case of older slings, but in any event reliance should not be placed on the colour code to establish the WLL of the made up sling and reference shall always be made to the label.

(3) The use of colour codes and protective treatments which are coloured limit the ability to de-rate slings for use in adverse conditions. When selecting slings where an increased factor of safety is required for a particular application, this should be achieved by selecting a sling of appropriately larger capacity and providing the operative with written instructions to ensure the correct capacity is selected. The nature of the materials used for flat woven webbing slings also limit their use in certain conditions, such as high temperature, severe abrasion and some chemical environments, for which de-rating is not appropriate.

16.5.2 Rating for Various Modes of Use

Always ensure that slings of sufficient capacity are selected and that careful consideration is given to the mode of assembly. The marked working load limit of the sewn webbing component must be multiplied by the appropriate mode factor to obtain the SWL for the particular mode of assembly and this SWL must not be exceeded. Various modes of assembly, mode factors and SWLs for single and endless slings are given in the following tables.

SWL In Tonnes				
			Basket Hitch	
Straight Pull (equal to WLL) M = 1	**(Colour)**	**Choke Hitch M = 0.8**	**Parallel M = 2**	**0-45° to vertical M = 1.4**
1	Violet	0.8	2	1.4
2	Green	1.6	4	2.8
3	Yellow	2.4	6	4.2
4	Grey	3.2	8	5.6
5	Red	4.0	10	7.0
6	Brown	4.8	12	8.4
8	Blue	6.4	16	11.2
10	Orange	8.0	20	14.0
10+	Orange			

SWL In Tonnes		
Straight Pull per Leg (= to WLL per Sling Leg) M = 1	**2 Leg Sling Assembly 0-45° to vertical M = 1.4**	**4 Leg Sling Assembly 0-45° to vertical M = 2.1**
1	1.4	2.1
2	2.8	4.2
3	4.2	6.3
4	5.6	8.4
5	7.0	10.5
6	8.4	12.6
8	11.2	16.8
10	14.0	21.0

M = Mode factor which must be applied to the WLL of the sewn webbing component. In the case of multi-leg sling assemblies, the slings used to form the assembly must be identical and the mode factor is applied to the WLL of an individual leg.

16.5.3 Sling Termination

Consideration must be given to the termination of the sling, i.e. whether the sling should have made in fittings or terminate with soft eyes. For many applications this will be a matter of personal choice, whilst for others the service conditions will be a factor in this consideration and will affect the expected service life of the sling.

16.5.3.1 Terminal fittings

Terminal fittings must be compatible with the other items to which they may be attached. The use of metal terminal fittings allows for more arduous conditions of wear on the eye and permits wide webbings to be readily attached directly onto hooks of lifting appliances without the need for other fittings, e.g. shackles. They help to ensure that the load is taken evenly across the width of the webbing. When selecting slings with made in terminal fittings the following should be considered:

(1) If the sling is always to be used in straight pull or in basket hitch, metal 'D' links or eye plates may be used.

(2) If the sling is to be reeved into choke hitch, choker 'D' links or eyeplates may be used. These allow one plate to pass through the other and also enable the sling to be used in straight pull or in basket hitch.

> If the sling is to be choke hitched around small diameter loads, a sling with soft eyes should be selected to avoid the risk of bending the fitting or the fitting cutting into the sling.

16.5.3.2 Soft eyes

Various soft eye formations are available. Selection of the eye formation will depend on the mode and method of use and on the intended attachment to the lifting appliance, i.e. direct or with an intermediate fitting such as a shackle. Although there are variations, they fall into three main types of formation, flat, reversed or folded. When selecting slings with soft eyes the following should be considered:

(1) A flat eye is most suitable for passing through shallow apertures. It does not however permit the sling to be reeved as this would cause the webbing to become twisted.

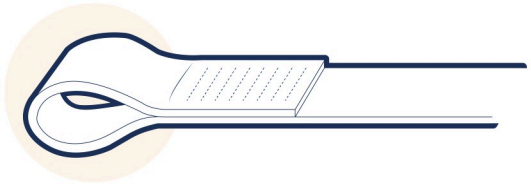


Figure 16.5.3.2-1

(2) A reverse eye allows the sling to be reeved but the webbing at the crown of the eye remains at the full width of the webbing.

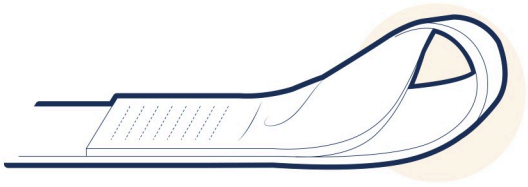


Figure 16.5.3.2-2

(3) A folded eye narrows the width of webbing at the crown of the eye, allowing for easier connection to other lifting devices, however, the eye becomes less flexible.

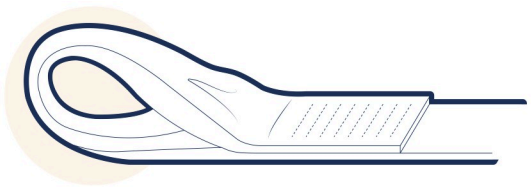


Figure 16.5.3.2-3

(4) A protective sleeve should be fitted to the bearing area of the soft eye. It reduces the risk of cutting and offers protection from wear to the seat of the eye. Various materials are used for this protection, although the most popular is soft leather. It should be remembered that such protection may reduce the flexibility of the eye and prevent visual inspection of the enclosed section.

(5) If webbing slings with soft eyes are used either directly onto the hook of a lifting appliance or onto other fittings, e.g. a shackle, careful consideration must be given to the compatibility of both the eye and the fitting. The part of the fitting onto which the sling bears should:

a. Have a diameter of not more than one-third of the inside length of the eye.

b. If the bearing width of the eye is 75mm or less, it may be placed directly onto a hook or similarly curved fitting. In such cases, the radius of curvature should be at least 0.75 times the bearing width of the eye.

c. Where the bearing width of the eye is greater than 75mm, the fitting should be straight. It is however recommended that the use of such slings is avoided and that a sling with integral terminal fittings is used.

These measures are intended to prevent damage to the stitching of the eye and to ensure that the load is taken evenly by the full width of the webbing. (See Figure 16.5.3.2-1 page 277)

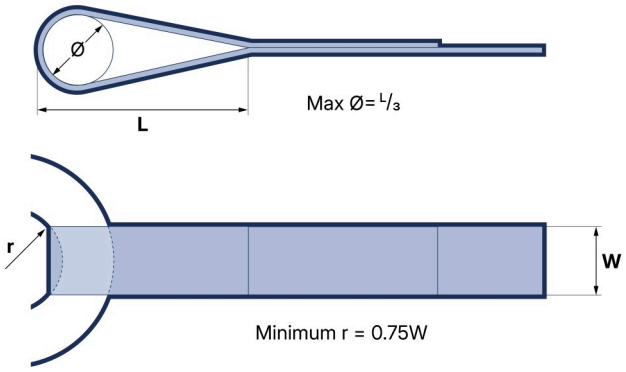


Figure 16.5.3.2-4

16.5.4 Sling Formation

The selection of the sling formation, i.e. single sling, multi-leg sling or endless sling should be carefully considered.

(1) Single slings are by far the most common as they allow for a wide range of applications. They may be used for straight line lifting, use in choke or basket hitch and they may be joined with suitable coupling devices to form temporary multi-leg sling arrangements.

(2) If a number of single slings are to be used in multi-leg formation, consideration must be given to the use of suitable coupling fittings such as shackles. The slings should be joined together by coupling fittings and not placed directly onto the hook of the lifting appliance. The seat of the fitting should be of adequate width to allow the slings to sit side by side without bunching or riding up on each other. This may require the use of multiple fittings for some arrangements.

(3) The use of made up multi-leg flat woven webbing slings is common practice in Europe, but is rare in the UK where it is more usual to use a number of single slings coupled together. However, for applications where a multi-leg arrangement is regularly called for, the selection of a multi-leg sling may be the more economic choice.

(4) Since the introduction of roundslings (see section of this code) the use of endless flat woven webbing slings has declined due to the lack of flexibility across their width, they are however commonly used to form the legs of multi-leg slings where they will be used in a straight pull. The same criteria must be applied to their use with other fittings as with slings having soft eyes. The use of endless flat woven webbing slings in choke hitch is not recommended as the webbing will twist in this configuration.

16.5.5 Adverse Conditions

The selection of webbing slings for use in adverse conditions should be carefully considered. Their use in high temperatures is more limited than that of slings of other materials, however they have selective resistance to chemicals and can be used in some applications where other materials cannot or require special measures to be taken.

16.5.5.1 Temperature

Flat woven webbing slings manufactured from polypropylene are suitable for use in the temperature range -40°C to 80°C whilst those produced from polyester or polyamide (nylon) are suitable for the range -40°C to 100°C. These temperatures may vary in a chemical environment and should be checked by reference to the supplier. Under no circumstances should webbing slings be used at temperatures outside of the range advised by the manufacturer.

Care must be taken when selecting slings for use at low temperatures. Although the qualities of the materials used for flat woven webbing slings makes them suitable for use at temperatures as low as -40°C, if moisture is present, ice will be formed. Ice will both act as an abrasive and cutting agent and will damage the sling. Slings selected for use at low temperatures should be dry and steps must be taken to prevent ice forming on or, more importantly, between the woven strands of the webbing.

16.5.5.2 Chemicals

If the webbing sling is for use in a chemical environment, consult the supplier for advice. Man-made fibres offer a high resistance to chemicals and can, subject to correct material selection, be used in certain chemical environments without detriment.

(1) Polyester is resistant to moderate strength acids but is damaged by alkalis.

(2) Polyamide (nylon) is virtually immune to the effect of alkalis but is attacked by moderate strength acids. Attention is also drawn to its loss of strength on wetting which can be in the order of 15%.

(3) Polypropylene is little affected by either acids or alkalis but is damaged by some solvents, tars, paints, etc. It is suitable for applications where the highest resistance to chemicals, other than solvents, is required.

(4) Consideration must be given to the suitability of the material from which terminal and connecting fittings are made. Certain grades of steel are susceptible to hydrogen embrittlement as the result of contact with acids. This can seriously reduce the ductility and load-bearing capacity, cause cracking and catastrophic brittle failures at stresses below the yield stress of the material. Other metals may be subject to corrosion. The advice of the supplier should always be sought when selecting flat woven webbing slings and/or fittings for use in chemical environments.

16.5.6 Abrasion and Sharp Edges

If abrasion or heat generated by friction is likely to occur, a webbing sling should be selected which is fitted with a protective sleeve or moulded wear pad, or steps taken to ensure suitable protective packing is available. Care must also be taken to protect the sling from edges and corners that might damage the sling. Protective sleeves or moulded wear pads may also be used for this purpose. Moulded wear pads are blocks of hardwearing material which are bonded to one side of the webbing surface, having no detrimental effect on the webbing. Their use is more limited than protective sleeves as they greatly reduce the flexibility of the sling and of course remain in a fixed position. They are ideal for repetitive lifts such as may occur on a production line.

Protective treatments may be applied to the webbing which help reduce the rate of wear. They also help prevent the ingress of dust or grit which can cause internal abrasion. This makes treated flat woven webbing slings ideal for use in more arduous conditions, such as on construction sites. However, these treatments may tend to reduce the flexibility and give a harder, rougher finish to the slings making them unsuitable for certain applications such as use in contact with polished surfaces. The advice of the supplier should be sought when considering the need for treated webbing slings.

16.5.7 Documentation

Ensure the selected sling is covered by the documentation required by legislation. If this is not on record refer the sling to a Competent Person for thorough examination.

16.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As flat woven webbing slings are frequently used for multi-purpose lifting applications, precise details of the load to be lifted and mode of use are not always available. In these circumstances, only a general specification can be given but should, as far as possible, include the following information:

(1) Type of sling required, i.e. single, two leg, etc.

(2) Details of soft eyes and eye protection OR if terminal fittings are required to be attached to the sewn webbing component, the type, e.g. choker eyeplates, etc.

(3) The gross weight and dimensions of the load to be lifted together with details of any permanently built in lifting points if known or alternatively, the maximum load to be lifted.

(4) The effective working length of the sling.

(5) The mode of use, i.e. whether the sling is to be used in choke hitch or basket hitch, etc. In the absence of other information, the manufacturer will assume straight pull.

(6) The environmental conditions, particularly if the temperature is outside the range of -40°C to +80°C, if there is any exposure to specific chemicals or liquids, if the sling will be exposed to strong sunlight for long periods.

(7) The conditions of loading, including:

a. Whether the sling is likely to be subject to shock load.

b. Whether the load is to be transported over areas involving high risk, e.g. work areas. (This should not be done if it can be avoided.)

c. Whether the load itself is hazardous.

(8) If any protective sleeves are required, the number, length and type of sleeves to be fitted.

(9) If any moulded wear pads are to be fitted, the length, number and position.

(10) The material of the sewn webbing component.

(11) Material and grade of any terminal fittings.

(12) If any special treatment or finish is to be applied to the sewn webbing component.

(13) Any special instructions including any special marking requirements.

16.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

16.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that flat woven webbing slings fall under the heading of lifting accessories. Unless a written scheme of examination, (for guidance refer to LEEA 032 Guidance to written schemes of examination) drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.



Although not required by legislation, it is recommended that new slings are issued with a manufacturer's certificate in accordance with the applicable standard and in addition to, although possibly combined with, the documents required by the applicable national legislation and, in the case of slings with terminal fittings, the details of the fittings. These documents form an important part of the record of the sling. They should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

16.8 MARKING, STORAGE AND HANDLING

16.8.1 Marking

The marking may be directly onto the sling or on a sewn-on label. This marking must be such that it will not affect the safety of the sling when in use. Depending on the standard being worked to, for some slings the material of the webbing will be identified by the colour of the label: for polyamide (nylon) this will be green, for polyester blue and for polypropylene brown. Terminal fittings should be individually marked to identify them with the appropriate record.

In addition to the marking required by the applicable standard and legislation the marking on the label should indicate the following minimum information:

(1) SWL in straight pull for single or endless slings, or for the appropriate range of angles in the case of multi- leg slings.

(2) Distinguishing mark(s). (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(3) Nominal length

(4) Material of the webbing

(5) Manufacturer's name or identification.

(6) Year of manufacture

Additionally the label may show the mode factors or SWLs for various modes of use and the grade of fitting if applicable.

> some slings are dyed with a colour code to indicate the working load limit of the sewn webbing component. The WLL may also be indicated by stripes or lines running along the length of the sling, i.e. 1 stripe = 1 tonne, 2 stripes = 2 tonnes and so on. These colours and markings relate to the WLL of the sewn webbing component only and older slings may be marked with alternative colours or no specific colouring. For these reasons and due to the fact that a large proportion of the working population are colour blind to some degree, the user should always check the label to confirm the WLL of the sling.

16.8.2 Storage and Handling

When not in use, flat woven webbing slings should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Prior to placing in storage, the sling should be inspected for any damage which may have occurred in use.

(2) Store flat woven webbing slings on a suitable rack.

(3) Store slings away from acids, alkalis and solvents, etc.

(4) Store at ambient temperatures, away from any heat source.

(5) Flat woven webbing slings are affected by ultra-violet rays and should not be stored in direct sunlight or sources of ultra-violet radiation.

(6) Slings that have been in contact with acids or alkalis should be thoroughly washed in clean water or otherwise neutralised prior to storage. Use only cleaning and neutralising agents approved by the manufacturer and in the manner instructed by them. Care must be taken to ensure that the sling is completely neutralised as a moderate concentration remaining on the sling will become an increasingly strong concentration by evaporation.

(7) Slings which are wet can be hung up and allowed to dry naturally, provided that chemicals are not involved as the drying process may concentrate the chemical to an unacceptable level. Do not apply heat or any other means of force drying.

(8) Wet slings which have become frozen should not be returned to storage but should be allowed to thaw and dry naturally.

16.9 IN-SERVICE INSPECTION AND MAINTENANCE

16.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all webbing slings should be visually inspected by a suitably qualified and experienced person prior to use. As flat woven webbing slings are easily damaged in use, they should be visually checked on each occasion prior to slinging the load.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the sling to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the sling and make a visual check for any obvious defects. This inspection must be carried out with the sling in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of webbing slings and if any are present, the sling should be withdrawn from service and referred to a Competent Person:

(1) Surface chafe. In normal use some chafing will occur and is unavoidable. If this is confined to the surface fibres as opposed to the yarns, it has no effect on the safe use. However, in extreme cases, the faces of the webbing become so worn that the outer yarns are severed.

(2) Local abrasion. If the webbing shows signs of local abrasion, as opposed to general wear, serious loss of strength may occur.

(3) Cuts. Both longitudinal and cross cuts into the surface of the webbing result in loss of strength.

(4) Cuts and chafing to the selvedge. A small cut into the selvedge of the webbing will result in serious loss of strength.

(5) Chemical attack. Whilst man-made fibres have a good resistance to selected chemicals, attack by other chemicals to the webbing fibres results in local weakening and softening of the material. This is indicated by flaking of the surface fibres, which can be plucked or rubbed off.

(6) Heat and friction damage. The surface fibres take on a glazed appearance and in extreme cases, fusion of the fibres occurs.

(7) Weld splatter burns. Textile slings are often used in welding processes as they insulate the work piece from the lifting appliance. Weld splatter will cause localised burning and will be embed in the webbing, causing internal abrasion.

(8) Damaged stitching. Any damage to the stitching or looseness of the threads noticed at any time must be treated very seriously.

(9) Loose webbing. The webbing becomes loose and soft to the touch so that the weft can be moved or split with the fingers.

(10) Damaged eyes or terminal fittings. Cuts, abrasion or any apparent damage to the stitching around folded eyes and where eye protection is fitted, check this for deep cuts or excessive wear. Cracks, bruising, deformation or any other form of damage to metal terminal fittings. Particular attention should be paid to the webbing where it passes around terminal fittings as this is a point of high wear and cutting can occur from misuse.

(11) Missing or illegible marking.

(12) Soiling. Heavy soiling can obscure damage, making detection during inspection difficult. It can also make identification difficult by obscuring any marking or colour coding. Grit and dirt will pick up on the face of soiled webbing and can cause rapid wear and abrasion. Clean the sling in an approved manner but if the soiling is such that cleaning has little or no effect, withdraw from service and refer to a Competent Person.



Only use cleaning agents approved by the manufacturer, whose instructions on its use must be sought and followed. Clean water may however be freely used.

16.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some webbing slings will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 16.9.1 Pre-use inspection page 281, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 16.9.3 Maintenance page 282 below.

16.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In general, there is little that can be done in terms of maintenance to the webbing component of the sling other than ensuring that they are cleaned and free from contaminants that can cause damage and deterioration.

16.9.4 Thorough examination

The webbing sling must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the sling's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of slings. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as tears, cuts, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as tears, cuts, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

16.10 SAFE USE OF FLAT WOVEN WEBBING SLINGS

In addition to any specific instructions relating to the safe use of the webbing sling issued by the manufacturer, the following points should be observed:

(1) The sling should be of adequate strength and length; never exceed the SWL for the particular mode of use. Care must also be taken to ensure the compatibility of any ancillary equipment used to sling the load, both in size and capacity. The angle in the eye of the webbing should never exceed 20° when in use.

(2) Where more than one sling is used to lift the load, each sling should be adequate for the share of the load imposed on it taking into account the slinging method. Do not overcrowd the hook of the lifting appliance. It is good practice when using more than one sling to join them with a shackle before placing them onto the hook.

(3) It should be noted that the various man-made fibres used to manufacture flat woven webbing slings have differing stretch and recovery rates and that the elongation of a sling is proportional to its length. This must be borne in mind in all arrangements using more than one sling. The slings should therefore be of the same material and account must be taken of this if they are of unequal length.

(4) Webbing slings have very different stretch characteristics to those of chain or wire rope slings. Their use in parallel with chain or wire rope slings to form multi-leg assemblies should therefore be avoided as the unequal stretch of the legs can lead to load instability. However, this is not intended to preclude their use combined in series as a means of connecting a sling to the load which can be advantageous in some circumstances. For example, a webbing sling can be wrapped and choked onto a polished surface then hooked into a chain sling thus gaining the advantage of the webbing protecting an easily damaged surface combined with the adjustability of a chain sling.

(5) Position slings correctly. Use packing protection for sharp edges and if protective sleeves are fitted, ensure they are correctly positioned to prevent cutting damage to the sling. Keep labels away from the load and the hook. Never place stitching over hooks or other fittings; always ensure the stitching, other than at a folded eye, is placed in the standing part of the sling.

(6) Position the slings so that the loading is uniformly spread over their width. Duplex or multi-layer slings should always have fittings to ensure that the webbing is loaded evenly across their width. Webbing slings must not be twisted or crossed in use. Care must be taken when using narrow or thin slings due to their greater vulnerability to abrasion, cutting and twisting in use.

(7) Position the bight for choke lift in the natural (120°) angle to avoid heat being generated by friction, which could cause damage. When loads are lifted in choke hitch or straight pull by slings with soft eyes, the eyes should be fitted with eye protection. Slings with terminal fittings should only be choke hitched around large diameter loads so that the terminal fitting does not cut into or distort the standing part of the webbing. Where small diameter loads are to be choke hitched, a sling with soft eyes should be selected.

(8) Great care should be taken to avoid shock loading as it effectively increases the weight of a load and could result in the lifting equipment being grossly overloaded. Man-made fibres have varying elastic characteristics and, dependent on the material in use, permanent elongation may result.

(9) When using slings in association with chemicals, ensure the sling material and that of the terminal fittings is suitable. Always follow the manufacturer's instructions, which may place limitations on the use of the sling. If any doubt exists, seek further advice.

16.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be familiar the methods of marking webbing slings together with the mode factors which vary the SWL according to the mode of use and assembly, e.g. choke hitch, basket hitch, single or multiple slinging, and fully understand how to apply them.

(2) Operatives should be instructed in the correct selection of slings for varying applications, e.g. use with chemicals, and the steps to be taken if accidental exposure to chemicals occurs.

(3) Operatives should be instructed in the meaning of colour codes, which denote the WLL of the sewn webbing component and the material from which the sling is constructed. Caution must be exercised, not only as some manufacturers may adopt alternative colour codes, but also as the operative may suffer colour blindness.

Section 17 - MAN-MADE FIBRE ROUNDSLINGS

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17.1 FOREWORD

Man-made fibre roundslings are a form of endless textile sling which is soft and pliable to use, easy to handle and especially useful on delicate surfaces. They are however less robust and more liable to damage than equivalent capacity wire rope and chain slings.

17.2 SCOPE

This section of the code covers man-made fibre roundslings for multi-purpose use made of Polyamide (Nylon), Polyester or Polypropylene. It should be noted that anything other than a roundsling as defined below is excluded from this section (e.g. an endless rope sling).

Although multi-leg slings are included in this section, their terminal and connecting fittings, such as shackles, are excluded and reference should be made to the appropriate section(s) of this code for specific guidance on their safe use, if required.

17.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted:

17.3.1 Roundsling

A roundsling is a sling comprising a core enclosed in a protective cover. The core is the load-bearing part of the roundsling and is in the form of a hank of yarn made up from one or more strands of the parent fibre material wound together continuously and joined to form an endless sling. The protective cover is a woven tubular outer sleeve of the same parent material as the core, which is designed to be non-load-bearing as it is intended only for protection and containment of the core.

17.3.2 Protective Sleeve

A protective sleeve is an additional sleeve fitted to a roundsling to provide extra protection for part of its length and is usually in the form of a loose sleeve, which slides over the outer cover. It has no effect on the strength of the roundsling.

17.3.3 Effective Working Length

The effective working length of a roundsling is as shown in Figure 17.3.3-1 page 286 and is equal to half its circumference.



Figure 17.3.3-1 Effective working length (equals half the circumference)

17.3.4 Terminal and Connecting Fittings

Terminal fittings, otherwise known as end fittings, are metal fittings attached to a roundsling to enable the sling to connect to the load and/or the lifting appliance when the sling is used in straight pull or to form a multi-leg configuration. They may be permanently attached to the roundsling in the course of manufacture or, more commonly, fitted by the means of a metal connecting fitting, otherwise known as a coupling component.

17.3.5 Working Load Limit

The working load limit marked on the roundsling label and indicated by any colour codes or stripe markings is the maximum load that the sling may sustain when it is in straight pull.

> For use in normal conditions the SWL of a roundsling in straight pull will be equal to the WLL.

17.3.6 Mode Factor

The mode factor is a numerical value which is applied to the marked working load limit of a roundsling to determine the maximum load which the sling may lift according to the mode of use and assembly, e.g. choke hitch, basket hitch or multiple slinging.

17.3.7 Manufacturer's Certificate, Statement of Conformity / Test Certificate

Roundslings are not subject to proof load testing, as this could be detrimental to the sling and will not reveal any additional information. They are however subject to strength tests made on representative slings during manufacture. A manufacturer's certificate or statement of conformity is supplied with each roundsling. This confirms compliance with the manufacturing standard and certifies that such manufacturing and sampling tests as are required have been completed. In the case of slings with integral fittings, this will also contain details of the verification of the fittings.

17.4 TYPES OF ROUNDSLINGS

Roundslings may be manufactured in (a) polyamide (nylon); (b) polyester; (c) polypropylene, in single endless form or multiple endless leg assemblies. It should however be noted that, whilst common in Europe, multi-leg roundsling assemblies are rare in the UK, users preferring to obtain single endless slings enabling a varied range of uses including assembly of more than one sling in any particular slinging arrangement.

The most popular roundslings are usually supplied as single endless slings, manufactured in polyester in a range of working load limits up to 12 tonne, although there is no restriction and higher capacities are becoming more commonly available. Roundslings of 1 metre to 6 metre effective working length are readily available but other lengths can be readily manufactured to order and again there is no restriction other than that imposed by the capacity of the manufacturing equipment. Similarly slings in polyamide and polypropylene can be supplied to order.

17.5 PRINCIPLES FOR THE SELECTION OF ROUNDSLINGS

17.5.1 Working Load Limit

Consideration must be given to the WLL of the sling for the particular service conditions so as to ensure that no part of the sling is overloaded by the method of use. The following should be considered:

(1) The WLL of a roundsling is based on the minimum breaking load in straight pull and is calculated on the basis of a factor of safety specified in the applicable legislation or standard. Where fitted, terminal fittings may well be rated at a different factor of safety. It is important to ensure that the roundsling and fittings are matched on the basis of their working load limits and not their factors of safety.

(2) Colour coding is often used in standards to relate the WLL of the round sling in a straight pull. However, standards prior to these permitted, but did not require colour coding. As a result many manufacturers adopted their own systems of colour coding, which were not universal. Care must therefore be

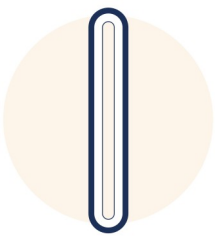
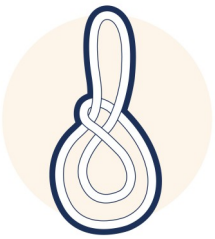
exercised in the case of older slings, but in any event reliance should not be placed on the colour code to establish the WLL of the sling and reference shall always be made to the label.

(3) As the covers of roundslings are colour coded to indicate their working load limit and marking is usually by means of a pre-printed label stitched to the cover, this limits the ability to de-rate slings for use in adverse conditions. If therefore a higher factor of safety is required for a particular application, this should be achieved by selecting a sling of appropriately larger capacity and providing the operative with written instructions to ensure the correct capacity is selected. The nature of the materials used for roundslings also limit their use in certain conditions, such as high temperature, severe abrasion and some chemical environments, for which de-rating is not appropriate.

17.5.2 Rating for Various Modes of Use

Always ensure that slings of sufficient capacity are selected, and that careful consideration is given to the mode of assembly. The marked working load limit of the roundsling must be multiplied by the appropriate mode factor to obtain the SWL for the particular mode of assembly and this SWL must not be exceeded. Various modes of assembly, mode factors and SWLs are given in the following tables:

Table 7 M = Mode factor which must be applied to the WLL of the roundsling

SWL tonnes (t)			
Straight pull = WLL  *Figure 17.5.2-1* **M** = 1	Choked  *Figure 17.5.2-2* **M** = 0.8	Basket (legs parallel)  *Figure 17.5.2-3* **M** = 2	Basket 0 - 45° to the vertical  *Figure 17.5.2-4* **M** = 1.4
1	0.8	2.0	1.4
2	1.6	4.0	2.8
3	2.4	6.0	4.2
4	3.2	8.0	5.6
5	4.0	10.0	7.0
6	4.8	12.0	8.4
8	6.4	16.0	11.2
10	8.0	20.0	14.0
10 +			

With multi-leg slings, it should be noted that the individual roundslings forming the legs will be colour coded for their own working load limits and not that of the sling assembly. As with single slings, the SWL for the particular sling configuration is obtained by multiplying the working load limit of a single endless leg by a mode factor. gives the SWLs for two leg and four leg slings having identical legs.

SWL load tonnes (t)		
Straight pull per leg (equal to WLL of a single sling) **M** = 1	Two leg sling 0-45° to vertical **M** = 1.4	Four leg sling 0-45° to vertical **M** = 2.1
1	1.4	2.1
2	2.8	4.2
3	4.2	6.3
4	5.6	8.4
5	7.0	10.5
6	8.4	12.6
8	11.2	16.8

17.5.3 Sling Formation

The selection of the sling formation, i.e. endless or multi-leg should be carefully considered.

(1) Single endless slings without integral fittings are by far the most common, as they allow for a wide range of applications. They may be used for straight line lifting, use in choke or basket hitch and they may be joined with suitable coupling devices to form temporary multi-leg sling arrangements.

(2) If a number of single endless slings are to be used in multi-leg formation, consideration must be given to the use of suitable coupling fittings such as shackles. The slings should be joined together by coupling fittings and not placed directly onto the hook of the lifting appliance. The seat of the fitting should be of adequate width to allow the slings to sit side by side without bunching or riding up on each other. This may require the use of multiple fittings for some arrangements.

17.5.4 Adverse Conditions

The selection of roundslings for use in adverse conditions should be carefully considered. Their use in high temperatures is more limited than that of slings of other materials, however they have selective resistance to chemicals and can be used in some applications where other materials cannot or require specials measures to be taken.

17.5.4.1 Temperature

Roundslings manufactured from polypropylene are suitable for use in temperatures from -40°C to 80°C whilst those produced from polyester or polyamide are suitable for the range -40°C to 100°C. These temperatures may vary in a chemical environment and should be checked by reference to the supplier. Under no circumstances should roundslings be used at temperatures outside of the range advised by the manufacturer.

Care must be taken when selecting slings for use at low temperatures. Although the qualities of the materials used for roundslings makes them suitable for use at temperatures as low as -40°C, if moisture is present, ice will be formed. Ice will both act as an abrasive and cutting agent and will damage the sling. Slings selected for use at low temperatures should be dry and steps taken to prevent ice forming on, or more importantly, between the strands of the sling core or cover.

17.5.4.2 Chemicals

If the roundsling is for use in a chemical environment, consult the supplier for advice. Man-made fibres offer a high resistance to chemicals and can, subject to correct material selection, be used in certain chemical environments without detriment.

(1) Polyester is resistant to moderate strength acids but is damaged by alkalis.

(2) Polyamide (nylon) is virtually immune to the effect of alkalis but it is attacked by moderate strength acids. Attention is also drawn to its loss of strength on wetting which can be in the order of I5%.

(3) Polypropylene is little affected by either acids or alkalis but is damaged by some solvents, tars, paints, etc. It is suitable for applications where the highest resistance to chemicals, other than solvents, is required.

(4) Consideration must be given to the suitability of the material from which fittings and connecting devices are made. Certain grades of steel are susceptible to hydrogen embrittlement as the result of contact with acids. This can seriously reduce the ductility and load-bearing capacity, cause cracking and catastrophic brittle failures at stresses below the yield stress of the material. Other metals may be subject to corrosion. The advice of the supplier should always be sought when selecting roundslings and/or fittings for use in chemical environments.

17.5.5 Abrasion and Sharp Edges

If abrasion or heat generated by friction is likely to occur, select a roundsling which is fitted with an additional protective sleeve or ensure suitable packing is available. Care must also be taken to protect the sling from edges or corners that might damage the sling. Additional protective sleeves may also be used for this purpose.

17.5.6 Documentation

Ensure the selected sling is covered by the documentation required by legislation. If this is not on record refer the sling to a Competent Person for thorough examination.

17.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As roundslings are frequently used for multi-purpose lifting applications, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given but should, as far as possible, include the following information:

(1) The gross weight and dimensions of the load to be lifted together with details of any permanently built in lifting points.

(2) The environmental conditions, particularly if the temperature is outside of the range -40°C to +80°C, if there is any exposure to specific chemicals or liquids, if the sling will be exposed to strong sunlight for long periods.

(3) The conditions of loading including:

a. Whether the sling is likely to be subjected to shock load.

b. Whether the load is to be transported over areas involving high risk e.g. work areas. (This should not be done if it can be avoided)

c. Whether the load itself is hazardous.

(4) The effective working length of the sling.

(5) The mode of use, i.e. whether the roundsling is to be used in choke hitch, basket hitch, etc.

(6) The material of construction.

(7) If additional protective sleeves are required, the length and number of sleeves to be fitted.

(8) Material and grade of any fittings or coupling devices.

(9) Any special instructions including any special marking requirements.

17.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

17.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that roundslings fall under the heading of lifting accessories. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

Although not required by legislation, new slings will be issued with a manufacturer's certificate in addition to, although possibly combined with, the documentation require by the applicable legislation and, in the case of slings with fittings, the details of the fittings. Similar requirements for a manufacturer's statement of conformity applied in the case of slings made to older now superseded standards. These documents form an important part of the record of the sling. They should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

17.8 MARKING, STORAGE AND HANDLING

17.8.1 Marking

Marking should be directly onto the outer cover or on a label attached to the outer cover of the roundsling. This marking must be such that it will not affect the safety of the sling when in use. Depending on the standard being worked to for some slings the material from which the sling is constructed will be identified by the colour of the label: for polyester slings this will be blue, for polyamide (nylon) green and polypropylene brown. Integral fittings and coupling components should be individually marked to identify them with the appropriate record.

In addition to the information required by the applicable legislation and standard the markings on the label should indicate the following minimum information:

(1) SWL in straight pull or for the appropriate range of angles in the case of multi-leg slings.

(2) Distinguishing mark(s). (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)..

(3) Nominal length.

(4) Material of the roundsling

(5) Manufacturer's name or identification.

(6) Year manufacture

Additionally the label may show the mode factors or SWLs for various modes of use and the grade of fitting if applicable.

Some slings are dyed with a colour code to indicate the working load limit of the roundsling in straight pull. The WLL may also be indicated by stripes or lines running along the length of the sling, i.e. 1 stripe = 1 tonne, 2 stripes = 2 tonnes and so on. Older slings may be marked with alternative colours or no specific colouring. For these reasons and due to the fact that a large proportion of the working population are colour blind to some degree, the user should always check the label to confirm the WLL of the sling.

17.8.2 Storage and Handling

When not in use, roundslings should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Prior to placing in storage, the sling should be inspected for any damage, which may have occurred in use.

(2) Store roundslings on a suitable rack.

(3) Store roundslings away from acids, alkalis and solvents.

(4) Store at ambient temperatures, away from any heat source.

(5) Roundslings are relatively unaffected by ultra-violet rays but should not however be stored in direct sunlight or sources of ultra-violet radiation.

(6) Slings that have been in contact with acids or alkalis should be thoroughly washed in clean water or otherwise neutralised prior to storage. Use only cleaning and neutralising agents approved by the manufacturer and in the manner instructed by them. Care must be taken to ensure that the sling is completely neutralised, as a moderate concentration remaining on the sling will become an increasingly strong concentration by evaporation.

(7) Roundslings which are wet can be hung up and allowed to dry naturally, provided that chemicals are not involved as the drying process may concentrate the chemical to an unacceptable level. Do not apply heat or any other means of force drying.

(8) Wet slings which have become frozen should not be returned to storage but should be allowed to thaw and dry naturally.

17.9 IN-SERVICE INSPECTION AND MAINTENANCE

17.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all roundslings should be visually inspected by a suitably qualified and experienced person prior to use. As round slings are easily damaged in use, they should be visually checked on each occasion prior to slinging the load.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the sling to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the sling and make a visual check for any obvious defects. This inspection must be carried out with the sling in a reasonably clean condition and in adequate lighting. The construction of roundslings is such that only the outer cover can be examined. The outer cover, whilst being of the same material as the inner fibres, is non-load-bearing. If however the outer sleeve is undamaged then, in the absence of any other evidence, the inner core can be considered to be undamaged also. The following are examples of the common defects which may become apparent in use or during the regular inspection of roundsling and if any are present, the sling should be withdrawn from service and referred to a Competent Person:

(1) Exposed core. Some scuffing and general wear of the protective cover is acceptable provided the inner load bearing core is not exposed.

(2) Cuts in the outer protective cover.

(3) Failure of the stitching.

(4) Heat and friction damage. Excessive heat, especially that generated by friction, will cause a smooth shiny area on the outer cover and may also cause internal damage. In extreme cases, fusion of the fibres occurs.

(5) Weld splatter burns. Textile slings are often used in welding processes, as they insulate the work piece from the lifting appliance. Weld splatter will cause localised burning and may embed in the cover, causing abrasion, but is more likely to penetrate the cover and damage the inner core.

(6) Chemical attack. Normally difficult to detect until advanced deterioration has occurred. In an advanced state, surface powdering occurs. Possible loss of colouring of the sleeve. Unless the manufacturer has agreed to such usage and a safe system of work has been agreed, slings exposed to chemicals (e.g. acids, alkalis, solvents) should be washed and cleaned in water and withdrawn from service for examination by a Competent Person.

(7) Illegible marking or missing label; i.e. the sling identification mark and SWLs.

(8) Soiling. Heavy soiling can obscure damage, making detection during inspection difficult. It can also make identification difficult by obscuring any marking or colour coding. Grit and dirt will pick up on the face of the cover and can cause rapid wear and abrasion. Clean the sling in an approved manner but if the soiling is such that cleaning has little or no effect, withdraw from service and refer to a Competent Person.



Only use cleaning agents approved by the manufacturer, whose instructions on its use must be sought and followed. Clean water may however be freely used.

17.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some roundslings will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of

one or more of the items listed in section 17.9.1 Pre-use inspection page 291, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 17.9.3 Maintenance page 292 below.

17.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In general there is little that can be done in terms of maintenance to the sling other than ensuring that they are cleaned and free from contaminants that can cause damage and deterioration.

17.9.4 Thorough examination

The roundsling must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the sling's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of roundslings. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as tears, cuts, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as tears, cuts, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

17.10 SAFE USE OF ROUNDSLINGS

In addition to any specific instructions relating to the safe use of the roundsling issued by the manufacturer, the following points should be observed:

(1) The sling should be of adequate strength and length; never exceed the SWL for the particular mode of use. Care must also be taken to ensure the compatibility of any ancillary equipment used to sling the load, both in size and capacity.

(2) Where more than one sling is used to lift the load, each sling should be adequate for the share of the load imposed on it taking into account the slinging method. Do not overcrowd the hook of the lifting appliance. It is good practice when using more than one sling to join them with a shackle before placing them onto the hook. When a number of single slings are to be coupled together to form a multi-leg sling, consideration must be given to the terminal and/or connecting fittings. The seating of the fitting where the roundsling engages should be smooth with radiused edges and it must allow the roundsling to adopt its natural flattened form under load.

(3) It should be noted that the various man-made fibres used to manufacture roundslings have differing stretch and recovery rates and that elongation of a sling is proportional to its length. This must be borne in mind in all arrangements using more than one sling. The slings should therefore be of the same material and account must be taken of this if they are of unequal length.

(4) Roundslings have very different stretch characteristics to those of chain or wire rope slings. Their use in parallel with chain or wire rope slings to form multi-leg assemblies should therefore be avoided as the unequal stretch of the legs can lead to load instability. However, this is not intended to preclude their use combined in series as a means of connecting a sling to the load which can be advantageous in some circumstances. For example, a roundsling can be wrapped and choked onto a polished surface then hooked into a chain sling thus gaining the advantage of the roundsling protecting an easily damaged surface combined with the adjustability of a chain sling.

(5) Position slings correctly. Use packing protection for sharp edges and if protective sleeves are fitted, ensure they are correctly positioned to prevent cutting damage to the sling. Keep labels away from the load, point of choke and hook.

(6) Position the bight for choke hitch in the natural (120°) angle to avoid heat being generated by friction, which could cause damage to the cover and inner core.

(7) Great care should be taken to avoid shock loading as it effectively increases the weight of a load and could result in the lifting equipment being grossly overloaded. Man-made fibres have varying elastic characteristics and, dependent on the material in use, permanent elongation may result.

(8) When using roundslings in association with chemicals, ensure the sling material and that of the terminal fittings is suitable. Always follow the manufacturer's instructions, which may place limitations on the use of the sling. If any doubt exists, seek further advice.

(9) Where endless slings are to be joined together then you should not either tie them or use a loop to loop knot. It is good practice when using more than one sling in a single line, to join them with a 'dee' shackle or other suitable connector before placing them onto the hook.

17.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be familiar with the methods of marking roundslings together with the mode factors which vary the SWL according to the mode of use and assembly, e.g. choke hitch, basket hitch, single or multiple slinging, and fully understand how to apply them.

(2) Operatives should be instructed in the correct selection of roundslings for varying applications, e.g. use with chemicals, and the steps to be taken if accidental exposure to chemicals occurs.

(3) Operatives should be instructed in the meaning of colour codes, which denote the WLL of the roundsling in straight pull and the material from which the sling is constructed. Caution must be exercised, not only as some manufacturers may adopt alternative colour codes, but also as the operative may suffer colour blindness.

Section 18 - FIBRE ROPE SLINGS

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18.1 FOREWORD

Fibre rope slings are the traditional form of textile sling whose origins are recorded in the earliest history of lifting equipment. Although their use has declined in recent years in favour of the newer forms of textile slings, i.e. flat woven webbing slings and roundslings, they may still be found in general use throughout industry.

Fibre rope slings are produced from cut lengths of rope which are then hand spliced. In the case of three strand rope this is an easily learned skill and as a result many fibre rope slings are produced by the user. The intention is not to condemn or condone this practice, but to acknowledge that it occurs. It must be remembered that the manufacturer of the sling is the responsible person (legal) under the applicable national legislation, who must comply fully with that legislation. LEEA therefore, strongly recommends that slings are obtained from a lifting equipment supplier who is able to guarantee compliance with the appropriate legislation and applicable standards.

Fibre rope slings are less pliable than other forms of textile sling and are more bulky to handle. Unlike flat woven webbing slings and roundslings they present a hard, point contact to the load although this is less severe than with chain or wire rope.

18.2 SCOPE

This section of the code covers fibre rope slings manufactured from three strand hawser laid or eight strand plaited construction ropes and which are used for general lifting purposes.

The fibre rope slings covered by this section of the code may be manufactured from the following natural or man-made fibre ropes only:

(1) Hemp (natural)

(2) Sisal (natural)

(3) Manila (natural)

(4) Polypropylene (man-made)

(5) Polyester (man-made)

(6) Polyamide [Nylon] (man-made)

All other fibre ropes, whether of natural or man-made fibres, are excluded.

Although multi-leg slings are included in this section of the code, their terminal and connecting fittings, such as shackles, are excluded and reference should be made to the appropriate section(s) of this code for specific guidance on their safe use, if required.

This section of the code refers only to fibre rope slings with eyes which are produced by hand splicing and excludes other methods of forming eyes, e.g. ferrule secured eyes, which may be unsuitable for lifting purposes.

18.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

18.3.1 Three Strand Hawser Laid Rope

Three strand hawser laid rope is constructed from three strands of yarns spun from fibres. The strands are twisted together (laid) in right hand lay, this is known as a Z direction of lay. (See Figure 18.3.1-1 page 296)

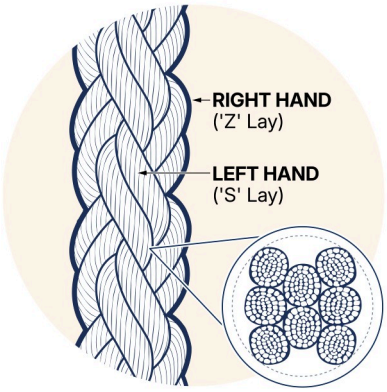


Figure 18.3.1-1

18.3.2 Eight Strand Plaited Rope

Eight strand plaited rope is constructed from eight strands of yarns spun from fibres. The strands are laid together in pairs, each alternative pair consisting of two left hand (S twist) strands and two right hand (Z twist) strands respectively. (See Figure 18.3.2-1 page 296) The eight strands collectively contain the same number of yarns as the three strand rope of equivalent size. Hence the weights and breaking strengths of both constructions are the same size for size.

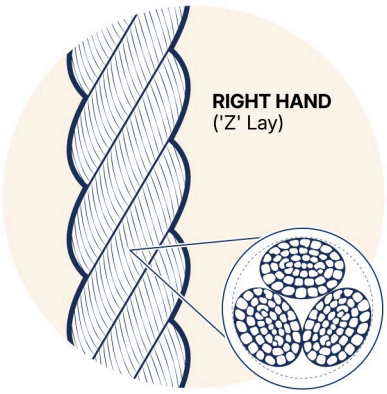


Figure 18.3.2-1

18.3.3 Splice

Splice is the term used to describe the joining made in the rope, either by forming a loop in the rope and tucking the strands of the free end back into the strands of the standing rope to form an eye, or by marrying both the free ends of rope and then tucking the free strands into the standing rope to form an endless sling.

18.3.4 Marrying

Marrying is the term used to describe that part of the operation of splicing an endless sling where the unlaid strands of one end of the rope are laid in between the unlaid strands of the other end of the rope. (See Figure 18.3.4-1 page 297)

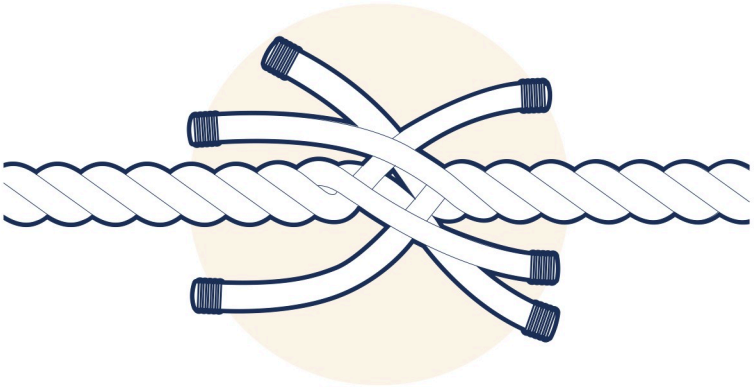


Figure 18.3.4-1

18.3.5 Soft Eye

A soft eye is an eye made at the end of a rope by forming a loop and splicing the free end into the standing part. The eye that is formed is not fitted with a protective thimble. (See Figure 18.3.5-1 page 297)

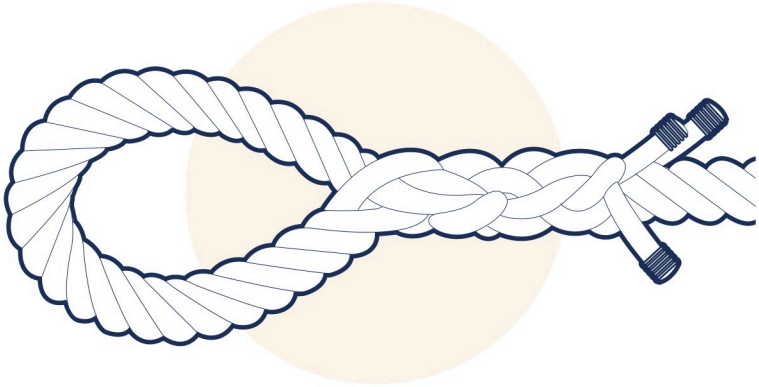


Figure 18.3.5-1

18.3.6 Thimbled or Hard Eye

A thimbled, or hard eye, is an eye which is made around a heart shaped thimble to give internal protection to the eye and to maintain its shape. It is used where terminal fittings are made onto the sling or where conditions are arduous and it is desirable to protect the inside of the eye from abrasion. (See Figure 18.3.6-1 page 297) Larger thimbles, known as reeving thimbles, which permit one eye to pass through another may be fitted when a sling is required for use in choke hitch.

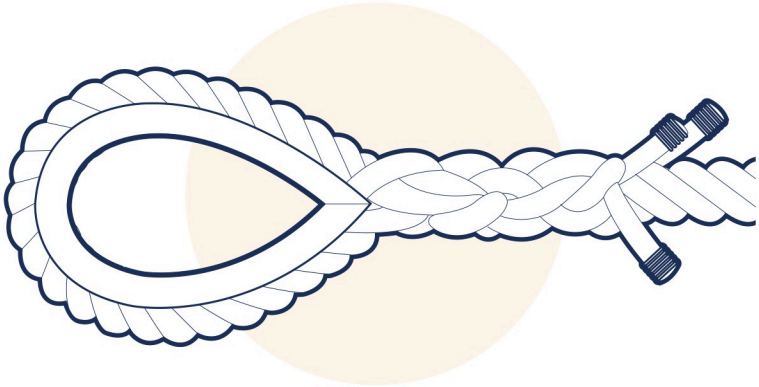


Figure 18.3.6-1

18.3.7 Manufacturer's Certificate, Statement of Conformity / Test Certificate

Fibre rope slings are not subject to proof load testing, as this could be detrimental to the sling and will not reveal any additional information. The rope is however subject to strength tests made on samples taken from the coil at the time of manufacture. The standard requires the sling manufacturer to perform type tests and manufacturing tests at certain intervals to ensure that the performance requirements are met and maintained. It also requires the manufacturer to issue a manufacturer's certificate with each batch of slings which states the WLL and, in the case of slings with integral fittings, this will also contain details of the fittings.

18.4 TYPES OF FIBRE ROPE SLINGS

Current standards permit a selected range of natural and man-made fibre ropes to be made into single, endless, two, three and four leg slings and allows for a range of terminal fittings to be used. The choice of material is dealt with in section 18.5 PRINCIPLES FOR THE SELECTION OF FIBRE ROPE SLINGS page 299, other matters relating to the various types of sling are covered in the following.

18.4.1 Sling Formations

The various formations are illustrated in Figure 18.4.1-1 page 298 and Figure 18.4.1-2 page 298 inclusive. A three leg sling is formed in the same way as a four leg sling but with two legs attached to one intermediate link and one to the other.

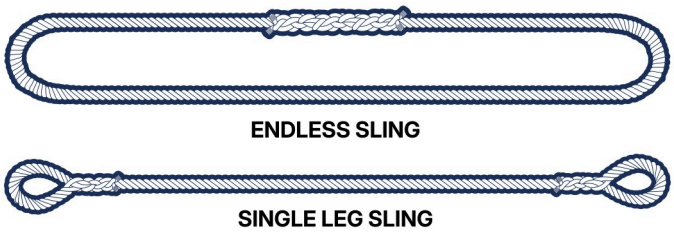


Figure 18.4.1-1

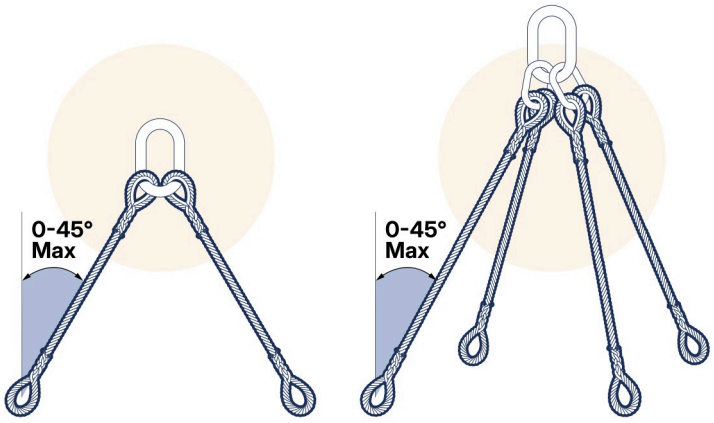


Figure 18.4.1-2

18.4.2 Eyes

Fibre rope sling legs may be made with soft eyes or hard eyes, hard eyes being fitted with heart shaped thimbles or reevable thimbles. Although current standards permit and show examples of soft eyes for attaching terminal fittings, e.g. links and hooks, it is strongly recommended that thimbles are used as they protect the rope from the worst effects of point loading and abrasion.

18.4.3 Terminal Fittings and Master-Links

A range of terminal fittings may be attached directly onto the sling legs. Examples of typical terminal fittings are links, hooks and shackles. The seating where the rope rests on the fitting should be smooth and not have sharp edges which might cause damage to the rope. Ideally, the seating should have a diameter of not less than twice the diameter of the rope and in no case must it be less than the diameter of the rope.

18.5 PRINCIPLES FOR THE SELECTION OF FIBRE ROPE SLINGS

18.5.1 Materials

Careful consideration must be given to the materials from which the sling is made. The material characteristics and mechanical properties of the various natural and man-made fibre ropes vary greatly. It is not possible, nor indeed desirable, in a document of this nature to detail all of the characteristics or properties and it is strongly recommended that the supplier's advice is always sought and followed when selecting fibre rope slings for specific applications. The following therefore only outlines the more important of these for comparison purposes.

18.5.1.1 Construction of man-made fibres

Man-made fibres are produced by extrusion and the size and shape of the fibres can be controlled to obtain the most desirable characteristics for a particular duty. Four types of fibre construction are generally used in the manufacture of ropes used for the production of fibre rope slings:

(1) Multifilaments are continuous fibres of very fine circular section less than 50 microns in diameter.

(2) Monofilaments are continuous fibres of larger diameter than multifilaments.

(3) Staple spun fibres are discontinuous lengths of fibres produced by selectively cutting either multifilament or monofilament fibres. This construction of man-made fibre is the one that nearest resembles natural fibre.

(4) Fibrillated film is extruded as a tape which, after hot stretching, is caused to split longitudinally during the spinning to allow the yarn so formed to assume a roughly circular cross section.

Continuous fibres, as their name suggests, are produced in long lengths without a break. It may be assumed that they run from one end to the other of a length of cordage without discontinuity.

18.5.1.2 Chemical resistance

The various materials have very differing resistances to chemicals. Natural fibre rope slings offer little or no resistance to chemicals, their fumes or to certain gases. Man-made fibre rope slings however offer selective resistance to chemicals as follows:

(1) Polyamide [nylon] is virtually immune to the effects of alkalis. It is attacked by moderate strength acids. It also suffers loss of strength on wetting which can be as much as 15%.

(2) Polyester is resistant to moderate strength acids but is damaged by alkalis.

(3) Polypropylene is little affected by acids and alkalis but is damaged by solvents, tars and paints.

18.5.1.3 Comparative strength

The strength of a fibre rope is somewhat less than the aggregate strength of the yarns used in its construction and as the size of rope is increased so the proportional strength of the rope is less. A size for size comparison shows that:

(1) Polyamide [nylon] is the strongest fibre rope.

(2) Polyester is weaker than polyamide [nylon] but stronger than polypropylene fibre rope.

(3) Polypropylene is the weakest man-made fibre rope but is stronger than the natural fibre ropes.

(4) Manila is the strongest natural fibre rope but is weaker than those of man-made fibre.

(5) Hemp and Sisal are approximately the same and are slightly weaker than manila fibre rope.

18.5.1.4 Unit weight

The cross section of the various fibres differs, allowing them to pack differently. Their densities also vary. These factors affect the weight of the finished ropes and thus, size for size, man-made fibre ropes tend to be lighter than those of natural fibre.

18.5.1.5 Rope surface

The nature of the fibres affects the surface finish of the rope. This in turn affects the operative when handling the rope and the ropes suitability for handling certain loads. Manila and sisal tend to be coarse fibres giving a rough, abrasive surface to the rope, whilst man-made fibres tend to be smoother. Frictional resistance of the rope surface is greater in natural fibre rope than in man-made fibre ropes and as a result the splicing requirements differ. Splices with fewer tucks are often possible in natural fibre ropes.

18.5.1.6 Elongation

All ropes elongate under load. In the case of natural fibre ropes, this is mainly due to bedding down of the yarns in the strands and the strands in the rope. Although this also occurs in man-made fibre ropes, the fibres themselves elongate resulting in greater rope elongation than with natural fibre ropes. As a general rule, once an initial amount of bedding down has taken place the rope will return to its original length when the load is removed.

18.5.1.7 Deterioration

Natural fibre ropes deteriorate with age and as natural lubricants dry out, the fibres become brittle. Mould and fungi, e.g. mildew, will readily grow on damp natural fibre ropes living on the cellulose and greatly weakening the rope. Man-made fibre ropes do not suffer in the same way, mould only being able to live on surface contamination, but they can be affected by ultra-violet light and therefore may suffer solar degradation if exposed to strong sunlight or other sources of ultra-violet radiation.

18.5.2 Terminations

Consideration must be given to the way in which the sling is to be terminated. A range of fittings are available and their selection will depend on the load, the need to connect with other fittings and the nature of the operation.

Sling legs which are to be used in choke hitch should terminate with soft eyes or be fitted with reeving thimbles which permit the passage of one eye through another whilst offering protection from abrasion.

Hooks and shackles can be made into the eyes of rope slings so that they are captive. In some cases shackles can be made detachable. When selecting slings with hooks, the pattern of hook will to some degree depend on the application. However, it is important that hooks and other similar devices provided for lifting be of a type that reduces the risk of the load becoming displaced from the hook or other devices. This requirement can be met by the use of hooks with safety catches or by the use of 'C' type hooks.

It is strongly recommended that thimbles are fitted to the eyes of sling legs that connect with other fittings, captive or detachable, so that the eye maintains a good shape and the rope is protected from abrasion. Similarly, thimbles should be fitted where the conditions are arduous and wear and abrasion are likely to occur to the inside of the eye.

18.5.3 Effective Working Length

The effective working length (EWL) must be considered. This is measured between the bearing surface of the upper and lower terminals or, in the case of an endless sling, with the sling pulled flat, as shown in the following illustrations:



Figure 18.5.3-1 Effective working length of a single leg sling

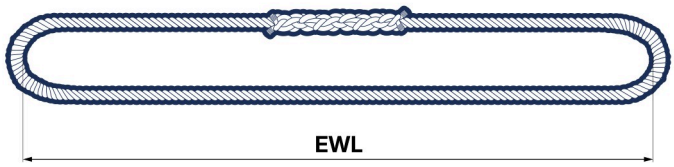


Figure 18.5.3-2 Effective working length of an endless sling

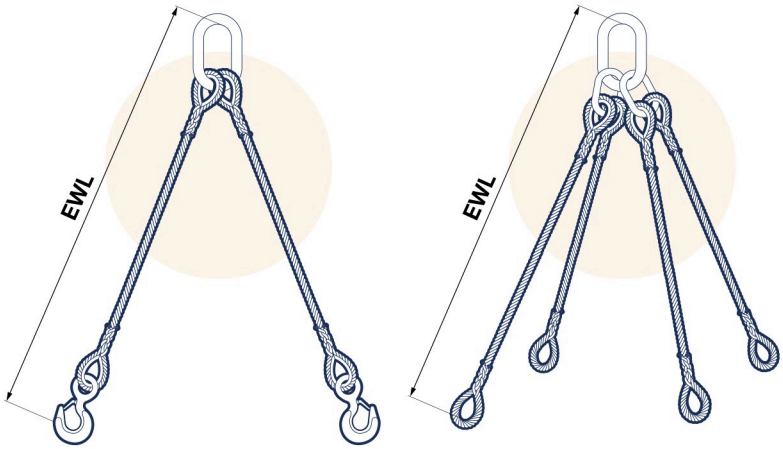


Figure 18.5.3-3 Effective working length of a multi-leg sling

18.5.4 Splices

There should be a minimum length of plain rope between the splices of 20 times the nominal rope diameter. This must be borne in mind when selecting slings for use where headroom is limited.

When selecting endless slings, the length of the splice may be restrictive in some applications. It must be remembered that the area of the splice will have a far larger bulk than the rest of the rope and will be far less flexible.

Three strand polyamide [nylon], polyester multifilament and polypropylene monofilament ropes are spliced with four full tucks, followed by a further tuck with not more than one half of the material cut out of each strand and a final tuck with not less than a quarter of the original strand material. Alternatively, they may be spliced with five tucks made with the full strand material.

Polypropylene fibrillated film, polypropylene staple and natural fibre ropes however are spliced with only four tucks of the full material.

In the case of endless slings, these requirements apply either side of the marrying point.

All splices should be made with the tucks against the lay of the rope. The type of splice where the tucks are made with the lay of the rope and the long splice should not be used, as this may undo if the rope is rotated under load.

Eight strand plaited ropes have different splicing requirements and the supplier should always be consulted with regards to these.

18.5.5 Working Load Limit

Consideration must be given to the WLL of the sling for the particular service conditions so as to ensure that no part of the sling is overloaded by the method of use. The following should be considered:

(1) Unlike other lifting equipment, the working load limit of fibre rope slings is not calculated by the application of a simple factor of safety. It is calculated from the specified breaking load of a single rope less a 10% allowance for the splice efficiency to which the factor of safety (coefficient of utilisation) is applied, i.e. 90% of specified breaking load divided by factor of safety. The resultant is then multiplied by an assembly factor to arrive at the WLL of a particular sling assembly.

product standard.

(1)

> Factors of safety, also known as working coefficients are defined in the legislation or applicable national

(2) The assembly factor takes the multiplicity of parts into account to determine the WLL of the sling assembly. For single and endless slings, this assumes the sling to be in a straight pull and for two leg, three leg and four leg slings it assumes the legs will be disposed at a maximum angle of 45° to the vertical (90° included angle) as shown in .

(3) The SWL marked on the sling is the maximum load which the sling may lift, in straight pull for single and endless slings or with the legs disposed at a maximum of 45° to the vertical (90° included angle) for two leg, three leg and four leg slings and this must never be exceeded. In many cases, this will be the same

as the WLL though, when a sling is to be used in adverse conditions or other circumstances where the Competent Person deems an increased reduction factor is desirable, it may be lower than the maximum SWL.

Sling assembly	Factor	WLL of Sling assembly
Single	1	1 x WLL of the single part
Endless	2	2 x WLL of the single part
Two leg	1.4	1.4 x WLL of the single part
Three and Four leg	2.1	2.1 x WLL of the single part

18.5.6 Rating for Various Modes of Use

The geometry of the slinging arrangement, i.e. mode of use, calls for a further factor to be applied to the marked SWL to arrive at the maximum load that may be lifted by the sling in a particular configuration. (See Figure 18.5.6-1 page 302 and Figure 18.5.6-2 page 302)

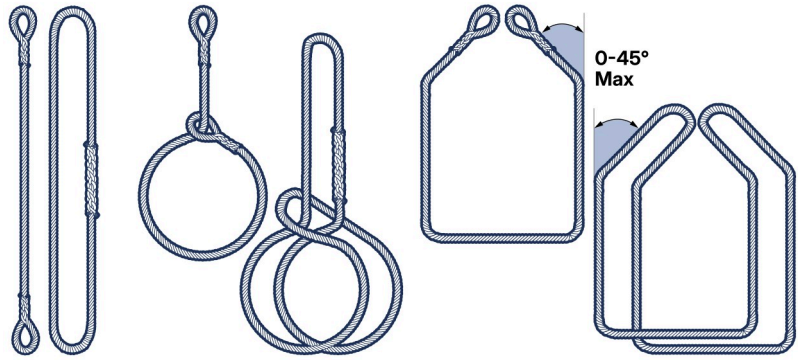


Figure 18.5.6-1 A. Straight pull Maximum load = marked SWL. B. Choke hitch Maximum load = 0.8 x marked SWL. C. Basket hitch Maximum load = 1.4 x marked SWL (max angle to vertical 45°)

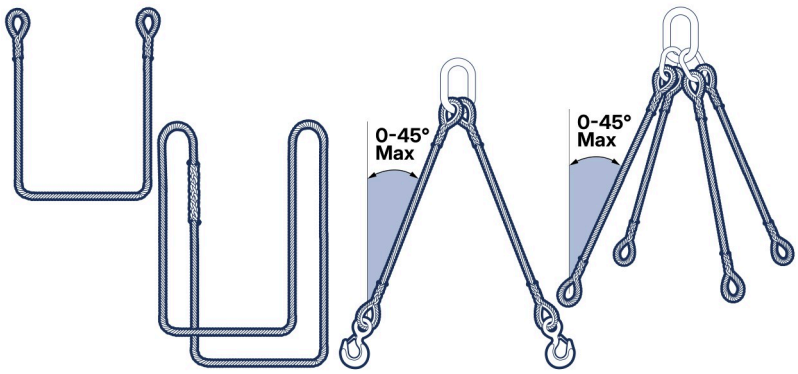


Figure 18.5.6-2 A. Basket hitch Maximum load = 2 x marked SWL. B. Two leg Maximum load = marked SWL. C. Four leg Maximum load = marked SWL.

The maximum load that may be lifted by a sling in choke hitch is 0.8 x marked SWL. If the sling is used in basket hitch, no part of the sling should be disposed at a greater angle than 45° to the vertical, i.e. the maximum angle between the parts of the sling is 90° and the maximum load that may be lifted is 1.4 x marked SWL. Where a sling is used in basket hitch and the parts of the sling are parallel, the maximum load that may be lifted is 2 x marked SWL.

18.5.7 Temperature

Fibre rope slings are suitable for use within the following temperature ranges:

(1) Manila, sisal, hemp and polypropylene - 40°C to 80°C.

(2) Polyester and polyamide [nylon] - 40°C to 100°C.

The presence of chemicals may affect this and the advice of the supplier should be sought and followed.

18.5.8 Protection and Packing

If abrasion or heat generated by friction is likely to occur, consideration should be given to the use of a sling which is fitted with a protective sleeve. Friction occurs in many ways associated with the load or the slinging method used. Even small amounts of movement of the load within the sling can cause heat, generated by friction, that is sufficient to damage the sling. Similarly, if the rope is allowed to rub one part with another, high temperatures can result, e.g. if the sling is used in choke hitch unless the bight is arranged at the natural angle of 120°, it will move to adopt this position as the load is taken. Whilst the safe use of the sling calls for care to be taken to minimize or avoid these practices, additional protection by way of a sleeve should be considered. Care must also be taken to protect the sling from edges and corners that might damage the sling. Protective sleeves may also be used for this purpose or, alternatively, consideration should be given to the use of suitable packing. (See section 1 1.A5.5.7 Control of Lifting Equipment, Storage, Handling and Inspection page 39) It should be noted that smaller diameter ropes are more prone to the effects of wear, abrasion and friction as more of the yarns are exposed on the surface of the rope than with larger diameter ropes.

18.5.9 Documentation

Ensure the selected sling is covered by the documentation required by legislation. If this is not on record refer the sling to a Competent Person for thorough examination.

18.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As fibre rope slings are frequently used for multi-purpose lifting applications, precise details of the load to be lifted and mode of use are not always available. In these circumstances, only a general specification can be given but should, as far as possible, include the following information:

(1) Type of sling required, e.g. single leg, endless.

(2) Type of eye, e.g. soft eyes, or if fittings are required, details of the fittings, e.g. hook.

(3) Gross weight and dimensions of the load to be lifted together with details of any permanently built-in lifting points or the maximum load to be lifted.

(4) Effective working length of the sling.

(5) The mode of use, e.g. whether the sling is to be used in choke hitch, basket hitch, etc.

(6) The environmental conditions, particularly if the temperature is outside the range of - 40°C to 80°C or if there is any exposure to specific chemicals, liquids or gases.

(7) The conditions of loading including:

a. Whether the sling is likely to be subject to shock load.

b. Whether the load is to be transported over areas involving high risk, e.g. work areas. (This should not be done if it can be avoided.)

c. Whether the load itself is hazardous.

(8) Material from which the sling is to be manufactured.

(9) If any protective sleeves are required, the length and number of sleeves to be fitted.

(10) Any special instructions including any special marking requirements.

> ⓘ In the absence of any specific information, the supplier will assume that the circumstances of use are suitable for the sling to be used at its maximum SWL and the sling(s) will be marked and certified on that basis.

18.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

18.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that fibre rope slings fall under the heading of lifting accessories. Unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local authority.

> Although not required by legislation, new slings which comply to current standards will be issued with a manufacturer's certificate in addition to, although possibly combined with, the documentation require by the applicable legislation. These documents form an important part of the record of the sling. They should be retained and cross referenced to the sling's historical records for inspection by the Competent Person or local enforcing authority.

18.8 MARKING, STORAGE AND HANDLING

18.8.1 Marking

The necessary marking should be made in such a way that it is not harmful to the sling. One suitable method is to apply the marking to a plastic sleeve which may be fitted over the rope during the sling manufacture and then shrunk to it. Sleeves should be of the following colours, which indicate the material from which the sling is made:

Green	Polyamide [nylon]
Blue	Polyester
Red/brown	Polypropylene
White	Sisal/manila/hemp

A further, clear plastic, sleeve may also be fitted over the marked sleeve protecting it from soiling.

Slings which incorporate a link should be marked on one leg as above or on a suitable tag permanently attached to it.

> Marking the link is acceptable providing that the mechanical properties of the link are not impaired. If the latter option is adopted, care must be taken to ensure the tag is such that it cannot become trapped by the sling thereby damaging the sling.

In addition to the information required by the national legislation and the standard being worked to, the marking should indicate the following minimum information:

(1) SWL in straight pull or for the appropriate range of angles in the case of multi-leg slings.

(2) Distinguishing mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(3) Material identification.

(4) Name and address of manufacturer

(5) year of manufacture

Additional marking may be added to indicate the maximum load that may be lifted for the various modes of use. Care must be taken to ensure such marking is not ambiguous or confusing.

18.8.2 Storage and Handling

When not in use, fibre rope slings should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Fibre rope slings should be stored hung from suitable non-corrosive pegs or hooks, e.g. wooden pegs, galvanised hooks, etc., so that air can freely circulate around them.

(2) Fibre rope slings should be stored at temperatures between 10°C and 20°C with a relative humidity between 40% and 60%.

(3) It is essential that natural fibre rope slings are not put into storage whilst wet. They should be allowed to dry naturally in freely circulating air at ambient temperature. This is a good practice which should be extended to man-made fibre rope slings.

(4) Where slings have been in contact with chemicals, great care must be taken. Natural fibre rope slings should not be placed in storage but be discarded, taking care to ensure they do not come into contact with uncontaminated slings. Man-made fibre rope slings can be used in contact with selective chemicals subject to the manufacturer's approval. The manufacturer's advice should be sought and followed. Subject to acceptable selective contamination, they should be thoroughly washed in clean water. Care must be taken to ensure they are completely neutralised as a moderate concentration remaining on the sling will become an increasingly strong concentration by evaporation.

(5) Whilst in store, fibre rope slings should be protected from damp, condensation, heat and ultraviolet light.

(6) Prior to placing in storage, the sling should be inspected for any damage which may have occurred in use.

18.9 IN-SERVICE INSPECTION AND MAINTENANCE

18.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all fibre rope slings should be visually inspected by a suitably qualified and experienced person prior to use. As fibre rope slings are subject to natural degradation and are easily damaged in use, they should be visually checked on each occasion prior to slinging the load.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the sling to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the sling and make a visual check for any obvious defects. This inspection must be carried out with the sling in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of fibre rope slings and if any are present, the sling should be withdrawn from service and referred to a Competent Person:

(1) Wear and chafing. The filaments and fibres are breaking down. In ordinary use some disarrangement or breaking of the fibres is to be expected. This is harmless if not excessive. It is natural for man-made fibre ropes, especially those of multifilament construction, to raise a pile or fur on their surface as the result of use. This is not cause for concern unless it becomes excessive.

(2) Abrasion. Localised areas of abrasion, as distinct from general wear, are caused by mishandling such as the passage of the sling over a sharp edge whilst under tension.

(3) Mechanical damage. Crushing of the strands, cuts or other forms of mechanical damage.

(4) Fraying. Fraying of the yarns or strands is often an indication of cutting.

(5) Internal wear. Excessive looseness of the strands or the presence of fibre dust within the rope. This is caused by repeated loading and flexing of the rope under tension. It is accelerated by the penetration of grit and particles into the rope.

(6) Mildew. In the case of natural fibre rope slings, the growth of mildew will cause serious loss of strength as the mould will live on the cellulose of the rope. It is caused by dampness, storage of wet slings or storage in stagnant air. In the case of man-made fibre rope slings, mildew will only grow on surface contamination, it does not affect the rope and may be removed by washing in clean water only. Detergents or other cleaning agents must not be used.

(7) Chemical attack. In the case of natural fibre rope slings, any known contact with chemicals or their fumes. In the case of man-made fibre rope slings, selective resistance permits some contact with chemicals however attack by strong solutions or by other chemical contaminants will result in loss of strength. Chemical attack may be recognised by embrittlement and flaking of the fibres or by a softening of the fibres, which may be rubbed or plucked from the rope.

(8) Heat damage.

(9) Charring of natural fibres, fusing of fibres and glazed appearance of man-made fibres indicate the sling has been subjected to excessive heat, often as the result of friction. This can occur in use, e.g. by careless handling when the sling is used in choke hitch. It is difficult to observe unless severe. Other forms of heat damage, such as burning caused by weld splatter, are more easily identified.

(10) Solar degradation. The outer fibres become brittle as the result of exposure to sunlight or other sources of ultra-violet radiation.

(11) Damaged fittings. Any damage or distortion, e.g. nicks, cracks, twisting or stretching of permanently attached fittings.

(12) Damaged thimbles. Collapsed, cracked, deformed or twisted thimbles.

> Great care must be taken when inspecting slings as the vulnerability of fibre rope slings to the effects of wear, abrasion and mechanical damage increases inversely with the size of rope. The smaller the rope diameter, the more of the yarns are exposed on the surface, hence the effects of wear and damage are more severe.

18.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some fibre rope slings will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 18.9.1 Pre-use inspection page 305, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 18.9.3 Maintenance page 306 below.

18.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In general there is little that can be done in terms of maintenance to the sling other than ensuring that they are cleaned and free from contaminants that can cause damage and deterioration.

18.9.4 Thorough examination

The fibre rope sling must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the sling's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of fibre rope slings, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and a number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as fraying, cuts, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as fraying, cuts, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

18.10 SAFE USE OF FIBRE ROPE SLINGS

In addition to any specific instructions relating to the safe use of the fibre rope sling issued by the manufacturer, the following points should be observed:

(1) The sling should be of adequate strength and length; never exceed the SWL for the particular mode of use. Care must also be taken to ensure the compatibility of any ancillary equipment used to sling the load, both in size and capacity. The diameter of components placed in a soft eye must be at least the same as the rope, but preferably twice the rope diameter. Care must be taken to ensure that the two parts of rope at the splice of a soft eye do not form an included angle exceeding 30°.

(2) Where more than one sling is used to lift the load, each sling should be adequate for the share of the load imposed on it taking into account the slinging method. Do not overcrowd the hook of the lifting appliance. It is good practice when using more than one sling to join them with a shackle before placing them onto the hook.

(3) It should be noted that the various fibres used to manufacture rope slings have differing stretch and recovery rates and that the elongation of the sling is proportional to its length. This must be borne in mind in all arrangements using more than one sling. The slings should therefore be of the same material and account must be taken of this if they are of unequal length.

(4) Fibre rope slings have very different stretch characteristics to those of chain or wire rope slings. Their use in parallel with chain or wire rope slings to form multi-leg assemblies should therefore be avoided as the unequal stretch of the legs can lead to load instability. However, this is not intended to preclude their use combined in series as a means of connecting a sling to the load which can be advantageous in some circumstances. For example, a fibre rope sling can be wrapped and choked onto a polished surface then hooked into a chain sling thus gaining the advantage of the fibre rope protecting an easily damaged surface combined with the adjustability of a chain sling.

(5) Position the slings correctly. Use packing protection for sharp edges and, if protective sleeves are fitted, ensure they are correctly positioned to prevent cutting damage to the sling. Keep labels and tags away from the load and the hook as these may damage the sling or themselves be damaged during the lifting operation.

(6) In the case of multi-leg slings and slinging arrangements, the legs should not be disposed at more than 45° to the vertical (90° included angle) or less than 15° to the vertical (30° included angle)

(7) Position the bight for choke lift in the natural (120°) angle to avoid heat being generated by friction which could cause damage to the sling. When using basket hitch, care should be taken to ensure that the load is secure since there is no gripping action as with choke hitch. Movement of the load in the sling will cause abrasion and heat from friction and may result in the load being dropped.

(8) When using endless slings, ensure the splice is positioned in the standing part of the rope away from the load, hook or point of choke.

(9) Great care should be taken to avoid shock loading as it effectively increases the weight of a load and could result in the lifting equipment being grossly overloaded. In particular, man-made fibres have very differing elastic characteristics and, dependent on the material in use, permanent elongation may result from shock loading.

(10) When using fibre rope slings in association with chemicals, ensure the sling material and that of the fittings is suitable. Always follow the manufacturer's instructions, which may place limitations on the use of the sling. If any doubt exists, seek further advice.

18.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be familiar with the methods of marking fibre rope slings together with the mode factors which vary the SWL according to the mode of use and assembly, e.g. choke hitch, basket hitch, single or multiple slinging, and fully understand how to apply them.

(2) Operatives should be instructed in the correct selection of fibre rope slings for varying applications, e.g. use with chemicals, and the steps to be taken if accidental exposure to chemicals occurs.

Section 19 - SHACKLES

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19.1 FOREWORD

There are, in the main, three types of shackle used for lifting: the bow, dee and grab types. They are normally forged from various grades of steel, the higher quality alloy steels giving, size for size, a higher working load limit than those made in higher tensile steels, and correspondingly higher tensile steel shackles have a higher working load limit than those made in mild steel.

Some manufacturers continue to make shackles to old now withdrawn standards, whereas many have now adopted the current standards. Also shackles often have a long service life so this section continues to include designs no longer produced but known to still be in service.

19.2 SCOPE

This section of the code covers shackles produced from higher tensile steels and alloy steels of types, Dee, bow and grab for general lifting purposes.

Whilst this section of the code is based on, and uses the terminology of, British, European and international standards, the general recommendations may also be applied to shackles which comply to the latest edition of US Federal Specification RR-C-271.

19.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

19.3.1 Shackle

A shackle is regarded as a lifting accessory consisting of a body and pin. The nomenclature used for parts of the shackle is as shown in Figure 19.3.1-1 page 310.

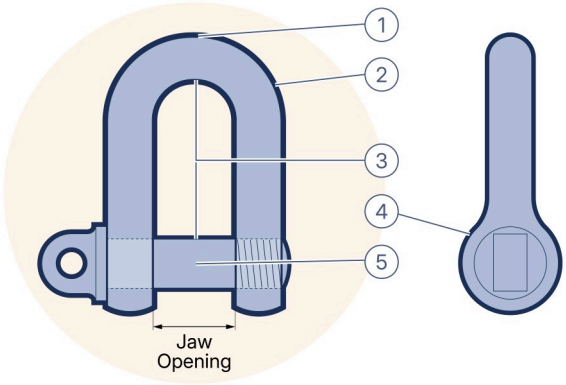


Figure 19.3.1-1

19.4 TYPES OF SHACKLE

19.4.1 Dimensions

The older now withdrawn shackle standards fully specified all dimensions of the shackle. In contrast the current standards tend to specify only some dimensions fully, the rest being specified as a maximum or minimum value.

Shackles to the older standards are sized by the diameter of the material in the shackle body and not the diameter of the pin. Shackles to later standards are usually sized by their WLL.

19.4.2 Shackle Bodies

The types of shackles covered by this code are shown in Figure 19.4.2.1-1 page 310 to Figure 19.4.3-2 page 311.

19.4.2.1 Dee shackle

All shackle standards specify dee shackles, with some specifying both a large dee and a small dee shackle. A large dee shackle is a shackle which has ample internal clearances in the body and jaw, and which is appropriate for general engineering purposes. A small dee shackle is a shackle which has moderate internal clearances in the body and jaw but, size for size, has a SWL higher than that of the large dee. It is suitable for use with hook eyes, eyebolts, egg links, wire rope thimbles, etc. and for the head fittings of ships' blocks.

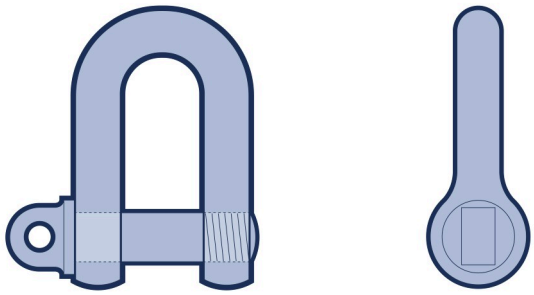


Figure 19.4.2.1-1

19.4.2.2 Bow shackle

All shackle standards specify bow shackles, with some specifying both a large bow and a small bow shackle. A large bow shackle is a shackle which has ample internal clearances in the body and jaw and which is appropriate for general engineering purposes. A small bow shackle is a shackle which has moderate internal clearances in the body and jaw but, size for size, has a SWL higher than that of the large bow. It is suitable for use with the eyes and bodies of hooks, eyebolts, egg links, wire rope thimbles, etc. and for the head fittings of ships' blocks.

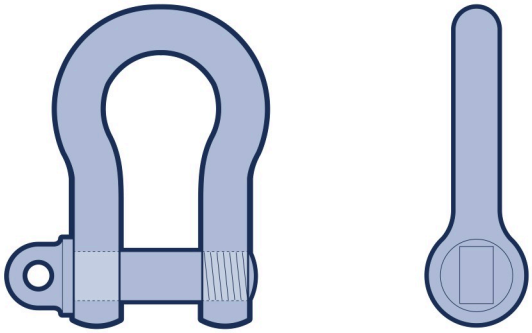


Figure 19.4.2.2-1

19.4.2.3 Grab shackle

A grab shackle is a dee shackle having a screwed countersunk pin, designed for use with grabs where the shackle must pass through a circular aperture of minimum diameter.

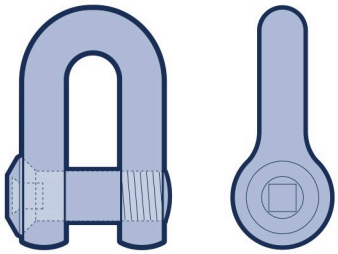


Figure 19.4.2.3-1 Grab shackle

19.4.3 Shackle Pins

The types of shackle pin covered by this code are shown in Figure 19.4.3-1 page 311 to Figure 19.4.3-10 page 313.

Dee and bow shackles of higher tensile steel type may be fitted with any of the pin types A, B, C, D, E and F. Grab shackles may only be fitted with pins type C or D.

Alloy steel shackles are available with three types of pin are designated, types W, X and Y. These are respectively similar in shape to types A, E and C referred to above.

Pin types 1-4 inclusive are alloy steel for shackles and may be readily identified by flats on the side of the pin collar or head.

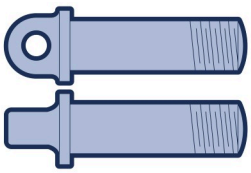


Figure 19.4.3-1 Screwed pin with eye and collar (types A and W).

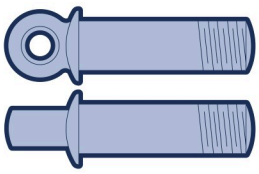


Figure 19.4.3-2 Screwed pin with eye and collar (type B)

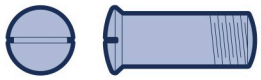


Figure 19.4.3-3 Countersunk screwed pin with slotted head (types C and Y)

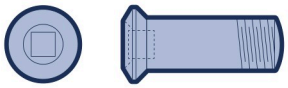


Figure 19.4.3-4 Countersunk screwed pin with sunk square socket (type D)

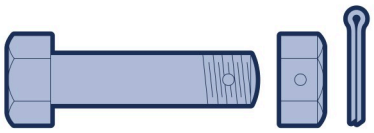


Figure 19.4.3-5 Bolt with hexagon head, hexagon nut and split cotter pin (types E and X)

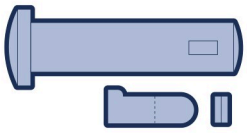


Figure 19.4.3-6 Plain cylindrical pin with circular head and forelock (type F)

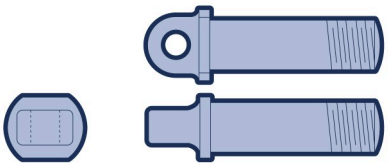


Figure 19.4.3-7 Screwed pin with eye and collar (type 1)



Figure 19.4.3-8 Screwed pin with circular head (type 2)



Figure 19.4.3-9 Bolt with circular head, hexagon nut and split cotter pin (type 3)

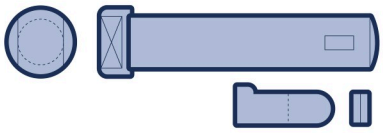


Figure 19.4.3-10 Plain cylindrical pin with circular head and forelock (type 4)

19.5 PRINCIPLES FOR THE SELECTION OF SHACKLES

19.5.1 Working Load Limit

A shackle must have a working load limit at least equal to the total load to be imposed upon it; alloy steel shackles will be dimensionally smaller load for load than those of higher tensile steel. The shackle pin and body are designed to be of equal strength. To attain this condition, the pin normally has a slightly larger diameter than the material of the body. If the load on the pin is distributed over its length, or part of its length, the load bearing capacity of the pin is effectively increased but that of the body is not. Distributing the load right across the pin will NOT INCREASE THE STRENGTH OF THE SHACKLE. Standard shackles are designed to take the SWL between the centre of the pin and the bearing point(s) in the crown. (See Figure 19.5.1-1 page 313)

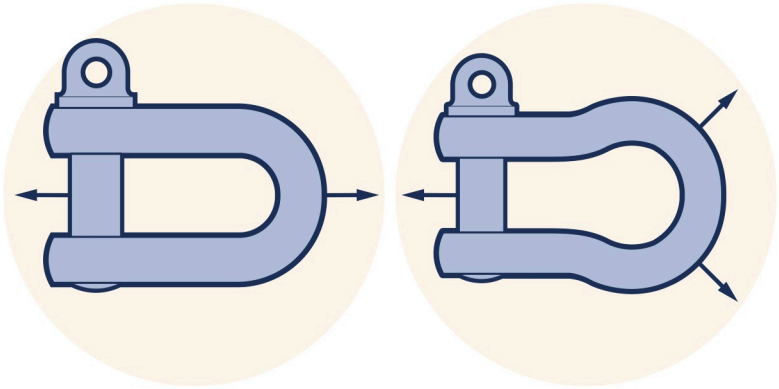


Figure 19.5.1-1

19.5.2 Choice of Body Shape

Select the shackle body shape based on intended use, using the smallest jaw opening that allows adequate connection articulation. Dee shackles are, in general, used to join two pieces of lifting equipment. Bow shackles are, in general, used where more than one attachment is to be made to the body, or to allow freedom of movement in the plane of the bow. (See Figure 19.5.2-1 page 313)

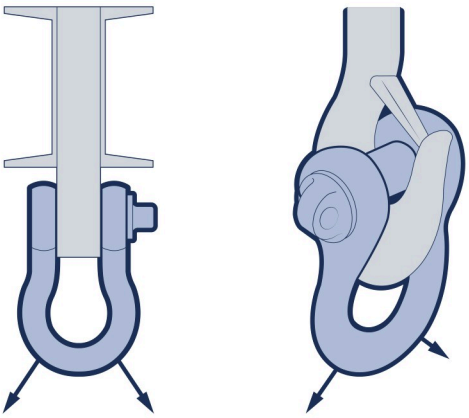


Figure 19.5.2-1

The necessity for the eye of a shackle to pass through another fitting may have to be considered. Where a shackle does not have to be dismantled, or where it is required to remain captive, it may be permanently attached by forming a link or thimble round the shackle body. (See Figure 19.5.2-2 page 314)

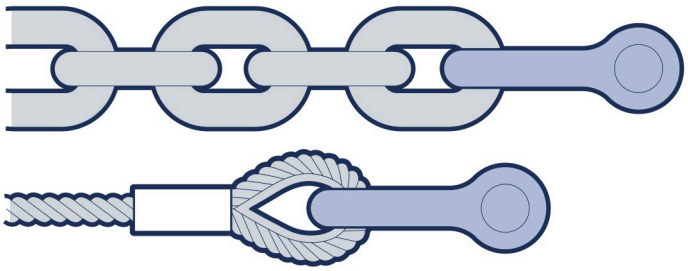


Figure 19.5.2-2

19.5.3 Choice of Pin Type

The choice of pin depends on the circumstances of use.

(1) Countersunk pins are used where the heads of other types might be an obstruction, as when passing over a sheave or when the shackle has to pass close to fixed structures.

(2) For general use, and where there is no tendency for the pin to unscrew and the shackle can be observed in use, screwed pins with eye and collar are very satisfactory and easily manipulated.

(3) For permanent installations or where there is an inherent tendency for the pin to unscrew or when the shackle cannot be observed, pins comprising bolt, nut and split cotter pin are recommended. When maximum security is required but for other reasons this type of pin is not suitable, then reference should be made to the manufacturer or Competent Person who will advise on alternative arrangements.

(4) The forelock pin is not a preferred type. Its advantage is ease of assembly, but it should only be considered for specialised applications.

19.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND DESIGNER OR SUPPLIER

As shackles are frequently used for multi-purpose applications, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given but should, as far as possible, include the following information:

(1) Type of shackle.

(2) Type of pin and locking requirements if any.

(3) SWL required.

(4) Any exceptionally hazardous conditions of use.

(5) Any limiting dimensions, such as pin size, opening in jaw, diameter of eye.

(6) If required to be to British or other standard dimensions, give standard and table number or other relevant reference.

(7) Any special marking requirements.

19.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

19.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that shackles fall under the heading of lifting accessories. Unless a written scheme of examination (for guidance refer to LEEA 032 Guide to written schemes of examination), drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the shackle's historical records for inspection by the Competent Person or local enforcing authority.

Although not required by legislation, new shackles which comply to current standards will usually be issued with a manufacturer's record of proof load testing in addition to, although possibly combined with, the documentation require by the applicable supply legislation. These documents form an important part of the record of the shackle. They should be retained and cross referenced to the shackle's historical records for inspection by the Competent Person or local enforcing authority.

19.8 MARKING, STORAGE AND HANDLING

19.8.1 Marking

In addition to the information required by the applicable legislation and specific standard the following information should be permanently and legibly marked on the shackle:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL.

(3) Grade.

(4) Unique trade mark

(5) Year of manufacture

In practice the grade will normally appear on the body only. It is strongly recommended by LEEA that the grade marking should appear on both the body and the pin.

The recommended positions for marking are as follows:

(1) On the shackle body, the marks should appear on the sides of the body between the eyes and the crown. In general, no marks should be stamped on either of the eyes or the crown of the shackle although in the case of alloy steel shackles, some standards do permit the quality mark to be stamped on the crown.

(2) On the shackle pin, the quality mark should appear on one end of the pin. In most cases, the screwed end of the pin will be most suitable, although with certain types of pin the head end will offer a larger flat surface for the mark.

19.8.2 Storage and Handling

When not in use, shackles should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Before each period of use and when placing into store, a check should be made to ensure that the shackle is fitted with its correct individual pin.

(2) When handling shackles, care should be taken to avoid damage to the screw threads.

(3) Shackles should not be dropped or thrown down.

19.9 IN-SERVICE INSPECTION AND MAINTENANCE

19.9.1 Pre-use inspection

In addition to the Thorough Examination necessary under statutory provisions, all shackles should be visually inspected by a suitably qualified and experienced person prior to use

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the shackle to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the shackle and make a visual check for any obvious defects. This inspection must be carried out with the shackle in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of shackles and if any are present, the shackle should be withdrawn from service and referred to a Competent Person:

(1) SWL missing or unreadable.

(2) Identification missing or unreadable.

(3) Incorrect pin.

(4) Damaged thread on pin or in tapped eye.

(5) Distorted body or pin.

(6) Worn body or pin.

(7) Nicks, gouges, cracks, corrosion.

19.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some shackles will require an interim inspection (s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 19.9.1 Pre-use inspection page 315, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Figure 19.9.2-1 page 316 illustrates the main areas of a shackle to be inspected and identifies the more common defects that may be found during the inspection.

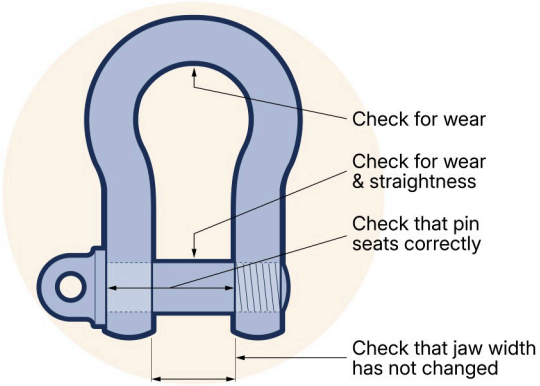


Figure 19.9.2-1 Shackle inspection areas

Interim inspections are often done at the same time as planned maintenance, see section 19.9.3 Maintenance page 316 below.

19.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In general there is little that can be done in terms of maintenance to the shackle other than ensuring that they are cleaned and free from contaminants that can cause damage and deterioration.

19.9.4 Thorough examination

The shackle must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the shackle's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of shackles, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

19.10 SAFE USE OF SHACKLES

In addition to any specific instructions relating to the safe use of the shackle issued by the manufacturer, the following should be observed:

(1) Select the correct type and capacity of shackle for the particular application, taking account of the information given in section 19.4 TYPES OF SHACKLE page 310.

(2) Before use check that the body of the shackle and the pin are both identifiable as being of the same quality grade. Typical grade markings are 4, 04, 06, 8, M, S, T. Alloy steel shackle pins to some standards can readily be identified by flats on the side of the pin collar or head.

(3) Ensure, where appropriate, that the pin is correctly screwed into the shackle eye, i.e. tighten finger tight, then lock using a small tommy bar so that the collar of the pin is seated on the shackle eye. Ensure that the pin is of 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.

(4) If the pin does not seat correctly it may be bent, the thread may be too tight or the pin holes out of alignment. Do not use the shackle but refer to a Competent Person.

(5) Never replace a shackle pin with a bolt, other than one designed for the purpose, as it may not be suitable for the loads imposed. (See Figure 19.10-1 page 317)

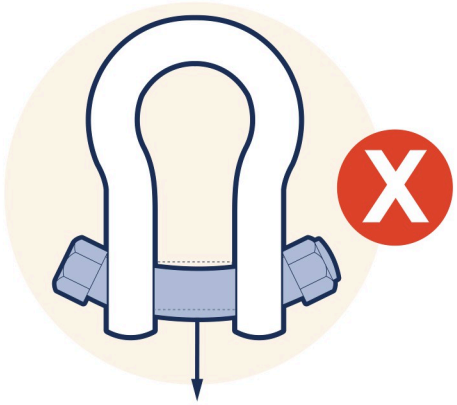
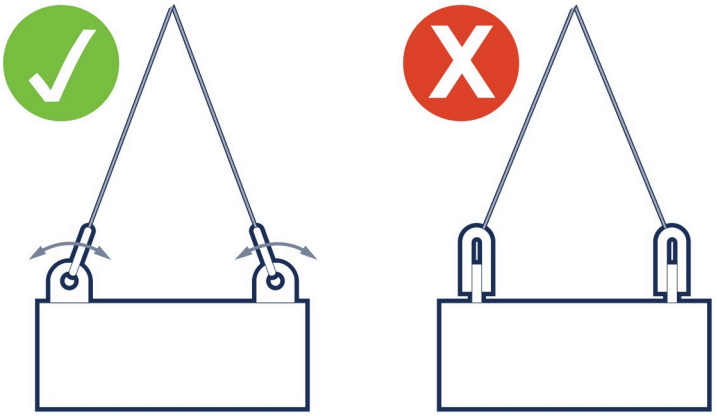


Figure 19.10-1 Never replace a shackle pin with a bolt. The load will bend the bolt.

(6) It is preferable, in the case of shackles fitted with a bolt and nut pin, that the length of the plain portion of the bolt is 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.

(7) Shackles should be fitted to the load in a manner that allows the shackle body to take the load in a true line along its centre line; and not in such a way that bending loads are induced, other than those for

which the shackle is designed. (See) When using shackles in conjunction with multi-leg slings, due consideration must be given to the effect of the angle at which the legs of the sling are disposed to the vertical. As the angle increases, so does the load in the sling leg and consequently in any shackle attached to that leg.



Some shackle manufacturers have designed and verified shackles to take a side loading with a reduction in the WLL. Unless specific manufacturers instructions are provided, then it shall be assumed that they cannot be loaded in this manner.

(8) To avoid eccentric loading of the shackle, a loose spacer may be used on either end of the shackle pin (See Figure 19.10-3 page 318) or a shackle with a smaller jaw width should be used. Do not reduce the width between the shackle jaws by welding washers or spacers to the inside faces of the eyes or by closing the jaws, as this will have an adverse effect on the properties of the shackle. Narrow jaw shackles can normally be obtained from a LEEA member if required.

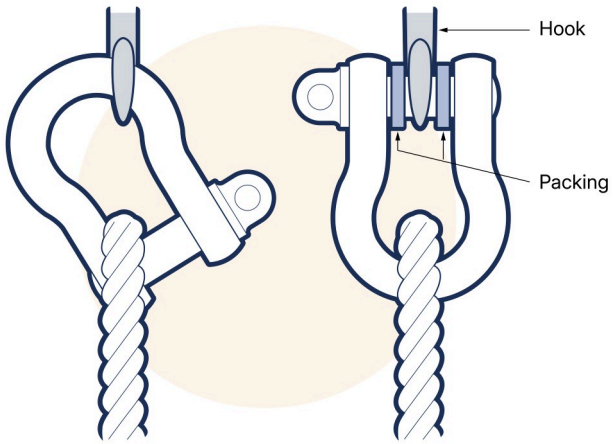


Figure 19.10-3

(9) When a shackle is used to secure the top block of a set of rope blocks, the load on this shackle is increased by the value of the hoisting effort. (See section 1, 1.A4 APPENDIX 4 - STRUCTURES page 19).

(10) Avoid applications where, due to movement of the load or rope, the shackle pin can roll and possibly unscrew. (See Figure 19.10-4 page 319 and Figure 19.10-5 page 319)

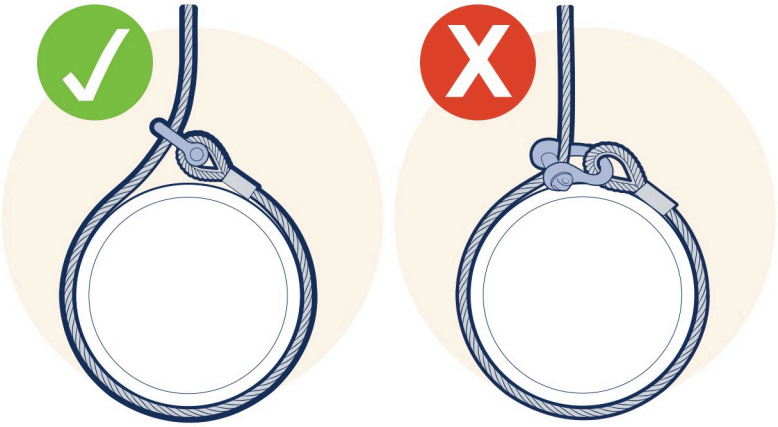


Figure 19.10-4 Correct - shackle pin cannot turn. Incorrect - shackle pin bearing on running line can work loose.

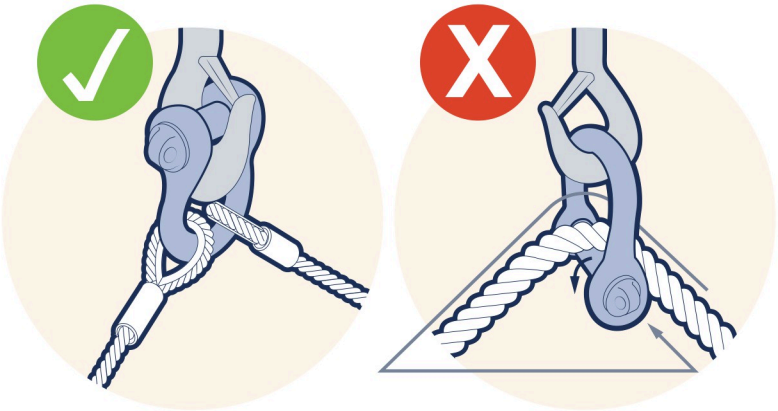


Figure 19.10-5 Correct - use two ropes with eyes. Incorrect - if the load shifts, the sling will unscrew the shackle pin.

19.11 TRAINING

Follow training requirements as detailed in section 1.10 TRAINING page 12 of this code.

Section 20 - EYEBOLTS

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20.1 FOREWORD

Eyebolts, one of the most widely used items of lifting gear, have severe limitations in usage and a high level of accidents occur as the result of misuse.

Types other than those to recognised standards are commonly used, as are eyenuts and bownuts. Guidance on the usage of these is therefore included in appendices to this section of the code.

Reference is made throughout to eyebolts used singly or in pairs. Any multi-point lifting requirements using three or more eyebolts calls for further measures and should be referred to a Competent Person.

20.2 SCOPE

This section covers three types of eyebolt:

(1) Eyebolts with link

(2) Collar eyebolts

(3) Dynamo eyebolts

In addition, 20.A1 APPENDIX - 1 EYE NUTS AND BOW NUTS page 330.

This code does not cover the use of eyebolts for haulage purposes, neither does it concern itself with collarless eyebolts which are not considered suitable for lifting purposes other than as part of a turnbuckle or rigging screw.

Lift cage and balance weight suspension eyebolts are intended for specialised use, not for general lifting purposes, and are therefore excluded.

20.3 DEFINITIONS

In addition to definitions given in section 1.3 DEFINITIONS page 2of the code, the following named parts should be noted as shown in Figure 20.3-1 page 322, Figure 20.3-2 page 322 and Figure 20.3-3 page 322 below.

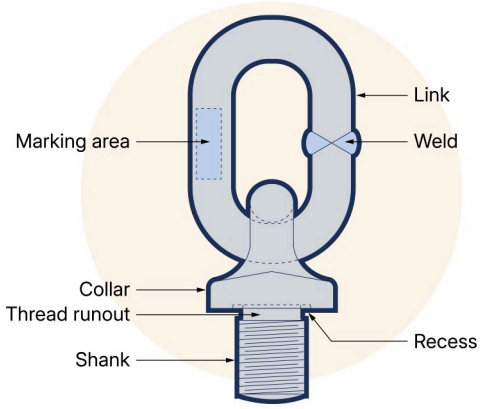


Figure 20.3-1 Eyebolt with link

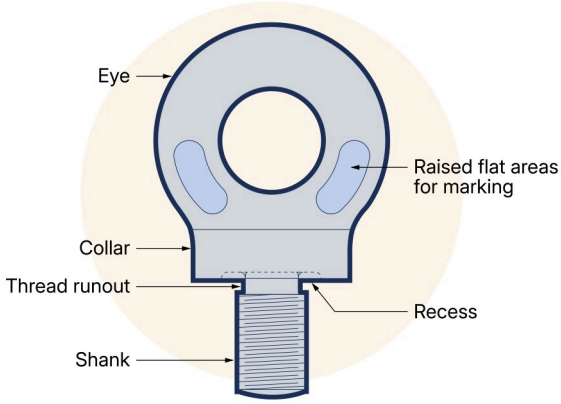


Figure 20.3-2 Collar eyebolt

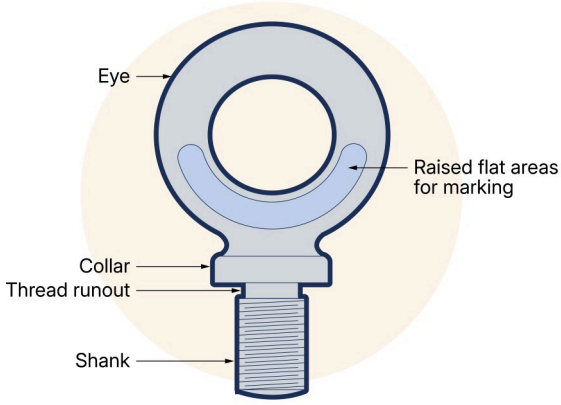


Figure 20.3-3 Dynamo eyebolt

20.4 TYPES OF EYEBOLT

Within the scope of this section there are only three types of eyebolt for lifting purposes which are available to current standards. The range of capacities and screw threads specified by the standards are detailed below but it should be appreciated that earlier standards had different ranges. In particular, they permitted certain sizes of thread where there was a danger of mismatch with other incompatible threads and also fine threads which are now considered unsuitable for general purpose applications due to wear and tolerance problems.

20.4.1 Eyebolts with Link

The eyebolt with link is illustrated in Figure 20.3-1 page 322. It is designed for both axial and angular loading and is available in a range of capacities of 1.0t to 6.3t SWL. The corresponding thread sizes range from 20mm to 48mm in the metric coarse pitch series or ¾" to 1¾" in the imperial BSW or UNC threads.

20.4.2 Collar Eyebolt

The collar eyebolt is illustrated in Figure 20.3-2 page 322. It is designed for both axial and angular loading and is available in a range of capacities of 0.4t to 25t SWL with corresponding thread sizes of 12mm to 72mm in the metric coarse pitch series. Imperial threaded collar eyebolts are also available in a range of capacities of 0.25t to 30t with corresponding thread sizes of 3/8" to 3" BSW or UNC. The SWL range of the imperial threaded collar eyebolt differs from that of the metric threaded collar eyebolt because they are intended as replacements for eyebolts to older now withdrawn standards.

> Eyebolts of 8 and 10mm are available, but LEEA does not recommend their use as they can be easily overtightened and subsequently overloaded. Always ensure that the manufacturers instructions are followed and that eyebolts are not overtightened.

20.4.3 Dynamo Eyebolt

The dynamo eyebolt is illustrated in Figure 20.3-3 page 322. It is designed for axial loading only and is available in a range of capacities of 0.32t to 10t with corresponding thread sizes of 12mm to 52mm in the metric coarse pitch series. Imperial threaded dynamo eyebolts are also available in a range of capacities of 0.25t to 10t with corresponding thread sizes of 3/8" to 2" BSW or UNC.

20.5 PRINCIPLES FOR THE SELECTION OF EYEBOLTS

20.5.1 Working Load Limit

An eyebolt must have a working load limit at least equal to the total load that will be imposed on it and each pattern of eyebolt has its own limitations in this respect. It is therefore important to ensure that the correct type of eyebolt and maximum load rating are selected to suit the application. Details of the permissible applications of each type of eyebolt are given in this subsection. Further details of angular load ratings are given in 20.A1 APPENDIX - 1 EYE NUTS AND BOW NUTS page 330.

> It is sometimes preferable to have a permanent link inserted into the eye of collar eyebolts rather than use a shackle. Such eyebolts must still be rated and used only as collar eyebolts and under no circumstances must they be considered as 'eyebolts with links'. (See section 20.5.4 Eyebolt with Link page 324)

20.5.2 Thread Form

Care must also be taken to ensure the correct thread form and diameter are used as mismatched threads are extremely dangerous. Eyebolts to some standards are marked with the thread designation and size. Where there is any doubt as to the thread size and type of the female thread into which the eyebolt is to be fitted, this must be carefully checked to ensure the correct eyebolt is selected.

All eyebolts intended for lifting purposes should have a thread runout under the collar. This ensures that the collar seats fully without binding on the thread. Commercial pattern eyebolts (particularly dynamo pattern) not intended for lifting purposes usually have rolled threads or threads produced with a die head. This gives a taper to the shank where it meets the collar. Under no circumstances should such eyebolts be used for lifting purposes.

20.5.3 Hazardous Conditions

Great care must be exercised when eyebolts are to be used in hazardous conditions such as temperature extremes, acidic or chemical environments, or where the lift is in areas involving high risk, e.g. work areas. If any doubt exists as to the suitability, consult a Competent Person.

20.5.4 Eyebolt with Link

(1) Eyebolts with link can in all respects be considered as the general purpose type for use whenever the loading cannot be confined to the plane of the eye. They offer considerable advantages over collar eyebolts as, whilst in axial loading, their SWL is lower; in some situations of angular loading their SWL may be greater than that of a collar eyebolt and the load can be applied at any angle to the plane of the eye.

(2) Eyebolts with links may be loaded in any direction up to the marked SWL provided that the angle of the load to the axis of the eyebolt screw thread does not exceed 15° (i.e. the included angle α = 30°). Beyond 15° they may be loaded to a lower SWL which reduces as the angle increases. See Figure 20.5.4-1 page 324. The reduction in SWL due to the increase in angle is not however as great as for collar eyebolts.

(3) The eyebolt with link is designed to accept a sling hook without the need for an intermediate component.

(4) Eyebolts with links may be used for trunnion lifting.

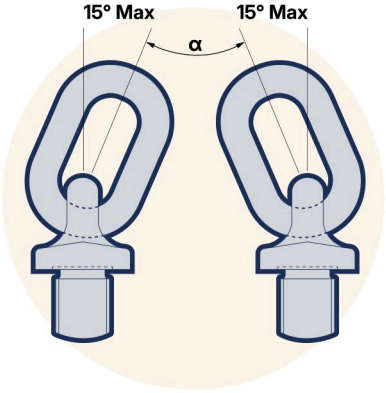


Figure 20.5.4-1

20.5.5 Collar Eyebolt

(1) Before the introduction of the eyebolt with link, the collar eyebolt was considered as the general purpose type. It is however more limited in its use than the eyebolt with link. Although the SWL in axial loading is greater than that of the eyebolt with link, it is markedly reduced in angular loading and alignment of the eye is important.

(2) Collar eyebolts may be used up to the marked SWL provided that the load is in line with the axis the SWL is reduced by the appropriate factors. In non-axial loading the load should be applied within ±5° of the plane of the eye. (See Figure 20.5.5-1 page 324)

(3) Collar eyebolts are not suitable for direct connection to a hook; a shackle is normally used as an intermediate link. For guidance on the selection and use of shackles see SECTION 19 page 309 of this code.

(4) Collar eyebolts may be used for trunnion lifting.

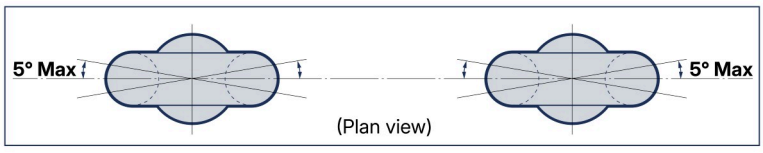


Figure 20.5.5-1

20.5.6 Dynamo Eyebolts

(1) Dynamo eyebolts are commonly fitted to the casings of plant, such as electric motors, by the manufacturers as they provide inexpensive lifting points. It is from this use that they derive their name. They are extremely limited in their use as their SWL is lower than that of the collar eyebolt for axial loading and they cannot be used for angular loading.

(2) Dynamo eyebolts may be used for axial lifting only and therefore may not be used in pairs unless steps are taken to guarantee this condition. Loading by even 5° out of the axial causes undue stress on the screw thread and shank. Extreme care must be taken to avoid tilting when a single eyebolt is being used. Where axial lifting cannot be ensured, an eyebolt with link or collar eyebolt must be used. If more than

one dynamo eyebolt is used to lift the load, a lifting beam will be required to facilitate axial loading. Extreme care is however still required to ensure the load does not tilt resulting in non-axial loading.

(3) The dynamo eyebolt is designed to accept a hook of similar capacity without the need for an intermediate component.

(4) Dynamo eyebolts must NOT be used for trunnion lifting.

20.5.7 Trunnion Lifting

Subject to observance of the following requirements, both eyebolts with link and collar eyebolts may be selected and used for trunnion lifting. (See Figure 20.5.7-1 page 325)

(1) When an eyebolt with link is used as a trunnion with the load applied at 90° to the eyebolt axis, the SWL should not be more than 63% of the axial SWL marked on the eyebolt.

(2) When a collar eyebolt is used as a trunnion with the load applied at 90° to the eyebolt axis, the SWL should not be more than 25% of the axial SWL marked on the eyebolt. Care should be taken to ensure that the applied load is within ±5° of the plane of the eye of the eyebolt.

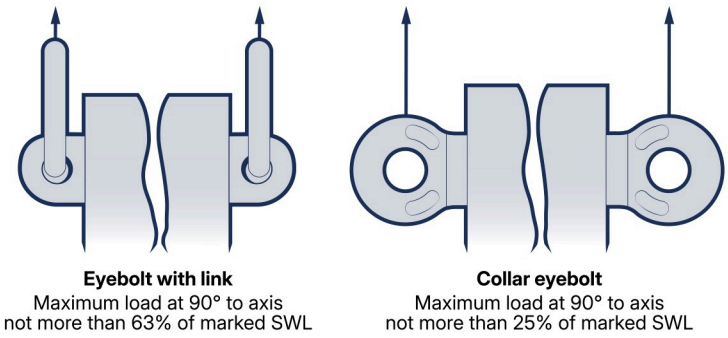


Figure 20.5.7-1 Trunnion lifting

20.5.8 Documentation

Ensure the selected eyebolt is covered by the documentation required by legislation. If this is not on record refer the eyebolt to a Competent Person for thorough examination.

20.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

As eyebolts are frequently used for multi-purpose applications, precise details of the load to be lifted are not always available. In these circumstances, only a general specification can be given but should, as far as possible, include the following information:

(1) British Standard reference.

(2) Maximum load to be lifted.

(3) Type required.

(4) Number required.

(5) If non axial loading is involved give details.

(6) Thread form and diameter.

(7) Any exceptionally hazardous conditions of use.

(8) Special identification marks if required.

20.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

20.7.1

The definition of lifting equipment and accessories used in this code make it clear that eyebolts fall under the heading of lifting accessories. Unless a written scheme of examination, drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the eyebolt's historical records for inspection by the Competent Person and local enforcing authority.

Eyebolts that are fitted to and intended to be a part of the design of other equipment or loads and are not removed for other purposes, are classed as a part of that equipment or load.

(1) Although not required by legislation, new eyebolts will usually be issued with a manufacturer's record of proof load testing in addition to, although possibly combined with, documentation required by the applicable national legislation. These documents form an important part of the record of the eyebolt. They should be retained and cross referenced to the eyebolt's historical records for inspection by the Competent Person or local enforcing authority.

(2) It is the recommendation of LEEA that 'in-situ' eyebolts not intended for lifting purposes are removed and discarded so as to avoid the hazard of them being accidentally used for this purpose. This may require their replacement with other devices, e.g. plugs, to protect threads, etc.

20.8 MARKING, STORAGE AND HANDLING

20.8.1 Marking

In addition to the marking required by the applicable national legislation and standard being worked to the following information should be permanently and legibly marked on each eyebolt:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL.

(3) Quality i.e. grade.

(4) Screw thread type.

(5) Year manufacture

(6) Unique trademark or symbol identifying the manufacturer

The marking shall be either:

(1) On the side of the link away from the weld in the case of eyebolts with link; or

(2) On the raised flat areas provided or similar positions in the absence of flat areas in the case of collar and dynamo eyebolts.

Additionally, in all cases where the designated area is insufficient the periphery of the collar may be used if it can be done without damage to the machined face.

The symbols should be as large as possible but in any case not less than 3mm high and in no case should the mechanical properties of the item be impaired.

Different forms of marking are to be found on the various types of eyebolts shown according to the date of issue. To avoid confusion and remove any anomalies, all existing eyebolts should be marked with any additional information necessary to bring them in line with the following:

(1) Identification mark - each eyebolt should be marked so as to identify it with its historical record.

(2) WLL marking - it is a requirement that each eyebolt should be marked with its axial WLL., e.g. WLL 1.6t.

(3) Quality marking - the material quality mark should be clearly shown. The quality mark may appear as raised figures in the forging on the side of the crown of the eye.

(4) Screw thread marking - Each eyebolt should be legibly and permanently marked with one of the following thread identifications as appropriate:

a. 'M' to denote ISO metric threads, coarse series, including the accepted metric thread diameter designation, e.g. M12;

b. 'BSW' to denote BS Whitworth threads, including the accepted BSW thread diameter designation, e.g. ½BSW;

c. ‘UNC’ to denote unified coarse threads, including the accepted UNC thread diameter designation, e. g. ½UNC.”

It is therefore recommended that, to avoid the possibility of mismatch, eyebolts of all types and standards and also any tapped holes not so identified should be marked with this information as soon as possible.

> These screw thread markings fulfil the recommendations that eyebolts and tapped holes are marked with their respective thread diameters and form, as a means to minimise the dangers of mismatch.

20.8.2 Storage and Handling

It is recommended that wherever practicable, eyebolts are not left in-situ but should be removed after use and returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Eyebolts should be handled with care as the thread and the underside of the collar are machined and normal precautions should be taken in respect of machined surfaces.

(2) Eyebolts should be lightly oiled or greased to prevent corrosion.

(3) In the case of eyebolts which have previously been left ‘in-situ’, remove the eyebolt. Check to see if it is in good condition, correctly documented and marked. If the eyebolt meets these criteria place in proper storage, if not refer to a Competent Person.

(4) Eyebolts fitted to items of plant and left in place (in-situ) demand the same attention as other eyebolts in that they should be verified, inspected and marked as recommended in this code. Where it is necessary to leave eyebolts in position, systems should be instituted to ensure that they are regularly removed and inspected.

> Where ‘in-situ’ eyebolts have been removed for storage, steps will be necessary to protect the hole and positively identify the thread. Clean and identify the tapped hole. Check to see if it is in good condition and suitable for use with an eyebolt bearing in mind its location and the strength of the surrounding material. If the hole meets these criteria, permanently mark it to identify the thread form and diameter. Plug the tapped hole with a removable plug to exclude debris.

20.9 IN-SERVICE INSPECTION AND MAINTENANCE

20.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all eyebolts should be visually inspected by a suitably qualified and experienced person prior to use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the eyebolt to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the eyebolt and make a visual check for any obvious defects. This inspection must be carried out with the eyebolt in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of eyebolts and if any are present, the eyebolt should be withdrawn from service and referred to a Competent Person:

(1) Distortion, such as bent shank, deformed eye, reduced diameter at undercut.

(2) Thread worn, corroded, damaged or incorrectly formed.

(3) Damage, such as nicks, cracks, gouges, corrosion.

(4) SWL, thread identification and identification markings missing or illegible.

20.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some eye bolts will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 20.9.1 Pre-use inspection page 327, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 20.9.3 Maintenance page 328 below.

20.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In general there is little that can be done in terms of maintenance to the eyebolt other than ensuring that they are cleaned, paying particular attention to threads and recesses, and free from contaminants that can cause damage and deterioration. Where eyebolts are susceptible to corrosion they should be lightly oiled or greased to protect them.

(1) Under NO circumstances should bent eyebolts be straightened.

(2) Any debris present in the thread or under the collar should be removed by cleaning with a wire brush.

20.9.4 Thorough examination

The eyebolt must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the eyebolt's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of eyebolts, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

20.10 SAFE USE OF EYEBOLTS

In addition to any specific instructions relating to the safe use of the eyebolt issued by the manufacturer, the following should be observed.

20.10.1 Mating Material/Locating Hole

Items of plant and equipment will be manufactured from a wide range of materials and may have several holes into which eyebolts could be inserted. These holes may not, however, have been intended for lifting purposes. They may have insufficient depth of thread, the material may have insufficient thickness or be of an unsuitable nature for the load which would be imposed upon it. If it is intended to lift an item using holes which have not been specifically designed as lifting points, they must be checked by a person competent for the purpose to ensure that those selected are suitable in every way.

20.10.2 Fitting the Eyebolt

(1) Eyebolts should only be fitted by a trained person.

(2) Inspect the eyebolt and tapped hole before fitting the eyebolt.

(3) Ensure that the contacting surface around the tapped hole is smooth, clean, flat, perpendicular to the thread axis and large enough to accept the eyebolt collar.

(4) Ensure that the tapped hole has a fully formed thread and a long enough threaded portion to engage with the full length of the eyebolt shank and that the material of the tapping is of adequate strength.

(5) Verify that the thread forms of the eyebolt and the tapped hole into which it is to be screwed are compatible.

(6) Ensure that the eyebolt is firmly screwed down without over tightening, that the collar sits evenly on the contacting surface and that the plane of the eye is correctly aligned. This is essential to avoid bending. Do not attempt to align the eyebolt by further tightening as this will impose excessive stress on the thread runout part of the shank.

(7) When screwing eyebolts into blind holes, it is essential that the hole and its threading are deep enough to allow the collar to seat fully. Ensure that the tapped hole is free from debris or other obstructions which might prevent the eyebolt seating fully.

(8) Eyebolts must not be re-machined or modified. For alignment purposes it is recommended that shims are used. When using collar eyebolts intended for non-axial loading, the load must be applied within ±5° of the plane of the eye. If, on screwing in the eyebolt this condition is not fulfilled, it can be achieved by the use of shims up to a maximum thickness of half the pitch of the thread. Alternatively, the hole may be spot faced down.

(9) Eyebolts used in clearance holes with back nuts should have a full nut of a grade comparable to the eyebolt. In addition, consideration should be given to preventing the nut unscrewing in service. Also ensure that taper washers are used when the hole is through a tapered flange. Particular attention should be paid to the adequacy of the material through which the eyebolt passes.

20.10.3 Attaching the Lifting Accessory

(1) Collar eyebolts without links need a shackle for connection to a hook.

(2) If a single eyebolt is used for lifting a load which is liable to revolve or twist, a swivel or swivel type hook should be used to prevent the eyebolt unscrewing.

(3) Where two eyebolts of the same capacity are used in conjunction with a two leg sling, the eyebolts should be rated to the appropriate maximum working load tables given in the manufacturer's instructions for use. Use the longest legs possible to minimise the angle to the vertical and thus the angular loading on the eyebolts. If practicable, a lifting beam or spreader should be used to obtain full SWL of the eyebolt in axial lift. Dynamo eyebolts are intended for axial lifting only; if used in pairs a lifting beam MUST be used.

(4) Ensure that eyebolts are not overloaded due to the method of slinging, especially when used in pairs. The correct and incorrect methods of slinging using a pair of eyebolts are shown in Figure 20.10.3-1 page 330. A sling should not be reeved through the eyebolts or shackles as by this method the loading in the eyebolt is considerably increased.

(5) If these requirements cannot be met or for more complex lifts using three or more eyebolts, a Competent Person must be consulted.

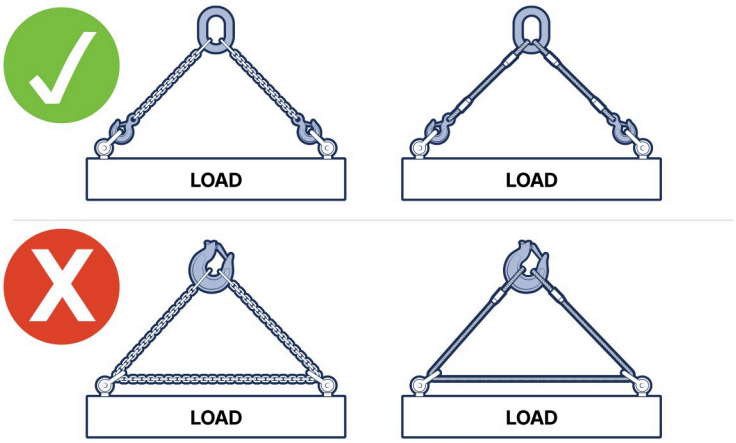


Figure 20.10.3-1

20.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives should be familiar with the identification of suitable holes and the inspection of the hole. The training should include the method of checking the thread, establishing its fitness for purpose and highlight the dangers of incompatible threads.

(2) Operatives should be shown the correct method of fitting eyebolts and use of shims.

(3) Operatives should be instructed in the correct method of attachment to other lifting accessories.

(4) Operative should understand the rating of eyebolts for angular loading.

20.A1 APPENDIX - 1 EYE NUTS AND BOW NUTS

20.A1.1 Grade and Material

There are no standards for eye nuts or bow nuts for lifting purposes. Their main use is in pipe hanging and rigging applications and as a result they are usually produced in lower grade material. They are also produced in other grades to the manufacturers commercial specifications. When the grade is uncertain, the user must therefore assume mild steel.

20.A1.2 Axial Lifting Applications

Although not primarily intended for lifting, eye nuts and bow nuts are useful in certain applications. They are suitable for axial lifting only and under no circumstances should they be used for angular loading. (See Figure 20.A1.2-1 page 330)

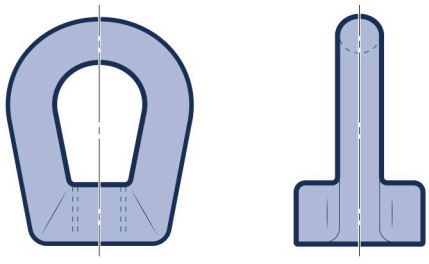


Figure 20.A1.2-1

20.A1.2.1 Selection

When selecting eye or bow nuts for lifting, ensure they are single-piece drop forgings with sufficient thread length to handle the load. The seating face should be machined flat and square to the thread. In addition, as with eyebolts, the user must ensure the thread form and diameter of eye or bow nut is compatible to that of the stud onto which it is to be fitted.

20.A1.2.2 Identification and Marking

In addition to information required by the applicable legislation each eye nut or bow nut should be legibly and permanently marked with the following information:

(1) A quality mark to denote the grade of material.

(2) The screw thread type and size.

(3) The SWL.

(4) An identification mark to identify with the report of thorough examination/verification details.

(5) Year of manufacture

(6) Manufacturers unique identification mark or symbol

20.A1.2.3 Fitting

In assessing the SWL, the manufacturer assumes that the stud on to which the eye or bow nut is to be screwed is of equal or higher grade; therefore care must be taken to ensure that the stud is adequate for the load. The user must ensure the stud has sufficient length of thread to engage fully with the eye or bow nut.

Eye or bow nuts, as with eyebolts, should be fully seated and the contacting surface around the stud should be smooth, clean and flat, with the stud perpendicular to it. Ensure that the stud is screwed firmly in position with sufficient thread engaged into the load to sustain the load. Ensure that the eye or bow nut is screwed firmly in position without over-tightening and sits evenly on the contacting surface.

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21.1 FOREWORD

Lifting beams, spreaders and frames are usually designed either for a specific purpose or as general purpose beams for a specified range of lifts. There are several standards available that cover such equipment in their scopes. Prior to these standards there were no standards for lifting beams, spreaders and frames and, as a result, most manufacturers produced a range of lifting beam, spreaders and frames to their own specifications. Lifting beams, spreaders and frames can have a long life. It is not therefore possible in a general purpose code to cover every variation and for certain designs special precautions or instructions may apply. The manufacturer's or supplier's instructions should always be sought and followed.

21.2 SCOPE

This section of the code covers beams, spreaders and frames which are attached to the load suspension point of a lifting machine or crane and can therefore be considered to be portable. It is not intended to cover beams which are permanently attached to a crane in place of a bottom block or patent lifting frames used in the handling of cargo containers.

21.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted; other terminology is adequately explained and illustrated in section 21.4 TYPES OF LIFTING BEAM, SPREADER AND FRAME page 333.

21.3.1 Suspension Point

The suspension point is that part of the beam by which it is attached to the crane hook or other lifting device. This is also known as the lifting point.

21.3.2 Load Attachment Point

The load attachment point is that part of the beam to which the load is attached. This is also known as the drop point.

21.4 TYPES OF LIFTING BEAM, SPREADER AND FRAME

21.4.1 Lifting Beam

The types of lifting beam are diagrammatically represented in Figure 21.4.4-1 page 334 to Figure 21.4.4-4 page 336. It will be noted that the suspension points are shown as being vertically below the crane hook. Although single suspension points are shown, multiple suspension points for use with two or more crane hooks can be provided, as can multiple load attachment points.

21.4.2 Lifting Spreader

A lifting spreader is diagrammatically represented in Figure 21.4.4-5 page 336. It can be considered to be a strut in pure compression. The line of action of the top sling and the load suspension point coincide at the neutral axis at the end of the spreader.

> Some bending will be induced due to self weight and the position of the suspension and attachment points and the direction of the load applied to them.

21.4.3 Lifting Frame

A lifting frame is diagrammatically represented in Figure 21.4.4-6 page 337, which is in effect a combination of four spreaders.

21.4.4 Combination Beams and Spreaders

In addition to the above types there can be a combination of a beam and spreader. One of the simpler forms is represented in Figure 21.4.4-7 page 337.

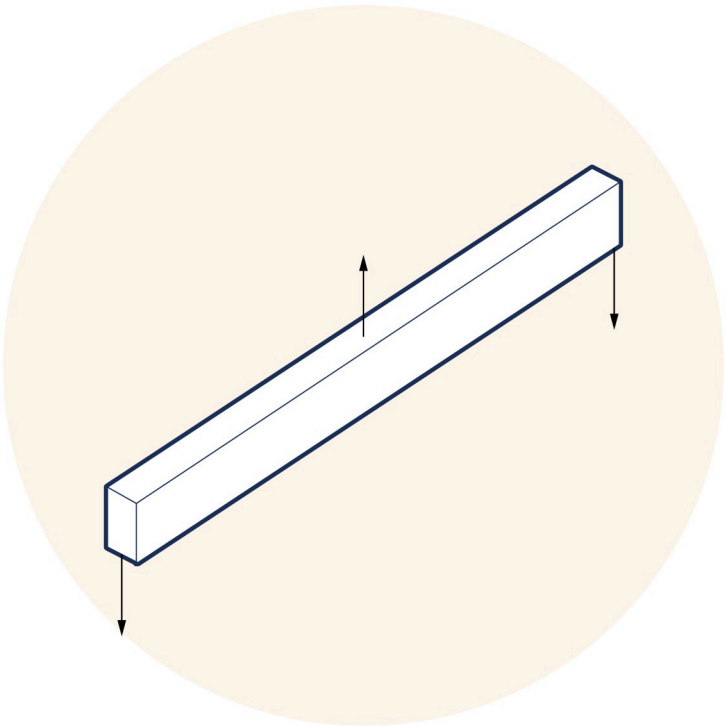


Figure 21.4.4-1

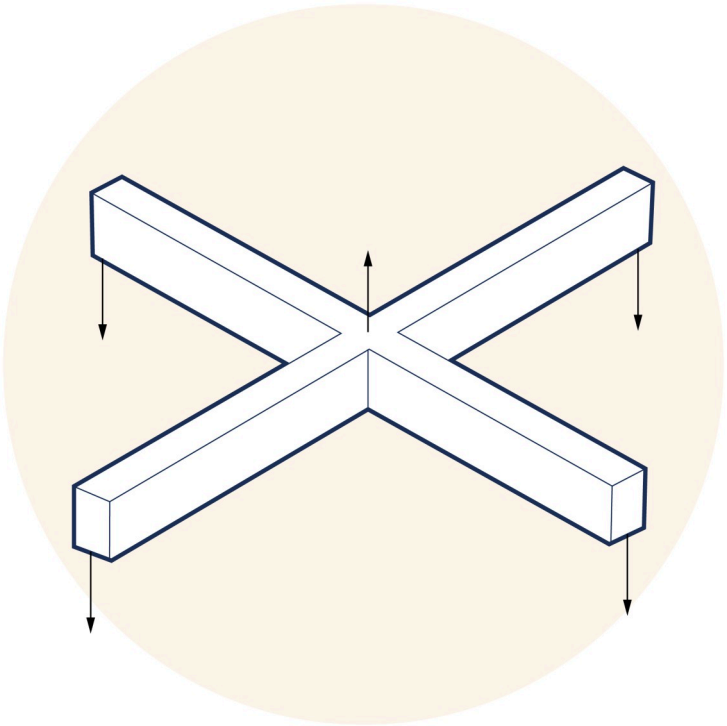


Figure 21.4.4-2

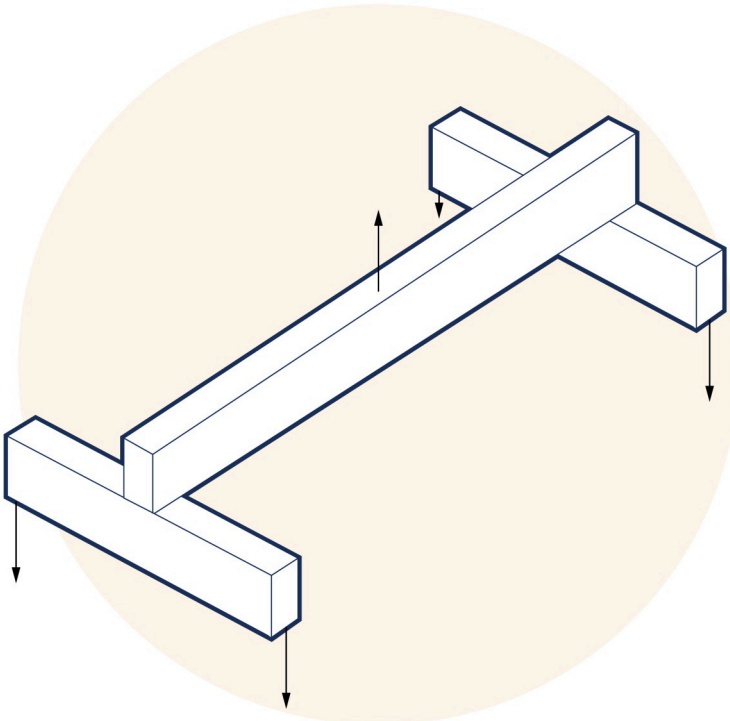


Figure 21.4.4-3

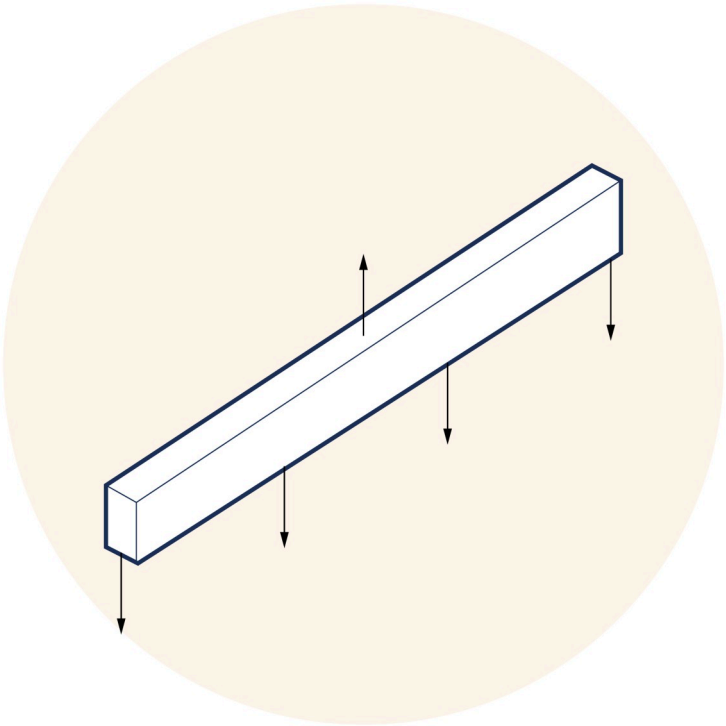


Figure 21.4.4-4

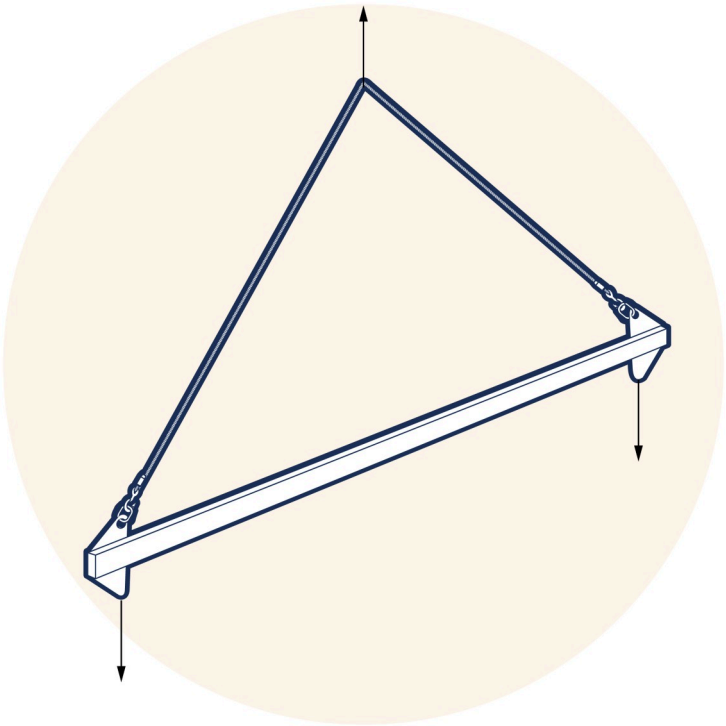


Figure 21.4.4-5

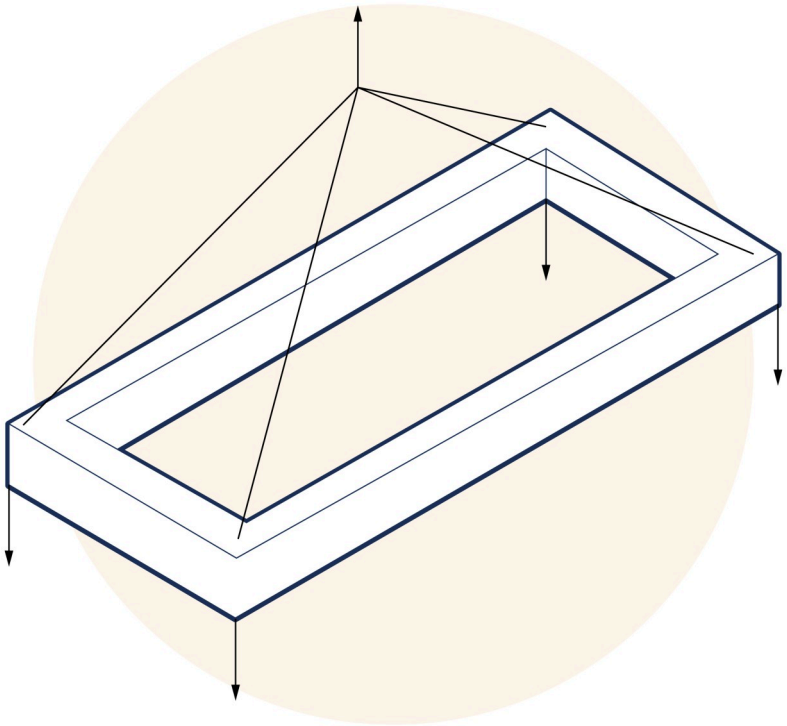


Figure 21.4.4-6

For the purpose of the code, lifting beams, spreaders, frames and combination beams and spreaders will be referred to under the generic term ‘lifting beam’.

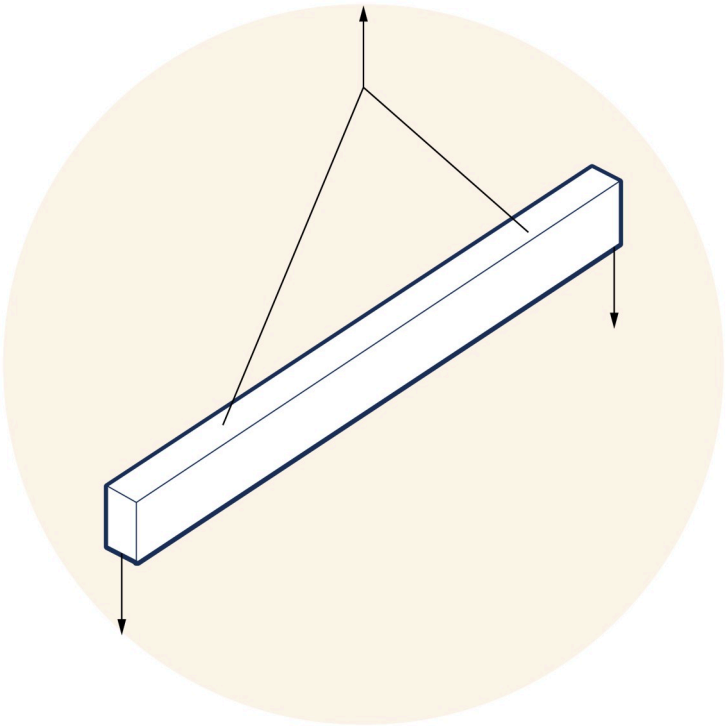


Figure 21.4.4-7

21.5 PRINCIPLES FOR THE SELECTION OF LIFTING BEAMS, SPREADERS AND FRAMES

21.5.1 Application of Lifting Beams

Lifting beams are used for various purposes as detailed below.

(1) To reduce the headroom required when lifting long loads.

(2) To provide multiple lifting points.

(3) To provide a means of handling out of balance loads.

(4) To provide a vertical lift with controlled or no inward pull for:

a. eyebolts and similar lifting points.

b. loads which must be protected from crushing forces.

(5) To provide a means of handling loads requiring special attachments such as hooks, plate clamps, etc.

(6) To provide a means of using two cranes in tandem.

(7) To provide lifting points at adjustable centres.

21.5.2 Stability

It should be noted that in the majority of cases, the use of a lifting beam instead of long slings will reduce the overall stability of the lift. Particular attention should be paid to the stability of the load when the lifting points are below the centre of gravity. Figure 21.5.2-1 page 338 shows the limiting condition for instability. To achieve a stable configuration, the height of the lifting triangle must be increased in relation to the loading triangle; i.e. for stability, 'A' must be greater than 'B' and 'D' must be equal to or greater than 'C'.

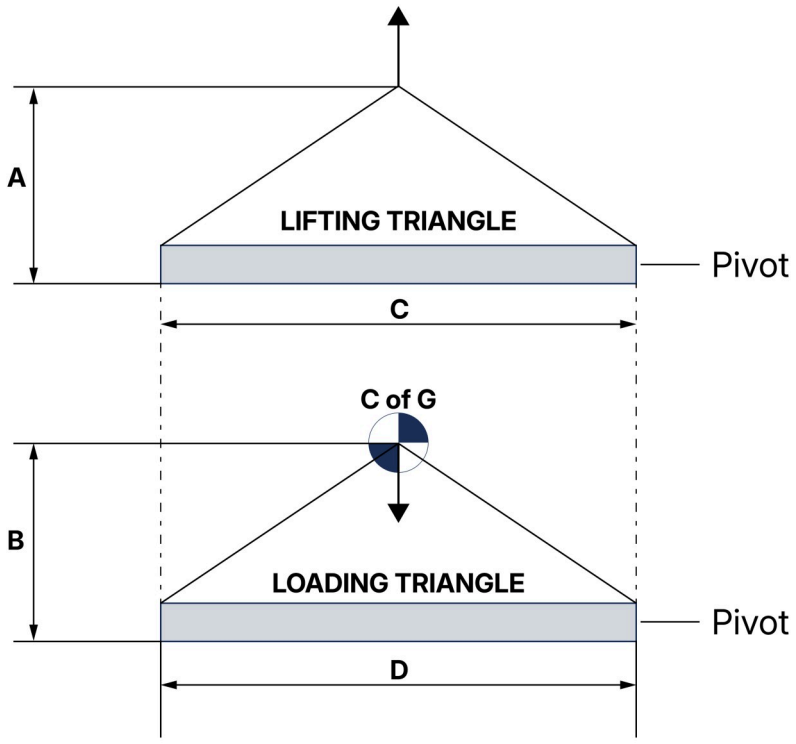


Figure 21.5.2-1

21.5.3 Beam Weight

The weight of the lifting beam, together with its associated lifting accessories, must be added to the weight of the load when assessing the total load imposed on the crane hook.

21.5.4 Lifting Accessories

Many lifting beams are fitted with standard lifting accessories such as shackles, wire rope slings, chain slings, web slings, plate clamps, turnbuckles, etc. The requirements of the individual sections of this code apply whether these items are readily removable from the beam or not. Whilst removable lifting accessories can be used for separate lifting applications, it is good practice to keep them together as if forming an integral part of the lifting beam. This is particularly the case if they are recorded with the beam on the documentation required by the supply legislation, manufacturers certificate, report of thorough examination, etc.

In the case of lifting accessories used separately, the onus is on the user to replace or reassemble these onto the beam. Care should also be taken to ensure that the component has in fact been thoroughly examined in accordance with current legal requirements and the relevant section of this code before using it for a different lifting application.

21.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

The following is the minimum amount of information which should be exchanged between the user and designer or supplier of a lifting beam:

(1) The reason for using a lifting beam instead of other methods of handling the load.

(2) The total maximum weight of the load to be lifted together with any other forces which may be superimposed on the load.

(3) A detailed description or drawing of the load to be lifted together with principal dimensions which affect the lifting operation including information on the position of the centre of gravity and available headroom.

(4) Details of external obstructions to the use of the beam. Attention is drawn to the fact that a lifting beam could foul the structure of a double beam crane before the upper limit is reached.

(5) The exact type, dimensions and capacity of the crane hook and SWL of the crane. Particular attention should be paid to the safety catch fittings and guards.

(6) The speed and duty rating of the crane.

(7) Frequency of use.

(8) Environmental considerations such as extremes of temperature or corrosive atmospheres.

(9) The level of operatives' skill and ergonomic considerations. It should be made clear if the beam is to be used by unskilled labour or if the design of the lifting operation requires the attention of a skilled fitter. If manipulation of the beam is necessary in order to carry out the lift, then the labour availability and requirements should be specified.

(10) Operating assembly and storage instructions.

(11) Any additional tests required by the purchaser.

(12) The weight of the lifting beam.

21.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

21.7.1 Statutory Thorough Examination

The definition of lifting equipment and accessories used in this code make it clear that the lifting beams, spreaders and frames covered in the scope of this section of the code fall under the definition of lifting accessories. Unless a written scheme of examination, (for guidance refer toLEEA 032 Guidance to written schemesof examination)drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

21.7.2 Post Repair Verification and Record Keeping

Following a repair, lifting beams must be re-verified by a Competent Person. In the case of structural repairs, the verification will usually be by way of a proof test and thorough examination. The report of the verification

should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

> LEEA 055 Verification of lifting beams, spreader and frames, contains detailed information, including verification, following repair for this equipment.

21.7.3 Keeping of Supply Documentation for Replacement Components

In the case of the replacement of lifting accessories with components which are identical in every respect, the initial documentation for the replacements should be retained and cross referenced to the equipment's historical records for inspection by the Competent Person or local enforcing authority.

> It is not uncommon for users to manufacture, or have manufactured to their specifications and drawings, lifting beams, spreaders and frames which they then send to a lifting equipment company for test and examination. Under older legislation, the company making the verification would have issued a test certificate, which allowed the item to enter service. Under current legislation this is no longer the case and it is the user who is the responsible person (legal) with the duty to comply with and issue marking and documentation in accordance with the applicable supply legislation to allow the item to enter service. The testing organisation will only issue a report of a test to the responsible person (legal) for retention in their technical file.

21.8 MARKING, STORAGE AND HANDLING

21.8.1 Marking

In addition to the marking required by the applicable legislation and the standard being worked to, the following shall be permanently and legibly marked on each lifting beam:

(1) Identification mark. This should be repeated on all detachable components. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)

(2) Working load limit and SWL, if different.

(3) The name and address of the manufacturer

(4) Year of construction

(5) Total mass of the assembly

> Some lifting beams have multiple lifting points and the maximum working load may depend upon the lifting points in use. The marking must clearly show the permitted options and the maximum working load for each.

> Some lifting beams are of modular design and the maximum working load may depend upon the configuration. If it is impractical to show the maximum working load for all configurations, a code may be used to identify the capacity of each component part and that code used in the manufacturer's instructions to determine the maximum working load for the particular configuration.

> Where the orientation of the beam is not obvious, this should also be indicated. A 'this way up' arrow may suffice.

> Occasionally lifting beams are fitted with fork lift pockets. These pockets are either intended to allow a fork lift truck to lift the load with the lifting beam or to allow the beam to be moved from location to location only. Whatever the intention, it is important that they are marked appropriately for their intended use, i.e. for lifting the unladen lifting beam only.

21.8.2 Storage and Handling

When not in use, lifting beams should be stored in a proper manner to prevent damage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Special stands or packing should be provided to support the beam if it will not stand on its own.

(2) Particular attention should be paid to beams that are designed to be dismantled for transportation and storage. Whilst in storage, the component parts should be positively identified and kept together. Only the manufacturer's component parts or parts manufactured to the same specification should be used in reassembly. There are certain cases where re-verification, e.g. a test and examination, may be required on reassembly and advice must be sought from the manufacturer or other competent authority on this point.

(3) A lifting beam fitted to a crane hook without the load attached is a load in its own right and all the rules governing operation of a crane or hoist with a load attached must be observed. In certain cases, a lifting beam suspended without the load may be very unwieldy and care must be taken in handling the beam on its own. This applies particularly to low headroom lifting beams.

21.9 IN-SERVICE INSPECTION AND MAINTENANCE

21.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, all lifting beams should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For lifting beams in regular use it is good practice to make an inspection at the start of each shift or working day. For lifting beams used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the lifting beam to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the lifting beam and make a visual check for any obvious defects. This inspection must be carried out with the lifting beam in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of lifting beams and if any are present, the lifting beam should be withdrawn from service and referred to a Competent Person:

(1) Lifting eyes, bows, bolts, etc, should be inspected for obvious signs of wear, distortion and physical damage.

(2) Load attachment points such as hooks fabricated into the beam should be inspected for wear, distortion and physical damage.

(3) Slewing, tilting, sliding, etc. devices should be inspected for any damage affecting functionality and operation.

(4) Attachment points for shackles used for lifting the beam or attaching the load should be inspected for wear and elongation of holes. It is usually necessary to remove the shackle to do this.

(5) Bolted connections to the beam should be checked for tightness.

(6) The beam should be checked for distortion.

(7) The beam should be checked for localised physical damage. Particular attention should be given to hollow sections which may have dents or localised buckling and to the flanges of structural steel sections.

(8) Corrosion damage.

(9) Signs of cracks and distortion especially in welded details.

(10) Ensure that requisite markings are clearly visible and correspond to the loadings stated on the documentation.

(11) Lifting accessories, such as shackles, eyebolts, wire rope slings, chain slings, synthetic web slings, plate clamps, hooks, turnbuckles, etc. should all be inspected in accordance with the respective sections of this code.

> ⓘ If the equipment is damaged, advice should be sought from a Competent Person. Repairs should only be carried out by competent manufacturers or under the supervision of a Competent Person.

21.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some lifting beams will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking

into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 21.9.1 Pre-use inspection page 341, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 21.9.3 Maintenance page 342 below.

21.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. Lifting accessories, such as shackles, eyebolts, wire rope slings, chain slings, synthetic web slings, plate clamps, hooks, turnbuckles, etc. should all be inspected in accordance with the respective sections of this code.

Adequate lubrication shall be applied to the moving parts of lifting beams where applicable and in accordance with the manufacturer's instructions. For certain applications, i.e. where there is a risk of contaminating other goods or products for example or where dirt is liable to mix with the lubricant for example, it may be desirable to use a dry lubricant spray. Any travel limits should be checked to ensure that they are correctly set and that the limit mechanism and switches operate freely and correctly.

In the case of any lifting beam which incorporates contactors, whether internal to the lifting beam or as a part of the control gear, they should be checked for wear and signs of arcing. They should be cleaned, maintained or replaced in accordance with the manufacturer's instructions.

21.9.4 Thorough examination

The lifting beam must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the lifting beam's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.



Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of lifting beams, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

21.10 SAFE USE OF LIFTING BEAMS, SPREADERS AND FRAMES

In addition to any specific instructions relating to the safe use of the lifting beam issued by the manufacturer, the following points should be observed. Reference should also be made to the individual sections of this code for the safe use of loose and detachable lifting accessories.

(1) Most lifting beams and spreaders are designed for a specific purpose and should not be used for other purposes without reference to a Competent Person.

(2) Lifting beams with lifting points designed for a particular crane hook size should always be used on the specified hook. Failure to do so can cause damage to both the hook and the lifting point.

(3) When using a lifting beam designed for operating with two cranes in tandem, the rules for multilifting and reducing the lifting capacities of the cranes must be observed. Refer to the equipment manufacturers instructions or suitable LEEA member organisation for guidance

(4) The use of load manipulation devices such as tag lines, Push/Pull Poles , etc is essential when manipulating long loads on a beam with a single suspension point. Where tag lines are used they should be of adequate length so that the personnel controlling the load can stand well clear of it. Tag lines must not be used to attempt to balance the load.

(5) The lifting beam should remain in its intended attitude during use.

(6) Lifting beams with multiple attachment points need particular attention to ensure that the SWL on the individual point is not exceeded.

(7) When lifting or setting the load down, care should be taken to ensure that individual load attachment points are not overloaded.

(8) The lifting beam should not be allowed to foul the underside of the crane structure. If this is possible then consideration should be given to adjusting the limit switch of the crane to a lower position.

(9) The weight of the beam must be added to the weight of the load when assessing the overall load on the crane hook.

(10) When using beams with adjustable lifting points, particular care must be taken to ensure that the manufacturer's specified loadings for the centres chosen are not exceeded.

21.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account, paying particular attention to the following:

(1) Operatives and drivers should be informed of the specific uses for which the lifting beam is intended. They should be shown the correct method of attaching the lifting beam or to the crane hook and the correct method of attaching the load to the lifting beams.

(2) In the case of beams which are dismantled for transportation and storage, operatives should be shown the correct method of assembling the lifting beam.

Section 22 - PLATE HANDLING CLAMPS

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22.1 FOREWORD

Plate clamps are widely used, particularly in the steel fabrication industry, for handling a variety of work including individual pieces of plate, fabricated assemblies and bundles of plates. The term covers several designs which fall into two basic types:

Type (1) – Clamps which grip the edge of the plate by friction. These are subdivided into those used to lift the plate in the vertical position only and those which lift from the horizontal to the vertical or viceversa.

Type (2) – Clamps designed to lift the plate in a horizontal position only, when used in conjunction with a two leg sling or reeved onto an endless loop, according to design.

22.2 SCOPE

This section of the code covers both vertical and horizontal plate handling clamps. There are several standards available that cover such clamps in their scopes. Prior to these standards there were no standards for plate clamps and, as a result, most manufacturers produced a range of plate handling clamps to their own specifications. Plate handling clamps can have a long life. It is not therefore possible in a general purpose code to cover every variation and for certain designs special precautions or instructions may apply. The manufacturer's or supplier's instructions should always be sought and followed.

22.3 DEFINITIONS

The definitions are as given in section 1.3 DEFINITIONS page 2 of this code.

22.4 TYPES OF PLATE HANDLING CLAMPS

22.4.1 Type (1) - Clamps Lifting From the Edge of the Plate by Friction

There are three main principles of operation in use:

(1) Those in which a system of levers actuated by the loading of the lifting eye or chain, or in which a chain or wire rope is attached to the jaws in such a way as to produce a force causing the jaws to come together and grip the plate. (See Figure 22.4.1-1 page 346) Such gripping action may be provided by the lever system itself, or by a combination of the leverage and the cam action of the jaw. Clamps which are provided with a spring loaded locking device which secures (locks) the clamp onto the plate without a force being applied to the lifting eye are preferred. Some clamps are capable of lifting plates from the horizontal to the vertical and vice versa but some will only maintain their grip away from the vertical one way around and so can only be used to turn a plate over if the plate is first lifted to the vertical, then temporarily supported whilst the clamp is removed and turned around prior to the plate being lowered. Those which retain their grip throughout the whole manoeuvre are preferred and users are reminded of their obligations to provide safe systems of work. It is unlikely that such equipment will meet these requirements. In addition some clamps have the further advantage of being able to accommodate a lifting load applied at any angle to the side plate of the clamp. The working load limit of such clamps is usually

reduced by a stated percentage (e.g. 50%) when so used. Confirmation should be sought from the manufacturer's instructions on the performance of their clamps.

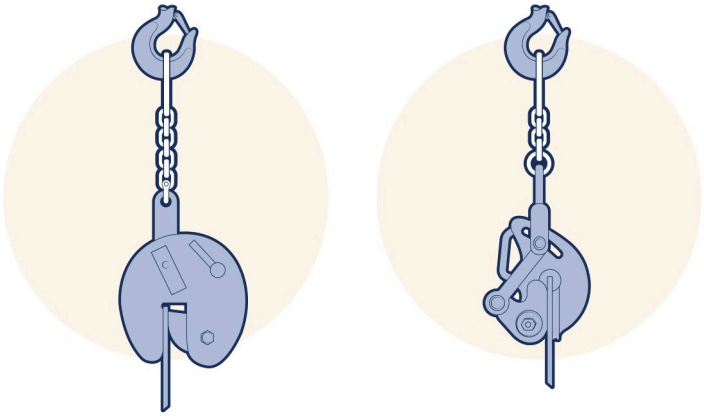


Figure 22.4.1-1

(2) Clamps which grip by the action of a wedge or cams but without lever action. (See Figure 22.4.1-2 page 346 a)

(3) Those in which the gripping force is provided by a screw tightened by a bar or spanner. (See Figure 22.4.1-2 page 346 b) It is emphasised that such clamps are purpose designed items and ordinary 'G' clamps are NOT suitable. In addition, special precautions are required in use.

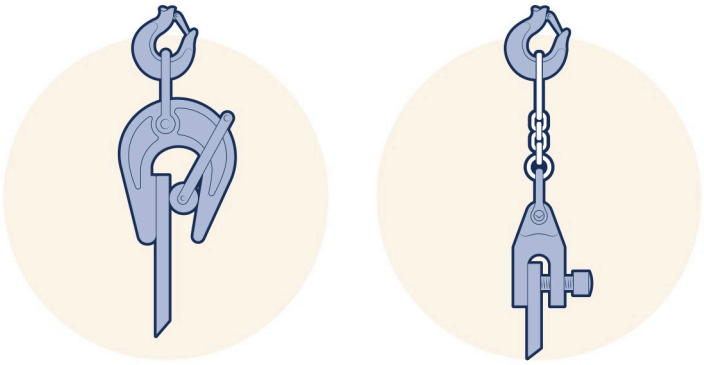


Figure 22.4.1-2

22.4.2 Type (2) - Clamps Lifting Horizontally

These clamps are used in pairs in conjunction with a two leg sling. The sling may be permanently attached to the clamps or the clamps may terminate in an eye or shackle into which the hook of the sling (preferably a safety hook) is inserted. The clamps may be provided with a toe or cam to grip the plate, (see Figure 22.4.2-1 page 347 a) which is by far the safest type, or grip only by the inward force produced by the angle of the sling. (See Figure 22.4.2-1 page 347 b)

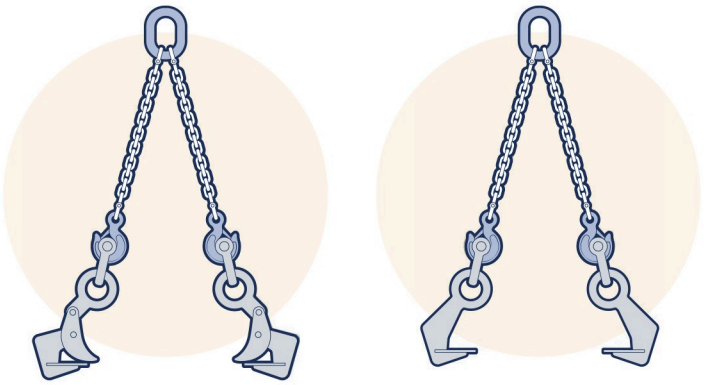


Figure 22.4.2-1

Despite their simplicity of operation, horizontal plate lifting clamps are purpose designed to take account of the forces which occur in the line of lifting. Some of these clamps are designed to be used on an endless loop in which case it must not be changed for a two leg sling nor should an endless loop be substituted for a two leg sling as in both cases this would alter the geometry of the arrangement and thus the forces.

Horizontal plate handling clamps may be designed to handle one plate at a time or a bundle.

22.5 PRINCIPLES FOR THE SELECTION OF PLATE HANDLING CLAMPS

22.5.1 Type (1)

(1) Clamps should have been tested to a proof load of twice the working load limit without showing permanent deformation and in samples tested to destruction they should not have released the load at less than three times the working load limit.

(2) In the case of clamps designed to lift at an angle to the side plate of the clamp, there should have been an additional test at the maximum angle permitted, of twice the working load limit for that angle.

(3) A design that permanently incorporates a short length of chain connecting the clamp to the crane hook is strongly recommended in preference to an eye.

(4) Proof tests should be carried out on the thinnest plate practicable within the clamps range.

(5) The range of thickness that may be lifted should be indicated on the clamp.

(6) Gripping cams and jaw teeth should be easily replaceable.

> Some designs of clamp, particularly those with a moving cam action jaw where the initial grip is provided by a spring, have a minimum load and minimum plate thickness they can safely lift. Wherever possible refer to the manufacturer's instructions but in the absence of specific guidance the load should not be less than 20% of the SWL and the plate thickness not less than 20% of the maximum.

22.5.2 Type (2)

(1) Clamps should have been tested to a proof load of twice the working load limit. The proof load should be applied at the angle(s) between the legs of the sling at which the maximum stress(es) occur in the clamps, without showing permanent deformation. In samples tested to destruction, they should not have released the load at less than three times the working load limit.

(2) The provision of handles on the heavier clamps aids handling and prevents pinched hands.

(3) This type of clamp may not be suitable where there is a tendency for the plate to sag when lifted. In this context, it should be noted that clamps designed for use on an endless loop usually exert a greater crushing force which aggravates the problem.

22.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

22.6.1 Types (1) & (2)

(1) Thickness or range of plates to be handled.

(2) Longest length and greatest width of plate to be handled.

(3) Maximum and minimum weight to be lifted.

(4) Effective section of crane hook on which the clamp or clamp sling is to be used.

(5) Whether the clamp is to be used to handle plates:

a. Horizontally only.

b. Vertically only.

c. Horizontal to vertical through 90° only.

d. Horizontal to horizontal through 180°.

e. At an angle to the plane of the clamp side plates.

(6) Material of plate and hardness if other than mild steel.

(7) If the plate is polished.

(8) If slight marking of the plate is any detriment.

(9) Details of any adverse conditions e.g. handling hot plates, acidic environment.

(10) The amount of headroom available.

(11) Thickness of any spacers or packing in between plates when stacked which may limit access for the clamp.

(12) Details of any additional tests required.

(13) Any special operating instructions.

22.6.2 Additionally for Type (2) Only

In addition to the above:

(1) Maximum number of plates to be lifted at one time.

(2) If the clamps are to be supplied complete with sling or if not the type and length of sling to be used.

22.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

22.7.1 Statutory Thorough Examination and Record Keeping

The definition of lifting equipment and lifting accessories used in this code make it clear that plate handling clamps fall under the heading of lifting accessories. Unless a written scheme of examination, (refer to LEEA 032 Guidance to Written Schemes of Examination) drawn up by a Competent Person, is in place and operating they must be thoroughly examined by a Competent Person at intervals not exceeding 6 months. Reports of thorough examination should be retained and cross referenced to the clamp's historical records for inspection by the Competent Person or local enforcing authority.

22.8 MARKING, STORAGE AND HANDLING

22.8.1 Marking

22.8.1.1 Type (1)

In addition to the information required by the applicable legislation and standard manufactured to the following information should be permanently and legibly marked on a suitable part of the plate clamp:

(1) Range of SWL in straight pull and, where applicable, also at an angle to the side plate of the clamp, specifying the angle.

(2) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)

(3) Range of plate thickness permitted.

(4) Business name and address of the manufacturer

(5) Weight of the unloaded attachment, when it exceeds 5% of the WLL of the equipment or 50kg, whichever is the less

(6) Permissible gripping range.

(7) Year of manufacture

22.8.1.2 Type (2) - Permanently attached to sling

In addition to the information required by the applicable legislation and standard manufactured to following information should be permanently and legibly marked on the head fitting of the sling or a tag attached to the head fitting:

(1) SWL as an assembly.

(2) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(3) Range of plate thickness permitted.

(4) Business name and address of the manufacturer

(5) Weight of the unloaded attachment, when it exceeds 5% of the WLL of the equipment or 50kg, whichever is the less

(6) Permissible gripping range, where applicable

(7) Year of manufacture

22.8.1.3 Type (2) - Loose clamps

In addition to the information required by the legislation or standard to which the equipment was made, the following information should be permanently and legibly marked on a suitable part of each clamp:

(1) SWL per pair.

(2) Identification mark; preferably as a pair. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(3) Range of plate thickness permitted.

(4) Angle of use and method of reeving i.e. two leg or endless loop.

(5) Business name and address of the manufacturer

(6) Weight of the unloaded attachment, when it exceeds 5% of the WLL of the equipment or 50kg, whichever is the less

(7) Year of manufacture

22.8.2 Storage and Handling

When not in use, plate clamps should be returned to proper storage. The general requirements are as in section 1.7.2 Storage and Handling page 9 of this code, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature, together with the following:

(1) Plate clamps normally used in pairs should be kept together along with any accessories such as shackles or chains.

(2) When being handled, plate clamps should not be dropped or thrown down.

22.9 IN-SERVICE INSPECTION AND MAINTENANCE

22.9.1 Pre-use Inspection

In addition to statutory thorough examinations, all plate clamps should be visually inspected by a suitably qualified and experienced person prior to use or on a regular basis. For plate clamps in regular use it is good practice to make an inspection at the start of each shift or working day. For plate clamps used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the plate clamp to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the plate clamp and make a visual check for any obvious defects. This inspection must be carried out with the plate clamps in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of plate clamps and if any are present, the plate clamp should be withdrawn from service and referred to a Competent Person:

22.9.1.1 Types (1) & (2)

(1) Blunted teeth in either fixed or moveable jaws. This point should be frequently checked as cam or wedge action may be affected.

(2) Frame opened out.

(3) Worn or bent pins.

(4) Mechanism not working freely.

(5) Wear on gripping surfaces.

(6) Nicks, cracks, gouges or corrosion present.

22.9.1.2 Additionally for type (1) only

(1) Broken or stretched spring in locking lever.

(2) Unsatisfactory action of locking lever.

(3) Tight, bent or damaged clamping threads.

22.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some plate clamps will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 22.9.1 Pre-use Inspection page 350, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 22.9.3 Maintenance page 350 below.

22.9.3 Maintenance

Plate clamps have working parts which can become inoperative if not maintained, therefore at appropriate intervals, plate clamps should be thoroughly cleaned and any moving parts lubricated, unless the manufacturer's instructions indicate otherwise. Particular care should however be taken with clamps having smooth jaws lined with friction material as lubricant on the jaws may be dangerous. Always ask the manufacturer for advice in such circumstances.

Teeth must NOT be re-sharpened or re-cut unless specifically approved by the maker.

22.9.4 Thorough examination

The plate clamp must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the plate clamp's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and retuning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of plate clamps, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

22.10 SAFE USE OF PLATE HANDLING CLAMPS

In addition to any specific instructions relating to the safe use of the plate clamp issued by the manufacturer, the following points should be observed:

22.10.1 Type (1)

(1) Plate clamps can be easily displaced by a heavy crane hook bearing down onto the lifting eye. With certain types of clamp this could actually release the clamping mechanism and thereby allow a plate resting vertically on edge to fall over. A way of preventing this is to provide a short length of chain between the clamp eye and the crane hook. This allows full articulation as well as ensuring that the crane hook does not impose its weight on the clamp.

(2) All plate clamps, except those capable of accommodating a lifting load applied at an angle to the side plates of the clamp, should always align with the chain or sling leg.

(3) Plate clamps in which the gripping force is provided by a screw (see Figure 22.4.1-2 page 346 b) may be used in pairs as shown in Figure 22.10.1-1 page 352, but the maximum angle to the vertical should be 15° (30° included angle) unless otherwise specified by the maker. Special precautions should be taken to ensure that these clamps are tightened correctly, sufficient to ensure that they don't slip. It is important to note that, with this type of clamp, any movement of the clamp relative to the plate may tend to slacken the screw. It is also important to note that this type of clamp should never be used in such a manner that a side pull is imposed on the shackle.

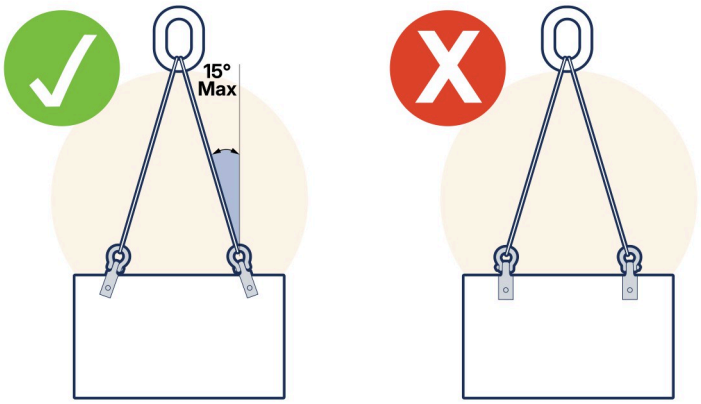


Figure 22.10.1-1

(4) In order to ensure full engagement, all plate clamps, other than those referred to in the preceding paragraph, should, unless otherwise permitted by the manufacturer, always be at right angles to the edge of the plate. In this context, account should also be taken of any edge preparation of the plate which may prevent full engagement.

(5) Where there is any risk that the limitations imposed by (2) to (4) above cannot be complied with or maintained throughout the course of a lift, then plate clamps which accommodate loading at any angle should be used.

(6) If the plate is long and tends to bend, use two or more clamps in conjunction with a lifting beam.

(7) Always put the clamp on as far as it will go. On cam operated types with a locking lever, if the plate is in the horizontal position and the clamp is put on with the cam uppermost, the operation of the clamping lever may tend to force the clamp off the plate if not corrected.

(8) Never lift more than one plate in the clamp.

(9) Never put packing of any kind between the jaws of the clamp and the plate being lifted.

(10) Do not use the clamp on hard or polished plates without the specific approval of the clamp manufacturer as the grip may be considerably reduced.

(11) Do not use clamps for lowering from vertical to horizontal or vice-versa or at an angle to the edge of a plate unless the manufacturer's or supplier's literature states that the clamps are suitable for this operation, and then only strictly in accordance with any procedure so advised.

(12) In cases where multipoint lifting is permitted and practical, then account should be taken of the recommendations made in section 1, subsection 1.8 of this code.

22.10.2 Type (2)

(1) Never use less than two clamps and always ensure that they face each other to balance out the horizontal clamping forces.

(2) Always work within the angles and reeve in the manner recommended by the manufacturer. Some clamps are ineffective outside the recommended angles but in addition, excessive forces may be imposed on the clamps or the sling legs. Changing the method of reeving will effectively change the angles and thereby affect the gripping action and the forces imposed. These factors are particularly important in the case of the open or camless type of clamp as shown in Figure 22.4.2-1 page 347 b.

(3) If the plates to be lifted are likely to sag longitudinally, use two or more pairs of clamps in conjunction with a lifting beam. The position and number of clamps should be adjusted to minimise the sag. Where multipoint lifting of this sort is carried out, account should be taken of the recommendations made in section 1, 1.9 SAFE USE OF LIFTING EQUIPMENT page 10 of this code.

(4) Unless specially designed for the purpose, horizontal plate lifting clamps should not be loaded at an angle to the side plate of the clamp. This will normally restrict them to use with a two leg sling.

(5) If the plates to be lifted are likely to sag transversely, then clamps which grip the plate by a cam or toe must be used. In any event, care should be taken to ensure that the plate or plates will not collapse under the horizontal compressive force. In this context, it should be remembered that clamps reeved onto an endless loop will exert a greater compressive force, for a given angle between the legs than those attached to a two leg sling.

22.11 TRAINING

The training requirements are as specified in section 1.10 TRAINING page 12 of this code.

Section 23 - RIGGING SCREWS AND TURNBUCKLES

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23.1 FOREWORD

Rigging screws and turnbuckles are used to facilitate the tensioning and fine adjustment of length in lifting assemblies and stays where chain, wire rope or textile elements form the main component of the assembly. They can also be used on their own for some applications. Further uses include cargo restraint, suspension, etc.

There are two distinct types:

(1) Rigging screws, which have a tubular body, with threads in the range 6mm – 100mm;

(2) Turnbuckles, which have an open drop forged body, with threads in the range 6mm – 72mm. The standards require rigging screws and turnbuckles used in lifting applications to be proof-load tested and stamped with the working load limit.

US Federation Specification FF-T-791b, Type 1, Form 1 also details a range of turnbuckles in the range ¼" – 2¾" (0.25" – 2.75") for such lifting applications.

23.2 SCOPE

This section of the code covers rigging screws and turnbuckles t used for adjusting the length of sling legs in chain, wire rope and textile slings, for other lifting applications and for the tensioning of stays and similar assemblies including cargo securing and rigging applications.

This section does not cover rigging screws and turnbuckles used for pipe hanging and other non-lifting applications, except as stated in section 23.4.1 Terminal Fittings page 356.

23.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

23.3.1 Rigging Screw

A tubular body, internally threaded at each end, with one right hand and one left-hand thread connecting to terminal fittings of various forms, e.g. screwed eyes, hooks or forks. They are also known in some industries as bottle screws.

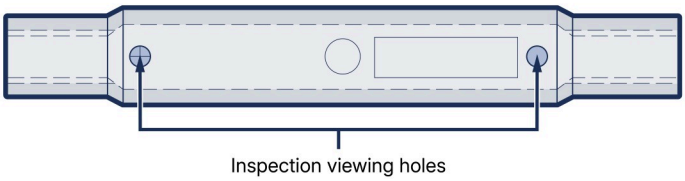


Figure 23.3.1-1 Tubular body of a rigging screw

23.3.2 Turnbuckle

An open body consisting of reins, with internally threaded bosses at each end, with one right and one left-hand thread connecting to terminal fittings of various forms, e.g. screwed eyes, hooks or forks.

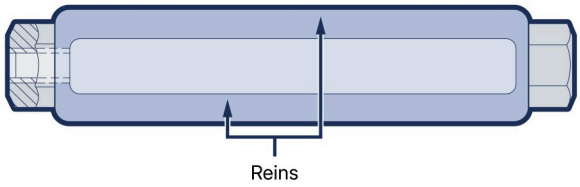


Figure 23.3.2-1 Open body of a turnbuckle

23.3.3 Reins

These are parallel steel sections forming the body of the turnbuckle.

23.3.4 Inspection Viewing Hole

A drilled hole across each end of the body of a rigging screw which facilitates checking that the threaded portion of the terminal fitting has adequately engaged with the body.

23.3.5 Effective Length

Usually the working range of the rigging screw, expressed as the minimum and maximum adjusted length. For the purpose of specifying the effective working length when used in a sling leg assembly, it is standard practice to state the leg length with the rigging screw in the midway position.

23.4 TYPES OF RIGGING SCREWS AND TURNBUCKLES

23.4.1 Terminal Fittings

The following standard terminal fittings are available and may be used in combination if required:

(1) Screwed Elongated Eye.

These are suitable for general usage, and designed to be compatible with small Dee shackles and shackles of the same WLL. They may be used with chain sling assemblies and textile slings provided suitable connecting devices are used. Wire ropes with thimble terminations may also be connected directly to this type.

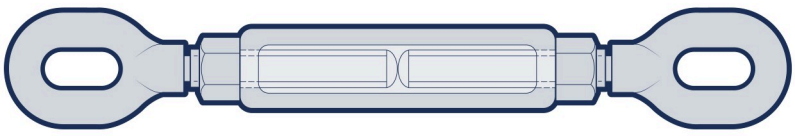


Figure 23.4.1-1 Turnbuckle with screwed elongated eye terminal fittings

(2) Screwed Trapezoidal Hook.

Suitable for hooking into attachments or anchorages provided that they fit freely into the seat of the hook and do not load the hook on the point or exert any side thrust on the hook. They may be used with chain assemblies provided suitable connecting devices are used.

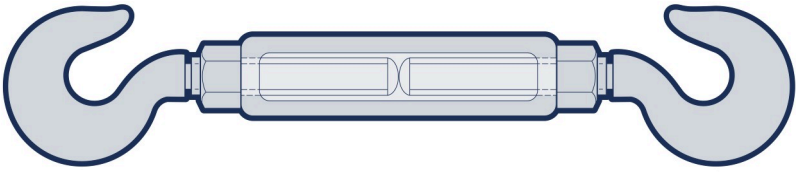


Figure 23.4.1-2 Turnbuckle with screwed trapezoidal hook terminal fittings

(3) Screwed Fork.

This configuration is suitable for use with solid thimble eye terminations on wire rope. They may be used with

chain assemblies provided suitable connecting devices are used and also directly onto lifting lugs.

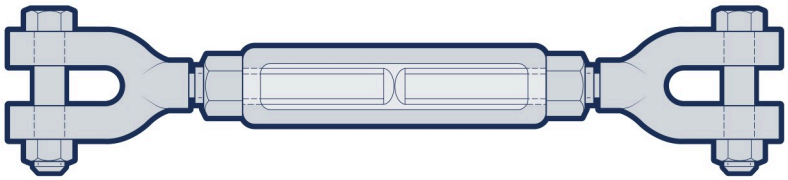


Figure 23.4.1-3 Turnbuckle with screwed fork terminal fittings

23.4.2 Other Attachments

Locknuts are available and should be used in applications where vibration may cause unscrewing of the terminal fittings. They are usually half-thickness nuts.

23.5 PRINCIPLES FOR THE SELECTION OF RIGGING SCREWS AND TURNBUCKLES

23.5.1 Working Load Limits

Table 8 Working Load Limit of Imperial threaded rigging screws and turnbuckles

Thread Diameter (Inches)	Working Load Limit (Tonnes)
0.375	0.45
0.5	0.5
0.625	0.75
0.75	1.2
0.875	1.7
1.0	2.2

Table 9 Working Load Limit of Metric threaded rigging screws and turnbuckles

Thread Diameter (mm)	Working Load Limit (Tonnes)
10	0.3
12	0.5
16	0.75
20	1.25
22	2.0
27	3.0

23.5.2 Strength

A rigging screw or turnbuckle must have a working load limit at least equal to the load that will be imposed on it, taking account of the angle of use. Care must also be taken to ensure that it is compatible in size with any mating equipment.

23.5.3 Length

The working range between maximum and minimum length must be adequate for the application.

23.5.4 Safety - Vibration

Where vibration may occur, locknuts or other suitable methods of securing must be used, e.g. wire seizing. If locknuts are used, the closed dimension will be increased by twice the dimension of one locknut.

23.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

The purchaser should ensure that any order includes the following information:

(1) Type of component required, i.e. rigging screw or turnbuckle.

(2) Finish required, i.e. self-colour or hot-dip galvanized.

(3) Type of terminal fittings required.

(4) Whether locknuts are required.

(5) Thread diameter and/or WLL required.

(6) Maximum and minimum length required or range of adjustment required.

(7) Applicable manufacturing standard.

(8) State that the item is to be used for a lifting application and should be verified and certified accordingly.

(9) Details of the application if known.

23.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

23.7.1 Supply Documentation

Rigging screws used for lifting applications fall within the definition of lifting accessories given in this code of practice. Therefore, the manufacturer should issue the appropriate documentation required by the applicable supply legislation. Although not required by legislation, new rigging screws specified as suitable for lifting applications should also be accompanied by a manufacturer's record of proof load testing. This may be provided as a separate document or combined with the documentation required by the applicable supply legislation. These documents form an important part of the record of the rigging screw. They should be retained and cross-referenced to the rigging screw's historical records for inspection by the Competent Person or local enforcing authority.

23.7.2 Statutory Thorough Examination

As lifting accessories, and unless a written scheme of examination (for guidance refer to LEEA 032 *Guide to Written Schemes of Examination*), drawn up by a Competent Person, is in place and operating, rigging screws must be thoroughly examined by a Competent Person at intervals not exceeding six months. Reports of thorough examination should be retained and cross-referenced to the component's historical records for inspection by the Competent Person or local enforcing authority.

23.8 MARKING, STORAGE AND HANDLING

23.8.1 Marking

In addition to the information required by the applicable supply legislation, rigging screws and turnbuckles used for lifting purposes should be marked with the following information.

(1) Working load limit.

(2) Identification mark traceable to the manufacturer's / supplier's documentation.

(3) Manufacturer's name or identification.

(4) Traceability code on all load bearing components, i.e. body, eyes, hooks, forks, etc.

(5) Year of manufacture

> Some products are still manufactured with the WLL marked in hundredweights (cwts). Few people are now familiar with these units so, to avoid possible confusion, LEEA strongly recommends that such products are re-marked in the weights and measures system of the country of use.

The marking should be in the specific areas shown in the following illustrations:

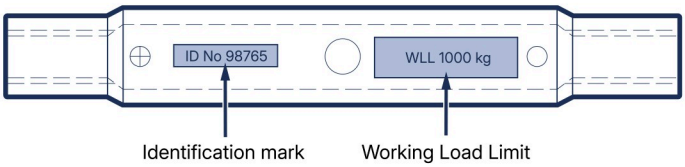


Figure 23.8.1-1 Marking of a rigging screw

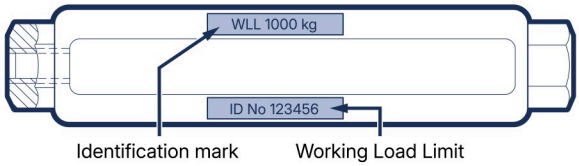


Figure 23.8.1-2 Marking of a turnbuckle

23.8.2 Storage and Handling

The general requirements for storage are as in section 1.7.2 Storage and Handling page 9, i.e. the storage area should be dry, free from injurious pollution and extremes of temperature together with the following:

(1) Screw threads should be lubricated, protected and handled with care.

(2) Self-coloured threads should be heavily greased and exposed threads wrapped with a suitable protective covering such as canvas or woven polypropylene sheet.

23.9 IN-SERVICE INSPECTION AND MAINTENANCE

23.9.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, a suitably qualified and experienced person should, prior to use, visually inspect all rigging screws and turnbuckles. For turnbuckles in regular use it is good practice to make an inspection at the start of each shift or working day. For turnbuckles used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the turnbuckle to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the turnbuckle and make a visual check for any obvious defects. This inspection must be carried out with the turnbuckle in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of turnbuckles and if any are present, the turnbuckle should be withdrawn from service and referred to a Competent Person:

(1) Working load limit missing or unreadable.

(2) Identification mark missing or unreadable.

(3) Damaged internal or external threads.

(4) Distorted body or end terminations, including load pins.

(5) Worn thread and/or end terminations.

(6) Nicks, cracks, gouges, corrosion.

(7) Incorrect load pins fitted to fork fittings.

(8) Damaged or missing locknuts.

> No attempt should be made to straighten distorted end terminations or turnbuckle bodies.

Figure 23.9.1-1 page 360 illustrates the main areas to be inspected and identifies the more common defects that may be found during the inspection.

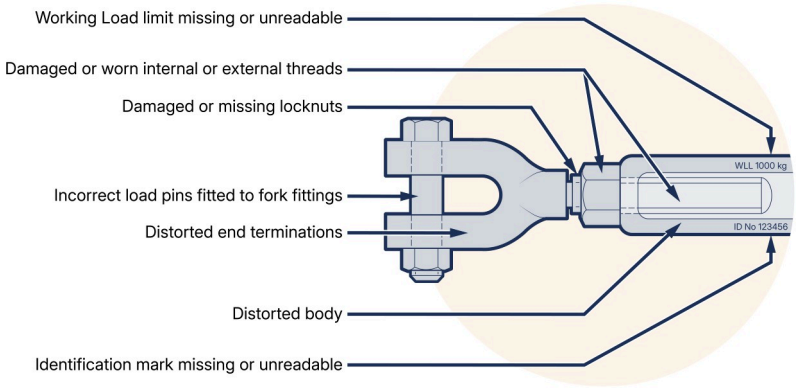


Figure 23.9.1-1 Areas of inspection

23.9.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some turnbuckles will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 23.9.1 Pre-use inspection page 359, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 23.9.3 Maintenance page 360 below.

23.9.3 Maintenance

Routine preventive maintenance should be carried out according to the manufacturer's instructions in addition to any requirements of the particular site due to the conditions of service. In general, there is little that can be done in terms of maintenance to the turnbuckle other than ensuring that it is cleaned and free from contaminants that can cause damage and deterioration.

23.9.4 Thorough examination

The turnbuckle must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the turnbuckle's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of turnbuckles, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

23.10 SAFE USE OF RIGGING SCREWS AND TURNBUCKLES

In addition to any specific instructions relating to the safe use of the rigging screws issued by the manufacturer, the following points should be observed:

(1) Never exceed the SWL for the particular mode of use.

(2) When used in a multi-leg assembly, an allowance must be made for the angle of the sling leg to the vertical.

(3) Take care to ensure that it is compatible in size with any mating equipment.

(4) Rigging screws should be fitted in a manner that allows the body and end terminations to align straight along their centre line, and not in a way that bending loads are induced. They should not be used in slinging applications where they are likely to become bent, e.g. positioned around the corner of a load.

(5) The terminal fittings must be fully screwed through the female threads. A minimum length of at least 1.6 times the thread diameter should be maintained within the body at each end.

(6) The inspection hole (if available) in the rigging screw body should be kept clear so that the position of the screw of the terminal fitting relative to the body can be seen. Where there are no viewing /inspection holes it is advisable to remove the end termination and measure the length of screwed shank to verify the minimum length of thread required for adequate and safe engagement.

(7) The plain length of the bolt fitted to a screwed fork should be long enough to ensure that the securing nut seats on the shoulder of the thread and not against the side of the fork body.

(8) Never replace the bolt of a screwed fork with anything other than an identically dimensioned and rated bolt.

(9) When tensioning rigging screws, torque should be applied by means of a short bar. A long bar or an extension to the bar should not be used.

(10) Hexagon-ended turnbuckle bodies should be tensioned by the use of a spanner on the hexagonal end.

(11) If locknuts are fitted, they must be securely tightened following the final adjustment. Care should be taken not to over-tighten locknuts. The security of all locking devices should be regularly checked.

(12) Rigging screws and turnbuckles should not be used in applications where they are liable to be unscrewed, e.g. by the rotation of a wire rope or load.

23.11 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of the code, operative training should take the manufacturer's instructions into account. Operatives should be instructed in the correct selection and adjustment of rigging screws or turnbuckles for varying applications, e.g. use with wire rope or chain assemblies.

Section 24 - BARREL LIFTERS

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24.1 FOREWORD

Barrel lifters are not usually regarded as “general purpose” equipment as they are generally employed in specific circumstances to lift specific loads. Additionally, it is often necessary to manipulate a barrel in some way, e.g. by rotating or tilting it whilst it is suspended, and the barrel lifter for such applications will be equipped with a mechanism to facilitate this manipulation. Such a mechanism will most often be operated by direct manual effort but in some cases will be through a geared mechanism.

24.2 SCOPE

This section of the code relates to manually operated barrel lifters which are used in conjunction with a separate lifting machine. They may be broadly split into three different types as follows:

(1) Those which grip the top of the barrel.

(2) Those which grip the ends of the barrel.

(3) Those which grip the side of the barrel.

This section of the code does not cover specialized barrel lifting attachments for fork lift trucks which are regarded as an integral part of the fork lift truck.

Because of the specialized nature of barrel lifting applications, the advice given in this section of the code should be regarded as general advice which should be augmented by the specialist advice provided by the supplier of the barrel lifter.

24.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

24.3.1 Barrel Lifter

A specialized lifting accessory which, when used with a lifting machine, will lift a barrel and, if fitted with the necessary mechanism, will manipulate the barrel whilst it is suspended.

24.3.2 Barrel Capacity

The amount of material that a barrel can hold when filled to capacity. This will normally be specified in units of volume, e.g. litres. Because the density of different materials varies widely, the barrel capacity does not directly give an indication of the weight of the contents.

24.3.3 Net Barrel Weight

Is the weight of a barrel when it is empty but complete with its lid and any permanent attachments.

24.3.4 Gross Barrel Weight

Is the weight of the barrel plus its contents. Note that this may be a variable figure dependent on the nature of the barrel's contents and whether the barrel is filled to capacity or only partially filled.

24.4 TYPES OF BARREL LIFTERS

There are principally three types of barrel lifters.

24.4.1 Top Gripping Barrel Lifters

This type of lifter grips the top of a barrel and is capable of lifting and lowering the barrel. The only possible manipulation of the barrel whilst suspended with this type of lifter, is rotation about the vertical axis of the barrel utilising the swivel in the hook of the lifting machine.

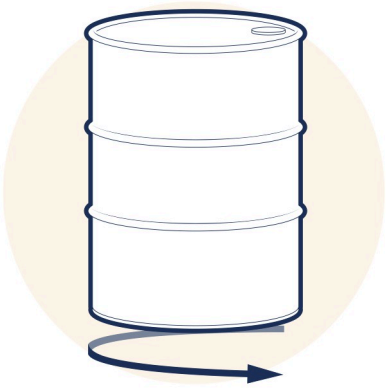


Figure 24.4.1-1 Top gripping barrel lifters provide rotation about the vertical axis only



Figure 24.4.1-2 Examples of top gripping barrel lifters

24.4.2 End Gripping Barrel Lifters

This type of lifter grips the ends of a barrel and is capable of lifting and lowering the barrel. The only possible manipulation of the barrel whilst suspended with this type of lifter, is rotation about the horizontal axis of the barrel utilising the swivel in the hook of the lifting machine.

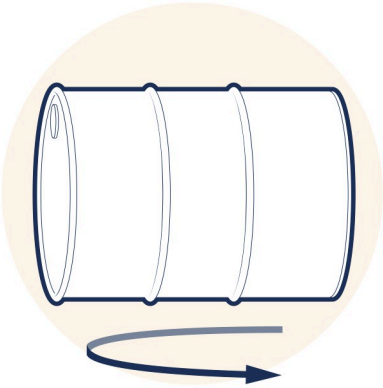


Figure 24.4.2-1 End gripping barrel lifters provide rotation about the horizontal axis only

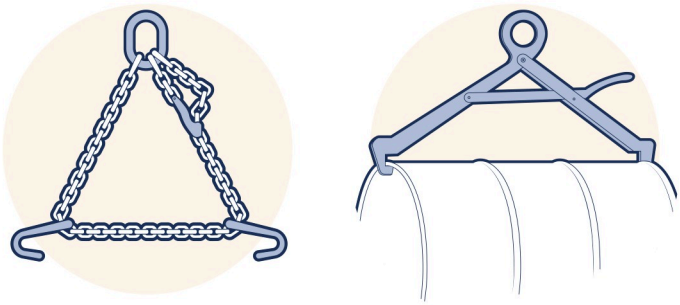


Figure 24.4.2-2 Examples of end gripping barrel lifters

24.4.3 Side Gripping Barrel Lifters

This type of lifter grips the side of the barrel and allows rotation of the barrel about its vertical axis utilising the swivel in the hook of the lifting machine and, if fitted with the appropriate mechanism, also facilitates tilting of the barrel or rotation about its horizontal axis.

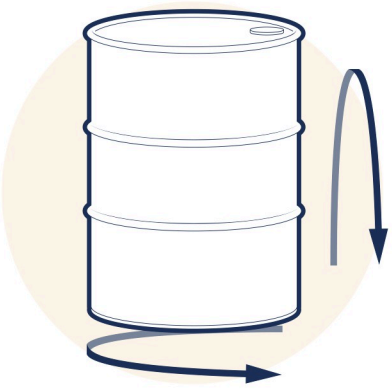


Figure 24.4.3-1 Side gripping barrel lifters provide rotation about both axis

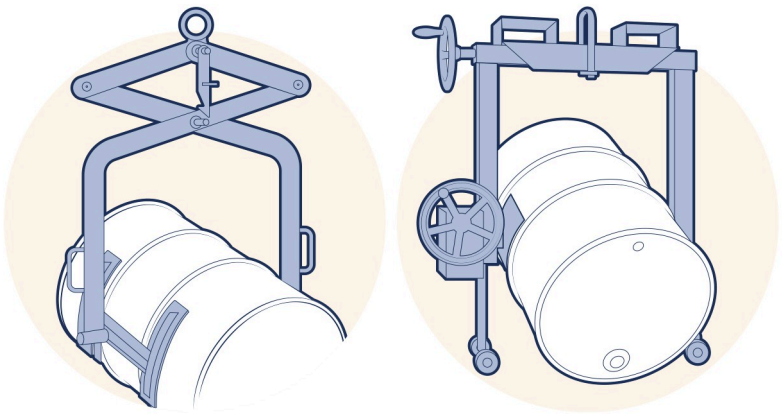


Figure 24.4.3-2 Examples of side gripping barrel lifters

24.5 PRINCIPLES FOR THE SELECTION OF BARREL LIFTERS

24.5.1 Applications

Barrel lifters are suitable for a variety of applications and dependent upon their design may grip the barrel in a variety of ways. They may be used to simply lift a barrel straight up and down or to manipulate the barrel in some way, e.g. to overturn or empty it whilst it is suspended.

A major factor in the safe use of a barrel lifter however is the characteristics of the barrel itself. The barrel must be capable of withstanding the forces exerted upon it by the barrel lifter. Whilst the ability of the load to resist the forces imposed on it during lifting is an important consideration in all lifting operations, when lifting barrels this assumes critical importance. It should be noted that this may not have been taken into account when the barrel was designed and it may therefore be necessary to do calculations or proving trials to ensure that the barrel can be lifted without undue distortion or potential to collapse.

It is strongly recommended that the exact nature of the application is adequately discussed between the user and the supplier.

24.5.2 General

Consideration should be given to the following:

(1) Lifting capacity required.

(2) Dimensions of the barrel(s) to be lifted.

(3) Lifting machine it is to be used with.

(4) Available headroom.

(5) Degree of portability required.

(6) The self weight of the barrel lifter.

(7) Whether, or not, manipulation of the suspended barrel is required and if so to what extent.

(8) The documentation required by legislation. If this is not on record, refer the barrel lifter to a Competent Person for thorough examination.

24.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

Barrel lifters are normally used for closely defined applications. It is therefore usually possible to give the designer or supplier precise details of the task to be performed. This information should include, but is not necessarily limited to, the following:

(1) The gross barrel weight to be lifted.

(2) The material and composition of the barrel to be lifted, e.g. steel or plastic.

(3) The physical dimensions and the shape of the barrel to be lifted and position of the centre of gravity.

(4) The ‘make up’ of the load to be lifted, e.g. a liquid, powder or granules.

(5) The method of attachment to the barrel, e.g. scissor action, screw clamp.

(6) If the barrel is to be manipulated, the axis and extent of rotation required and method of manipulation.

(7) The number, shape and orientation of the gripping pads.

(8) The detail of the operating environment and service conditions, i.e. extremes of temperature, probability of shock loading and the uncertainty of the mass of the load.

(9) The available headroom.

(10) The type of suspension.

(11) The speed of the hoisting mechanism.

(12) Details of any possible surface contamination as this may be damaging to the material from which any gripping pads are made and may affect their ability to grip the barrel.

24.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

24.7.1 Supply Documentation

The definitions of lifting equipment and accessories used in this code of practice make it clear that a device used to connect a load to a lifting appliance is a lifting accessory and should be supplied with the documentation required by the applicable supply legislation. A barrel lifter is therefore a lifting accessory. The supply documentation, together with the Reports of Thorough Examination, should be retained and cross-referenced to the barrel lifter's historical records for inspection by the Competent Person or local enforcing authority.

24.7.2 Statutory and Post Installation Thorough Examination

Barrel lifters must be examined by a Competent Person at intervals not exceeding six months. For some applications, it may also be necessary to have the installation thoroughly examined by a Competent Person before the barrel lifter is put into service. This may be necessary to ensure that the operation of the lifter in practice complies with theoretical predictions (see section 24.8 INSTALLATION AND COMMISSIONING page 367 and section 1.4 GENERAL LEGAL REQUIREMENTS page 6)

24.7.3 Post Repair Verification and Record Keeping

Following repair, barrel lifters must be re-verified by a Competent Person. The record of the repair and report of verification should be retained and cross referenced to the lifter's historical records for inspection by the Competent Person or local enforcing authority.

24.8 INSTALLATION AND COMMISSIONING

24.8.1 Installation

Installation will vary from simply hanging a portable barrel lifter from a correctly sized, free to articulate crane hook, to a more complex operation if the barrel lifter is to be permanently incorporated into a lifting machine. For all types IT IS ESSENTIAL to ensure that the barrel lifter is only installed on the equipment and for the lifting operations for which it has been chosen. In addition:

(1) Take account of the self weight of the barrel lifter – it can be significant.

(2) Ensure that the lifting eye of the barrel lifter correctly engages with the seat of the lifting machine hook and articulates freely with it so that the barrel lifter hangs level. If necessary use an intermediate lifting accessory such as a shackle.

(3) Ensure that the lifting pads of the barrel present themselves to the barrel in the correct position relative to the barrel's centre of gravity.

(4) Where manual manipulation of the suspended load is required, the risks to the operator or other persons must be considered.

24.8.2 Commissioning

The commissioning required will depend on the type of barrel lifter used and the installation conditions. Generally, portable barrel lifters are installed by the user simply by hooking them onto the lifting machine and do not require commissioning before use. For a permanently installed type where safety depends upon it being correctly installed, a thorough examination should be made before first use to ensure that it has been correctly installed and is safe to use.

In addition, because the integrity of the load is of critical importance, it may be necessary to make a type test for each type and size of barrel to ensure that the strength of the barrels is compatible with the method by which the barrel lifter attaches to and manipulates the barrel.

24.9 MARKING, STORAGE AND HANDLING

24.9.1 Marking

In addition to information required by the applicable national legislation and standard to which the barrel lifter was made, the following information should be permanently and legibly marked on a suitable part of the barrel lifter unless the barrel lifter is a permanently installed component of a lifting machine in which case the lifting machine may be so marked.

(1) Identification mark.(If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports)

(2) SWL.

(3) Minimum working load if appropriate and information about the barrel size and material, etc.

(4) Name of the Manufacturer.

(5) Year of manufacture.

(6) Self weight of the barrel lifter if it exceeds 5% of the WLL or 50 kg, whichever is the less.

24.9.2 Storage and Handling

When not in use, barrel lifters should be returned to proper storage. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code and it is additionally recommended that:

(1) They are stored off the ground in clean dry conditions which are free from pollution or extremes of temperature.

(2) As they can be heavy, unless naturally stable, they must be supported to prevent toppling.

(3) Equipment that is returned to the stores in a dirty condition should be cleaned and dried. In particular the barrel gripping pads or bands if fitted should be cleaned and protected from contamination whilst in storage. Powerful solvents or cleaning agents should not be used and exposure to high temperatures should be avoided. Surfaces liable to corrosion should be lightly oiled or otherwise protected.

(4) When a barrel lifter has been in storage and is to be taken in to use, it should be checked by a suitably qualified and experienced person, section 24.10.1 Pre-use inspection page 368, for any signs of damage or deterioration before use. Any problems or defects found should be reported to the Competent Person for resolution before being put into service.

24.10 IN-SERVICE INSPECTION AND MAINTENANCE

24.10.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, a suitably qualified and experienced person should, prior to use, visually inspect the barrel lifter. For barrel lifters in regular use it is good practice to make an inspection at the start of each shift or working day. For barrel lifters used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the barrel lifter to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the barrel lifter and make a visual check for any obvious defects. This inspection must be carried out with the barrel lifter in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in

use or during the regular inspection of barrel lifters and if any are present, the barrel lifter should be withdrawn from service and referred to a Competent Person:

(1) General damage to the body of the barrel lifter.

(2) Damage to the lifting eye or other means of suspension.

(3) Failure or malfunction of any of the operating mechanisms.

(4) Missing or illegible markings, load rating information, etc.

(5) Dirt, grit or other debris on the barrel pads or bands if fitted.

24.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some barrel lifters will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 24.10.1 Pre-use inspection page 368, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 24.10.3 Maintenance page 369 below.

24.10.3 Maintenance

The degree of maintenance required will vary dependent on the type and design of the barrel lifter. Simple mechanical mechanisms will have linkages which need to be checked for wear, security of link pins, distortion of components, etc. For lifters fitted with gripping pads or bands, these may become contaminated or worn and are usually replaceable. Specific maintenance instructions issued by the manufacturer should be followed.

24.10.4 Thorough examination

The barrel lifter must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the barrel lifter's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of barrel lifters, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit

24.11 SAFE USE OF BARREL LIFTERS

In addition to any specific instructions relating to safe use issued by the manufacturer, the following points should be observed:

(1) Do not use to lift people.

(2) Do not lift loads while there are people in the danger zone.

(3) Do not use for operations other that those specified.

(4) Barrel lifters may be designed to lift a specific size, shape or type of barrel or may be suitable to lift a range of barrels. Therefore do not attempt to lift barrels that the lifter has not been designed to lift.

(5) Do not attempt to use a barrel lifter to lift loads other than barrels unless specifically authorised to do so by a Competent Person.

(6) Ensure that the surface of the load to which the barrel lifter is attached is clean and dry. Lubricants or other substances contaminating the surface may severely impair the ability of the barrel lifter to grip the load adequately.

(7) Do not attempt to lift the load until you are satisfied that the barrel lifter is capable of doing so. The methods of ensuring this will vary from one manufacturer to another and it is essential that the manufacturer's instructions relevant to the particular type of barrel are consulted.

(8) Do not subject the lifter to shock loads particularly once the load has been raised.

(9) Be aware of the danger of unbalanced loads.

(10) Take particular care when manipulating a suspended barrel to empty it. Be aware that during discharge, the position of the centre of gravity may change causing a lateral movement of the barrel. Also, if the arrangement is such that a sudden discharge of the contents can occur, this may cause a recoil which, for some designs, may result in release of the barrel.

(11) Transport suspended barrels gently to prevent swaying.

(12) Do not attempt to release the lifter until the load has been set down and is stable.

(13) The contents of the barrel may be hazardous and in such cases appropriate safe working practices and the use of personal protective equipment must be observed.

24.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12of this code, operative training should take into account the manufacturer's instructions and also pay particular attention to the following:

(1) The limits of the applications for which the particular barrel lifter has been specified or is otherwise suitable.

(2) How to attach the barrel lifter to the various loads for which it is suitable.

(3) How to check that the load is securely held, and correctly balanced.

(4) How to manipulate the load.

(5) If the operation involves discharge of the barrel contents, how to do so including any necessary precautions.

The training should emphasize that barrel lifters are for use in a limited number of applications and should not be regarded as “general purpose” equipment. For this reason training should cover the fundamentals of safe lifting, the use of barrel lifters in general and the use of the particular barrel lifter in the particular application.

Section 25 – LIFTING FORKS

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25.1 FOREWORD

Lifting forks are used in conjunction with a crane or other lifting machine to lift palletised loads of the type that are more usually lifted with a forklift truck. They are utilized in scenarios where forklift trucks are impractical, such as uneven terrain or when the required lift height or lateral movement exceeds forklift capabilities. They are sometimes known by the alternative name of either a loading fork or crane fork.

They are available in a range of lifting capacities. Standard models are available up to a capacity of approximately 5 tonnes and bespoke designs can be manufactured to handle virtually any weight of load. Most designs incorporate a method of levelling the load by either manual or automatic adjustment mechanisms or balance weights.

25.2 SCOPE

This section of the code relates to both standard and special design lifting forks.

The advice given in this section of the code should be regarded as general advice, which should be augmented by the specialist advice provided by the manufacturer or supplier of the lifting fork.

25.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

25.3.1 Lifting Fork

Equipment consisting of two or more arms fixed to an upright with an upper arm, essentially to lift palletized or similar loads.

25.3.2 Fork Arms

These are the individual load bearing members that directly support the palletised load. Usually, lifting forks are equipped with two fork arms but models with larger numbers of fork arms may be used for specific applications.

25.3.3 Upright

The upright section of the lifitng fork.

25.3.4 Upper Arm

The upper, horizontal or inclined section of the lifting fork, which incorporates the lifting eye and any adjustment mechanism.

25.3.5 Grab Handles

Handles incorporated into the lifting fork for the purpose of manually manipulating its orientation.

25.3.6 Balance Weight

A weight incorporated into the lifting fork to ensure that in the unloaded state it remains level.

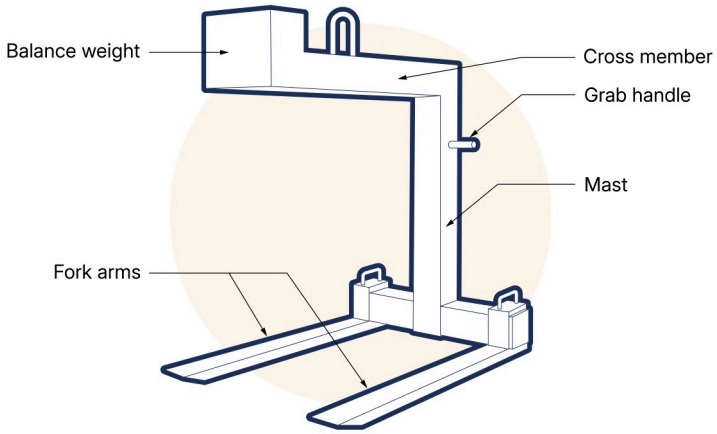


Figure 25.3.6-1 Components of a lifting fork incorporating a balance weight

25.3.7 Secondary positive holding device

A net, cage or other means of preventing the release of the whole load or any loose parts of the load. The device is intended to be deployed whenever a load is to be lifted to a height where persons or other assets would be at risk in the event of some or all the load being inadvertently released.



Figure 25.3.7-1 Lifting fork fitted with a safety net to retain any part of the load inadvertently released

25.4 TYPES OF LIFTING FORKS

Although very similar in appearance there are three basic types of lifting fork.

25.4.1 Fixed Suspension

A lifting fork with a fixed suspension point has no facility to adjust the position of the lifting eye. This type of lifting fork is designed for use with a specific load where the position of the centre of gravity does not vary. Figure 25.4.2-1 page 375 illustrates a typical example.

25.4.2 Manual Adjustment

A lifting fork where the position of the lifting eye can be manually adjusted along the length of the upper arm to facilitate lifting loads where the position of the centre of gravity may vary.

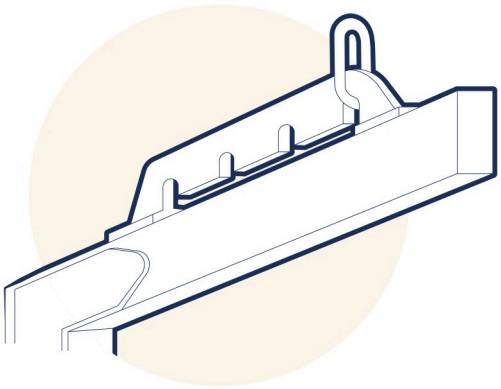


Figure 25.4.2-1 One type of manual adjustment

25.4.3 Automatic Adjustment

A lifting fork where the position of the lifting eye is automatically adjusted to facilitate lifting loads where the position of the centre of gravity may vary.

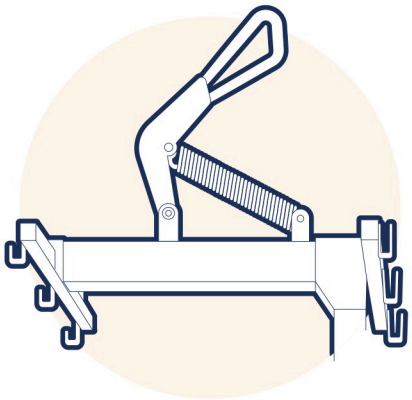


Figure 25.4.3-1 One type of automatic adjustment

25.5 PRINCIPLES FOR THE SELECTION OF LIFTING FORKS

25.5.1 Applications

Lifting forks are suitable for lifting palletised loads in many situations where a forklift truck cannot operate or would prove to be inadequate, e.g. where substantial heights of lift are required. They may be used for a specific application, i.e. where identical loads are lifted each time, or perhaps more typically may be used as general purpose lifting accessories to lift a variety of loads which may vary in size, shape and weight.

It is strongly recommended that the exact nature of the application is adequately discussed between the user and the supplier.

25.5.2 General

Consideration should be given to the following:

(1) Lifting capacity required.

(2) Adjustment required to facilitate varying loads, e.g. suspension eye and fork arms.

(3) Available headroom.

(4) The self-weight of the lifting fork.

(5) Degree of portability required.

(6) Method of control and control features required, e.g. grab handles.

(7) Proximity of persons during operations.

(8) Other safety features required, e.g. secondary positive holding device.

(9) The documentation required by legislation. If this is not on record, refer the lifting fork to a Competent Person for thorough examination.

25.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

Lifting forks may be used for specific applications or for a variety of similar applications. It is therefore usually possible to give the designer or supplier precise or general details of the tasks to be performed. This information should include but is not necessarily limited to the following:

(1) The minimum and maximum mass of the load to be lifted.

(2) The size and type of pallet to be lifted or, if self palletised, the position of the fork arm apertures and method of securing the load elements e.g. banding, wrapping.

(3) The physical dimensions and shape of the load to be lifted.

(4) The make up of the load to be lifted, i.e. a single object or multiple objects, and if multiple, the method of securing them, e.g. building blocks secured by shrink wrap.

(5) The type of suspension, i.e. fixed, manual or automatic adjustment.

(6) The available headroom.

(7) The control features required, e.g. grab handles.

(8) Details of the operating environment and service conditions, e.g. extremes of temperature, probability of shock loading, uncertainty of mass of the load.

(9) Other safety features required, e.g. secondary positive holding device.

25.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

25.7.1 Supply Documentation

The definitions of lifting equipment and accessories used in this code of practice make it clear that a device used to connect a load to a lifting appliance is a lifting accessory and should be supplied with the documentation required by the specific supply legislation applicable to lifting accessories. The supply documentation, together with the Reports of Thorough Examination should be retained and cross-referenced to the lifting fork's historical records for inspection by the Competent Person or local enforcing authority.

25.7.2 Statutory Thorough Examination

As a lifting accessory, lifting forks must also be thoroughly examined, as recommended by this code, at intervals not exceeding six months.

25.7.3 Post Repair Verification and Record Keeping

Following repair, lifting forks must be re-verified by a Competent Person. The record of the repair and report of verification should be retained and cross referenced to the lifting fork's historical records for inspection by the competent person or local enforcing authority.

25.8 INSTALLATION AND COMMISSIONING

25.8.1 Installation

Installation will vary from simply hanging a lifting fork from a correctly sized, free to articulate crane hook, to a more complex operation if the lifting fork is to be permanently incorporated into a lifting machine. For all types IT IS ESSENTIAL to ensure that the lifting fork is only installed on the equipment and for the lifting operations for which it has been chosen. In addition:

(1) Take account of the self weight of the lifting fork – it can be significant.

(2) Ensure that the lifting eye of the lifting fork correctly engages with the seat of the lifting machine hook and articulates freely with it so that the unloaded lifting fork hangs with the fork arms within 5° of horizontal to facilitate access to the load. If necessary use an intermediate lifting accessory such as a shackle.

25.8.2 Commissioning

The commissioning required will depend on the type of lifting fork used and the installation conditions. Generally, portable lifting forks are installed by the user simply by hooking them onto the lifting machine and do not require commissioning before use. For a permanently installed type where safety depends upon it being correctly installed, a thorough examination should be made before first use to ensure that it has been correctly installed and is safe to use.

25.9 MARKING, STORAGE AND HANDLING

25.9.1 Marking

In addition to the information required by the applicable legislation and the standard manufactured to, the following information should be permanently and legibly marked on a suitable part of the lifting-fork unless it is a permanently installed component of a lifting machine in which case the machine itself may be so marked:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) Working load limit.

(3) Minimum working load if appropriate.

(4) Name of manufacturer.

(5) Year of manufacture.

(6) Self weight of the lifting fork if it exceeds 5% of the WLL or 50 kg, whichever is the less.

(7) The limits of the intended position of the load centre of gravity.

(8) On lifting forks where a minimum load is required to tilt the fork backwards with an angle greater than or equal to 5° to prevent the load from sliding from the fork arms. Mark the minimum load required

25.9.2 Storage and Handling

When not in use, lifting forks should be returned to proper storage. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code and it is additionally recommended that:

(1) They are stored off the ground in clean, dry conditions, which are free from injurious pollution or extremes of temperature.

(2) As they can be heavy, unless naturally stable, they must be supported to prevent toppling.

(3) Equipment that is returned to stores in dirty condition should be cleaned and dried. Powerful solvents or cleaning agents should not be used and neither should direct heat. Surfaces liable to corrosion should be lightly oiled or otherwise protected.

(4) When a lifting fork has been in storage and is to be taken into use, it should be checked by a suitably qualified and experienced person, see section 25.10.1 Pre-use inspection page 377, for any signs of damage or deterioration before use. Any problems found should be reported to a Competent Person for resolution.

25.10 IN-SERVICE INSPECTION AND MAINTENANCE

25.10.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, a suitably qualified and experienced person should, prior to use, visually inspect the lifting forks. For lifting forks in regular use it is good practice to make an inspection at the start of each shift or working day. For lifting forks used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the lifting forks to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the lifting forks and make a visual check for any obvious defects. This inspection must be carried out with the lifting forks in a reasonably clean condition and in adequate lighting. The following are examples of the common defects which may become apparent in use or during the regular inspection of lifting forks and if any are present, the lifting forks should be withdrawn from service and referred to a Competent Person:

(1) General damage to the fork arms, upright or upper arm.

(2) Damage to the lifting eye or other means of suspension.

(3) Damage to the adjustment mechanism if fitted.

(4) Missing or illegible markings, model, manufacturer, serial number, load rating information, etc.

25.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some lifting forks will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 25.10.1 Pre-use inspection page 377, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 25.10.3 Maintenance page 378 below.

25.10.3 Maintenance

Lifting forks usually need little or no routine maintenance other than keeping them clean and dry. Specific maintenance instructions issued by the manufacturer should be followed.

25.10.4 Thorough examination

The lifting fork must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the lifting fork's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be NDT, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of lifting forks, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit.

25.11 SAFE USE OF LIFTING FORKS

In addition to any specific instructions relating to safe use issued by the manufacturer, the following points should be observed:

(1) Do not use to lift people.

(2) Do not lift loads over people who are in the danger zone unless the lifting fork has the features needed to address this situation. These features usually include a secondary positive holding device. If the lifting fork does not have such features, it will be necessary to exclude persons from the danger zone.

(3) Ensure that the fork arms of the lifting fork are correctly adjusted for width.

(4) Use the grab handles to control the lifting fork and ensure that it is presented to the load so that the fork arms pass right through the pallet at the appropriate positions.

(5) The condition of the load is of paramount importance. The load itself must be capable of being lifted safely and of withstanding the forces imposed upon it. Loads comprised of loosely stacked materials should not be lifted. Such loads require additional security such as strapping or netting to keep them in place.

(6) For lifting forks fitted with manual adjustment, position the lifting eye so that the load will hang correctly when lifted.

(7) Make a trial lift to ensure that the load hangs correctly. When lifted, the fork arms should be tilted backwards by an angle equal to or slightly greater than 5° to prevent the load from sliding off the fork arms.

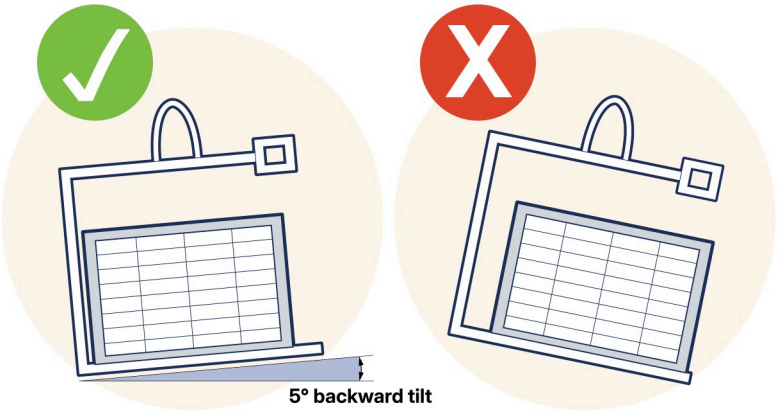


Figure 25.11-1 Checking that the load hangs correctly

(8) Adjust as necessary before proceeding. For lifting forks with a fixed suspension, this will require repositioning of the lifting fork within the load.

(9) Be aware that a lifting fork with an automatic mechanism to adjust the position of the lifting eye may not work at very low loads. Check the manufacturer's instructions for any minimum load information.

(10) Be aware of the danger of unbalanced loads causing the lifting fork to tilt sideways. The C of G of the load should be located centrally between the fork arms.

(11) Do not use for operations other than those specified.

(12) Do not attempt to hoist the load until you are satisfied that the lifting fork is capable of doing so. Methods of ensuring this will vary from one manufacturer to another and it is essential that the manufacturers' instructions relevant to the particular type of lifting fork are consulted. Do not subject the lifting forks to shock loads particularly once the load has been raised.

(13) Be aware of the pendulum effect of a load attached to a crane hook.

(14) Remember to include the self weight of the lifting fork when calculating the total load on the lifting machine.

(15) When the load comprises a stack or bundle, e.g. blocks or sheets, care must be taken to ensure that the stack or bundle is held together during the lifting operation. This may necessitate the use of strap banding or netting. Alternatively the lifting fork may have a built in securing mechanism or clamp.

25.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account the manufacturer's instructions and also pay particular attention to the following:

(1) The limits of the applications for which the particular lifting fork has been specified or is otherwise suitable.

(2) For manually adjusted lifting forks, the method of adjusting the balance.

(3) For automatically adjusted lifting forks the minimum load if any.

(4) The precautions to be taken before lifting if the load comprises loose material.

(5) The precautions to be taken when lifting over people in the danger zone including correct fitting of the secondary positive holding device.

(6) How to check that the load is securely held, and correctly balanced.

The training should emphasize that lifting forks are for use in a limited number of applications and should not be regarded as "general purpose" equipment. For this reason training should cover the fundamentals of safe lifting, the use of lifting forks in general and the use of the particular lifting fork in the particular application.

Section 26 - MAGNETIC LIFTERS

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26.1 FOREWORD

Although some manufacturers offer a standard range of magnetic lifters, unlike other lifting equipment, they are not usually regarded as “general purpose” equipment. Magnetic lifters are usually employed in specific circumstances to lift specific loads. As there is no positive connection between the lifting device and the load, the ability of the magnetic lifter to safely lift a particular load needs to be carefully considered. This will normally involve tests to determine the lifting power of the magnet on the specific load.

Magnets will only work on a magnetic material which usually means a ferrous metal although some other materials such as cobalt or nickel are capable of being lifted magnetically.

26.2 SCOPE

This section of the code applies to four different types of magnetic lifters as follows:

(1) Battery-fed electric lifting magnets

(2) Mains-fed electric lifting magnets

(3) Permanent lifting magnets

(4) Electro-permanent lifting magnets

Because of the specialized nature of magnetic lifting applications, the advice given in this section of the code can only be of a general nature and should be augmented by the specialist advice provided by the manufacturer or supplier of the magnetic lifter.

26.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

26.3.1 Ferro-Magnetic Material

A Ferro-Magnetic material is one which behaves like iron under the influence of a magnet, that is, it is attracted by the magnetic field. Some examples are cast iron and carbon steels.

26.3.2 Magnetic Field

The “field” of a magnet is the space beyond the physical boundaries of the magnet where the effects of magnetism can be detected.

26.3.3 Magnetic Flux

Magnetic flux is a measure of the quantity of magnetism taking account of the strength and extent of the magnetic field. As such it is a measure of the “power” of a magnet.

26.3.4 Magnetic Poles

Magnetic poles are at the ends of a magnet and are the points at which the magnetic field is concentrated.

26.3.5 Permanent Magnet

A magnet that is permanently magnetised and does not depend upon an electric current.

26.3.6 Electro Magnet

A magnet where the magnet field is created by an electric current.

26.3.7 Electro-Permanent Magnet

A magnet where an electric current is used to switch the polarity of the magnetic material. There are no moving parts and the electric current is only required to create the magnet, not to sustain it.

26.4 TYPES OF MAGNETIC LIFTERS

Magnetic lifters may take the form of electro-magnets (battery or mains operated), permanent magnets, or electro-permanent magnets.

26.4.1 Electro-Magnets

If an electrical current is passed through a wire it will produce a magnetic field around that wire which will exist whilst the current flows. In most cases when the current is switched off the magnetic field will collapse. The strength of the magnetic field can be intensified by forming the wire into a coil containing a core made of magnetic material. The core will display the properties of a magnet for as long as current flows through the wire. The power can be supplied to an electro-magnet lifter from the mains electricity or from built in rechargeable batteries. Electro-magnet lifters can vary from small portable units to large multi-head units integrated into the crane.

Battery fed electric lifting magnets should provide a tear-off force corresponding to at least 2 times the working load limit under the conditions specified by the manufacturer. There should also be an indicator to show if the magnet is switched on or off. An automatic warning device should be provided which monitors the power supply and provides a warning at least 10 minutes before the supply reaches the level where the load will be released. The warning device can either be optical or audible. There should also be a safety device which, in the event that the low power warning is activated, prevents the magnet from being switched on again until the battery is recharged to the minimum level at which the low power warning is not activated.

Mains fed electric magnets should also provide a tear-off force corresponding to at least 2 times the working load limit working under the conditions specified by the manufacturer. There should be an indicator to show if the magnet is switched on or off and, for magnets with variable power, to distinguish between full and partial magnetism. An optical or audible warning device should be fitted to indicate mains power supply failure. A stand- by battery should be fitted to supply power to the magnet in case of mains failure. The battery should be capable of supplying enough power to hold the working load limit for at least 10 minutes.

The warning device and stand-by battery are not necessary if the unit is working in a ‘no go’ area or if the maximum height of lift at the magnet is restricted to 1.8m and the load is less than 20kg.

Magnets lifting loads such as plates, sheets or bars from the top of a stack, should have controls to allow the operator to reduce the power to shed any excess load and restore full power when the excess has been removed.

26.4.2 Permanent Magnets

Some substances are naturally magnetic and others are capable of being “magnetized” and retaining that magnetism. The most common form of permanent magnet is a substance called Magnetite and this is used for domestic applications. Industrial permanent magnets use “rare earth” substances such as Samarium or Neodymium which produce very much stronger magnetic fields. An industrial permanent magnet is switched

“on and off” by mechanically rotating a moveable magnet or magnets within the device thereby arranging it to add to or cancel out the field of the static magnets.

Most permanent magnetic lifters are switched manually by means of a lever, but some manufacturers offer the option of electrical or pneumatic powered mechanisms.

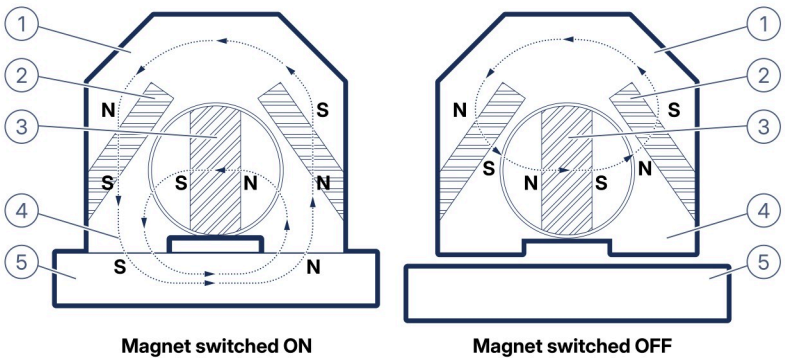


Figure 26.4.2-1

Key

(1) Ferromagnetic crown

(2) Static permanent magnet

(3) Reversible permanent magnet

(4) Magnetic flux collectors

(5) Ferromagnetic work piece

This type of magnetic lifter shall provide a tear off force at least three times the working load limit under the conditions specified by the manufacturer. The controls shall clearly indicate whether the magnet is on or off.

26.4.3 Electro-Permanent Magnets

An electro-permanent magnet is one where an electrical current passes through a coil enclosing magnetic material. A pulse of electricity creates a permanent magnet, the polarity of which can be created either way. There are no moving parts and the electric current is only required to create the magnet, not sustain it. Changing the polarity of this magnet has the same effect as the mechanical movement within a permanent magnet thereby causing it to add to or cancel out the field of the static magnets.

If the degree of magnetisation is controlled, the magnetic lifter can be partially magnetised, providing the facility to shed excess load then fully magnetise to secure the remaining load.

The electrical energy may be supplied via batteries (small magnets) or mains power (larger magnets).

The unit shall provide a tear off force of at least 3 times the working load limit under the conditions specified by the manufacturer. An indicator should be fitted to show when the magnets are magnetised and for magnets with variable power it shall distinguish between full and partial magnetism.

26.4.4 Method of Attachment

Portable magnets are generally of the permanent or electro-permanent type with a lifting capacity up to approximately 3 tonnes or of the battery type with a lifting capacity up to up to approximately 5 tonnes. They will usually be fitted with a lifting eye to facilitate easy connection to the lifting machine hook. Higher capacity magnets of the electro-permanent or electro type are often an integral part of the lifting machine.

Multiple magnets of all types may be used with advantage in conjunction with a lifting beam to lift long and/or flexible loads.

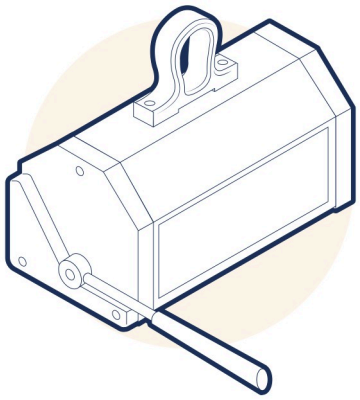


Figure 26.4.4-1 Typical portable permanent magnetic lifter with lifting eye

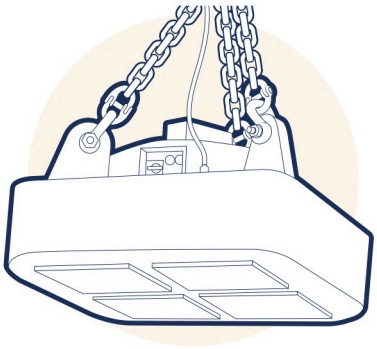


Figure 26.4.4-2 Electro-permanent magnetic lifter suspended via a chain sling

In the case of electro-magnets, the magnetic forces are only generated when the electrical supply is flowing. Failure of the electrical supply will cause the magnet to lose its lifting power instantaneously. Without additional safety features, their use is therefore limited to situations where a risk assessment has established that falling loads do not present a hazard to people. The warning devices and stand-by battery referred to above are intended to allow time for persons to leave the danger zone. In applications where it may be difficult to leave the danger zone within a safe period of time, further measures will be required. These may include a redundancy of the supply lines and control systems or a secondary mechanical holding system which can be deployed before exposing persons to danger.

26.5 PRINCIPLES FOR THE SELECTION OF MAGNETIC LIFTERS

26.5.1 Applications

Magnetic lifters can be suitable for a variety of applications. Some may be used as general purpose lifting accessories, and therefore require their capacity to be assessed for each application, whereas others may be dedicated to a single application and are selected specifically for it. However not every load with ferromagnetic properties can safely be handled with a magnetic lifter.

The magnetic lifter selected must match the characteristics of the load. As well as the weight, this includes the shape, surface finish and magnetic properties of the load.

The shape of the magnet should be compatible with that of the load. For example, a magnet with a flat face can handle sheet material whereas for lifting round section material, a magnet with a V shaped recess in the face is more suitable. For long loads, an arrangement of several magnets used in conjunction with a lifting beam is generally suitable as it provides the load with adequate support along its length. The position and capacity of the individual magnets should be such as to ensure that the share of the load imposed on each does not exceed its working load limit. For flexible loads, the positioning should provide support at short enough spaces to prevent the load from peeling off the magnet.

Lifting magnets are normally rated for lifting a horizontal load in the vertical plane only. If the line of pull is not at right angles to the plane of the load, their lifting capacity will be substantially reduced and slippage may occur. For such applications, the advice of the manufacturer should be obtained.

26.5.2 General

Consideration should be given to the following:

(1) Lifting capacity required.

(2) Characteristics of the load in terms of shape, surface finish and magnetic properties.

(3) Nature of the lifting operation.

(4) Lifting machine it is to be used with.

(5) Available headroom.

(6) Self weight of the magnetic lifter and degree of portability required.

(7) Method of control and control features required.

(8) Electrical requirements for electro or electro-permanent magnetic lifters.

(9) Proximity of persons during operations.

(10) Backup and other safety features required.

(11) The documentation required by legislation. If this is not on record, refer the magnetic lifter to a Competent Person for thorough examination.

26.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

It is strongly recommended that as much detail as possible about the application(s) is given to the manufacturer or supplier. If the magnetic lifter is for a specific application, it is usually possible to provide precise details of the task to be performed. For general purpose use such as handling a variety of steel stock in a machine shop, the information may have to be restricted to a selection of typical examples.

The information should include but is not necessarily limited to the following:

(1) Mass of the load to be lifted.

(2) Material of the load to be lifted, e.g. grade of steel, and the surface finish.

(3) Shape and dimensions of the load to be lifted.

(4) The structure of the load to be lifted e.g. a single slab, bundle or multiple sheets.

(5) Details of the lifting operation including, height, travel and whether load shedding is required.

(6) Characteristics of the lifting machine including the hoisting speed, travel speeds and headroom.

(7) Method of connection to the lifting machine.

(8) Availability of electrical supply if appropriate.

(9) The control mechanism required, i.e. manual, power, integrated or remote.

(10) The control features required e.g. load shedding.

(11) Backup and other safety features required.

(12) Details of the operating environment and service conditions e.g. extremes of temperature, probability of shock loading, uncertainty of mass of the load, whether persons can quickly leave the danger zone.

26.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

26.7.1 Supply Documentation, Statutory and Post Installation Thorough Examination

The definitions of lifting equipment and accessories used in this code of practice make it clear that a device used to connect a load to a lifting appliance is a lifting accessory and should be supplied with the documentation required by the supply legislation applicable to lifting accessories. The supply documentation, together with the Reports of Thorough Examination should be retained and cross-referenced to the magnetic lifter's historical records for inspection by the Competent Person or local enforcing authority.

26.7.2 Statutory and Post Installation Thorough Examination

As a lifting accessory Magnetic lifters must be thoroughly examined, as recommended by this code, at intervals not exceeding six months. In certain applications it may also be necessary to have the installation thoroughly examined by a Competent Person before the magnetic lifter is put into service. This may be necessary to ensure that the operation of the lifter in practice complies with theoretical predictions. (see section 26.8 INSTALLATION AND COMMISSIONING page 386)

26.7.3 Post Repair Verification and Record Keeping

Following repair, magnetic lifters must be re-verified by a competent person. The record of the repair and report of verification should be retained and cross referenced to the lifter's historical records for inspection by the Competent Person or local enforcing authority.

26.8 INSTALLATION AND COMMISSIONING

26.8.1 Installation

Installation will vary from simply hanging a portable permanent magnet type of lifter from a correctly sized, free to articulate crane hook, to a more complex operation involving an electro or electropermanent magnetic lifter. For all types, IT IS ESSENTIAL to ensure that the magnetic lifter is only installed on the equipment and for the lifting operations for which it has been selected. In addition:

26.8.1.1 Permanent Magnet Type

(1) Take account of the self weight of the magnetic lifter – it can be significant.

(2) Ensure that the lifting eye of the magnetic lifter correctly engages with the seat of the lifting machine hook and articulates freely with it so that the magnetic lifter hangs level. If necessary use an intermediate lifting accessory such as a shackle.

(3) Ensure that the lifting machine hook can rotate so as to facilitate correct orientation of the magnetic lifter to the load, bearing in mind that this type of magnetic lifter is usually rectangular.

26.8.1.2 Electro and Electro–Permanent Magnet Type

(1) As for permanent magnet types point 1 – 3 inclusive.

(2) Ensure availability of electrical supply (either battery or mains).

(3) Ensure that appropriate electrical safety tests are carried out.

26.8.2 Commissioning

The commissioning required will depend on the type of magnetic lifter used and the installation conditions. Generally, portable magnetic lifters are installed by the user simply by hooking them onto the lifting machine and do not require commissioning before use. For a permanently installed type where safety depends upon it being correctly installed, a thorough examination should be made before first use to ensure that it has been correctly installed and is safe to use.

For electro and electro-permanent magnetic lifters equipped with indicators, thorough examination should verify their proper functionality.

26.9 MARKING, STORAGE AND HANDLING

26.9.1 Marking

In addition to the information required by the applicable legislation and standard manufactured to, the following information should be permanently and legibly marked on a suitable part of the magnetic lifter unless the magnetic lifter is a permanently installed component of a larger lifting appliance in which case the appliance itself may be so marked:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) Working load limit.

(3) Name of manufacturer.

(4) Year of manufacture.

(5) Load rating information relating to thickness of load, air gaps, etc.

(6) Self weight of the magnet if it exceeds 5% of its WLL or 50 kg whichever is the less.

26.9.2 Storage and Handling

When not in use, portable magnetic lifters should be returned to proper storage. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code and it is additionally recommended that:

(1) They are stored in clean, dry conditions which are free from injurious pollution or extremes of temperature. In particular it must be dry. Neodymium, used in most permanent magnets is extremely susceptible to corrosion.

(2) They are stored off the ground and away from potential sources of damage. It must be borne in mind that they can be heavy.

(3) Equipment that is returned to stores in dirty condition should be cleaned and dried. Powerful solvents or cleaning agents should not be used and neither should direct heat. Surfaces liable to corrosion should be lightly oiled or otherwise protected e.g. the face of the magnet.

(4) When a magnetic lifter has been in storage and is to be taken into use, it should be checked by a suitably qualified and experienced person, see section 26.10.1 Pre-use inspection page 387, for any signs of damage or deterioration before use. Any problems found should be reported to a competent person for resolution.

26.10 IN-SERVICE THOROUGH EXAMINATION, INSPECTION AND MAINTENANCE

26.10.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, a suitably qualified and experienced person should, prior to use, visually inspect the magnetic lifter. For magnetic lifters in regular use it is good practice to make an inspection at the start of each shift or working day. For magnetic lifters used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the magnetic lifter to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the magnetic lifter and make a visual check for any obvious defects. This inspection must be carried out with the magnetic lifter in a reasonably clean condition and in adequate lighting. It should include an operational check of all the controls and indicators of the magnetic lifter and a visual check for mechanical damage. For battery operated models it is also necessary to check the condition of the battery and its state of charge.

The following are examples of the common defects which may become apparent in use or during the regular inspection of magnetic lifters and if any are present, the magnetic lifters should be withdrawn from service and referred to a Competent Person:

(1) General damage to the body of the magnetic lifter.

(2) Damage to the lifting eye or other means of suspension.

(3) Damage to the magnet face.

(4) Failure or dysfunction of any operating controls, warning indicators or other warning devices.

(5) Missing or illegible markings, model, manufacturer, serial number, load rating information, etc.

26.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some magnetic lifters will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 26.10.1 Pre-use inspection page 387, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 26.10.3 Maintenance page 388 below.

26.10.3 Maintenance

Magnetic lifters usually need little or no routine maintenance other than keeping them clean and dry since the working parts are contained within a substantial steel shell and any working mechanism is essentially very simple. Specific maintenance instructions issued by the manufacturer should be followed. The condition of all batteries must be checked on a regular basis. The state of charge of standby batteries used with mains fed electro lifting magnets should be regularly checked. The battery for battery fed electric lifting magnets must be charged on a regular basis.

26.10.4 Thorough examination

The magnetic lifter must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the magnetic lifter's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be functional test, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of magnetic lifters, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit.

26.11 SAFE USE OF MAGNETIC LIFTERS

In addition to any specific instructions relating to safe use of the magnetic lifter issued by the manufacturer, the following points should be observed:

(1) Do not use to lift people.

(2) Do not lift loads over people who are in the danger zone unless the magnetic lifter has the features needed to address this situation. These features can include a redundancy of critical supply cables and controls or a secondary mechanical means of securing the load. When establishing the danger zone, take account of the nature of the load. For example, sheet material can fly a considerable distance to the side. If necessary establish a 'no go' area.

(3) Only use the magnetic lifter for applications for which it has been specified or is otherwise suitable.

(4) Ensure that the load is of sufficient thickness to absorb the full magnetic flux of the magnet otherwise the lifting capacity will be reduced.

(5) Do not magnetize the lifter before setting it on the load.

(6) Do not attempt to hoist the load until you are satisfied that the magnetic lifter is capable of doing so. Methods of ensuring this will vary from one manufacturer to another and it is essential that the manufacturers' instructions relevant to the particular type of magnetic lifter are consulted. The capability may be checked by inserting a piece of non magnetic material between the load and the magnet and performing a test lift by raising the load a small distance from the ground. This is called an artificial air gap test.

(7) Ensure the load is balanced. An unbalanced load will tilt and may become detached by slipping.

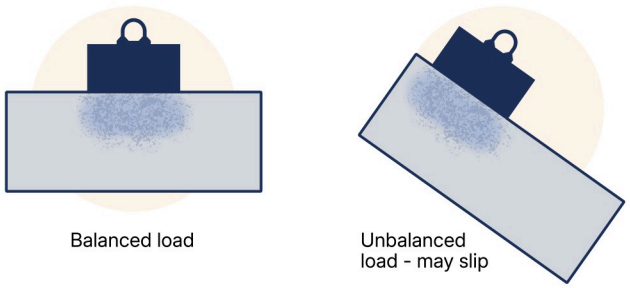


Figure 26.11-1 Balanced and unbalanced load

(8) Be aware that flexible loads can peel off the magnet face. Do not attempt to lift a load if this is likely to happen.



Figure 26.11-2 Beware of flexible loads peeling off the magnet face

(9) To overcome this problem, use two or more magnetic lifters in conjunction with a suitable lifting beam or spreader, ensuring that the share of the load taken by each magnetic lifter does not exceed its capacity.



Figure 26.11-3 Support flexible loads with two or more magnetic lifters in conjunction with a lifting beam

(10) If the load is comprised of a stack of material, e.g. of steel plates, the magnetic lifter can only lift the material permeated by the magnetic field. For this type of application, magnetic lifters with variable power are required. This facilitates shedding of excess load by reducing the power then securing the remaining load by restoring full power. Without this facility, the lowest part of the stack lifted is likely to be very insecurely held and therefore present a high risk of becoming detached.

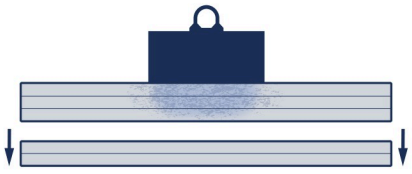


Figure 26.11-4 Magnetic lifters with variable power facilitates shedding of excess load

(11) Porous objects will have a lower density than solid objects made from the same material. This will affect the lifting capacity of the magnet. By comparing the density of the solid material with the bulk density of the porous material the available percentage of the magnet's power may be calculated, see example below.

Bulk density = mass/volume

Solid steel density = 7.8gm/cc and magnet capacity = 100%

Porous steel with e.g. bulk density = 5, therefore magnet capacity = 5/7.8 x 100 = 64%

(12) Loads with internal voids should be treated in the same way i.e. the bulk density should be calculated and the above principles applied.

(13) Ideally, the surface of the load to be lifted magnetically should be flat such that intimate contact with the sole plate of the magnetic lifter is made. An air gap may however be present due to an irregular shape, surface texture or surface coating. If so the capability of the magnet to lift the load should be checked by the artificial air gap test. If in doubt the advice of the manufacturer should be sought. Air gaps are tolerable within the limits laid down by the manufacturer.

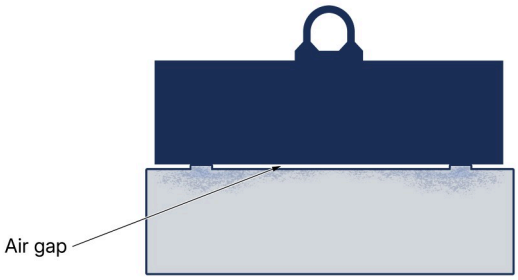


Figure 26.11-5 An air gap will reduce the lifting capacity of the magnetic lifter

(14) It is possible to lift loads other than those having a flat surface. For example, round sections can be handled by a magnetic lifter with a suitably profiled sole plate. However, the lifting capacity will be less than it is for a load with a flat surface.

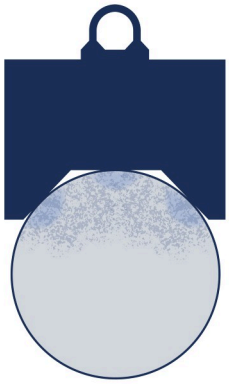


Figure 26.11-6 Handling round sections with a suitably profiled sole plate

(15) Always use the entire lifting pole surface.

(16) Ensure that, once hoisted, the load is transported gently to avoid swaying and is not subjected to shock loads.

(17) Except in scrap handling applications, do not attempt to “demagnetize” the magnetic lifter until the load has been set down.

(18) Beware of accidentally picking up other magnetic objects when the magnetic lifter is activated.

(19) Remember to include the self weight of the magnetic lifter when calculating the total load on the lifting machine.

26.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account the manufacturer’s instructions and also pay particular attention to the following:

(1) The limits of the applications for which the particular magnetic lifter has been specified or is otherwise suitable.

(2) The controls, indicators and warning devices of the magnetic lifter.

(3) The precautions to be taken to avoid risk to persons in the vicinity of the lifting operation.

(4) The precautions to be taken when lifting the various types of load such as thin material, low density material and material with poor surface finish.

(5) How to check that the load is securely held, balanced and not at risk of slipping, peeling or otherwise becoming detached.

The training should emphasize that magnetic lifters are for use in a limited number of applications and should not be regarded as “general purpose” equipment. For this reason training should cover the fundamentals of safe lifting, the use of magnetic lifters in general and the use of the particular magnetic lifter in the particular application. To do so, it may be necessary to enlist the services of the manufacturer or supplier of the magnetic lifter.

Section 27 - VACUUM LIFTERS

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27.1 FOREWORD

Although some manufacturers offer a standard range of vacuum lifters, unlike other lifting equipment, they are not usually regarded as “general purpose” equipment. Vacuum lifters are usually employed in specific circumstances to lift specific loads. As there is no positive connection between the lifting device and the load, the ability of the vacuum lifter to safely lift a particular load needs to be carefully considered. This will normally involve tests to determine the lifting power of the vacuum lifter on the specific load whilst manipulating it in any way required for the lifting operation.

27.2 SCOPE

This section of the code relates to four different types of vacuum lifter as follows:

(1) Self-priming

(2) Non-self-priming (Mechanically pumped)

(3) Non-self-priming (Venturi)

(4) Non-self-priming (Turbine)

It does not cover hand held vacuum devices such as those commonly used by glaziers to handle sheets of glass. These are not items of lifting equipment.

Because of the specialized nature of vacuum lifting applications, the advice given in this section of the code should be regarded as general advice which should be augmented by the specialist advice provided by the supplier of the vacuum lifter.

27.3 DEFINITIONS

In addition to the definitions given in section 1.3 DEFINITIONS page 2 of this code, the following should be noted.

27.3.1 Vacuum

In the context of vacuum lifters it refers to a partial vacuum which is a reduction in air pressure below that of the atmosphere.

27.3.2 Vacuum Reservoir

A vessel from which some of the air has been removed thus creating a partial vacuum. The vessel is usually a welded steel cylinder.

27.3.3 Adhesion Force

The adhesion force is the result of pressure differences between the vacuum inside the pad and the atmospheric pressure outside, multiplied by the vacuum pad's surface area. i.e. the force required to remove the load from a vacuum lifter.

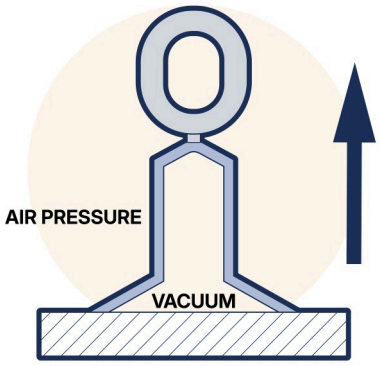


Figure 27.3.3-1 Adhesion force arising from pressure difference and vacuum pad area

27.3.4 Vacuum Pump

A device for removing air from an enclosed and sealed volume or vessel thus creating a vacuum. There are three types of pump: an electrically powered piston pump, a compressed air powered Venturi system and an electrically powered turbine.

27.3.5 Vacuum Pad

A vacuum pad is usually in the form of an inverted "dish" fitted with a flexible seal around its perimeter. When the vacuum pad is placed on the load and the pressure within the vacuum pad is reduced, an adhesive force is created.

27.3.6 Venturi

When air under pressure flows through a constricted section of pipe, the air velocity increases through the constriction and its pressure drops creating a partial vacuum which can be piped to a vacuum pad.

27.3.7 Turbine

A machine comprising of a rotor with one or more shaped blades which when rotated will cause suction and this in turn creates a vacuum in the vacuum pad.

27.3.8 Working Range

Vacuum lifters can only operate safely within a limited range of vacuum which is called the working range.

27.3.9 Danger Range

The range of vacuum levels below the working range but which is still capable of holding the load is called the danger range.

27.4 TYPES OF VACUUM LIFTERS

For convenience, the four types of vacuum lifter covered by this section can be dealt with in two groups, the self priming or self actuating type and the non self priming or powered type.

All vacuum lifters should be designed to hold a load corresponding to two times the working load limit at the end of the working range and the beginning of the danger range at all intended angles of lift.

The shape of the vacuum pads should be matched to the load to be lifted and if more than one vacuum pad is being used, the share the load imposed on each vacuum pad must not exceed the working load limit of the individual vacuum pad.

For vacuum lifters with the facility to orientate the load, the controls for tilting or turning the load must be the hold to run type.

27.4.1 Self Priming or Self Actuating Type Vacuum Lifters

This type of vacuum lifter has a integrated piston and cylinder which creates the vacuum. The vacuum lifter is initially held in contact with the load by its own weight which acts on the flexible seal around the vacuum pad. On hoisting, the piston is pulled up creating a partial vacuum in the cylinder and vacuum pad. The piston moves within the cylinder until the force generated by the vacuum within the cylinder equals the weight of the load. The vacuum generated is therefore proportional to the weight of the load.

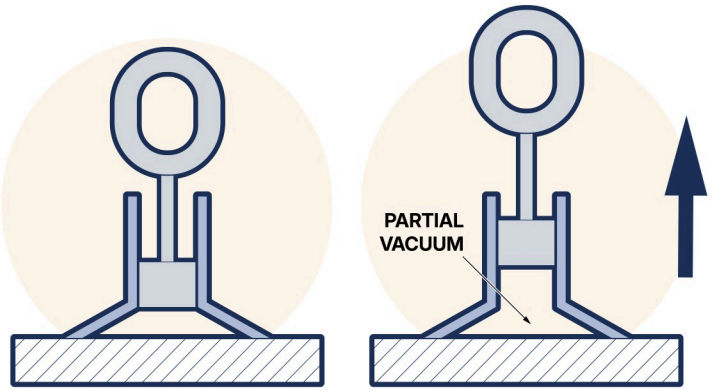


Figure 27.4.1-1 Principle of operation of a self priming vacuum lifter

The area of the vacuum pad is greater than that of the cylinder thereby increasing in proportion the adhesive force arising from the vacuum.

The basic range of self priming vacuum lifters have only one vacuum pad although models are available with multiple vacuum pads attached to a lifting beam with a central cylinder and piston assembly connected to all the vacuum pads.

The self priming or actuating type vacuum lifters must be equipped with an indicator to show the operator that the end of the working range has been reached. This indicator must be visible to the slinger, or if there is no slinger, to the driver of the crane. To prevent risks due to vacuum losses a reserve stroke capacity of at least 5% of the total stroke of the piston must be provided.

27.4.2 Powered Vacuum Lifters

Powered vacuum lifters use a pump to generate the vacuum and are normally electrically operated either by mains or battery. The pump may be housed within the vacuum lifter itself or may be separate, with the vacuum transmitted to the vacuum lifter by means of a hose. They may be equipped with single or multiple lifting pads dependent upon the application.

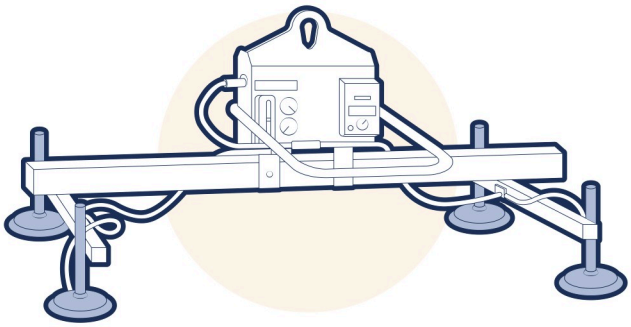


Figure 27.4.2-1 Vacuum lifter with multiple lifting pads

There are three basic types of pump. The piston type has the advantage of generating a high level of vacuum, essential for applications where the size of the vacuum pads must be kept to a minimum. The venturi type has the advantage of simplicity and the facility to be powered by a remote source of compressed air which is useful in applications where the presence of electricity is a hazard. The turbine type produces a relatively low level of vacuum but can pump a high volume of air. The turbine is usually integral with a single large area vacuum pad and the combination of low vacuum and high air volume is an advantage when lifting porous loads and those where the adhesive force must be spread over a large area.

The non self priming or powered type of vacuum lifter must be fitted with an optical or audible warning device to automatically warn that the danger range is reached when vacuum losses cannot be compensated for. The warning device must work even if there is a power failure.

They must also be equipped to prevent the risks arising from vacuum losses. Where a vacuum pump is used, a vacuum reservoir with a non-return valve fitted between the reservoir and the pump must be provided. Where a venturi is used, a pressure reserve tank or a vacuum reservoir with a non-return valve between the system and the tank or reservoir must be provided. For a turbine system, a supporting battery or an additional flywheel mass must be provided.

In the case of a power failure, the vacuum lifter must be able to hold the load for 5 minutes. This is not necessary in 'no go' areas where persons are excluded from the danger zone. It is also not necessary for turbine types provided that the operator controls the load through steering handles which ensure that the operator is outside the danger zone, the height of lift is restricted to a maximum of 1.8m and a warning sounds as soon as the power fails.

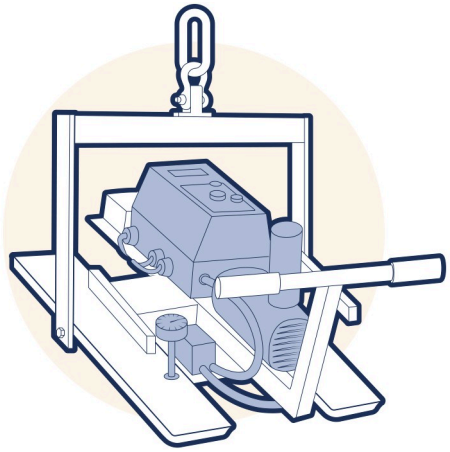


Figure 27.4.2-2 Multi head vacuum lifter with integral vacuum pump

For powered vacuum lifters used to lift loads over areas where persons are present, e.g. on a construction site, a secondary positive holding device which can be deployed to secure the load is required or there must be a duplication of the vacuum systems including the vacuum reservoirs and vacuum pads.

The release of the load must be actuated by a two action control unless the vacuum lifter is being used in a 'no go area' or release is not possible until the load has been set down.

27.5 PRINCIPLES FOR THE SELECTION OF VACUUM LIFTERS

27.5.1 Applications

Vacuum lifters can be suitable for a variety of applications. However, it is essential that the characteristics of the vacuum lifter are matched to those of the load and it is strongly recommended that the exact nature of the application is adequately discussed between the user and the supplier.

Generally they are most suitable for lifting loads which have a smooth, non-porous surface such as metal plates, glass, stone slabs, cardboard boxes, etc. If required, the vacuum lifter can have the facility to tilt a load, such as a steel or glass plate from horizontal to vertical or vice versa, and be capable of rotating the load. These facilities may be by means of either a manual or powered actuator.

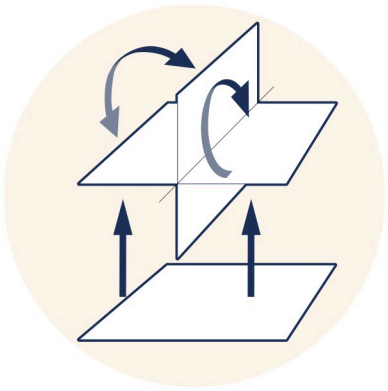


Figure 27.5.1-1 Vacuum lifters can include the facility to tilt and rotate the load

Loads with a porous surface or a textured surface may be lifted with vacuum lifters provided that the means of generating the vacuum is sufficiently powerful to counteract the leakage of air. Turbine operated types are usually used in these applications.

A further variant is a device using vacuum pads to grip the load in a scissor action.

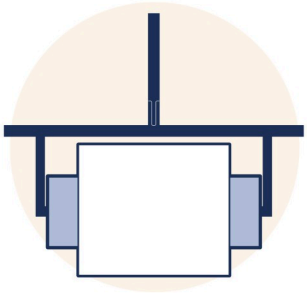


Figure 27.5.1-2 Vacuum lifter gripping the load in a scissor action

27.5.2 General

Consideration should be given to the following:

(1) Lifting capacity required.

(2) Characteristics of the load in terms of shape, surface finish and porosity.

(3) Lifting machine it is to be used with.

(4) Available headroom.

(5) Self weight of the vacuum lifter and degree of portability required.

(6) Whether self priming or non-self-priming type required

(7) For powered lifters, whether battery or mains power required

(8) For venture types, the pressure, volume and quality of air required.

(9) Method of control and control features required

(10) Proximity of persons during operations

(11) Back up and other safety features required

(12) The documentation required by legislation. If this is not on record, refer the vacuum lifter to a Competent Person for thorough examination.

27.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER

It is strongly recommended that as much detail as possible about the application(s) is given to the manufacturer or supplier. Vacuum lifters are normally used for closely defined applications. It is therefore usually

possible to give the designer or supplier precise details of the task to be performed. This information should include but is not necessarily limited to the following:

(1) The mass of the load to be lifted

(2) The material and composition of the load to be lifted, e.g. surface finish and porosity.

(3) The physical dimensions and shape of the load to be lifted and location of the centre of gravity.

(4) The “make up” of the load to be lifted e.g. a single slab, packages, boxes, etc.

(5) The number, shape and orientation of the lifting pads.

(6) Details of the operating environment and service conditions, e.g. extremes of temperature, probability of shock loading, uncertainty of mass of the load.

(7) The available headroom.

(8) The type of suspension.

(9) The speed of the hoisting mechanism.

(10) Availability of electrical supply or compressed air supply if appropriate.

(11) The control mechanism required, that is, integrated or remote.

(12) Details of any possible surface contamination of the load as this may affect the material from which the pads are made.

(13) Back up and other safety features required.

27.7 LEGAL REQUIREMENTS

Particular attention is drawn to section 1.4 GENERAL LEGAL REQUIREMENTS page 6 of this code.

27.7.1 Supply Documentation

The definitions of lifting equipment and accessories used in this code of practice make it clear that a device used to connect a load to a lifting appliance is a lifting accessory and should be supplied with the documentation required by the supply legislation applicable to lifting accessories. The supply documentation, together with the Reports of Thorough Examination should be retained and cross-referenced to the vacuum lifter’s historical records for inspection by the Competent Person or local enforcing authority.

27.7.2 Statutory and Post Installation Thorough Examination

Vacuum lifters must be thoroughly examined, as recommended by this code, at intervals not exceeding six months. For some applications, it may also be necessary to have the installation thoroughly examined by a Competent Person before the vacuum lifter is put into service. This may be necessary to ensure that the operation of the lifter in practice complies with theoretical predictions. (see section 27.8 INSTALLATION AND COMMISSIONING page 398)

27.7.3 Post Repair Verification and Record Keeping

Following repair, vacuum lifters must be re-verified by a Competent Person. The record of the repair and report of verification should be retained and cross referenced to the lifter’s historical records for inspection by the competent person or local enforcing authority.

27.8 INSTALLATION AND COMMISSIONING

27.8.1 Installation

Installation will vary from simply hanging a portable self priming type of vacuum lifter from a correctly sized, free to articulate crane hook, to a more complex operation involving an electrically powered or venture type of vacuum lifter.

Portable vacuum lifters are relatively rare and most vacuum lifters will be permanently installed as an integral part of a lifting appliance. For all types IT IS ESSENTIAL to ensure that the vacuum lifter is only installed on the equipment and for the lifting operations for which it has been chosen. In addition:

27.8.1.1 Self priming or actuating type

(1) Take account of the self weight of the vacuum lifter – it can be significant.

(2) Ensure that the lifting eye of the vacuum lifter correctly engages with the seat of the lifting machine hook and articulates freely with it so that the vacuum lifter hangs level and presents itself to the load such that the surface of the load is parallel to the face of the lifter's vacuum pads. If necessary use an intermediate lifting accessory such as a shackle.

(3) Ensure that the lifting pads of the vacuum lifter are presented to the load in the correct position relative to the load's centre of gravity.

(4) Take account of the shape of the load and match the vacuum pads to the load.

(5) Where manual manipulation of the suspended load is required, the risks to the operator or other persons must be considered.

27.8.1.2 Electrically powered types

(1) As for self priming types point 1 – 5 inclusive.

(2) Ensure availability of electrical supply (either battery or mains).

(3) Ensure that the appropriate electrical safety tests are carried out.

27.8.1.3 Venturi types

(1) As for self priming types point 1 – 5 inclusive.

(2) Ensure availability of compressed air supply.

27.8.2 Commissioning

The commissioning required will depend on the type of vacuum lifter used and the installation conditions. Generally, portable vacuum lifters are installed by the user simply by hooking them onto the lifting machine and do not require commissioning before use. For a permanently installed type where safety depends upon it being correctly installed, a thorough examination should be made before first use to ensure that it has been correctly installed and is safe to use.

For power operated vacuum lifters, the thorough examination should include checking whether the various indicators and warning devices are functioning correctly.

27.9 MARKING, STORAGE AND HANDLING

27.9.1 Marking

The following information should be permanently and legibly marked on a suitable part of the vacuum lifter unless the vacuum lifter is a permanently installed component of a larger lifting appliance in which case the appliance itself may be so marked:

(1) Identification mark. (If the manufacturer has not provided a unique serial number then it is the responsibility of the user to add the identification mark to identify the equipment with the inspection and examination reports).

(2) SWL.

(3) Name and Address of the manufacturer and where applicable, an authorized representative.

(4) Year of manufacture.

(5) Serial Number

(6) Designation of the equipment

(7) Self weight of the unloaded vacuum lifter when it exceeds 5% of the WLL or 50 kg, whichever is the less.

(8) On self priming vacuum lifters, the minimum load.

(9) On turbine vacuum lifters where the holding time in the event of power failure is less than 5 minutes, the following shall be marked in the local language.

a. For loads less than 20 kg "Warning – the top of the lLoad must not be lifted above 1,8 m"

b. For loads less than 35 kg "Warning – the top of the load must not be lifted above 1,2 m"

27.9.2 Storage and Handling

When not in use, vacuum lifters should be returned to proper storage. The general requirements are as recommended in section 1.7.2 Storage and Handling page 9 of this code and it is additionally recommended that:

(1) They are stored off the ground in clean, dry conditions which are free from injurious pollution or extremes of temperature. It must be borne in mind that they can be heavy.

(2) Equipment that is returned to stores in dirty condition should be cleaned and dried. In particular the vacuum pads should be cleaned and protected from contamination whilst in storage. Powerful solvents or cleaning agents should not be used and neither should direct heat. Surfaces liable to corrosion should be lightly oiled or otherwise protected.

(3) When a vacuum lifter has been in storage and is to be taken into use, it should be checked by a suitably qualified and experienced person for any signs of damage or deterioration before use. Any problems found should be reported to a competent person for resolution.

(4) Storage conditions should not be subject to extremes of temperature and must above all else be dry.

(5) It is important that during use and storage between lifts, the vacuum lifting pads are kept clean as grit and other debris may damage the pads and impair their efficiency. A convenient way to facilitate this is to use a stand which holds the pads clear of the ground.

27.10 IN-SERVICE INSPECTION AND MAINTENANCE

27.10.1 Pre-use inspection

In addition to the thorough examination necessary under statutory provisions, a suitably qualified and experienced person should, prior to use, visually inspect the vacuum lifter. For vacuum lifters in regular use it is good practice to make an inspection at the start of each shift or working day. For vacuum lifters used infrequently it should be done before each use on each day of use.

It is recommended that a formal system of pre-use inspection is implemented, and a written record kept identifying the date inspected, confirmation that it passed inspection and the name and signature of the person making the inspection. In the event that it does not pass inspection, there should be procedure to quarantine the vacuum lifter to prevent further use of the equipment until the problem has been resolved.

The purpose of the pre-use inspection is to check functionality of the vacuum lifter and make a visual check for any obvious defects. This inspection must be carried out with the vacuum lifter in a reasonably clean condition and in adequate lighting. It should include an operational check of all the controls and indicators of the vacuum lifter and a visual check for mechanical damage. For battery operated models it is also necessary to check the condition of the battery and its state of charge.

The following are examples of the common defects which may become apparent in use or during the regular inspection of vacuum lifters and if any are present, the vacuum lifter should be withdrawn from service and referred to a Competent Person:

(1) General damage to the body of the vacuum lifter.

(2) Damage to the lifting eye or other means of suspension.

(3) Damage or contamination of the vacuum lifting pads.

(4) Failure or dysfunction of any operating controls, warning lights or other warning devices.

(5) Missing or illegible markings, model, manufacturer, serial number, load rating information, etc.

(6) Air leaks from any hoses or couplings.

27.10.2 Interim Inspection

In addition to the thorough examination and pre-use inspection some vacuum lifters will require an interim inspection(s). The number, frequency and extent of the interim inspections is based on a risk assessment taking into account the possibility of deterioration of components or assemblies due to the specific conditions of use, to ensure that defects are identified and remedied before they become a danger to persons.

The risk assessment must take account of the manufacturer's literature and actual conditions of use, for example environmental conditions and utilisation that can cause deterioration. The inspection can be restricted to those critical components identified in the risk assessment and therefore they do not have to be as detailed and time consuming as a thorough examination. Typically the inspection will be a more detailed inspection of one or more of the items listed in section 27.10.1 Pre-use inspection page 400, but may also cover some or all of the components covered by the thorough examination (refer to the manufacturers literature or LEEA Lifting equipment examiners hand book for guidance to defined scopes of thorough examination including acceptance and rejection criteria).

Interim inspections are often done at the same time as planned maintenance, see section 27.10.3 Maintenance page 401below.

27.10.3 Maintenance

Vacuum lifters usually need little or no routine maintenance other than keeping them clean and dry since the working mechanism is essentially very simple. Specific maintenance instructions issued by the manufacturer should be followed. Vacuum pads and the seals around them must be inspected regularly and replaced in accordance with the manufacturer's instructions. For battery powered types, the condition of all batteries must be checked regularly.

27.10.4 Thorough examination

The vacuum lifter must regularly be thoroughly examined by a Competent Person to check whether it remains safe to use. This is to be done within a maximum period of 6 months unless a written scheme of examination (for guidance refer to LEEA 032 Guidance to Written Schemes of Examination), drawn up by a competent person is in place and operating.

Reports of thorough examination should be compliant with the legal requirements or the LEEA template report documents, retained and cross referenced to the vacuum lifter's historical records for inspection by the Competent Person or the enforcement authority.

Any defects found by the examination should be reported to the owner of the equipment, who must assess the root cause of the defect and implement procedures to prevent reoccurrence, e.g. training of operators, increased inspections, etc., before remedying the equipment and returning it to service.

The competent person may deem it necessary to supplement their examination with testing. Such testing could be functional test, overload testing, etc. The nature and extent of testing is always at the discretion of the competent person in support of their thorough examination.

Unless a mandatory requirement of the applicable national legislation or manufacturer, LEEA does not recommend the routine overload testing of vacuum lifters, except following an exceptional circumstance such as significant modification or repair. This is because overload testing has few benefits and number of disadvantages;

- Some manufacturers do not recommend overload tests, except in 'exceptional' circumstances.
- Repeated overloads can cause deterioration of the equipment over time.
- Most failures are the result of defects such as deformation, fatigue cracking, etc. that will not be revealed by an overload test but can be identified during thorough examination.
- Defects such as deformation, fatigue cracking, etc. can be made worse by overload testing but may still not be identified by the test.
- Inspection bodies do not recommend it as there is no defined structural or mechanical benefit.

27.11 SAFE USE OF VACUUM LIFTERS

In addition to any specific instructions relating to safe use issued by the manufacturer, the following points should be observed:

(1) Do not use to lift people.

(2) Do not lift loads over people who are in the danger zone unless the vacuum lifter has the features needed to address this situation. These features can include a redundancy of critical components and controls or a secondary mechanical means of securing the load. When establishing the danger zone, take account of the nature of the load. For example, sheet material can fly a considerable distance to the side. If necessary establish a 'no go' area.

(3) Only use the vacuum lifter for applications for which it has been specified or is otherwise suitable.

(4) Ensure that the surface of the load to which the vacuum lifter is to be attached is clean and dry. Light oil or other liquid coverings may be acceptable and may indeed make the vacuum lifter more efficient but see section 27.6 INFORMATION WHICH SHOULD BE EXCHANGED BETWEEN THE USER AND THE DESIGNER OR SUPPLIER page 397 (12).

(5) Do not actuate the lifter before setting it on the load.

(6) Do not attempt to hoist the load until you are satisfied that the vacuum lifter is capable of doing so. Methods of ensuring this will vary from one manufacturer to another and it is essential that the manufacturer's instructions relevant to the particular type of vacuum lifter are consulted.

(7) Ensure the load is balanced. An unbalanced load will tilt and may become detached by slipping.

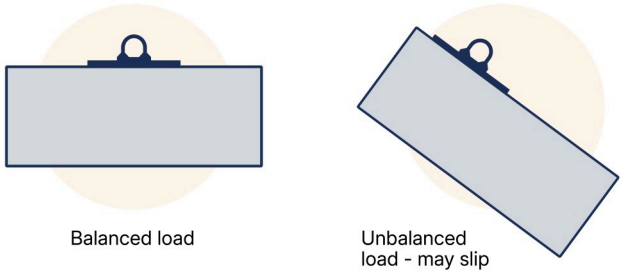


Figure 27.11-1 Balanced and unbalanced loads

(8) Be aware that flexible loads can peel off the vacuum pad. Do not attempt to lift a load if this is likely to happen.



Figure 27.11-2 Beware of load peeling

(9) To overcome this problem, use a vacuum lifter with two or more vacuum pads in conjunction with a suitable lifting beam or spreader, ensuring that the share of the load taken by each vacuum pad does not exceed its capacity.



Figure 27.11-3 Use of multi-headed vacuum lifter to avoid load peeling

(10) Vacuum lifters can be used to remove one plate or sheet of material from a stack. If used in this way, care should be taken to ensure that the top plate or sheet is free to move, i.e. not attached to the stack by strap banding, etc. Also be aware that smooth finished plates and sheets can adhere to each other particularly if a liquid is present, e.g. oiled steel sheet or wet glass.

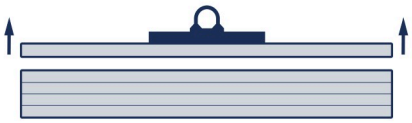


Figure 27.11-4 Vacuum lifter used to remove one plate or sheet from a stack

(11) Porous objects will have a lower density than solid objects made from the same material and will thus be lighter in weight. Their porosity will however allow the vacuum within the lifting pad to be dissipated through the load. This does not necessarily mean that the use of a vacuum lifter is out of the question. It does however mean that the vacuum dissipation must be taken into account.

(12) Ideally, the surface of the load to be lifted should be flat such that intimate contact with the lifting pads of the vacuum lifter is made. Air gaps may however be present due to irregular shapes and in this situation the advice of the manufacturer should be sought. Surface texture and the presence of a non-adherent coating on the material may have an adverse effect on the vacuum lifter's capacity. Air gaps may be tolerable within the limits laid down by the manufacturer.

(13) It is possible to lift loads with other than flat surfaces using vacuum lifters. Round sections for instance can be handled provided that the vacuum lifter has suitably profiled lifting pads.

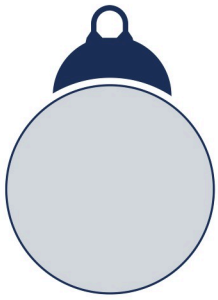


Figure 27.11-5 Lifting a round section with suitably profiled lifting pad

(14) Always use the entire lifting pad surface. Air leaks will catastrophically affect the safe use of a vacuum lifter

(15) Ensure that, once hoisted, the load is transported gently to avoid swaying and is not subjected to shock loads.

(16) Do not attempt to release the vacuum lifter until the load has been set down in its final resting place.

(17) Remember to include the self weight of the vacuum lifter when calculating the total load on the lifting machine.

27.12 TRAINING

In addition to the training requirements specified in section 1.10 TRAINING page 12 of this code, operative training should take into account the manufacturer's instructions and also pay particular attention to the following:

(1) The limits of the applications for which the particular vacuum lifter has been specified or is otherwise suitable.

(2) The controls, indicators and warning devices of the vacuum lifter.

(3) The precautions to be taken to avoid risk to persons in the vicinity of the lifting operation.

(4) The precautions to be taken when lifting the various types of load such as thin material, low density material and material with poor surface finish.

(5) How to check that the load is securely held, balanced and not at risk of slipping, peeling or otherwise becoming detached.

The training should emphasize that vacuum lifters are for use in a limited number of applications and should not be regarded as "general purpose" equipment. For this reason training should cover the fundamentals of safe lifting, the use of vacuum lifters in general and the use of the particular vacuum lifter in the particular application. To do so, it may be necessary to enlist the services of the manufacturer or supplier of the vacuum lifter.

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