

Introduction – NCMT

NCMT has mastered in quality of training and certification and taken pride in offering you some programs that our uncountable satisfied clients have raved that.

A Tradition of Excellence Since 1995

National Centre for Management and Training (NCMT) is an independent and dynamic training institution established in 1995 situated in Abu Dhabi.

Our main agenda is to:

- ✓Bring a change in the training sector.
- ✓Develop the practice of continuous learning.
- ✓Build a strong NCMT community in UAE.

We are the leading ACTVET certified training institution who are registered with and approved by the reputed leaders, such as: Abu Dhabi Municipality, ADNOC, NPCC, ADWEA, ENEC and many more. e company is dedicated in providing quality assured trainings, manpower development courses and consultation services with the help of ISO 14001, ISO 9001, ISO 45001 and ICV Certifications.

COURSE PROGRAM

DAY ONE

RIGGING / SLINGING

1. **Course Introduction**
2. **The Law & Standards**
3. **Duties & Responsibilities**
4. **Classification of Lifting Equipment**
5. **Lifting Accessories Types & Use.**
6. **Lifting Appliances Types & Use.**
7. **Lifted Equipment Types & Use.**
8. **Color Code System.**
9. **SWL & WLL**
10. **Load Weight Calculations**
11. **Centre Of Gravity**
12. **Kinds of Hitches**
13. **Angles of Lifting**
14. **Multi-Leg Slings Rating**
15. **Rigging Equipment Good & Bad Practices**
16. **Lifting Accessories Inspection**
17. **Hand Signals**

DAY TWO

MOBILE CRANE

- 1. Mobile Cranes Types**
- 2. Operation Manual & Log Book**
- 3. Proximity Hazards**
- 4. Working with Crane**
- 5. Crane Set Up**
- 6. Bad Lifting Practices**
- 7. Load Rating Chart**
- 8. Lifting Areas Diagram**
- 9. The Range Diagram**
- 10. RCI, SLI and LMI**
- 11. Safety and Control Devices**
- 12. Tandem Lifting**
- 13. Video Illustration (Day-2)**
- 14. Case Study**
- 15. Assignment (Day-2)**

DAY THREE

LIFTING PLAN PREPRATION

1. **Lifting management System**
2. **Risk Assessment**
3. **Lifting Plan Classification**
4. **Lifting Plan Contents**
5. **Method Statement**
6. **Lifting Data table**
7. **Lifting Plan Case Study (All Attendees to practice preparing a Lifting Plan)**
8. **Video Illustration (Day-3)**
9. **Assignment (Day-3)**

DAY FOUR

EXAMINATION

- 1. Written Exam- Individual**
- 2. Lifting Plan Exam (Either group of 2 Attendees or**

COURSE INTRODUCTION

COURSE STRUCTURE

THIS IS A FOUR – DAY COURSE

- ▶ Tutorials (Theoretical power points presentations)
- ▶ Discussion
- ▶ Video Illustration
- ▶ Examination (Written exam & Lift Plan Preparation Exam)

COURSE OBJECTIVES

Successful delegates would be able to:

- ▶ Know the Law governing the safe use of lifting equipment,
- ▶ Know the duties, responsibilities and importance as an Appointed Person as well as other team members for lifting operations.
- ▶ Classification of Lifting Equipment and Lifting Operations.
- ▶ Know the Rigging & Slings Best Practices.
- ▶ Assess dangers to the lifting operation from change circumstances on site.
- ▶ Know the different types of Mobile Cranes,
- ▶ Know Safety devices and it's important role for Mobile crane as well as importance and use of Log book & maintenance records,

COURSE OBJECTIVES

Successful delegates would be able to:

- ▶ Understand the crane operation procedure and correct crane set up procedure.
- ▶ Ensure the correct crane configuration has been utilized according to load Chart.
- ▶ Understand the various types of Load Charts of different Mobile Cranes
- ▶ know the crane range diagram & lifting area diagram
- ▶ Understand the lifting area diagram and Standard Hand Signals.
- ▶ Understand the Safe Load Indicator (SLI), Rated Capacity Indicator (RCI) and Load Moment Indicator (LMI).
- ▶ Understand the tandem lifting procedure.
- ▶ Direct & supervise the lifting operation as per method statement.
- ▶ Give clear, unambiguous instructions to all the lifting team members.

PRE-REQUISITES

- ▶ Attendees should have sufficient experience to use the various types of cranes based on requirements on site and various types of lifting operations activities.
- ▶ Be physically fit with regard to eyesight, hearing, reflexes and ability to take the necessary action relevant to lifting operation success;
- ▶ Be familiar with the equipment manufacturer's instructions for the operation and its basic maintenance
- ▶ Experienced in lifting operations and Rigging / Slings
- ▶ Be familiar and know how to prepared method statements, lifting plans & risk assessment,
- ▶ Be prepared and experienced to deal with contingency plans in emergency cases.

PRE-REQUISITES

- ▶ Hold 3 years Diploma in Mechanical Engineering or equivalent; However, Competency of AP may be considered with regards to Equivalent qualifications if there is proven record of experience are full filled subject to LTA Approval & official interview GC panel. Note: This may not be considered to add for each position.
- ▶ Have relevant oil & gas offshore and onshore lifting related experience of not less than 7 years with minimum 5 years in a similar position;
- ▶ Have adequate training and hands on professional experience and be competent to act as an Appointed Person for lifting equipment;
- ▶ Be able to write Lifting plans, supervise and execute critical lifting in oil & gas companies;
- ▶ Have focus on HSE priorities and lead a team of Crane Operators, Riggers and Banksmen for Safe Lifting Practices across different locations of the organization;
- ▶ Be familiar with international standard related to Lifting engineering practices with sufficient knowledge in interpretation and to bring excellence in Change management

THE LAW & STANDARDS

THE LAW & STANDARDS

Acts	These are law that we have to follow
Regulations	These explain what the law means
Codes of practice or compliance code	These are instructions on how to follow the law, based on industry standards
Standards	These tell us what the minimum requirement is for a job, product or hazard

Terminology:

Law (Act of Federal Government bodies/Statute): The highest form of legal rule, setting fundamental duties. Laws are the formal rules of a country or community. They are created through a political process and are binding on everyone within that jurisdiction.

Regulation: A specific, legally binding rule made under a law, detailing what must be done (e.g., LOLER requires lifting equipment to be fit for purpose, examined, and planned).

Guidance/Code of Practice: Explanations, interpretations, and practical advice (often from bodies like the HSE) on how to comply with laws and regulations, not legally binding themselves but used in court to show compliance.

Standards: A technical specification or guidelines developed by expert bodies (e.g., BS, ISO) for how to meet legal requirements, often referenced in regulations (e.g., specifying sling strength).

THE LAW & STANDARDS

- ▶ **Law:** Law is an umbrella term. It refers to the entire system of rules that a country or community recognizes as binding
- ▶ **Legislation (The "Must"):** This is the high-level law passed by the government, such as the **Occupational Safety and Health Act**. If you break this, you are breaking the law of the land.
- ▶ **Regulations (The "How"):** These are created under the authority of legislation. For example, LOLER (Lifting Operations and Lifting Equipment Regulations) or OSHA. These give you the specific rules for inspections and safety.
- ▶ **Standards (The "Best Practice"):** Things like BS EN 13889 (for Shackle inspection) are not legislation, but if an accident happens, the "Law" will look at whether you followed these standards to decide if you were negligent.
- ▶ **The Golden Rule:** All legislation is law, but not all law is legislation.

COMPARISION TABLE

Term	Meaning	Legal Status	Example	Level
Law	Top legal rule of country	✓ Enforceable	Health & Safety Act	Highest
Legislation	Collection of laws	✓ Enforceable	Acts of Parliament	High
Regulation	Detailed rules under law	✓ Enforceable	LOLER, PUWER	High
Standard	Industry best practice	✗ (unless referenced)	BS 7121	Medium
Code of Practice	Practical guidance	✗ (supportive)	ACOP LOLER	Medium

UAE NATIONAL LEGISLATION

- (a) The following laws on protection of the environment and people are applicable:
- (i) Federal Law No. 8 of 1980: Regulation of Labor Relations.
 - (ii) Federal Law No. 24 of 1999 for the Protection and Development of the Environment and subsequently issued executive regulations (Cabinet Order No. 37/2001 Executive Regulations of F.L. No. 24/1999).
- (b) In addition, local law dictates the machinery; equipment and materials used in operations shall be in conformity with international standard specifications and shall satisfy safety and efficiency requirements.
- (i) Local Law No. 8 of 1978 Conservation of Petroleum Resources.
- (c) Specific to Lifting Equipment the legal requirement according to:
Ministerial Order Decree 32 of 1982, Article 20, on the Determination of Preventative Methods and Measures for the Protection of Labor from Risks at Work.
- (d) Abu Dhabi Occupational Safety and Health System Framework (ADOSH-SF) Code of Practice CoP 34.0 – Safe Use of Lifting Equipment and Lifting Accessories Version 4.0 (July 2024).

THE LAW & STANDARDS

The following National laws and standards shall be considered during lifting operations

- ▶ UAE Ministerial Order No.32 of 1982 (U.A.E. FEDERAL LAW)
- ▶ Abu Dhabi Occupational Safety And Health System Frame Work (ADOSH-SF COP 34)-V4.0-July 2024
- ▶ ADNOC Group Lifting And Hoisting Operations standard (HSE-OS-ST19)(OLD)-2019
- ▶ Personal Safety and WMS :ADNOC Group Lifting and Hoisting Operations CORPORATE PRACTICE(HSE-PSW-CP19)(Newly Updated)-2025
- ▶ ADNOC 10 Life-Saving Rules

THE LAW & STANDARDS

The following International laws and standards as well as if any latest one which are relevant shall also be considered during lifting operations

- ▶ Lifting Operation and Lifting Equipment Regulations (LOLER) 1998
- ▶ Provision and Use of Work Equipment Regulations (PUWER) 1998
- ▶ Code of Practice for safe use of crane - BS 7121
- ▶ BS 7121-2-1:2012 Code of practice for the safe use of cranes - Inspection, maintenance and thorough examination. General

THE LAW & STANDARDS

- ▶ BS 7121-2-3:2012 Code of practice for the safe use of cranes - Inspection, maintenance and thorough examination. Mobile cranes
- ▶ BS 7121-2-4:2013 Code of practice for the safe use of cranes - Inspection, maintenance and thorough examination. Loader cranes
- ▶ International Association of Oil and Gas Producers (IOGP) Lifting & Hoisting Recommended Practice, Report No. 376, Aug 2022.
- ▶ BS 7262 (1990) Specification for automatic safe load indicators.

THE LAW & STANDARDS

UAE MINISTERIAL ORDER NO.32 OF 1982 (UAE FEDERAL LAW)

Ministerial Order Decree 32 of 1982, Article 20, on the Determination of Preventative Methods and Measures for the Protection of Labor from Risks at Work.

Specific to Lifting Equipment the legal requirement according to UAE Ministerial Order No.32 of 1982 states that every lifting appliance and every piece of lifting gear shall be thoroughly examined and, where necessary tested:

- (a) before it is used for the first time; or
- (b) having already been used, if and whenever subsequently substantially altered or repaired, before it is again used; and
- (c) at the times and interval set out in this article 20 to this regulation, which is every 6 months.

The inspected /tested parts shall be color coded.

THE LAW & STANDARDS

ABU DHABI OCCUPATIONAL SAFETY AND HEALTH SYSTEM FRAME WORK (ADOSH-SF)

- ▶ This code of practice (cop) applies to all employer within the emirate of Abu Dhabi. This cop is designed to incorporate requirements set by Abu Dhabi occupational safety and health center (ADOSH) and sector regulatory authorities in the emirate of Abu Dhabi.
- ▶ This Code of Practice (CoP) establishes the requirements & standards so that the risks associated with the use of lifting equipment and lifting accessories are assessed, that control measures are implemented in accordance with the hierarchy of controls measures are taken to prevent injury, illness and disease to persons who might be exposed to risks rising from those activities

THE LAW & STANDARDS

ABU DHABI OCCUPATIONAL SAFETY AND HEALTH SYSTEM FRAME WORK (ADOSH-SF)

Abu Dhabi Environmental Health & Safety Regulatory Body COP 034 of July 2024
“Safe use of Lifting Equipment and Lifting Accessories”.

1. Training & Competency.
2. Roles & Responsibilities.
3. Appointed Person Requirements.
4. Lifting Plan Requirements.
5. Planning & Assessment.
6. Selection of Lifting Equipment.
7. Safe use of Lifting Equipment.
8. Emergency Procedure.
9. Crane Type Specification Requirement.
10. Goods & Passenger Hoists.
11. Thorough Examination, Inspection & Testing.
12. Maintenance of Lifting Equipment & Records Keeping

THE LAW & STANDARDS

ADNOC GROUP LIFTING AND HOISTING OPERATIONS STANDARD CORPORATE PRACTICE (HSE-PSW-CP19)

- ▶ ADNOC Group Lifting And Hoisting Operations standard is in place to ensure that all lifting equipment is used as well as lifting and hoisting operations are planned and conducted in a safe manner. This standard defines the ADNOC Group requirements for management of Lifting and Hoisting Operations.
- ▶ This Standard shall apply to all ADNOC Group personnel, contractors and third parties engaged in lifting and hoisting operations and to all lifting equipment to be used at all ADNOC Group operating facilities, Major Projects, Greenfield Projects, Brownfield Projects, Drilling, Logistics, Operations, Maintenance, Inspection and Decommissioning both in the onshore and offshore facilities.

THE LAW & STANDARDS

ADNOC Life-Saving Rules



LIFE-SAVING RULES

	<p>WORK AUTHORIZATION Work with a valid permit when required</p>		<p>SAFE MECHANICAL LIFTING Plan lifting operations and control the area</p>
	<p>CONFINED SPACE Obtain authorization before entering a confined space</p>		<p>TOXIC GAS Follow the rules for working in toxic gas environments</p>
	<p>ENERGY ISOLATION Verify isolation and zero energy before work begins</p>		<p>DRIVING Follow safe driving rules</p>
	<p>BYPASSING SAFETY CONTROLS Obtain authorization before overriding or disabling safety controls</p>		<p>LINE OF FIRE Keep yourself and others out of the line of fire</p>
	<p>WORKING AT HEIGHT Protect yourself against a fall when working at height</p>		<p>HOT WORK Control flammable and ignition sources</p>

100% HSE

This is THE ADNOC WAY

THE LAW & STANDARDS

LIFTING OPERATION AND LIFTING EQUIPMENT REGULATIONS (LOLER) 1998

- ▶ If you have a lift you must comply with LOLER (Lifting Operations and Lifting Equipment Regulations 1998).
- ▶ LOLER regulations came into force on 5th December 1998.
- ▶ LOLER is a specific regulation, which covers all equipment that involves lifting people and goods at work.
- ▶ LOLER is applicable to all industries where lifting operations are been carried out.
- ▶ The LOLER Regulations aim to make working life safer for everyone using and coming into contact with lifting equipment

THE LAW & STANDARDS

LIFTING OPERATION AND LIFTING EQUIPMENT REGULATIONS (LOLER) 1998

- Reg. 1 - Citation and commencement
- Reg. 2 - Interpretation
- Reg. 3 - Application
- Reg. 4 - Strength and stability
- Reg. 5 - Lifting equipment for lifting persons
- Reg. 6 - Positioning and installation
- Reg. 7 - Marking of lifting equipment
- Reg. 8 - Organization of lifting operations
- Reg. 9 - Thorough examination and inspection
- Reg. 10 - Reports and defects

THE LAW & STANDARDS

LIFTING OPERATION AND LIFTING EQUIPMENT REGULATIONS (LOLER) 1998

- ▶ Reg. 11 - Keeping of information
- ▶ Reg. 12 - Exemption for the armed forces
- ▶ Reg. 13 - Amendment of the Shipbuilding and Ship-repairing Regulations 1960
- ▶ Reg. 14 - Amendment of the Docks Regulations 1988
- ▶ Reg. 15 - Repeal of provisions of the Factories Act 1961
- ▶ Reg. 16 - Repeal of section 85 of the Mines and Quarries Act 1954
- ▶ Reg. 17 - Revocation of instruments

THE LAW & STANDARDS

PROVISION AND USE OF WORK EQUIPMENT REGULATIONS (PUWER) 1998

- ▶ The PUWER 1998 regulations deal with the work equipment and machinery used every day in workplaces and aims to keep people safe wherever equipment and machinery is used at work.
- ▶ PUWER regulations came into force on 5th December 1998.
- ▶ PUWER covers all equipment that is used by an employee at work,
- ▶ PUWER states that all work equipment must be suitable for the purpose for which it is used.

THE LAW & STANDARDS

PROVISION AND USE OF WORK EQUIPMENT REGULATIONS (PUWER) 1998

- ▶ Reg. 1 - Citation and commencement
- ▶ Reg. 2 - Interpretation
- ▶ Reg. 3 - Application
- ▶ Reg. 4 - Suitability of work equipment
- ▶ Reg. 5 - Maintenance
- ▶ Reg. 6 - Inspection
- ▶ Reg. 7 - Specific risks
- ▶ Reg. 8 - Information and instructions
- ▶ Reg. 9 - Training
- ▶ Reg. 10 - Conformity with Community requirements
- ▶ Reg. 11 - Dangerous parts of machinery
- ▶ Reg. 12 - Protection against specified hazards

THE LAW & STANDARDS

PROVISION AND USE OF WORK EQUIPMENT REGULATIONS (PUWER) 1998

- ▶ Reg. 13 - High or very low temperature
- ▶ Reg. 14 - Controls for starting or making a significant change in operating conditions
- ▶ Reg. 15 - Stop controls
- ▶ Reg. 16 - Emergency stop controls
- ▶ Reg. 17 - Controls
- ▶ Reg. 18 - Control systems
- ▶ Reg. 19 - Isolation from sources of energy
- ▶ Reg. 20 - Stability
- ▶ Reg. 21 - Lighting
- ▶ Reg. 22 - Maintenance operations
- ▶ Reg. 23 - Markings
- ▶ Reg. 24 - Warnings

THE LAW & STANDARDS

CODE OF PRACTICE FOR SAFE USE OF CRANE - BS7121

BS 7121 gives recommendations for the safe use of cranes permanently or temporarily installed in a work environment.

What BS 7121-1 covers:

- ▶ Safe systems of work selection
- ▶ Erection and dismantling
- ▶ Maintenance
- ▶ Inspection
- ▶ Thorough examination
- ▶ Operation
- ▶ Planning and management

DUTIES & RESPONSIBILITIES

ROLES & RESPONSIBILITIES

The roles and responsibilities of the following key personnel shall be considered:

- ▶ Appointed Person (Person in Charge)
- ▶ Lifting / Crane Supervisor
- ▶ Crane Operator
- ▶ Rigger/Slinger
- ▶ Banksman/Signaler



ROLES & RESPONSIBILITIES

APPOINTED PERSON

- ▶ Appointed Person is a person nominated by the management to be in overall control of lifting operations in his area, he shall be qualified, trained, certified and be competent to plan and supervise the specific Lifting Operations
- ▶ Appointed Person can be any one of the following established posts, i.e. Lifting Supervisor/Crane Supervisor/Site Foreman/Project Supervisor/Barge Captain/Asst. Rig Manager/Vessel Master.

ROLES & RESPONSIBILITIES

APPOINTED PERSON

The Appointed Person has operational control of the lift and:

- ▶ Is designated as being in charge of planning, coordinating, controlling and executing the lift
- ▶ Selecting the correct crane and accessories for the specific task
- ▶ Ensure that the requirements of ADNOC permit to work and job safety analysis are complied with;
- ▶ Prepare the lift plan and ensure the required controls are in place
- ▶ Ensures that the lifting equipment is maintained, examined and appropriate for use
- ▶ Checks that load integrity and stability as well as soil stability are satisfactory
- ▶ Ensures that people involved are competent for performing their task, aware of the task and procedures to be followed and aware of their responsibilities
- ▶ Ensure competent supervisor available should the Appointed Person delegate his duties of part thereof to others

ROLES & RESPONSIBILITIES

APPOINTED PERSON

- ▶ Ensure all necessary test certificates and other documents are available;
- ▶ Ensure all other statutory requirements and any necessary work permits are in place;
- ▶ Identify all hazards and restricted areas;
- ▶ Emergency Procedures in case of damage or impairment to the crane during operation, and for safe recovery of the crane to a holding location on the installation;
- ▶ Ensuring that the person directing crane movements (Signaller / Banksman) is readily identifiable to the crane operator by wearing high visibility clothing or distinguishing markings;
- ▶ Briefs people involved in or affected by the lift;

ROLES & RESPONSIBILITIES

APPOINTED PERSON

- ▶ Ensures the lift is carried out following the plan. Suspends the lift if changes or conditions (eg, wind) occur that would cause a deviation from the plan;
- ▶ Monitors the performance of all involved personnel to ensure that adequate standards of performance are maintained;
- ▶ Manages any special issues such as language barriers and new/inexperienced staff;
- ▶ Checks that there is no deviation from standards for routine lifts;
- ▶ Shall allow for concurrent or simultaneous operations that may affect or be affected by the lift, eg, helicopter operations, ballast control, other cranes.
- ▶ During complex lifting operations, the Appointed Person (AP), who also may acts as the Performing Authority, may delegate the task of lifting supervision to the Deck Foreman, Deck Pusher, or a Competent Crane Operator—provided the delegated individual is certified Lifting Supervisor and acting as the Job Performer (JP) in the Permit to Work (PTW). However, the AP remains accountable for the overall Operation, safe planning and for conducting the Toolbox Talk (TBT) prior to the start of the job

ROLES & RESPONSIBILITIES

APPOINTED PERSON

The Appointed Person is responsible for implementing a **Safe System Of Work**. He is responsible for ensuring that this safe system of work is communicated to all personnel involved, usually via a method statement.

A **Safe System Of Work** should be established and complied with for each lifting operation, whether it is an individual lift or a group of repetitive operations. A safe system of work should be applied if the lifting operations are carried out at a site or if the crane is a permanent fixture (e.g. in a factory or at a dock).

The **safe system of work** should include the following:

- a) Risk assessment;
 - b) Planning of the operation;
 - c) Preparation of a method statement;
 - d) Selection, provision and use of a suitable crane(s) and equipment, including:
 - 1) maintenance; 2) inspection; 3) examination, and testing if required;
 - e) Preparation of the site, if required;
 - f) Provision of properly trained and competent personnel aware of their statutory responsibilities;
- (NOTE: It is essential for the safety of the operation to ensure that all personnel can communicate clearly.)
- g) Supervision by properly trained and competent personnel with authority;
 - h) Ensuring that all test certificates and other documents are available;
 - i) Always preventing unauthorized movement or use of the crane;
 - j) Consideration for the safety of persons in the danger zone but not involved in the lifting operation.

Planning should include consideration of the following:

- a) the load characteristics and the method of lifting; (NOTE It may also be necessary to allow for any adhesion between the load and its support.)
- b) selection of an appropriate crane(s) for the operation, ensuring that sufficient clearances are maintained between the load(s) and the crane structure;
- c) selection of lifting accessories, including taking into account the weight of accessories on the total load on the crane(s);
- d) the position of the crane(s) and load before, during and after the operation;

APPOINTED PERSON DUTIES

- Coordinating
- Method Statement & Risk Assessment Preparation
- Planning (Safe System of Work)
- Selection of Crane(s), Lifting Gear & Equipment
- Instruction, Supervision & Consultation
- Inspection & Maintenance
- Reporting procedures
- Organisation and Control
- Stopping the Job if Unsafe

ROLES & RESPONSIBILITIES

LIFTING SUPERVISOR

- ▶ Person nominated by the Appointed Person to implement the Lifting Plan in his area, he shall be qualified, trained, certified and be competent to supervise the specific Lifting Operations; he could prepare certain categories of Lifting Plans provided he is qualified, trained and certified to do so Ensures the lift is carried out following the plan. Suspends the lift if changes or conditions (eg. wind) occur that would cause a deviation from the plan;
- ▶ The Lifting Supervisor is the only person who has operational control of the lift and has the authorization to give instructions to the lifting crew during the operations. The Lifting Supervisor has the required level of competence to plan and supervise the specific lifting and hoisting operation.

ROLES & RESPONSIBILITIES

LIFTING SUPERVISOR

- ▶ Their responsibilities include all the tasks of the AP except the development and approval of Lift plan but may be involved in its development.
- ▶ Define the lifting appliance set-up/configuration, ensuring the correct equipment is available and safety devices are installed and operational as per approved lift plan
- ▶ Ensure the travel route of the lifting operation is clear and free from hazards and obstructions (e.g., overhead obstacles such as powerlines) to enable the lifting equipment and load to safely travel from the lifting to landing point without being impeded by any obstacles
- ▶ Ensure there are good access and egress routes for the lifting team, including putting in place safe alternative routes if walkways are obstructed.

ROLES & RESPONSIBILITIES

LIFTING SUPERVISOR

The Lifting / Crane Supervisor has operational control of the lift and:

- ▶ Is designated as being in charge of coordinating, controlling and executing the lift as per the lift plan and ensure the required controls are in place;
- ▶ Ensures the lift is carried out following the plan. Suspends the lift if changes or conditions (eg, wind) occur that would cause a deviation from the plan;
- ▶ Ensures that the lifting equipment is maintained, examined and appropriate for use;
- ▶ Checks that load integrity and stability are satisfactory;
- ▶ Ensures that people involved are competent for performing their task, aware of the task and procedures to be followed, and aware of their responsibilities;
- ▶ Monitors the performance of all involved personnel to ensure that adequate standards of performance are maintained;

ROLES & RESPONSIBILITIES

LIFTING SUPERVISOR

- ▶ Manages any special issues such as language barriers and new/inexperienced staff
- ▶ Checks that there is no deviation from standards for routine lifts
- ▶ Shall allow for concurrent or simultaneous operations that may affect or be affected by the lift, eg. other cranes.
- ▶ Ensure all necessary test certificates and other documents are available
- ▶ Ensure all other statutory requirements and any necessary work permits are in place
- ▶ Ensure a Red Zone is established and Identify all hazards and restricted areas

ROLES & RESPONSIBILITIES

LIFTING SUPERVISOR

- ▶ Emergency Procedures in case of damage or impairment to the crane during operation, and for safe recovery of the crane to a holding location on the installation;
- ▶ Ensuring that the person directing crane movements (Signaler / Banksman) is readily identifiable to the crane operator by wearing high visibility clothing or distinguishing markings;
- ▶ Ensuring that the workplace is provided with adequate lighting for lifting;
- ▶ Briefs people involved in or affected by the lift;

ROLES & RESPONSIBILITIES

CRANE OPERATOR

- ▶ The crane operator is responsible for the correct operation of the crane as per the instruction given by the manufacturer.
- ▶ Be responsible to operate specific type of Crane only for which he is trained and assessed.
- ▶ He shall only respond to the instruction (signals) given by the Banksman; however, he shall follow the Emergency Stop Signal from any one at site in case of any emergency.
- ▶ Daily pre-start checks shall be performed prior to commencing operations and should assist with the change out of ropes and hook blocks and procedures recommended by the crane manufacturer and operating company including updating the log book.
- ▶ The crane should be secured at the end of each working shift.
- ▶ The crane Operator shall also be responsible for reporting all defects noted during operation of the crane to the Site Lifting Supervisor / Crane Supervisor or Maintenance Focal Person.

CRANE OPERATOR

- ▶ Ensure that the crane and other involved accessories etc. are within inspection and testing intervals by examination of periodic re-certification tags or/and documentation.
- ▶ Not engaged in any other activity that might divert the attention while engaged in the operation of the crane.
- ▶ Drive the Crane at speed appropriate for the existing conditions(space, load, lighting, surface condition etc.) and at or below posted limits.
- ▶ Assess the stability of the ground/equipment and environmental conditions are within operating procedures and test the communications system. .
- ▶ Observe and note other activities within load /equipment operating area to avoid the development of any unforeseen hazards.
- ▶ Duly complete all required operations log, pre-use inspection procedure and checks.
- ▶ Perform pre-operational checks and function testing of equipment they operate to demonstrate operational readiness of the equipment.

CRANE OPERATOR

- ▶ Ensure that the mobile crane should be used on level ground or else set level on outriggers before any load is applied.
- ▶ Fully conversant with the correct use of mobile crane outriggers and where outriggers should be fitted, and aware of how to properly support the outrigger feet (this requires regular monitoring to ensure that no movement occurs throughout the operation).
- ▶ Able to set and check the functioning of the rated capacity limiter and rated capacity indicator.
- ▶ Aware of the effects of wind, sea condition and other climatic effects on the crane and load.
- ▶ Able to resist pressures from other persons to carry out unsafe operations.
- ▶ Able to take the action to avoid dangerous situations, including stopping operations.
- ▶ Able to operate fire extinguishers / fire suppressant equipment.

CRANE OPERATOR

- ▶ Warn other personnel in the area of proximity, load or equipment movements.
- ▶ Not knowingly operate the faulty and defective equipment.
- ▶ Be responsible to take the action to avoid dangerous situations, including stopping operations
- ▶ Crane operator shall be responsible to control the crane operations as per approved lifting Plan.
- ▶ Shall verify the lifted personnel wear the required PPE for the Lift.

ROLES & RESPONSIBILITIES

RIGGER / SLINGER

Rigger / Slinger Shall be:

- ▶ Be responsible for the selection of the correct lifting arrangement in accordance with planned lifting operations
- ▶ Check that the lifting equipment being used is in good condition, certified for use, correctly color coded, and sufficient capacity to carry out the lift
- ▶ Be responsible for attaching and detaching the load to and from the crane
- ▶ Ensure that no load is to be lifted where the weight is not stated or unknown;
- ▶ Be aware of any obstructions within the crane radius and working area
- ▶ Observe and note other activities within the crane's operating area to avoid the development of any unforeseen hazards
- ▶ Ensure that crane hook is positioned above load center signaling to the crane operator

RIGGER / SLINGER

- ▶ Ensure that no personnel standing near the load or near the load already position;
- ▶ Ensure that escape route is identified;
- ▶ Check that no personnel are beneath the load whilst lifting is in progress;
- ▶ Ensure all hands are free of lifting accessories and stand clear before the load strain is taken;
- ▶ Ensure at times that the load is under complete control by the use of tag lines, or whatever assistance that is deemed necessary;
- ▶ Clearly indicate to the crane operator where the load has to be moved to or placed and, where possible, he shall follow each load to its destination;
- ▶ Warn other personnel in the area of the movement of the load; and
- ▶ Stop the lifting operation if anything out of the ordinary occurs and check that it is safe to continue the operation, solely direct the lifting and load activities and operations.

RIGGER / SLINGER

Have at least following experience for relevant lifting operations:

- ▶ For Trainee Rigger : 0-6 months of on-site working experience; e (not allowed to work independently, always supervised by another experienced rigger);
- ▶ For Rigger Level-1: Minimum 6-12 months of experience;
- ▶ For Rigger Level-2: 12-24 months of experience; and
- ▶ For Rigger Level-3: Minimum of 36 months of experience.
- ▶ Be trained for 2-days course, by an ADNOC Group approved Training Company using approved Tutor and be assessed every 2 years,
- ▶ Hold certificate of competency issued by ADNOC Group approved Training Company using approved Tutor on completion of above stated course;

LIFT CATEGORY			
RIGGER LEVEL	SIMPLE	COMPLICATED	NON-ROUTINE COMPLEX
1	√	X	X
2	√	√	X
3	√	√	√

ROLES & RESPONSIBILITIES

BANKSMAN / SIGNALLER:



Banksman / Signaller shall be:

- ▶ Responsible for directing the movement of the crane / load using the designated signaling method;
- ▶ Stand in a place where he can see the Load and Crane Operator can clearly see him;
- ▶ Banksman has the duties to guide the Crane / Forklift / MEWP (Man-lift) during Equipment transport;
- ▶ Where Radio System is being used as means of communication; Crane Operator shall agree with the Banksman and Rigger for the Frequency Channel during TBT (Tool Box Talk);
- ▶ Banksman shall wear high visibility clothing to identify him from other personnel;
- ▶ The Banksman cannot work as a Rigger unless he was trained, experienced and competent.

PERSONAL PROTECTIVE EQUIPMENT

BASIC PPE

Personal protective equipment is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection.

The Banksman, Riggers & Crane operators shall wear the required P. P. E. as state below:

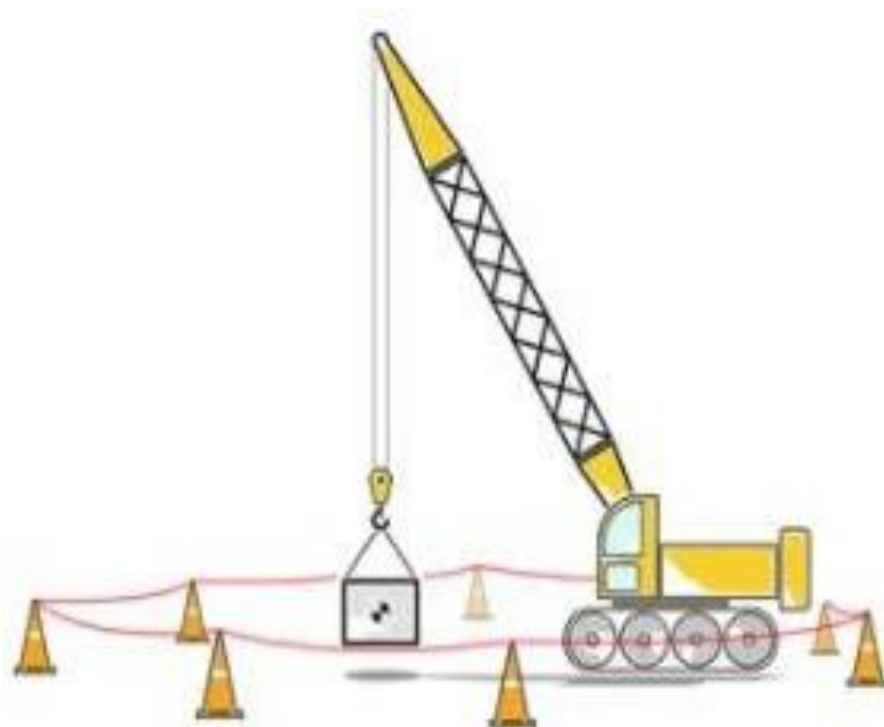
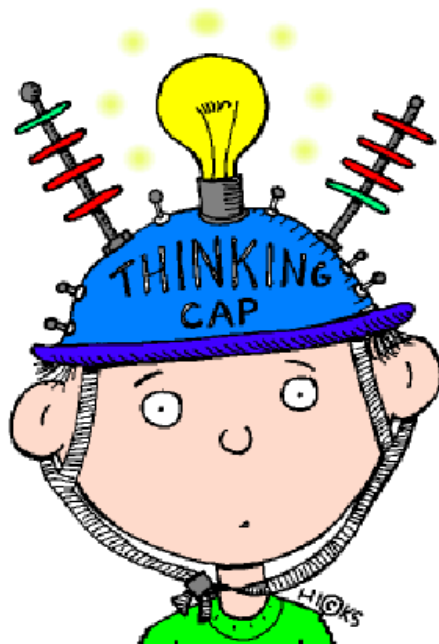
- ▶ Helmet with Chin Strap,
- ▶ Safety shoes,
- ▶ Coverall,
- ▶ Gloves,
- ▶ Hi Visibility vest for Banksman,

and special requirements as applicable (such as ear plugs, gas mask, glasses ... etc.).



WHAT IS LIFTING OPERATION

Transfer of load / personnel from one place to the other place with the help of lifting equipment in a safe and controlled manner.



WHAT IS SAFE LIFTING OPERATION:

No damage to:

- ▶ Personnel
- ▶ Property
- ▶ Lifting Equipment
- ▶ Environment.
- ▶ Site etc.



CATEGORIZATION OF LIFTING OPERATIONS

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING AND HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

As a pre-requisite and in order to identify minimum controls, Lifting and hoisting operations shall, at all times, be categorized. The following lift categories are recognized as per ADNOC Lifting and Hoisting Operations standard (HSE-PSW- CP19) :

- ▶ Simple Lift,
- ▶ Complicated Lift and
- ▶ Non-Routine Complex.

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

1. Simple Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
<ol style="list-style-type: none"> 1. Load Net Weight less than or equal to 80% SWL; within the normal operating parameters of the lifting equipment. 2. Permanent/Temporarily installed lifting equipment. 3. Certified lifting point or points. 4. Ample headroom to complete lifting operations. 5. Not lifting over live plant or occupied areas or people. 6. Not lifting over or in close proximity (less than 3 m) to active or energized hydrocarbon process or pressurized utilities process equipment. 7. Load has known and uniformly distributed Weight, Uniform Shape, and Identified Centre of Gravity. 8. Centre of gravity below the lifting points. 9. Lifts with or without pre-slung arrangement and/ or not using any special lifting accessories/ attachments or slinging methods (Standard rigging arrangement), 10. Suitable lay down area available. 11. Single Lifting Appliance. 12. Not lifting personnel. 13. Using proprietary lifting accessories or attachments for vehicle loading and unloading (See Example 6 below). 14. Skidding Operation using Skates & Ground Trolleys. 	<ol style="list-style-type: none"> 1. Risk Assessment (generic) in line with the requirements of ADNOC HSE Corporate Practice for JSA. 2. Lifting Plan (generic reviewed annually) 3. Work Permit as required by ADNOC HSE Corporate Practice for permit to work. 4. Toolbox Talk. 5. Ten questions for a safe lift through IOGP Mechanical Lifting Start-Work Check (SWC). 	<ol style="list-style-type: none"> 1. Lifting Equipment Operator and Rigger/ Banksman as required. 2. Lifting Supervisor

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

2. Complicated Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
<ol style="list-style-type: none"> 1. Load Net Weight more than 80% SWL but less than 90% SWL; without any Factor of Safety with exception of Overload Testing of Fixed and Mobile Lifting Appliances”. 2. Temporary installed lifting equipment. 3. Non-certified lifting point or points Where load testing is not applicable but validated through engineering calculation 4. Limited headroom to complete lifting operations. 5. Lifting in close proximity (less than 3 m) to active or energized hydrocarbon process or pressurized utilities process equipment. 6. Load is unknown or not uniformly distributed weight, or not uniform shape, or difficult to identify center of gravity or not Robust Packaging. 7. Centre of gravity above the lifting points. 8. Use of special lifting accessories, attachments or slinging methods (Non-standard rigging arrangements). 9. Unsuitable or unavailable lay down area. 10. Use of two or more Lifting Appliances including tailing pipes using winch and crane (Tandem Lift). 11. Lifting of personnel, including rig floor Man-Riding winch operations. 	<ol style="list-style-type: none"> 1. Risk Assessment (generic) in line with the requirements of ADNOC HSE Corporate Practice for JSA. 2. Lifting Plan (generic reviewed annually) 3. Work Permit as required by ADNOC HSE Corporate Practice for permit to work. 4. Toolbox Talk. 5. Ten questions for a safe lift through IOGP Mechanical Lifting Start-Work Check (SWC). 	<ol style="list-style-type: none"> 1. Lifting Equipment Operator and Rigger/ Banksman as required. 2. Rigging Foreman 3. Appointed Person, 4. Single Point Authority 5. TPA competent person.

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

2. Complicated Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
12. Load lowered into or lifted from a confined space. 13. When the wind load is calculated with applicable Crane wind speed limit as per OEM. 14. Overload testing 15. Cross-hauled the load or restrained using two or more non powered (Manual) lifting appliance.		
Examples: 1. Direct Lifting operation near pipe corridor but not over it; however, crane's failure could lead to part of the Crane or load coming close to a pipe. 2. Transferring loads from ship to ship or ship to shore/ platform in adverse weather (high winds or wave height above 4 m). 3. Jacket Piles installation and possible upending of pile on-board the Barge prior to install it vertically. 4. Lifting Tubulars (All types)		

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

3. Non-routine Complex Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
<ol style="list-style-type: none"> 1. Load Net Weight is ≥ 90 % of SWL (without any factor of safety); however Dynamic Lift Load which is compared to Load Chart shall not exceed 100% SWL considering all applicable Factors of Safety. 2. Temporary installed lifting equipment. 3. Limited headroom to complete lifting operations. 4. Lifting over active or energized hydrocarbon or pressurized utilities process equipment. 5. Load is unknown or not uniformly distributed weight, or not uniform shape, or difficult to identify centre of gravity or not Robust Packaging. 6. Centre of gravity above the lifting points. 7. Large loads (large Surface Area/ Volume) requiring special lifting and slinging requirements. 8. Unsuitable or unavailable lay down area. 9. Tandem lift with two cranes or more. 10. Dangerous goods cargo lifting, such as explosives, propane tanks etc. 11. Load is special and/or expensive the loss of which would have a serious impact on production operations, e.g. power plant turbine. 12. Snatching a load from untied vessel for None DP/II (Dynamic Positioning) vessels. 	<ol style="list-style-type: none"> 1. Formal work pack (Lifting Plan Dossier Appendix 6) with method statement. 2. Risk Assessment (Activity specific scenario based) in line with the requirements of ADNOC WMS 3. Lifting Plan specific to the task prepared by AP, reviewed by qualified TPA (If required) and reviewed/ approved by SPA/ TA. 4. Drawings shall mention Crane Position in Plan & Elevation and Rigging Plan before and after Lift and clearly marked (to scale if identified in risk assessment). 5. Work Permit as required by ADNOC WMS. 6. Toolbox Talk. 7. Ten questions for a safe lift through IOGP Mechanical Lifting Start Work Check (SWC). [Refer to Section 7.3.3] 	<ol style="list-style-type: none"> 1. At site-Competent Lifting Equipment Operator. 2. In addition, for cranes- Rigger level 3/ Signaler/Banksman. 3. Lifting Supervisor 4. Appointed Person. 5. Single Point Authority. 6. Asset Owner. 7. Lifting Technical Authority. 8. Third Party Lifting Specialists (If requested by the site or the project).

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

3. Non-routine Complex Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
13. Transferring the load from one lifting appliance to another. 14. Lifting with a helicopter. 15. Subsea lifting (the entire Load to be submerged in the water regardless of Crane's Hook Block).		
Examples: 1. Recovering a failed lifting operation with additional/ replacement equipment due to malfunction, inadequacy or unsuitability of existing equipment. 2. Heavy Loads or loads likely to be affected by environmental/ weather conditions such as high winds. 3. All Helicopter lifting operations (Snatch Lift).		

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(✓)		
		Simple	Complicated	Non-routine Complex
1	Load Net Weight $\geq 90\%$ of SWL (without any factor of safety); however Dynamic Lift Load which is compared to Load Chart shall not exceed 100% SWL considering all applicable Factors of Safety.			✓
2	Large loads (large Surface Area/Volume) requiring special lifting & slinging arrangements, when the wind load is calculated.			✓
3	Dangerous goods cargo lifting, such as explosives, propane tanks etc.			✓
4	Load is special and/or expensive the loss of which would have a serious impact on production operations, e.g. power plant turbine.			✓
5	Lifting overactive or energized process equipment or utilities.			✓
6	Transferring load from one lifting appliance to another			✓

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(✓)		
		Simple	Complicated	Non-routine Complex
7	Tandem lift with two cranes or more.			✓
8	Snatching a load from untied vessel for none DP/II (Dynamic Positioning) vessels.			✓
9	Subsea lifting (the entire Load to be submerged in the water regardless of Crane's Hook Block).			✓
10	Lifting with a helicopter			✓
11	Load Net Weight more than 80% SWL but less than 90% SWL without any Factor of Safety (with exception of Overload Testing of Fixed and Mobile Lifting Appliances).		✓	
12	Load unknown or having not uniformly distributed weight, or not uniform shape, or difficult to identify centre of gravity or not Robust Packaging.		✓	
13	COG is above the lifting points.		✓	

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(√)		
		Simple	Complicated	Non-routine Complex
14	Non-certified Lifting points where load testing is not applicable but validated through engineering calculation		√	
15	Unsuitable or unavailable lay down area.		√	
16	Load lowered into or lifted from a confined space, or blind lift		√	
17	Large loads (large Surface Area/ Volume) requiring special lifting and slinging arrangements, when the wind load is calculated with applicable Crane wind speed limit as per OEM.		√	
18	Lifting in close proximity (less than 3m), but not over live/energized process equipment or utilities, or occupied areas or people.		√	
19	Cross-hauled the load or restrained using two or more non-powered (Manual) lifting appliance		√	
20	Using two or more Lifting Appliances, including tailing pipes using winch and one crane (Tandem Lift).		√	

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(√)		
		Simple	Complicated	Non-routine Complex
21	Personnel lifting, including rig floor Man-Riding winch operations.		√	
22	Overload testing of the crane.		√	
23	Permanent / Temporary installed lifting equipment.	√		
24	Using Proprietary lifting accessories or attachments for vehicle loading and unloading.	√		
25	Lifts without pre-slung arrangement and/ or use of specialist lifting accessories; attachments or slinging methods (Non-std. rigging arrangements).	√		
26	Limited headroom to complete lifting operations.	√		
27	Skidding Operation using Skates & Ground Trolleys.	√		

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(✓)		
		Simple	Complicated	Non-routine Complex
28	Load Net Weight less than or equal to 80% SWL within the normal operating parameters of the lifting equipment.	✓		
29	Load is known and having uniformly distributed Weight, Uniform Shape, and Identified Centre of Gravity.	✓		
30	COG is below the lifting points.	✓		
31	Permanently installed lifting equipment.	✓		
32	Lifts with / without pre-slung arrangement and/ or not using any special lifting accessories/ attachments or slinging methods (Standard rigging arrangement).	✓		
33	Ample headroom to complete lifting operations.	✓		
34	Certified Lifting points.	✓		

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(✓)		
		Simple	Complicated	Non-routine Complex
35	Suitable lay down area available.	✓		
36	No lifting over or in close proximity (less than 3m)to live/energized process equipment or utilities, or occupied areas, or people.	✓		
37	Single Lifting Appliance.	✓		
38	No personnel lifting.	✓		

CATEGORIZATION OF LIFTING EQUIPMENT

CATEGORIZATION OF LIFTING EQUIPMENT

THERE ARE THREE CATEGORIES OF LIFTING EQUIPMENT:

- ▶ **Lifting Appliances** : Any Mechanical Device capable of raising or lowering a load.
- ▶ **Lifting Accessories** : Any Device that is used or designed to be used directly or indirectly to connect a load to a Lifting Appliance and does not form part of the load.
- ▶ **Lifted Equipment** : Any Device that is used to carry the load (containers, baskets, cargo nets, pipe racks, skids, bulk containers etc.).

Lifting Equipment: Comprises of Lifting Appliances, Lifting Accessories and Lifted Equipment.

CATEGORIZATION OF LIFTING EQUIPMENT

Lifting Appliances	Lifting Accessories	Lifted Equipment
<ol style="list-style-type: none"> 1. Cranes - Pedestal Crane, Mobile Crane, Overhead Crane, Free Standing Knuckle Crane, Tower Crane, Jib Crane, Floor Crane, etc. 2. Life Boat /Life Raft/Fast Rescue. Boat Davits with Associated Equipment. 3. Davit for General Purposes. 4. Forklift Trucks. 5. Pallet Stackers. 6. Pallet Trucks. 7. Personnel & Goods Lift. 8. Suspended Cradles. 9. Powered Hoists (Pneumatic & Electric). 10. Manual Hoists (Chain Blocks, Lever Hoists and Hoists with Built-in Trolleys). 	<ol style="list-style-type: none"> 1. Wire Ropes for Appliances (Cranes, Davits, Elevators, Cradles, Winches etc.). 2. Wire Rope Slings. 3. Chain Slings. 4. Hooks & Fittings. 5. Webbing Slings. 6. Shackles. 7. Eye Bolts. 8. Rigging Screws (Turn Buckles). 9. Open Wedge Sockets. 10. Rings. 11. Swivels. 12. Links. 13. Plate Clamps. 14. Beam Clamps. 15. Lifting Beams/ Spreader Bars. 	<ol style="list-style-type: none"> 1. CCUs (Containers, Baskets, Racks, Boxes, Waste Skips etc.). 2. Skid Mounted Equipment. 3. Man Basket (Work basket). 4. Man basket (Transfer Basket). 5. Cargo Net. 6. Pallets. 7. Dead Weights (Test Weights). 8. Mooring Blocks. 9. Gangway. 10. Skates & Ground Trolleys. 11. Flexible Intermediate Bulk Containers (Jumbo Bags). 12. Pallet forks.

CATEGORIZATION OF LIFTING EQUIPMENT

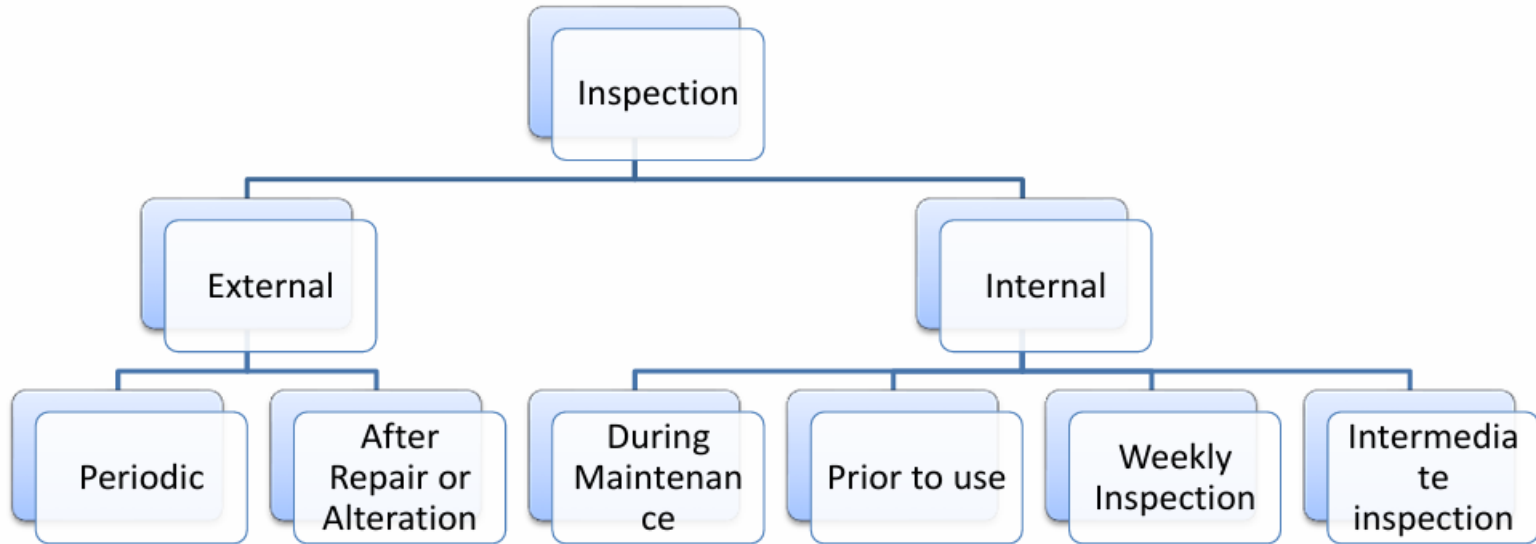
Lifting Appliances	Lifting Accessories	Lifted Equipment
11. Jaw Winches (e.g. Tirfors). 12. Beam Trolleys. 13. Runway Beams/Monorails. 14. Sheave/Pulley/Snatch Block. 15. Fixed Structural Pad Eyes. 16. Crane Hook Block. 17. Hydraulic Rams & Jacks. 18. Winch (Pneumatic, Electric, 19. Hydraulic, Manual and Man Riding) including Mooring/Towing/Anchor Winches. 19. Mobile Elevated Work Platform (Man-Lift). 20. Launching & Recovery System (LARS). 21. A-Frame gantry. 22. Personnel Rescue Equipment (Tripod c/w Winch). 23. Vehicle Lift. 24. Gin Wheel.	16. Drum Lifter. 17. Towing Assembly 18. HMPE Ropes (e.g. Dyneema).	

CATEGORIZATION OF LIFTING EQUIPMENT

Lifting Appliances are sub-categorized as Fixed Lifting Appliances, Mobile Lifting Appliances and Portable Appliances. (Powered and Non Powered)

Fixed Lifting Appliances	Mobile Lifting Appliances	Portable Lifting Appliances
<ol style="list-style-type: none"> 1. Pedestal Cranes. 2. Overhead/ Gantry Cranes. 3. Jib Cranes. 4. Overhead Runway beams. 5. Davits for general purposes. 6. Life Raft/ Life Boat Davits. 7. Passenger and Goods Lifts. 8. Mooring Winches. 9. Screen Winches. 	<ol style="list-style-type: none"> 1. Mobile Cranes. 2. Forklift Trucks. 3. Mobile Elevating Work Platform (MEWP- Man Lift); 4. All Jacks (Manual, Mechanical, Electrical and Hydraulic) components within standalone mobile unit. 	<ol style="list-style-type: none"> 1. Beam Trolleys. 2. Chain Blocks. 3. Lever Hoists. 4. A-Frame Gantries. 5. Personnel Rescue Tripods. 6. Personnel Carriers. 7. Pulley Blocks/ Snatch Blocks. 8. Jaw Winches (e.g. Tirfors). 9. Gin Wheels. 10. Vacuum Lifters. 11. Fall arrestors.

INSPECTION FREQUENCY FOR LIFTING EQUIPMENT



Specified period of thorough examination

Six monthly thorough examination

Twelve monthly thorough examination

Periodic Examination

Periodic Examination of lifting equipment

- Legal requirements for a Thorough Examination of all Lifting equipment by a competent Person by Approved Third party company..
- Companies using lifting equipment shall ensure that all type of Lifting appliances, accessories and lifted equipment are certified by a competent third party authority as per Regulations.



Thorough Examination & Certification is essential During Initial examination and

- Every 12 months max, for powered/Lifting appliances (except for man riding using lifting appliances, which is valid for 6 months);
- Or after repair/modifications following a dismantling or after any incident/accident.
- Every 6 months max, for Lifting accessories and non powered portable(manual operating) appliances

INSPECTION FREQUENCY FOR LIFTING EQUIPMENT

Visual Inspection:

A visual check and, where necessary, a function check of the lifting equipment by a competent person before each use. In determining the suitability and scope of the inspection, reference shall be made to information such as manufacturer's instructions and relevant industry standard.

Functional Test:

Operation of each motion of a Lifting Appliance without a load being applied in order to determine whether the Lifting Appliance performs as the OEM intended. It might be necessary to include the lifting of a suitable load once the Lifting Appliance has been tested without a load applied.

Thorough Examination:

An assessment carried out by a sufficiently independent Competent Person (Third Party Lifting Equipment Inspector) in such depth and details as the competent person considers necessary to enable him to determine whether the equipment being examined is safe to continue in use. This may include Visual Inspection, Dimensional Measurement, Functional Testing, Load Testing and Non-Destructive testing where deemed appropriate by the Competent Person. These examinations are performed at specified intervals; before putting the crane into service for the first time, following major refurbishment, repair or alteration and following an exceptional occurrence which may have affected the safety and integrity of the crane.

INSPECTION FREQUENCY FOR LIFTING EQUIPMENT

GENERAL FREQUENCY OF STATUTORY INSPECTION AND CERTIFICATION:

Type of Equipment		Frequency of Thorough Examination	Frequency of Load Testing	
			<i>SWL Test and Examination</i>	<i>PLT and Examination</i>
Cranes and Powered Lifting Appliances	Pedestal, Mobile, Overhead, Gantry, Forklift, Powered hoists etc.	Every 12 months	Every 12 months (material lifting) 6 months (personnel lifting)	Every 48/60 months
Manual Lifting Appliances	Chain blocks, Lever hoists etc.	Every 6 months	Every 12 months	N/A
Lifting Accessories	Shackles, Clamps, Eye bolts/ etc.	Every 6 months	N/A	N/A

LIFTING ACCESSORIES TYPE, USE & INSPECTION

LIFTING ACCESSORIES

Wire Rope Sling



LIFTING ACCESSORIES

Wire Rope:

A wire rope is a mechanical component made of multiple steel wires twisted together into strands and then laid around a core.

A wire rope is a load-bearing steel rope used for transmitting force, lifting, pulling, or hoisting in machines such as cranes, winches, and elevators.

Construction:

- Individual wires → strands → laid around a core
- Core types: fibre core (FC) or steel core (IWRC)
- Designed for continuous use in equipment

Common Uses:

- Crane hoist ropes
- Winch lines
- Excavators
- Elevators
- Towing systems

Key Point:

Wire rope is not ready-made lifting gear for attaching loads directly unless fitted with end terminations.

LIFTING ACCESSORIES

Wire Rope Sling:

A wire rope sling is a finished lifting accessory made from wire rope that is fabricated, terminated, and certified for lifting loads.

A wire rope sling is a pre-assembled lifting device made from wire rope with end fittings (eyes, hooks, or sockets) used to connect loads to lifting equipment.

Construction:

- Wire rope + termination fittings
- Types of terminations:
 - Flemish eye splice
 - Ferrule pressed eye
 - Swaged sockets
- Certified and tagged with WLL (Working Load Limit)

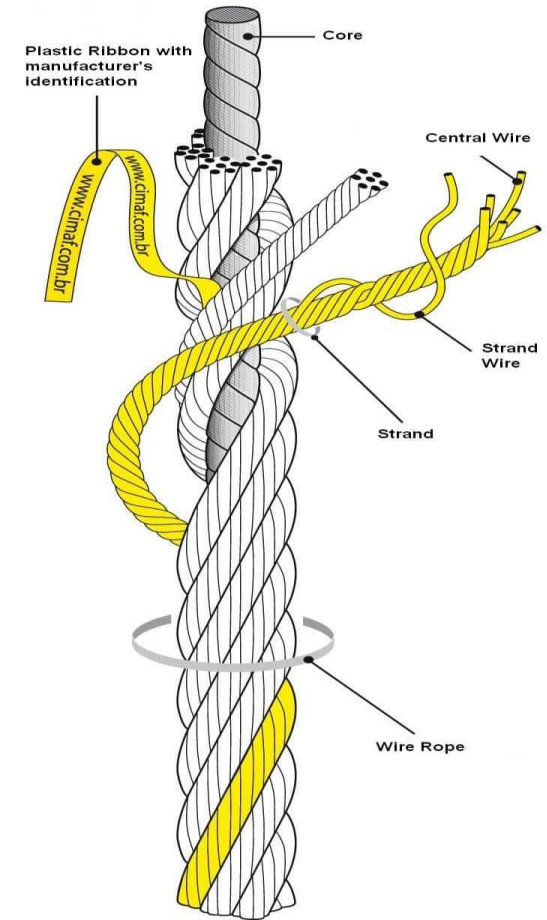
Common Uses:

- Direct lifting of loads
- Rigging applications
- Construction lifting
- Offshore lifting operations

LIFTING ACCESSORIES

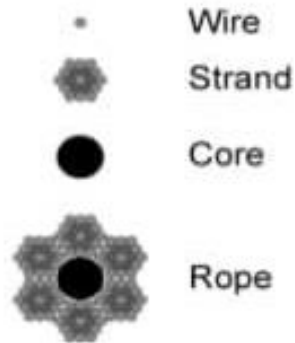
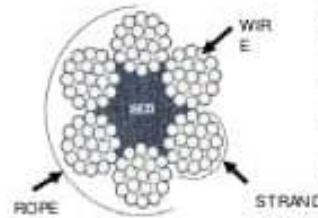
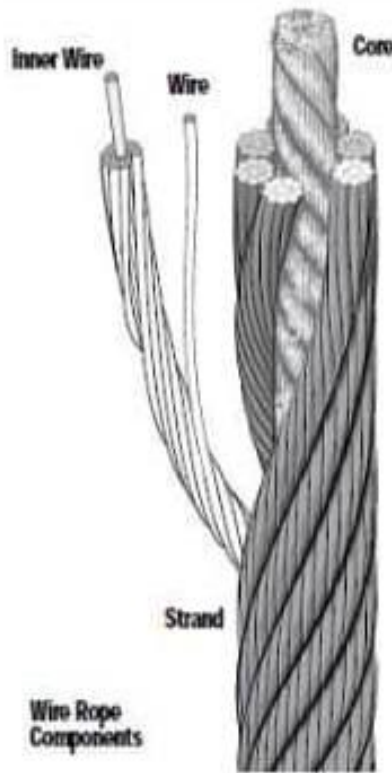
WIRE ROPE SLING: CONSTRUCTION

The construction of the wire rope is normally chose to suit the specific application. E.g. wire ropes with a steel core are preferred for winch operations as they have a greater resistant to crushing and flattening on the drums whereas both steel core and fibre core wire are suitable for sling manufacture.



LIFTING ACCESSORIES

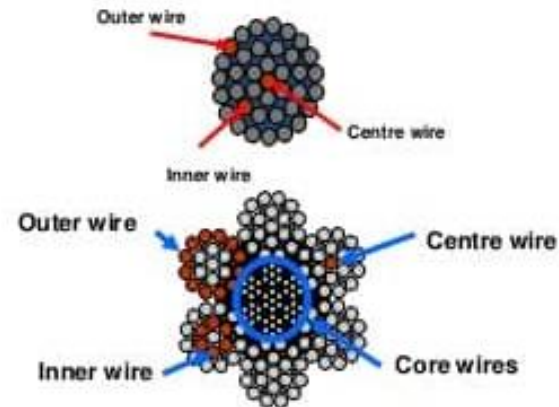
Wire Rope Sling



Used to hoist materials

Selection considerations:

- ✓ strength
- ✓ ability to bend without cracking
- ✓ ability to withstand abrasive wear
- ✓ ability to withstand abuse



LIFTING ACCESSORIES

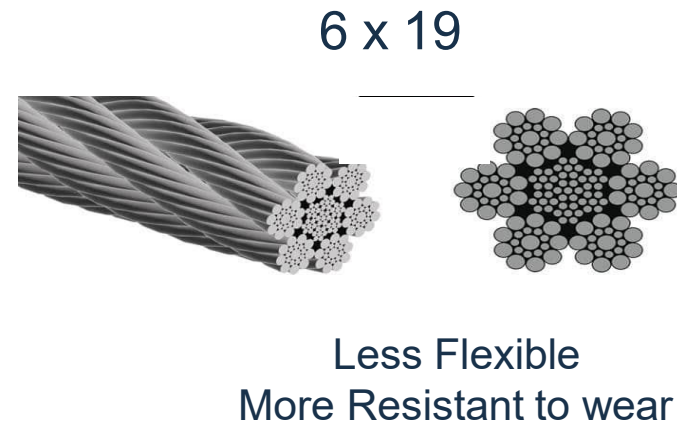
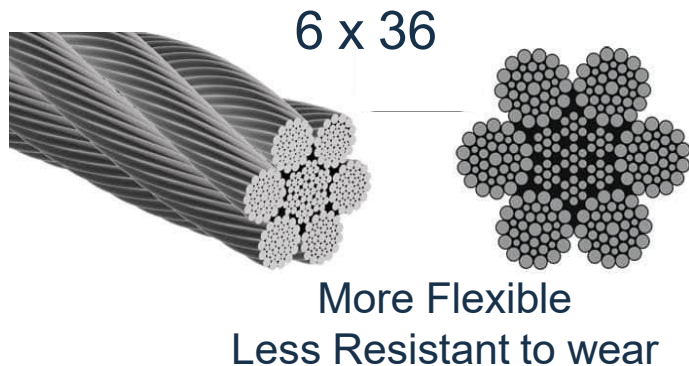
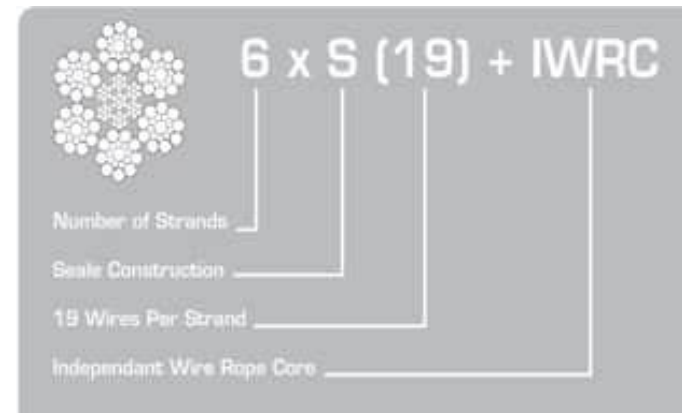
WIRE ROPE SLING: CONSTRUCTION

Interpreting Rope Construction Information:

Wire rope construction descriptions follow this format:

6 x S(19) + IWRC - 6 Strands, Seale Construction, 19 wires, Independent Wire Rope Core

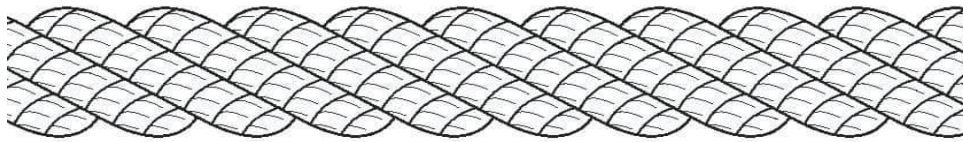
Typical Construction:



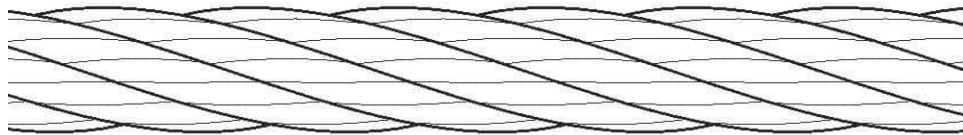
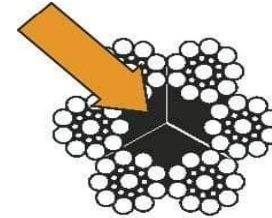
LIFTING ACCESSORIES

WIRE ROPE SLING: CONSTRUCTION

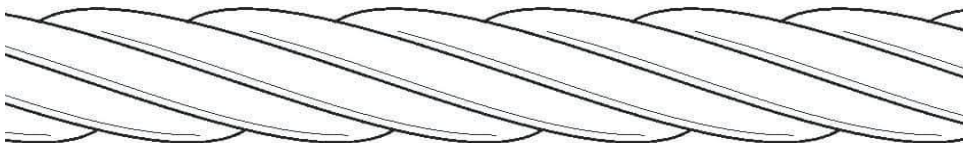
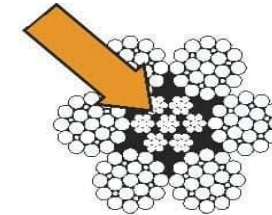
Core Type



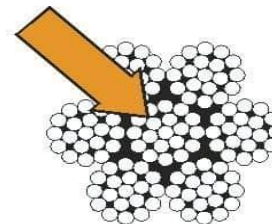
Fiber Core (FC)



Independent Wire Rope Core (IWRC)



Wire Strand Core (WSC)



LIFTING ACCESSORIES

Fiber core wire rope slings are versatile, flexible lifting tools used across industries like construction, marine, and manufacturing for general to delicate lifts, offering good shock absorption and ease of handling, though less heat-resistant than steel core slings, making them ideal for handling machinery, bundles, and items needing gentler rigging, relying on their braided wire construction for strength and a central fiber core for flexibility and load cushioning, often used with thimbles for durability at connection points.

Uses in Lifting Operations & Industries:

89

- Construction: Lifting steel beams, concrete, rebar, and machinery.
- Manufacturing: Moving heavy dies, machine parts, and assembly line components.
- Maritime/Shipping: Handling cargo, anchoring, and general rigging.
- Mining: Transporting heavy equipment and materials.
- Theatrical/Specialized: Delicate lifts requiring minimal load damage and precise positioning.

LIFTING ACCESSORIES

Advantages of Fiber Core Slings:

- Flexibility: Easier to bend and conform to load shapes.
- Shock Absorption: The fiber core helps cushion impacts.
- Maneuverability: Lighter and easier to handle than steel core.
- Corrosion Resistance: Good for humid or outdoor environments.
- Cost-Effective: Often more affordable for lighter applications.

Key Considerations:

90

- Load Capacity: Always verify load weight and ensure the sling's Working Load Limit (WLL) is sufficient.
- Heat Sensitivity: Do not use above 200°F (approx. 93°C), as heat degrades the fiber core.
- Strength vs. Steel Core: Steel core slings offer superior strength and heat resistance for heavy-duty tasks.
- Safety: Use thimbles to protect eyes, choose appropriate hitch configurations, and inspect for wear (broken wires, diameter reduction).

LIFTING ACCESSORIES

WIRE ROPE SLING: CONSTRUCTION

Type of cores	Textile	Metallic
Description	The textile core is generally made with some kind of synthetic fibres more resistant in the time than the natural fibres.	<ul style="list-style-type: none"> - Independent Wire Core (IWRC) which is itself an independent wire rope. - Wire Strand Core (WSC) used on ropes smaller than 13mm diameter, and normally the same construction as the outer strands.
Advantage	<ul style="list-style-type: none"> · Give a good flexibility to the rope. · Act as internal lubricator. 	<ul style="list-style-type: none"> - Give a higher breaking load to the rope. - Give a better resistance to crushing
Disadvantage	Poor resistance to crushing	Poor flexibility

LIFTING ACCESSORIES

COMPARISON TABLE FOR CORE CONSTRUCTION

Feature	FC (Fibre Core)	WSC (Wire Strand Core)	IWRC (Steel Core)
Material	Natural/Synthetic fibre	Single wire strand	Independent wire rope
Strength	Low	Medium	High
Flexibility	High	Medium	Low
Heat resistance	Low	Medium	High
Crushing resistance	Low	Medium	High
Weight	Light	Medium	Heavy
Cost	Low	Medium	High
Best use	Light duty	Medium duty	Heavy duty

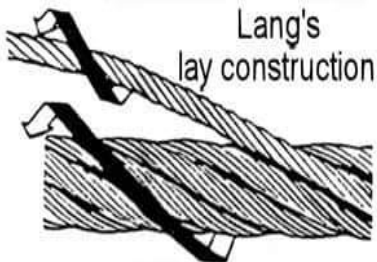
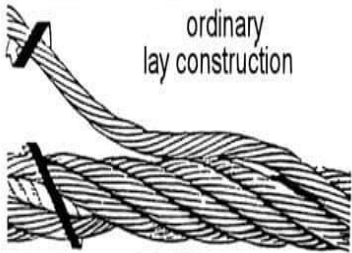
LIFTING ACCESSORIES

WIRE ROPE SLING: CONSTRUCTION

Lay Construction

The lay is the designation of the direction in which the wires are spun in the strand and the strands are spun in the rope. It will be either right hand or left hand. The right or left hand appellation for a rope is due to the direction of lay of the strands in the rope.

There are two types:



Ordinary Lay
The strands rotate around the rope in the opposite direction to the wires in the strand.



Right Hand Ordinary Lay



Left Hand Ordinary Lay

Langs Lay
The strands rotate around the rope in the same direction as the wires in the strand.



Right Hand Langs Lay



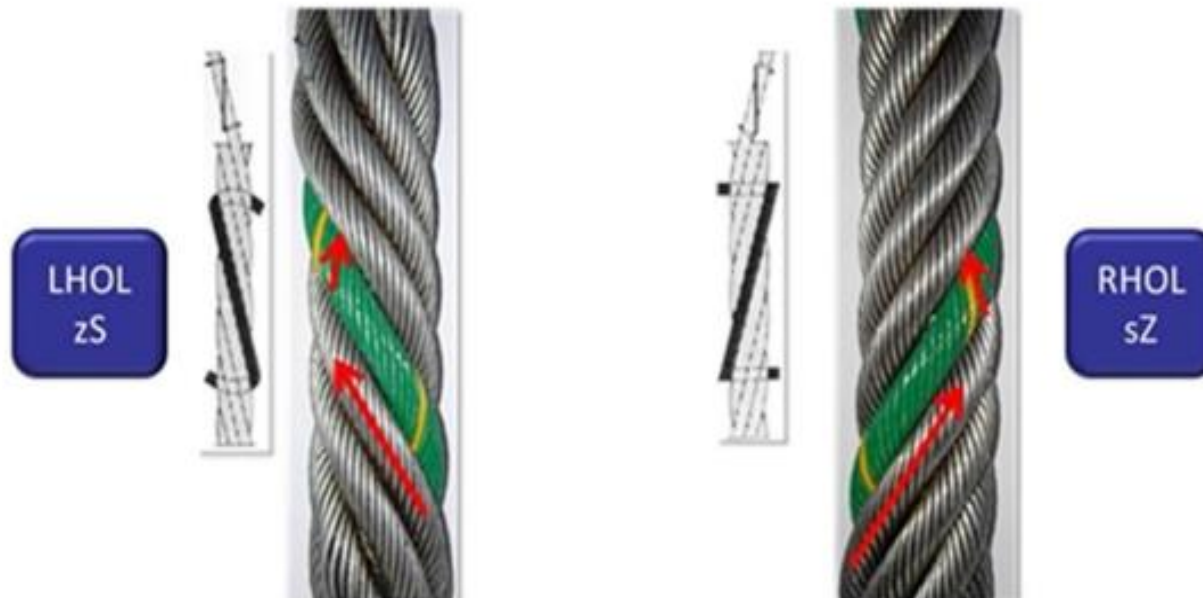
Left Hand Langs Lay

LIFTING ACCESSORIES

WIRE ROPE SLING: CONSTRUCTION

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

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



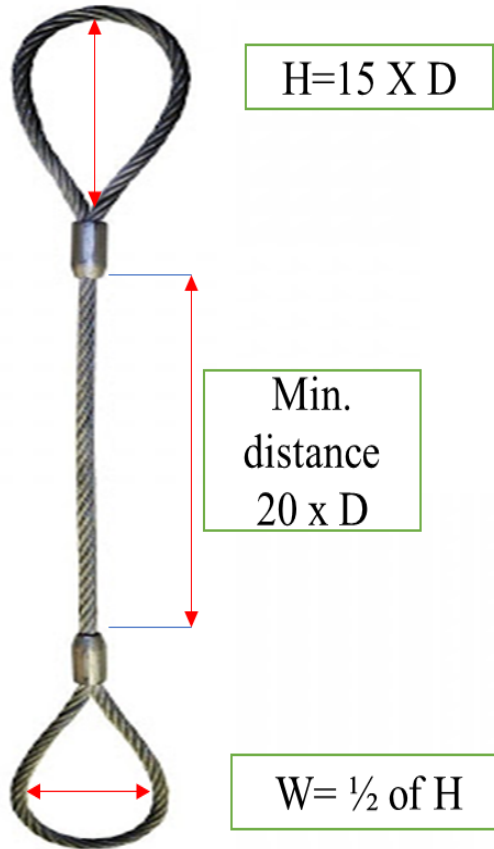
LIFTING ACCESSORIES

WIRE ROPE SLING: CONSTRUCTION

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

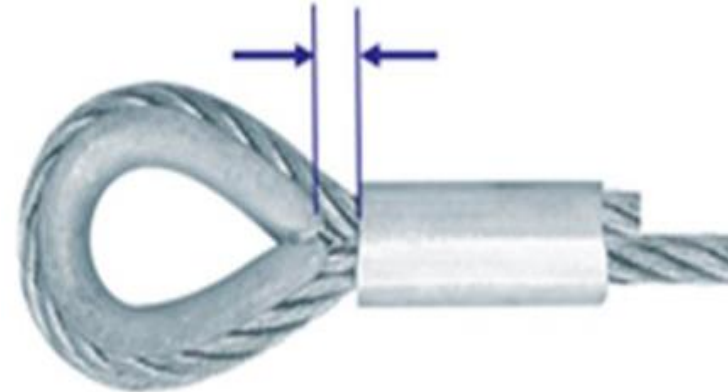
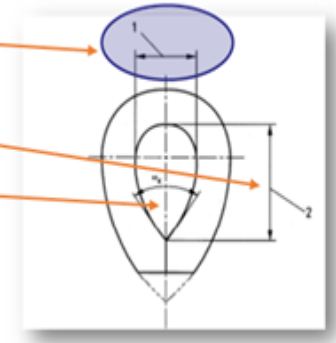


LIFTING ACCESSORIES



Thimbles of any size should comply with the following dimensions:

- 2.5 to 3.5 x rope diameter (dimension 1)
- 1.5 to 2 x dimension 1
- Angle $\leq 50^\circ$



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

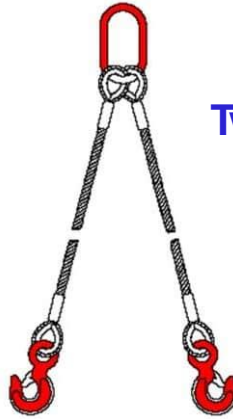
LIFTING ACCESSORIES

WIRE ROPE SLING: TYPES

Single & Multi-Legs:



Single leg



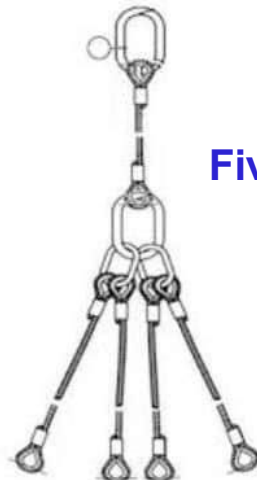
Two Legs



Three Legs



Four Legs



Five Legs

LIFTING ACCESSORIES

Rotating Wire Rope (Rotation-Resistant / Non-Rotating Rope)

A rotating (rotation-resistant) wire rope is specially designed to minimize or eliminate twisting (spin) under load. It prevents the load from rotating while lifting.

Construction:

- Multiple layers of strands
- Strands are laid in opposite directions
- Outer strands counteract inner strand rotation

Uses:

- Tower cranes
- Mobile cranes (main hoist)
- Lifting of long or free-hanging loads
- Single-line lifting where load spin is dangerous

Advantages:

- Prevents load spinning
- Improves load control
- Safer for precise lifting

LIFTING ACCESSORIES

Non-Rotating Wire Rope (Standard Wire Rope)

A non-rotating (standard) wire rope is a conventional rope that tends to twist or rotate under load. It does NOT resist spinning.

Construction:

- Single layer of strands
- All strands laid in the same direction

Uses:

- Winches
- Towing
- General engineering work
- Applications where rotation is not critical

Advantages:

- Strong and durable
- Less expensive
- Easier to handle

Disadvantages:

Load may rotate or spin and can cause load instability, twisting of slings

LIFTING ACCESSORIES

Is a Wire Rope Sling Rotating or Non-Rotating?

A wire rope sling is generally NON-ROTATING (standard wire rope).

Why Wire Rope Sling is Non-Rotating?

Designed for Strength & Flexibility

- Slings are used for direct load lifting and rigging
- Standard (non-rotating) constructions like 6×19, 6×36 provide:
 - High strength
 - Good flexibility
 - Better resistance to wear and abrasion

Rotation Control Comes from Rigging Method (Not Rope Type)

In sling applications, load rotation is controlled by:

- Proper hitch (basket, choke, multi-leg)
- Correct sling angle
- Use of tag lines and therefore, rotation-resistant rope is not necessary

Rotation-Resistant Ropes Are Not Suitable for Slings

- Rotation-resistant ropes (like 19×7, 35×7):
 - Are **more delicate**
 - Can be **damaged easily** when bent or choked
 - Not ideal for **frequent handling and rigging**

LIFTING ACCESSORIES

Rotating vs Non-Rotating (Comparison)

Aspect	Rotating Rope	Non-Rotating Rope
Rotation	Minimal	High
Construction	Opposite lay	Same lay
Load control	Excellent	Poor
Cost	High	Lower
Handling	Sensitive	Strong & robust
Crane use	Main hoist lifting	Limited

Simple Understanding:

Rotating (rotation-resistant) rope → NO spinning → safer for lifting

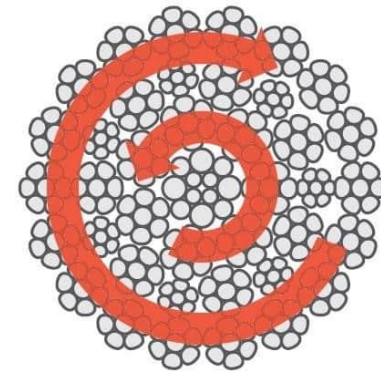
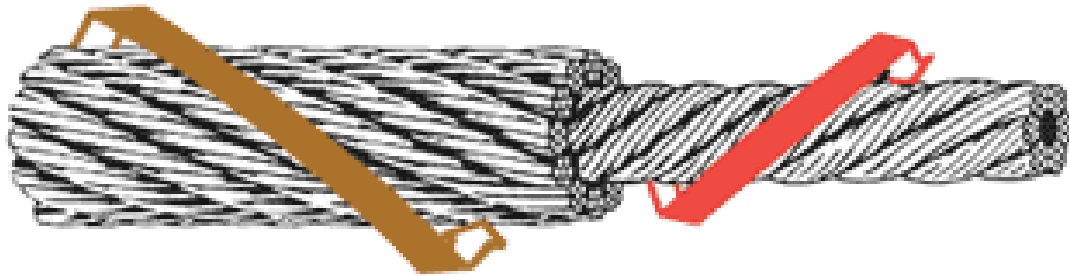
Non-rotating rope → spins → not suitable for critical lifts

Rotating (rotation-resistant) wire rope minimizes load spinning and is used for crane lifting, while non-rotating wire rope tends to rotate under load and is used for general purposes lifting. The importance lies in safety, load control, and preventing accidents during lifting operations.

WIRE ROPE TYPES: (CRANE WIRE)

Crane Wire: Non-rotating (Rotation-Resistance) Rope:

A rope construction in which the direction of lay of the outer layer of strands is opposite to the direction of lay of the strands in the rope.



A rope construction has two layers of strands lay down opposite to each other

WIRE ROPE TYPES: (CRANE WIRE)

Multi-Stranded Rope

Both Lang's lay and regular/ordinary lay are used, with a double-layer (or triple layer) construction.

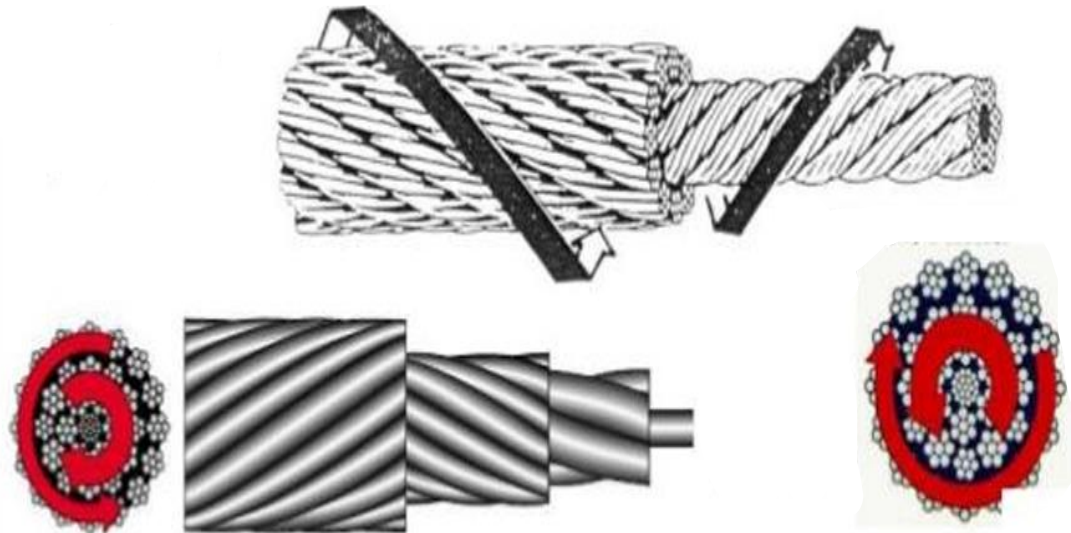
If the inner rope is left-handed, then the outer covering will be right-handed, or vice versa. Occasionally used for crane pennants.

It is a rotation-resistant rope — has a steel core which is an independent rope, closed in the opposite direction to the outer strands. Under load the core tries to twist the rope in one direction, the outer strands try to twist it in the opposite direction. The moments in the core and the outer strands compensate each other over a wide load-spectrum, so that even with great lifting heights no rope twist

Multi Strand rope

Outer – Right hand

Inner – Left hand



WIRE ROPE TYPES: (CRANE WIRE)

In a pre-formed wire rope during the closing stage the strands are given a helical shape.

This process reduces almost completely the tendency of the rope to unravel and reduces the elastic stress in the wires forming the strands.

This process has a few advantages:

- Reducing the stresses in the wires improves their fatigue resistance and extends the service life of the rope.
- Broken wires don't tend to protrude. In every rope some wires break during use due to fatigue or wear. In non-preformed ropes, these tend to protrude from the rope. This may cause damage to adjacent strands and cause injuries during maintenance.
- Preventing unraveling of the cut ends. When a non-preformed wire rope is cut, the end tends to unravel. Seizing is still necessary at the end to ensure that it will not unravel if it is hit by something but one seizing is enough. See additional information in the Storage, handling, installation and maintenance section.



WIRE ROPE TYPES: (CRANE WIRE)

Main and Auxiliary Hoists: Non Rotating / Rotation-resistant Rope Wire ropes fitted to the main and auxiliary hoists are usually of a construction intended to reduce twisting of the ropes when lowered through tens of meters and are referred to as **Non Rotating / Rotation-resistant Rope**.

Boom Hoist: Boom hoist ropes have some very unique and specific requirements. The ASME B30.5 standard allows boom hoist ropes to be used at a design factor of 3.5:1 with a minimum bending ratio of 15:1. Primarily because of these factors, rotation-resistant ropes are not allowed to be used as boom hoist ropes. The only exception is that a luffing jib boom hoist rope may be a rotation-resistant rope if used at a design factor of 5:1 and a bending ratio of 18:1.

Generally referred as **Rotating type wire rope**

LIFTING ACCESSORIES

WIRE ROPE SLING: TERMINATIONS

Wedge Socket

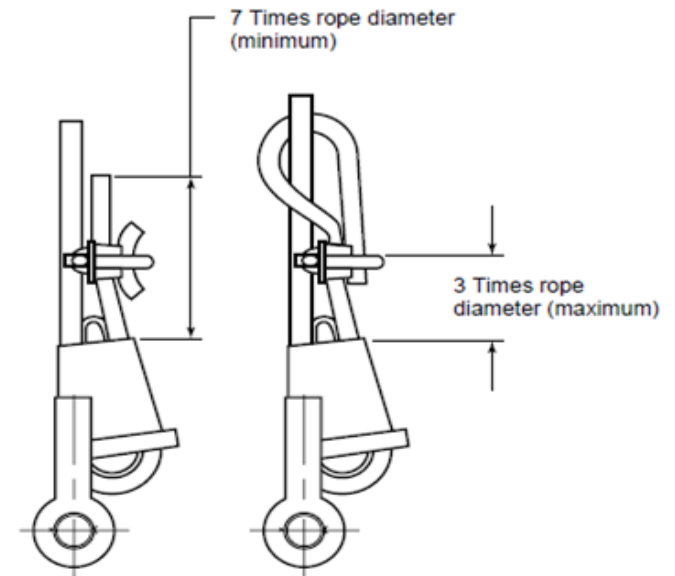
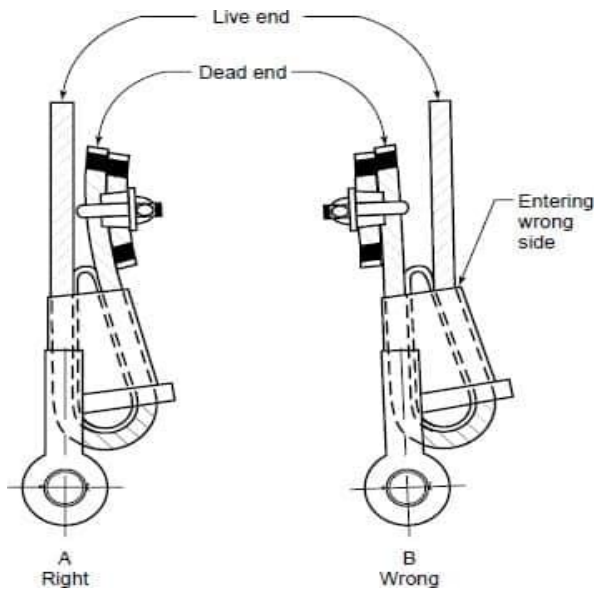


LIFTING ACCESSORIES

WIRE ROPE SLING: TERMINATIONS

Wedge Socket

API RECOMMENDED PRACTICE 2D



Allowable methods for securing dead ends of wedge sockets attachments

LIFTING ACCESSORIES

WIRE ROPE SLING: TERMINATIONS

Spelter Socket



Top of Broom



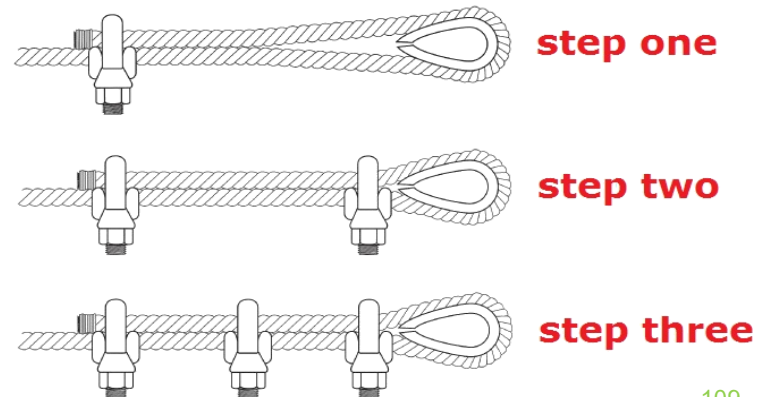
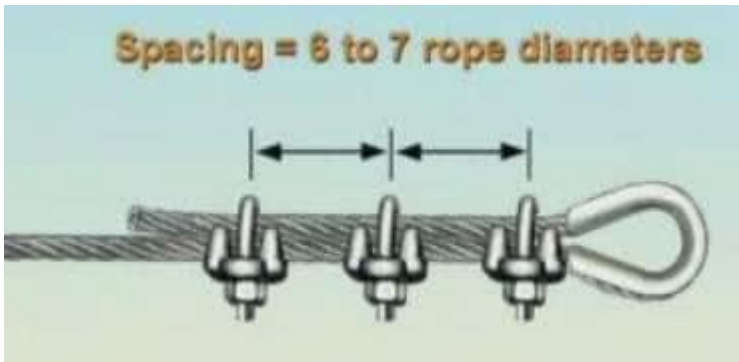
Top of Seizing



LIFTING ACCESSORIES

WIRE ROPE SLING: TERMINATIONS

Wire Rope Clips (Bull Dog Grips) –Note: This type of termination shall NOT to be used in Lifting Operations.



LIFTING ACCESSORIES

WIRE ROPE SLING: TERMINATIONS

Slings Eye terminations



Soft Eye Hand Spliced



Thimble Eye Hand Spliced



Soft Eye Machine Swaged



Thimble Eye Machine Swaged



Steel Ferrule Machine Swaged



Closed Swag Socket



Open Spelter Socket
Socket














Closed Spelter

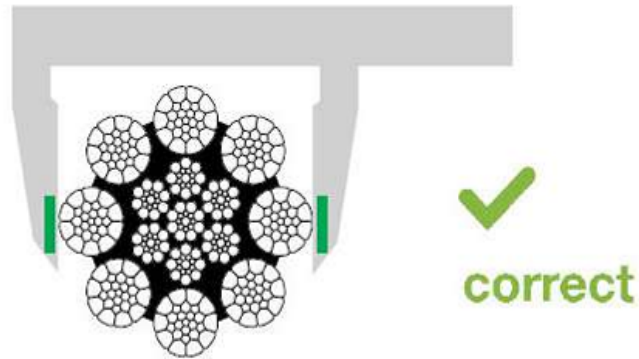
LIFTING ACCESSORIES

WIRE ROPE SLING: TERMINATIONS

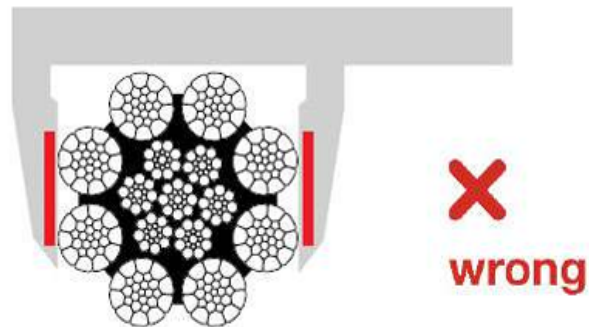
Slings Eye terminations

						 <p>2 Leg with Slings Hooks</p>	 <p>2 Leg with Soft Eye</p>
<p>Flemish Soft Eyes</p>	<p>Flemish Spliced Thimble Eyes</p>	<p>Aluminum Ferrule Secured Soft eyes</p>	<p>Aluminum Ferrule Secured Thimble eyes</p>	<p>Hand Spliced</p>	<p>Flemish Spliced Choker Sling</p>	 <p>4 Leg with End Fittings</p>	 <p>4 Leg with Soft Eye</p>
						 <p>Basket Sling</p>	

LIFTING ACCESSORIES



The correct way to measure wire rope with Vernier callipers



The incorrect way to measure wire rope with Vernier callipers

LIFTING ACCESSORIES

WIRE ROPE SLING: INSPECTION

Prior to using any sling, the following checks should be made:

- ▶ The WLL is adequate for the load.
- ▶ The colour coding (where applicable) is current and the sling has a plant number / ID mark.
- ▶ Examine each individual leg along its entire length and check for wear, corrosion, abrasion, mechanical damage and broken wires.
- ▶ Examine each ferrule and ensure the correct size of ferrule has been fitted.
- ▶ Check that the end of the loop does not terminate inside the ferrule (i.e. the rope end should protrude slightly but not more than 1/3rd of diameter) unless the ferrule is of the longer tapered design which has an internal step.

Note: Safety factor of wire rope sling is 5:1

Factor of Safety (FOS) : Factor of Safety is the ratio of the load that would cause failure of an item of Lifting Equipment to the load that is imposed upon it in service.

LIFTING ACCESSORIES

WIRE ROPE SLING: INSPECTION

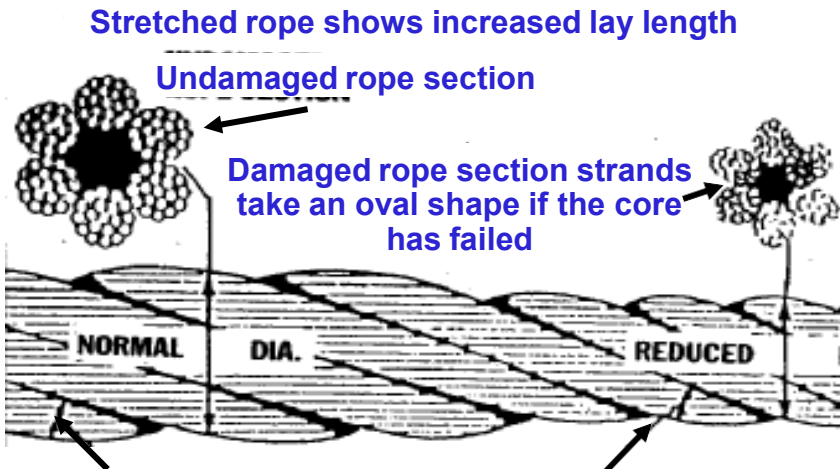
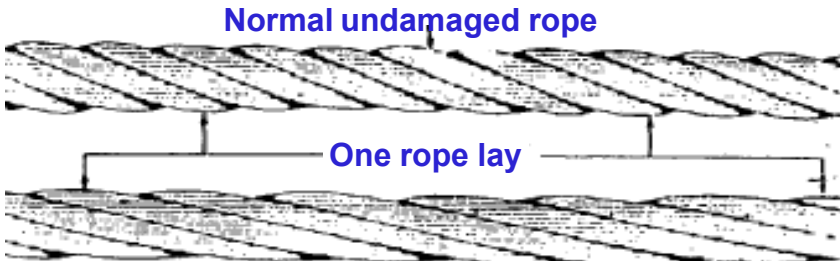
- ▶ The ferrule should be free from cracks or other deformities.
- ▶ Examine each thimble and check for correct fitting, snagging damage and elongation. (stretched thimbles/eyes could indicate possible overload).
- ▶ Examine wire rope around thimbles as it is often abraded due to sling being dragged over rough surfaces.
- ▶ If fitted, examine master link/quadruple assembly and check for wear, corrosion and cracking.
- ▶ If fitted with hooks, check for wear, corrosion, and cracking and ensure safety latch functions.

Broken Wires (As per BS EN 13414-1):

- Randomly distributed broken wires 6 randomly distributed broken outer wires in a length of $6d$ but no more than 14 randomly distributed broken wires in a length of $30d$, where d is the nominal rope diameter.
- Concentrated broken wires: 3 adjacent broken outer wires in one strand.
- ▶ **Rope wear (As per BS EN 13414-1):** 10% of the nominal rope diameter (d).

LIFTING ACCESSORIES

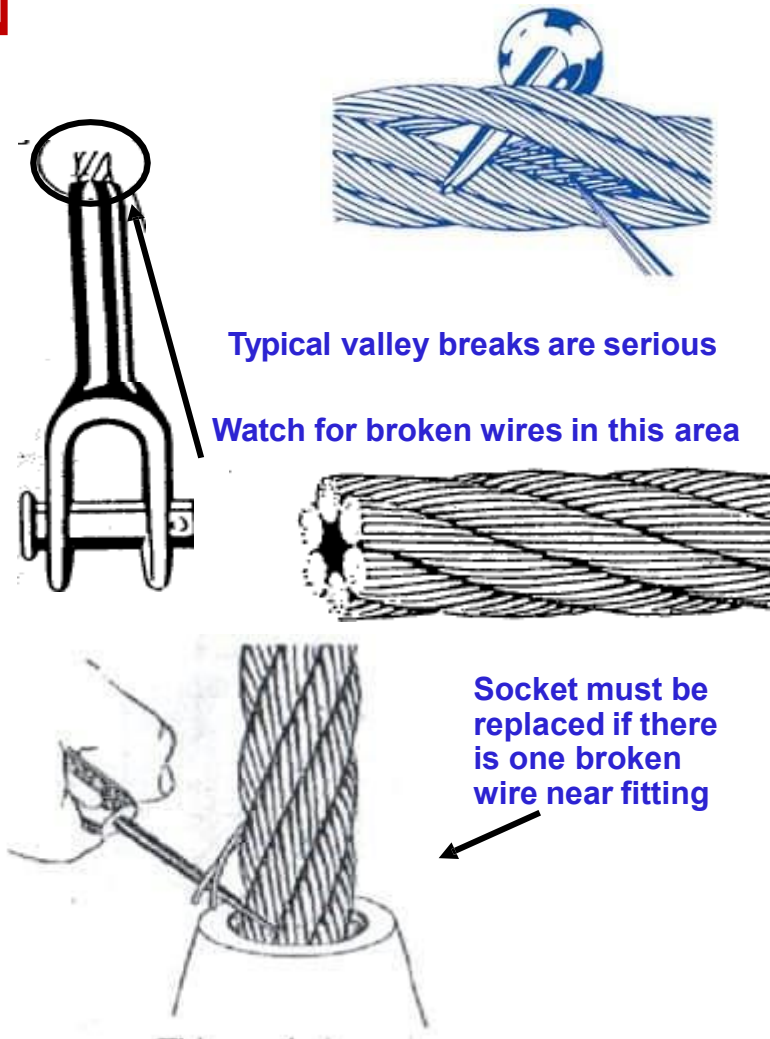
WIRE ROPE SLING: INSPECTION



Due to core deterioration discard rope if there is decrease by 3% of the nominal rope diameter for rotation-resistant ropes or 10% for other ropes.

Due to external wear discard rope if there is decrease by 7% or more of the nominal rope diameter.

Reduction in wire rope diameter



Wire breaks near fittings & inside a rope

LIFTING ACCESSORIES

WIRE ROPE SLING: INSPECTION

To ensure that your non-rotating rope is free from internal wire breaks.

The easiest way to detect inside wire breaks is

“LISTENING”

Hold a length of rope up to your ear and bend it back and forth, if you hear popping voice, there are likely broken wires inside the rope

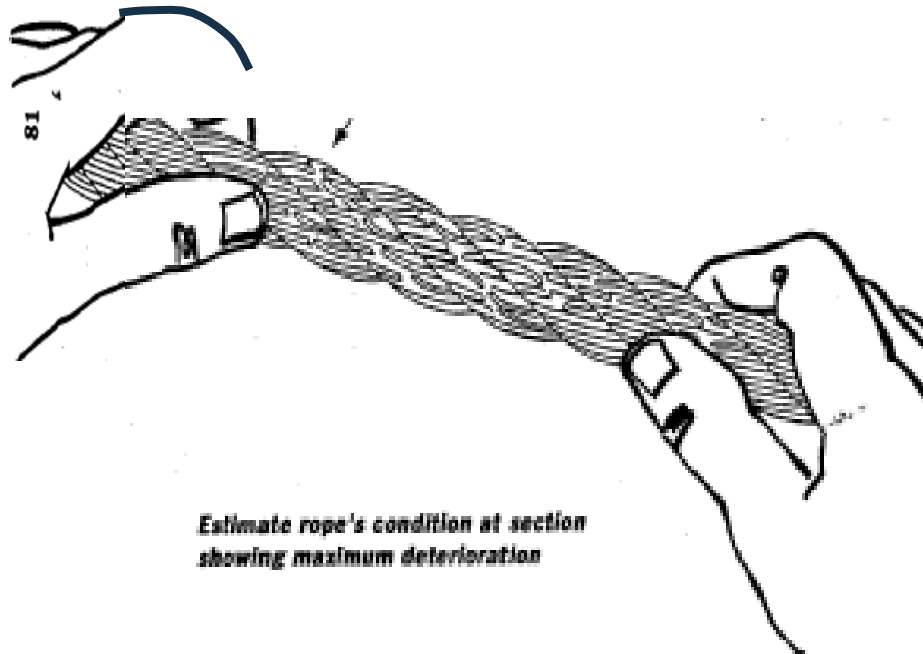


LIFTING ACCESSORIES

WIRE ROPE: INSPECTION

To check if your rope has broken wires

**THE EASIEST WAY IS
"LOOKING"**



Estimate rope's condition at section showing maximum deterioration

API 2D – 7TH EDITION - REPLACE THE ROPE IF THERE ARE:

Boom Hoist wire rope:

- ▶ 6 or more random broken wires in one lay
- ▶ 3 or more broken wires in one strand of a rope lay.

Main & Auxiliary Hoist wire rope (Non Rotation):

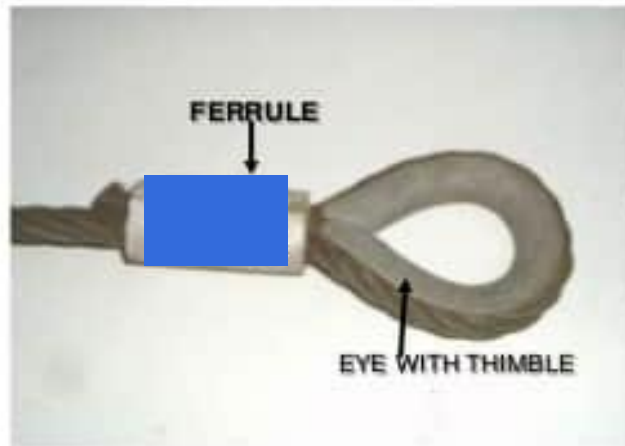
- ▶ 4 randomly distributed broken wires in a length of 30 d where d is the nominal rope diameter.
- ▶ 2 Broken wires in one strand within 6 rope diameter.

Pendant wire ropes:

- ▶ 3 broken wires in one lay.
- ▶ 2 broken wires at the end termination.

LIFTING ACCESSORIES

WIRE ROPE SLING: Marking



- ✓ SERIAL NUMBER
- ✓ DATE MANUFACTURE / LOAD TEST

- ✓ WLL (work load limit)
- ✓ COLOUR CODED COLOUR CODE



LIFTING ACCESSORIES

WIRE ROPE: DEFECTS



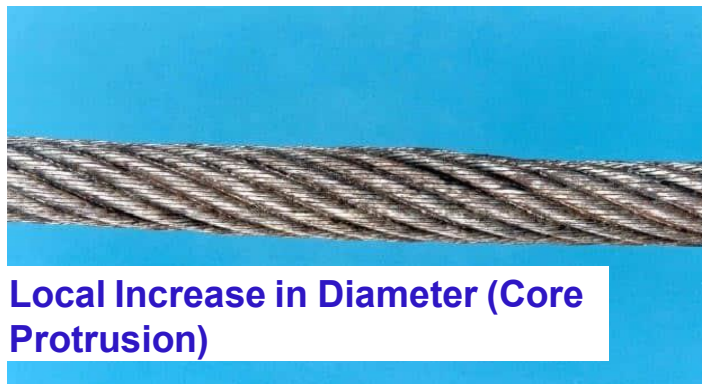
LIFTING ACCESSORIES

WIRE ROPE: DEFECTS



LIFTING ACCESSORIES

WIRE ROPE: DEFECTS



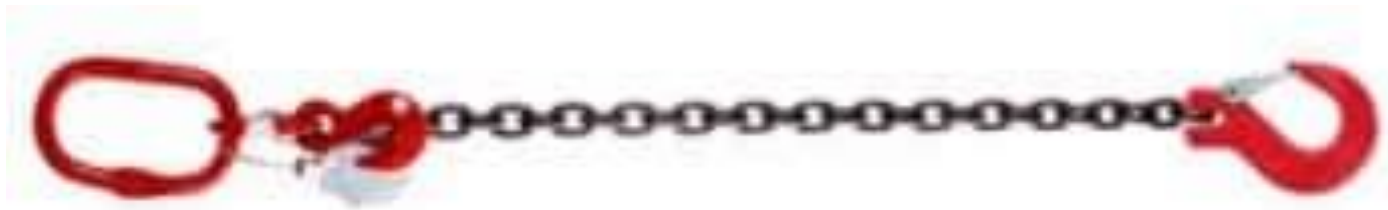
LIFTING ACCESSORIES

WIRE ROPE: DEFECTS



LIFTING ACCESSORIES

Chain Sling



A chain sling is a lifting accessory made of high-strength alloy steel chains, designed and certified for lifting and handling heavy loads safely.

A chain sling is an assembly of chain links with end fittings (such as hooks, rings, or shackles) used to attach a load to a lifting device like a crane.

LIFTING ACCESSORIES

CHAIN SLINGS - CONSTRUCTIONS

▶ Chain sling assemblies are manufactured in various material/ heat treatment combination 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

2. By use of a mechanical joiner device

▶ Grade T should only be used for Manual machines as this type of chain is fine tolerance chain. Grade 10 and 12 chain slings are also available.

▶ The higher the grade is, the stronger and more resistant to bending and breaking the chain is.

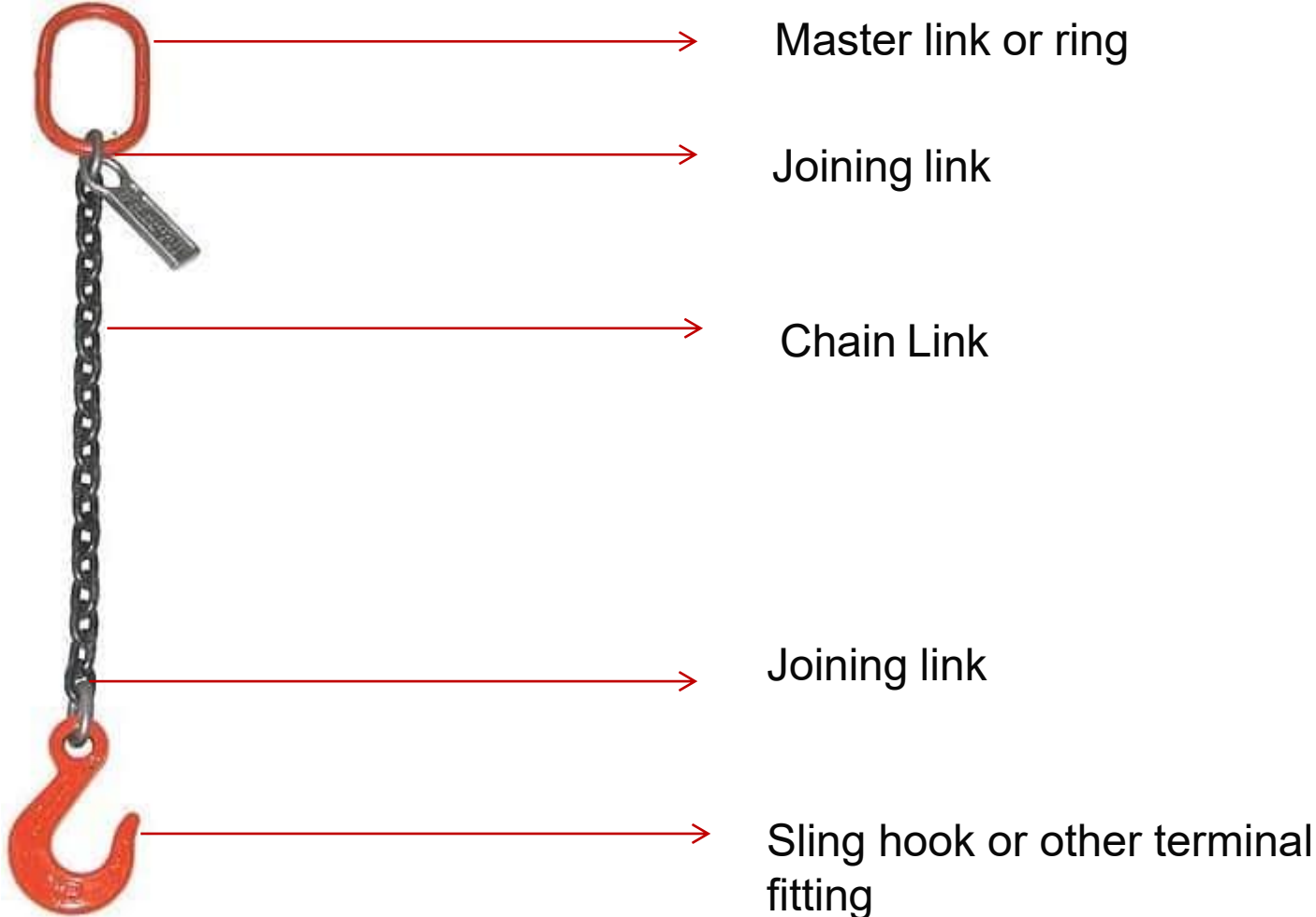
▶ Never use fine tolerance (hoist) chain to make a lifting sling. Fine tolerance chain is specifically heat-treated for wear resistance within a hoist's internal mechanism. It lacks the high ductility (stretch) required for slings to safely handle the shock loads and "choke" hitches common in rigging. Conversely, a medium tolerance chain will likely jam or damage a hoist because its links will not align correctly with the internal load wheel.



LIFTING ACCESSORIES

CHAIN SLINGS - CONSTRUCTIONS

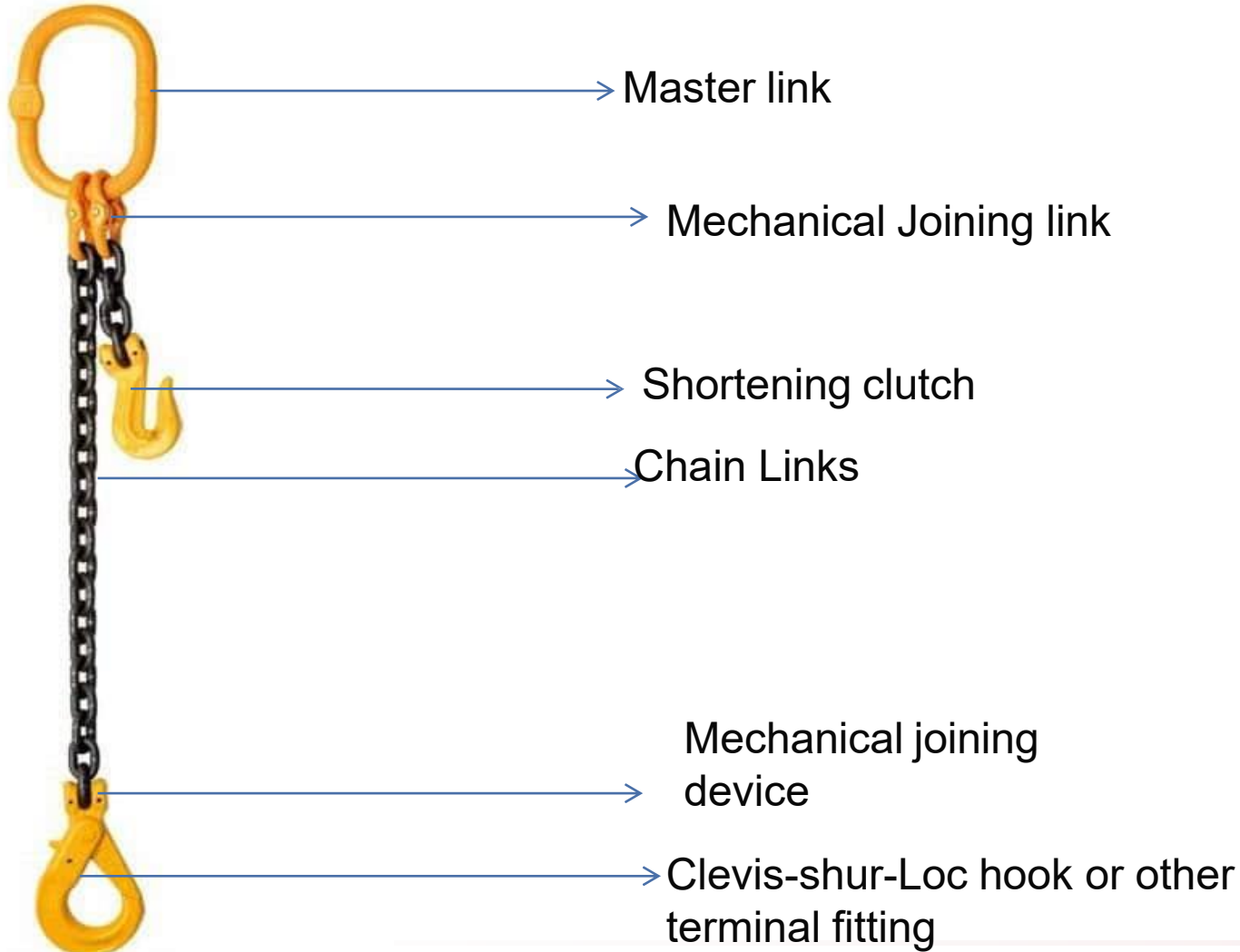
1. Single leg sling of welded construction



LIFTING ACCESSORIES

CHAIN SLINGS - CONSTRUCTIONS

2. Single leg sling with mechanical joining device



LIFTING ACCESSORIES

CHAIN SLINGS - TYPES



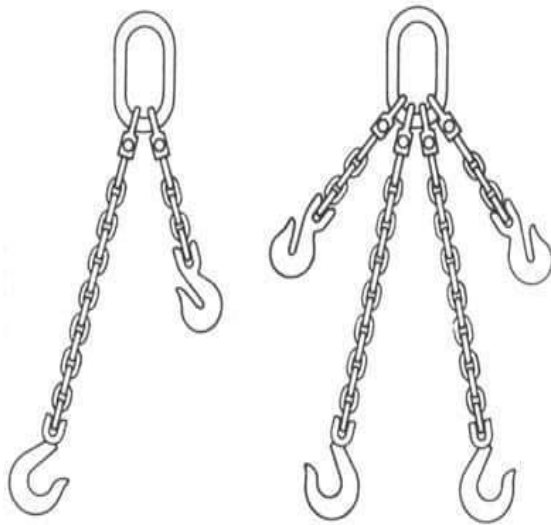
TYPES OF CHAIN SLING



LIFTING ACCESSORIES

CHAIN SLINGS - TYPES

Slings with shortening clutches



Endless chain slings



LIFTING ACCESSORIES

CHAIN SLINGS – INSPECTION

Prior to using a chain sling the following checks should be carried out:

1. The WLL is adequate for the load
2. The colour coding (where applicable) is current and sling has the plant number/ID mark
3. Layout the chain slings on the floor or suspend from the crane hook and remove all twists from the legs.
4. Match up the legs and check for stretch/deformation in the individual legs.
5. Visually examine each leg along its entire length and check for distortion of the links, e.g. bends, twists, elongation and nicks.
6. Check for wear between chain links and load point pins. (Reject if is more than 8%)
7. Check for heat damage or chemical attack.

LIFTING ACCESSORIES

CHAIN SLINGS – INSPECTION

8. Examine end terminations, e.g. hooks and connectors, etc. and check for wear, stretch and distortion.
9. Ensure safety catches function (when fitted)
10. Ensure all load pins are secure.
11. When using shortening clutches, always make sure the chain is correctly seated in the clutch prior to taking the strain.

Note: Safety factor of chain sling is 4:1

INSPECTION

Fine Tolerance Chain (Calibrated):

Fine tolerance chain, often referred to as calibrated chain, is designed to run over moving parts. Its most critical feature is its dimensional precision, particularly the pitch (the internal length of a link).

Primary Use: Used as "load chain" inside lifting appliances like electric hoists, manual chain blocks, and lever hoists.

Precision: It is manufactured to extremely tight tolerances so that every link fits perfectly into the pockets of a hoist's load wheel (sprocket). If the chain were off by even a millimeter, it would jump, bind, or grind against the wheel, causing dangerous mechanical failure.

Properties: These chains often have a harder surface (case-hardened) to resist the constant wear of moving through sprockets. However, this hardness makes them slightly less "stretchy" (ductile) than sling chains.

Markings: Usually identified by letters such as T, DAT, or DT (e.g., Grade T).

Standards: BS EN 818-7 .

INSPECTION

Medium Tolerance Chain (Non-Calibrated)

Medium tolerance chain is the standard for chain slings used for overhead lifting. Because these chains do not pass over sprockets, their exact link-to-link pitch is less critical.

Primary Use: Used for manufacturing chain slings (the "legs" that attach a load to a crane hook).

Precision: While still high-quality, the tolerances are "medium" because the chain only needs to connect hooks and fittings. A slight variation in pitch doesn't affect safety or performance in a sling.

Properties: These chains prioritize ductility and shock absorption. If a load "jolts," a medium tolerance chain is designed to stretch slightly rather than snap. They are usually through-hardened rather than case-hardened.

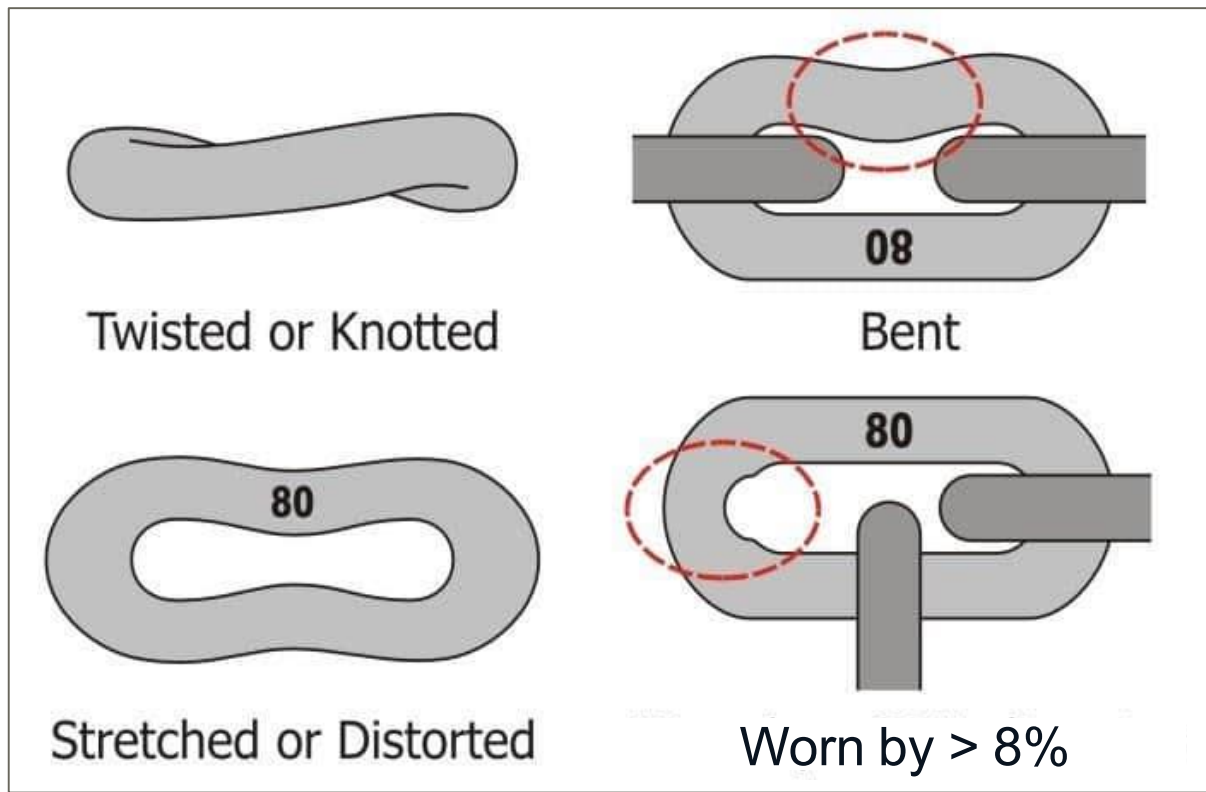
Markings: Identified by numbers, most commonly 8, 10, or 12 (referring to Grade 80, 100, or 120).

Standards: BS EN 818-4.

LIFTING ACCESSORIES

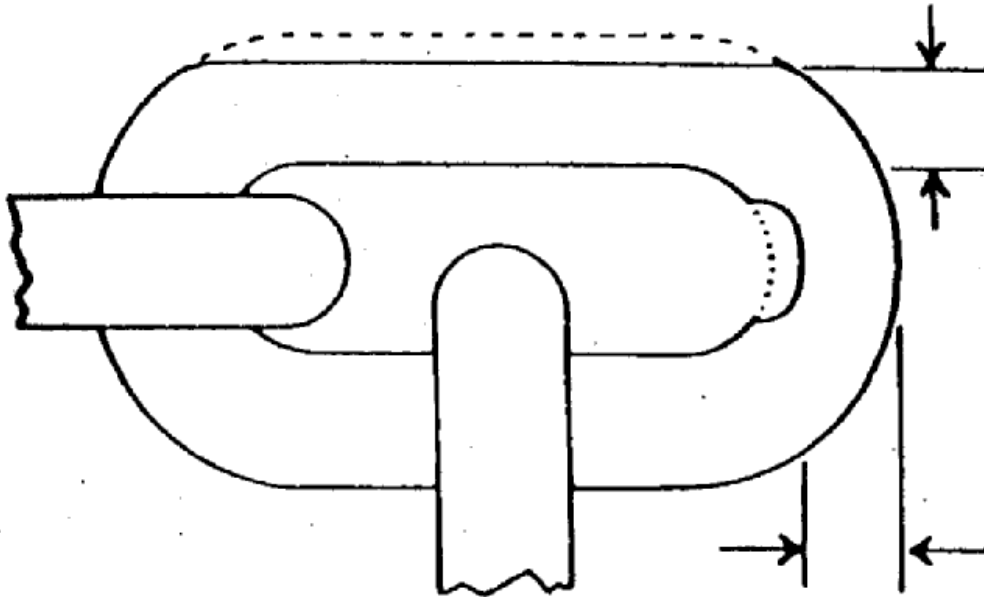
CHAIN SLINGS – DEFECTS

Chains should be inspected for defects before use Chain should not be used for lifting if there is no identifying tag



LIFTING ACCESSORIES

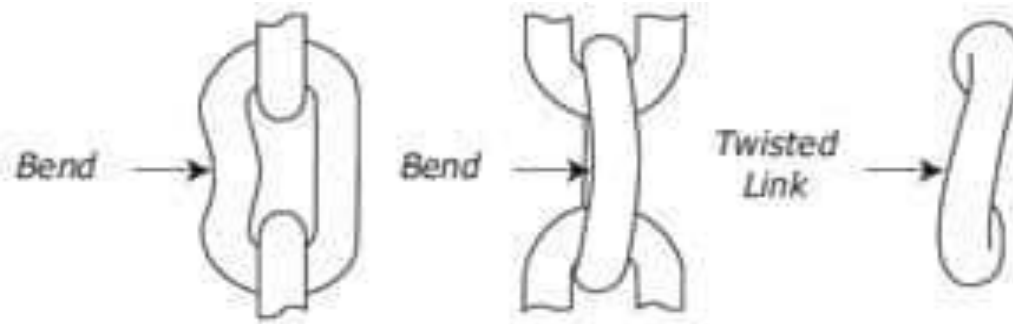
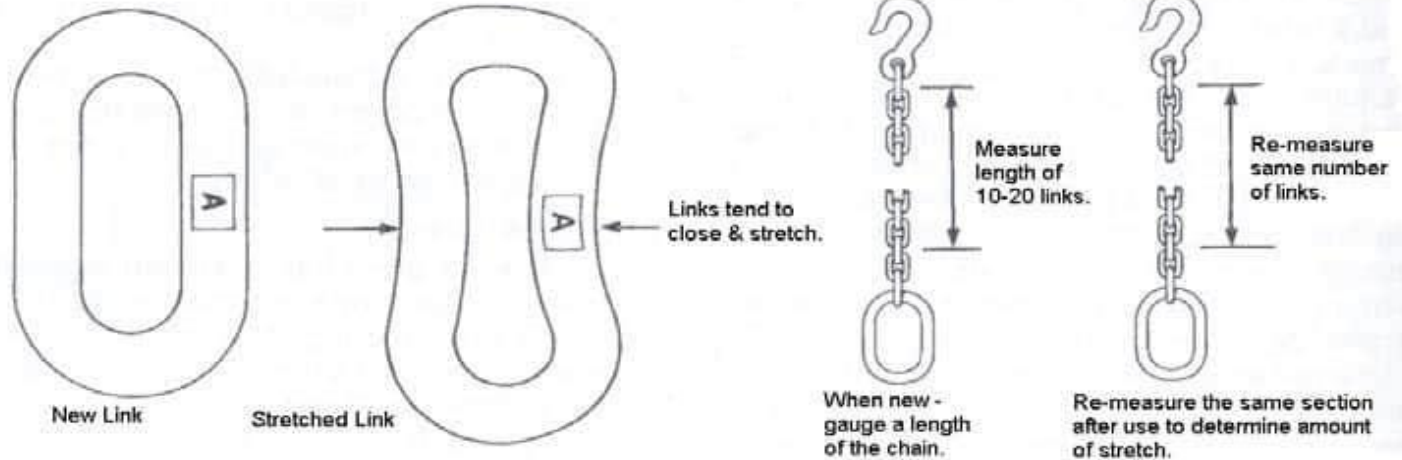
CHAIN SLINGS – DEFECTS



Measure The Remaining Material And
Discard If It Is Less Than Allowed By
Manufacturer.

LIFTING ACCESSORIES

CHAIN SLINGS – DEFECTS

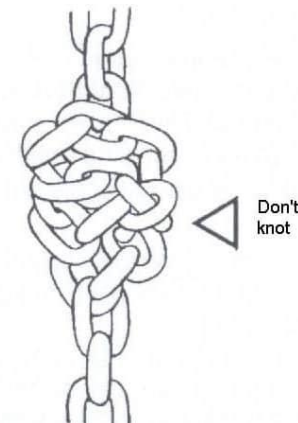
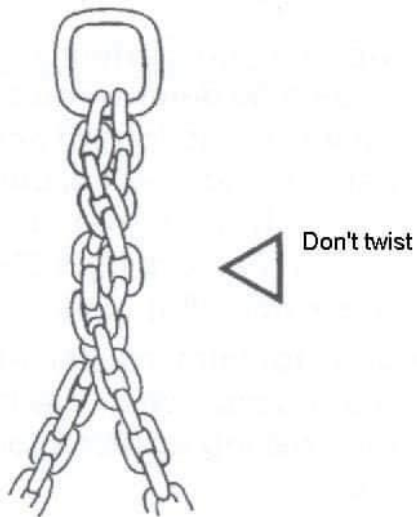
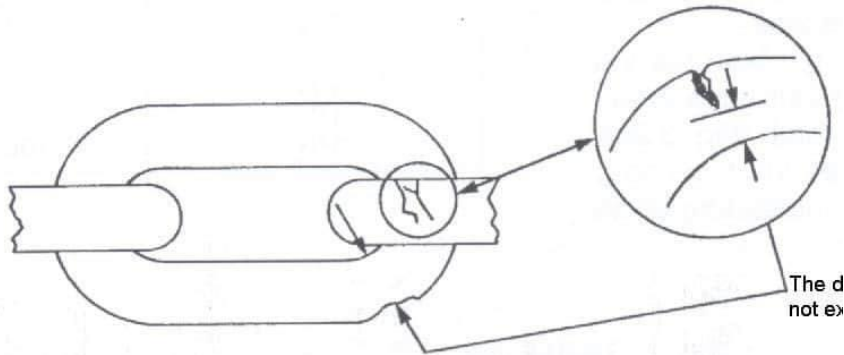


Examine all Chain Links

LIFTING ACCESSORIES

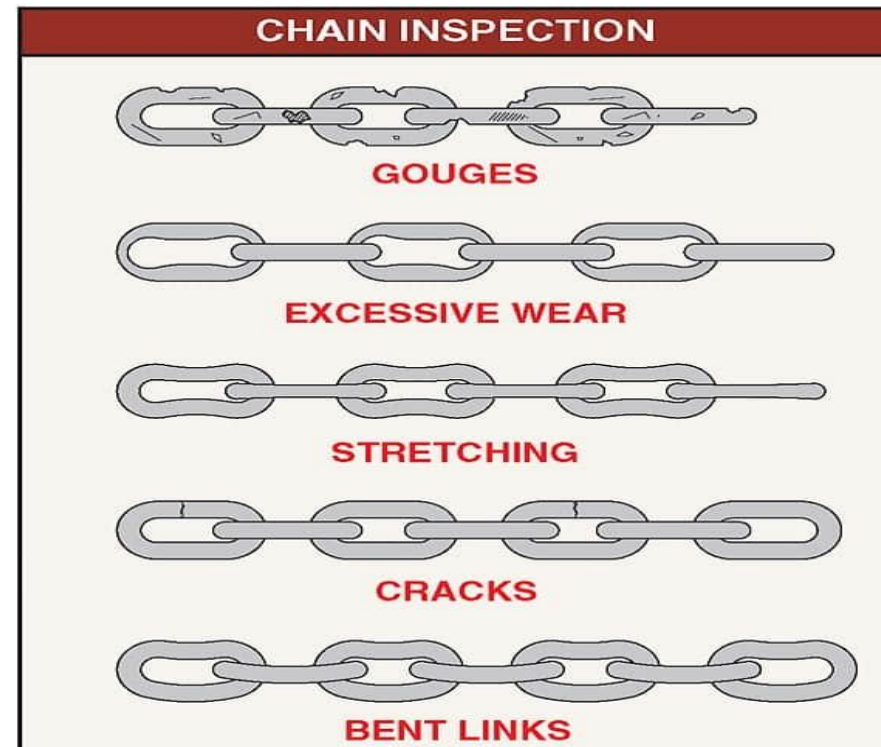
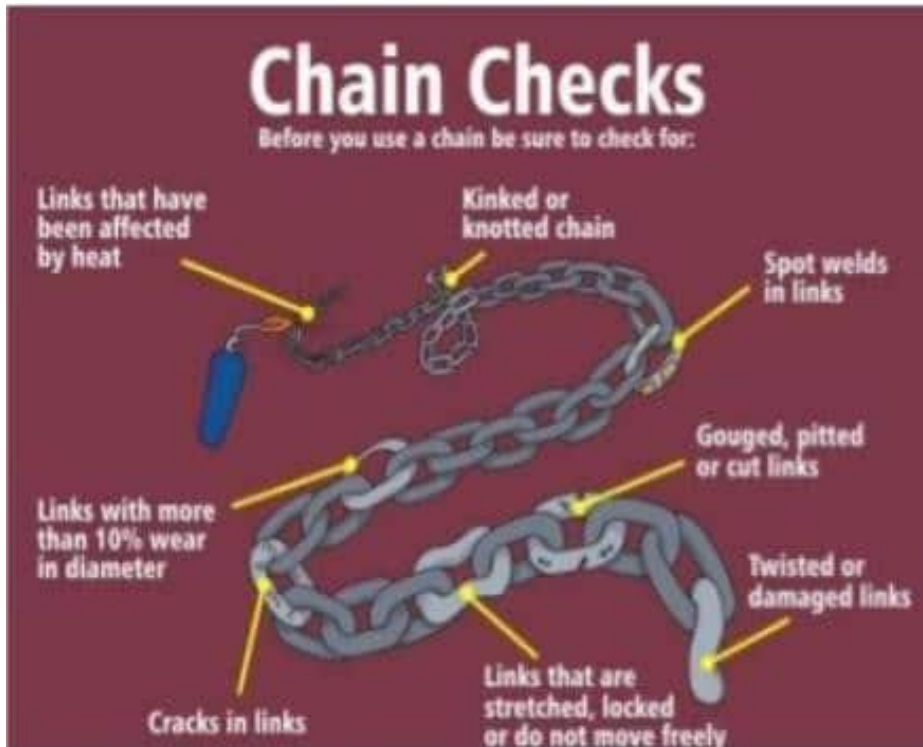
CHAIN SLINGS – DEFECTS

cuts, cracks, nicks, gouges



LIFTING ACCESSORIES

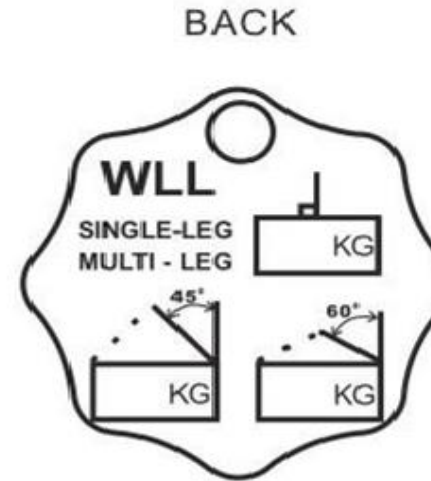
CHAIN SLINGS – DEFECTS



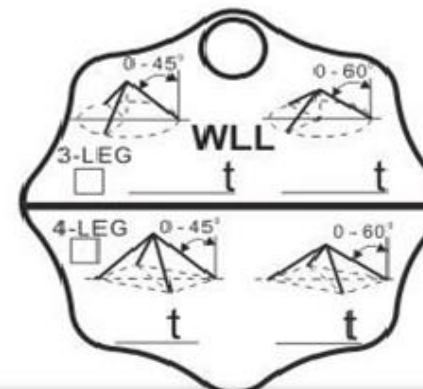
LIFTING ACCESSORIES

CHAIN SLINGS – DEFECTS

Chain Sling Tag for 1&2 Leg



Chain Sling Tag for 3&4 Leg



LIFTING ACCESSORIES

Webbing Sling



Synthetic (man-made fiber) lifting slings used in rigging for safely lifting loads, especially where **surface protection and flexibility** are important.

LIFTING ACCESSORIES

WEBBING SLINGS - MATERIALS

Flat woven webbing slings & Round slings are made from three basic man-made materials processed as synthetic fibres.

These materials are:

- ▶ Polyamide (Nylon)
- ▶ Polyester
- ▶ Polypropylene

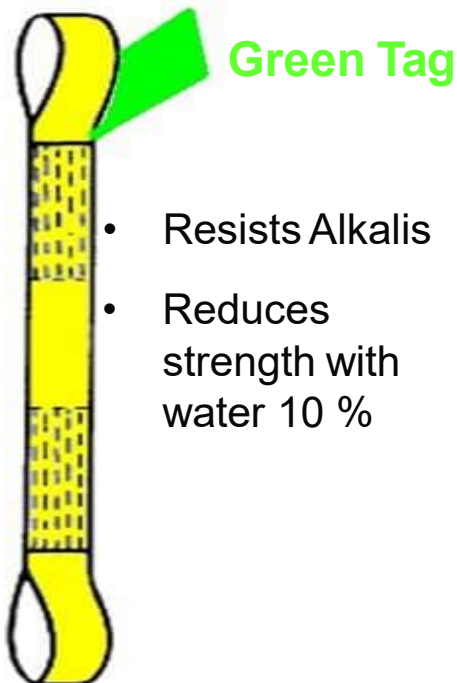


LIFTING ACCESSORIES

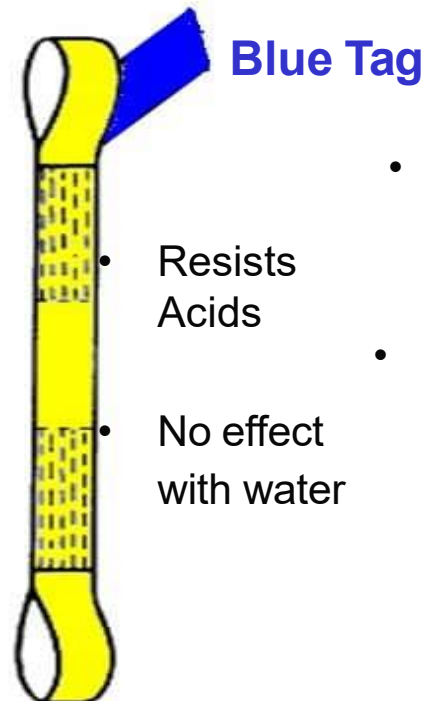
WEBBING SLINGS - MATERIALS

Effects of Acids and Alkalis:

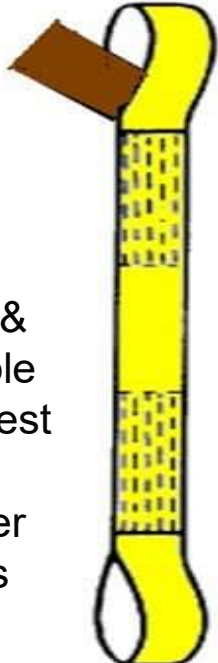
Polyamide (Nylon)



Polyester



Polypropylene Brown Tag

- 
- Increase in strength with water
 - Resists Alkalis & Acids. Is suitable where the highest resistance to chemicals, other than solvents is required

LIFTING ACCESSORIES

USES OF POLYAMIDE WEBBING SLINGS

Polyamide (nylon) webbing slings are specialized, high-strength lifting tools made from woven synthetic fibers, widely used in lifting operations for their exceptional flexibility, high stretch, and resistance to alkaline environments. They are preferred in scenarios requiring shock absorption (due to 6–10% elasticity under load) or when lifting delicate, polished, or easily damaged surfaces, such as machinery, aluminum components, or painted items.

Uses in Lifting Operations:

- **Shock Absorption/Dynamic Lifting:** Because they stretch more than polyester, nylon slings are ideal for applications involving sudden jerks, crane movements, or lifting dynamic loads that need to be dampened.
- **Delicate Load Handling:** The soft texture and wide, flat bearing surface prevent scratching, crushing, or denting of finished components.
- **Chemical-Specific Lifting:** They offer superior resistance to grease, oil, and alkaline environments.
- **Versatile Configurations:** They are suitable for vertical, choke (choker), and basket hitch configurations.

LIFTING ACCESSORIES
















USES OF POLYAMIDE WEBBING SLINGS

Common Applications in Industries

- Construction & Infrastructure: Used for lifting concrete panels, steel pipes, timber, and delicate or coated materials.
- Manufacturing & Engineering: Employed to move machined components, molds, and finished equipment.
- Marine Industry: Ideal for boat lifting, dock operations, and handling machinery on ships, as they do not corrode or rust.
- Logistics: Used for securing and lifting cargo, such as engines, motors, and fragile crates.

Key Advantages of Polyamide Webbing Slings

- High Elasticity: Absorbs shock loads to prevent load failures.
- Strength-to-Weight Ratio: Stronger than or equal to polyester in many applications while remaining lightweight and easy to handle.
- Robustness: Good resistance to abrasion, making them suitable for some rough environments.
- Temperature Range: Perform well in a wide range of temperatures (roughly -40°C to +100°C).

Webbing Material	Resistance to Acid	Resistance to Alkalies	When used in Water	Resistance to Solvents, Paint & Tar	Tag Color	Storing under Sun
Polyamide			10% reduction in WLL		GREEN 	
Polyester			None		BLUE 	
Polypropylene			Increase in WLL		BROWN 	

COMPARISONS

Material Type	Other Name	Main Characteristic	Uses in Rigging	Advantages	Limitations / Precautions
Polyamide Webbing Sling	Nylon Sling	High elasticity and shock absorption	Lifting loads where shock loading may occur (machinery, construction components)	Very strong, excellent shock resistance, durable	Can be damaged by acids, absorbs water which reduces strength
Polyester Webbing Sling	PES Sling	Low stretch and good dimensional stability	General lifting operations, oil & gas, steel fabrication	Resistant to most acids, low stretch improves load control	Sensitive to strong alkalis and high temperatures
Polypropylene Webbing Sling	PP Sling	Lightweight synthetic fiber with good chemical resistance	Chemical plants, marine environments, light-duty lifting	Good resistance to chemicals, floats on water	Lower strength compared to nylon and polyester

COMPARISONS

Property	Polyamide (Nylon)	Polyester	Polypropylene
Strength	Very High	High	Medium
Stretch / Elasticity	High	Low	Medium
Shock Absorption	Excellent	Moderate	Low
Resistance to Acids	Poor	Good	Good
Resistance to Alkalis	Good	Poor	Excellent
Water Absorption	High	Very Low	None
Typical Application	Dynamic loads	General lifting	Chemical / marine environments

Application	Recommended Material
Heavy machinery lifting	Polyamide (Nylon)
General crane lifting	Polyester
Chemical plants / marine use	Polypropylene

COMPARISONS

Material Type	Key Characteristic	Typical Lifting Uses	Industries Where Commonly Used	Advantages for Riggers	Limitations / Precautions
Polyamide (Nylon)	High strength and elasticity, excellent shock absorption	Lifting heavy machinery, structural components, equipment installation	Construction, heavy engineering, shipbuilding, mining	Handles dynamic loads well, very durable	Can be damaged by acids, absorbs moisture
Polyester (PES)	Low stretch, stable under load, resistant to most acids	General lifting operations with cranes and hoists	Oil & Gas, construction, logistics, manufacturing	Better load control due to low stretch	Sensitive to strong alkalis
Polypropylene (PP)	Lightweight and highly resistant to chemicals	Handling loads in corrosive environments	Chemical plants, wastewater treatment, marine industries	Excellent chemical resistance, floats on water	Lower lifting strength than nylon or polyester

COMPARISONS

Industry	Common Sling Material Used	Reason for Selection
Oil & Gas / Offshore	Polyester	Good strength, low stretch, resistant to acidic environments
Construction	Polyamide (Nylon) or Polyester	High strength and durability for heavy lifting
Chemical Plants	Polypropylene	Strong resistance to chemical corrosion
Marine / Shipbuilding	Polypropylene or Polyester	Resistant to water and chemical exposure
Manufacturing / Warehousing	Polyester	Good load control and reliability
Mining	Polyamide (Nylon)	Excellent shock absorption for heavy loads

LIFTING ACCESSORIES

WEBBING SLINGS – TYPES

Types of Eyes:

1. Webbing sling with metal fittings
(Hard eyes)



2. Webbing sling with soft eyes



LIFTING ACCESSORIES

WEBBING SLINGS – TYPES

Types of body:

1. Flat Webbing Sling



2. Endless Round webbing Sling



LIFTING ACCESSORIES

WEBBING SLINGS – CAPACITY

Flat Webbing Sling

NOTE: Body Color – indicates the SWL (**Based on two layer**)

VIOLET



GREEN



YELLOW



GREY



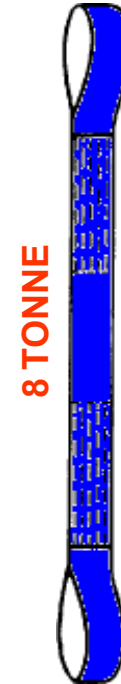
RED



BROWN



BLUE



ORANGE

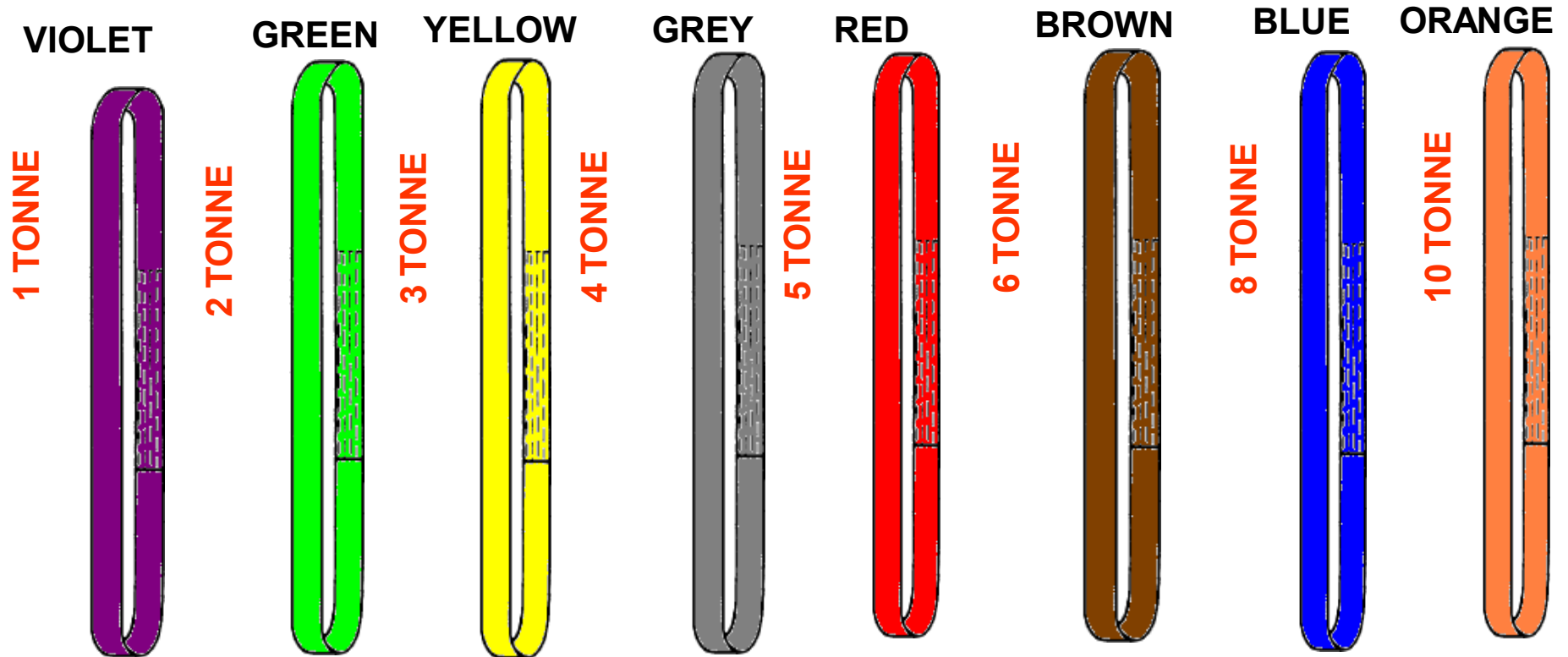


LIFTING ACCESSORIES

WEBBING SLINGS - CAPACITY

Endless Round Sling

NOTE: Body Color – indicates the SWL



LIFTING ACCESSORIES

WEBBING SLINGS - CAPACITY

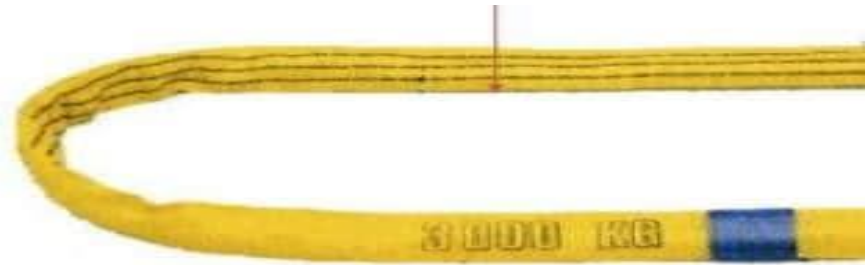


SWL/WLL	Width Inch mm	Colour	SWL/WLL in Kg different modes			
1T	1 25	VIOLET	1000	2000	1400	800
2T	2 50	GREEN	2000	4000	2800	1600
3T	3 75	YELLOW	3000	6000	4200	2400
4T	4 100	GREY	4000	8000	5600	3200
5T	5 125	RED	5000	10000	7000	4000
6T	6 150	BROWN	6000	12000	8400	4800
8T	8 200	BLUE	8000	16000	11200	6400
10T	10 250	ORANGE	10000	20000	14000	8000
12T	12 300	ORANGE	12000	24000	16800	9600

LIFTING ACCESSORIES

WEBBING SLINGS - CAPACITY

NOTE: Number of black stripes indicates SWL



1 Ply Webbing



2 Ply Webbing

LIFTING ACCESSORIES

WEBBING SLINGS – INSPECTION

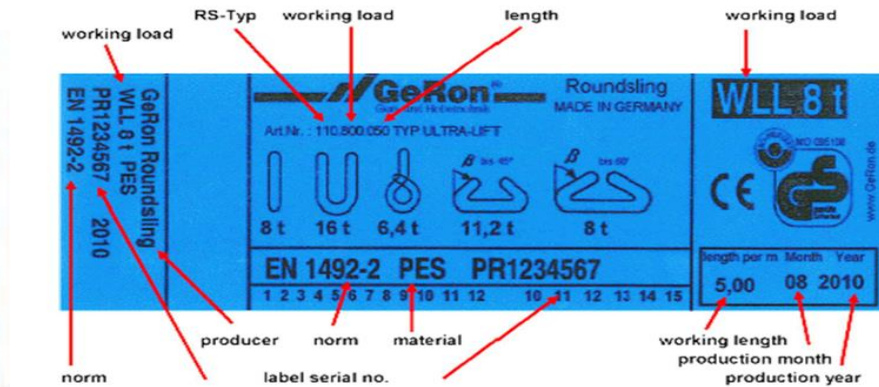
Textile slings should be discarded if any of the following is found:

- ▶ Missing or illegible sling identification
- ▶ Acid or caustic burns
- ▶ Melting or charring of any part of the sling,
- ▶ Holes, tears, cuts, or snags
- ▶ Broken or worn stitching in load bearing splices,
- ▶ Excessive abrasive wear
- ▶ Knots in any part of the sling,
- ▶ Discoloration and brittle or stiff areas on any part of the sling,
- ▶ Pitted, corroded, cracked, bent, twisted, gouged, or broken fittings, and
- ▶ Other conditions that cause doubt as to continued use of a sling.

Note: Safety factor of webbing sling is 7:1

LIFTING ACCESSORIES

WEBBING SLINGS – MARKINGS



WRONG MARKING

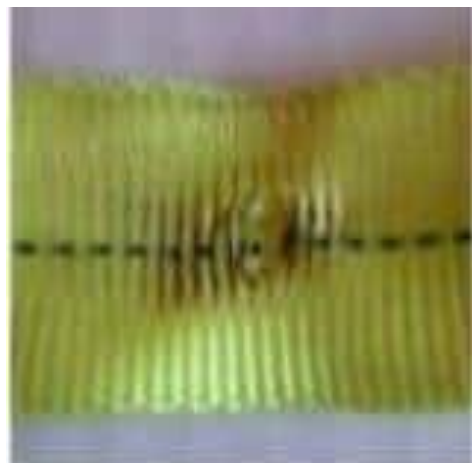
Webbing Sling must be marked clearly with WLL

LIFTING ACCESSORIES

WEBBING SLINGS – DEFECTS



Web slings should be examined along their length for surface chafe, cuts in the webbing, cuts or chafe damage to the selvedges and any damage to the stitching, eyes or end fittings.



Melting or charring on any part of the sling

LIFTING ACCESSORIES

WEBBING SLINGS – DEFECTS



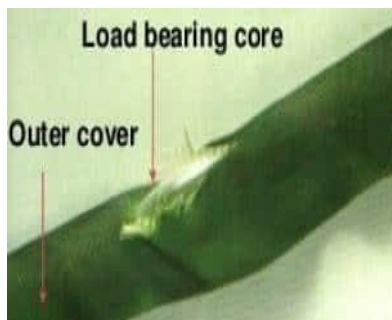
Broken stitches



Holes, tears, cuts or snags

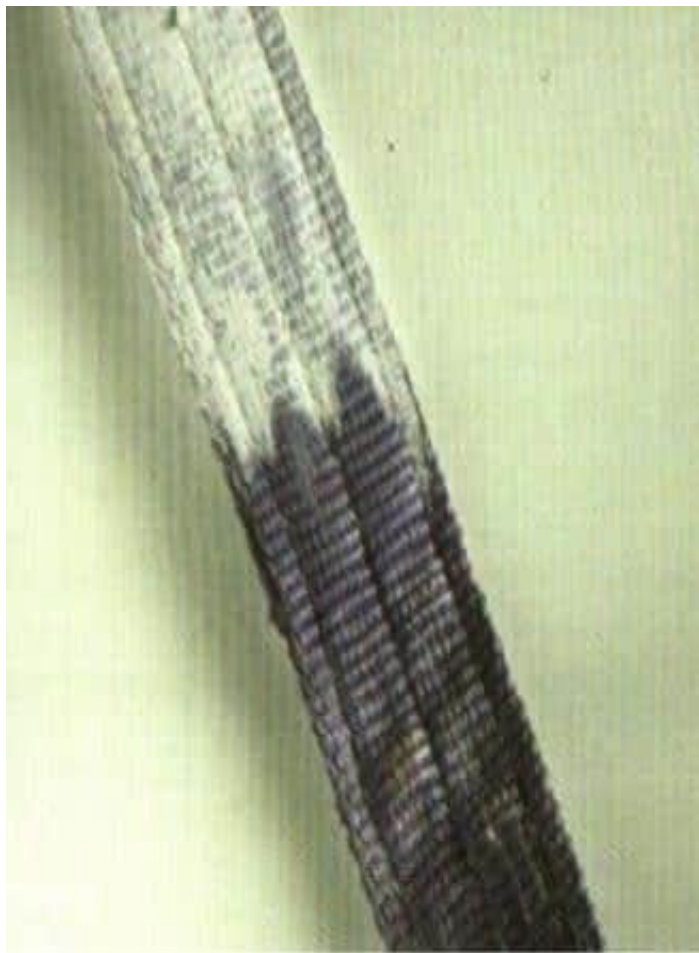


Holes, tears, cuts or snags



LIFTING ACCESSORIES

WEBBING SLINGS – DEFECTS



CHEMICAL ATTACK

It is indicated by local weakening or softening of the material in the webbing so that surface fibres can be rubbed off, as a powder in extreme cases.

Chemical attack/contamination: May show as discoloration and is a clear indication of damage to the sling.

LIFTING ACCESSORIES

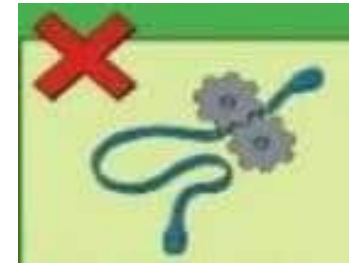
WEBBING SLINGS – STORAGE

Synthetic slings must be stored:

- ▶ In a clean, dry, well ventilated place
- ▶ Away from the ground or floor
- ▶ Away from direct sunlight, ultra-violet and fluorescent lights
- ▶ Away from extremes of heat
- ▶ Away from sources of heat and ignition
- ▶ Away from all types of chemicals such as oxidizing agents and alkalis
- ▶ Away from possibility of mechanical damage
- ▶ Safe from vermin attack



Don't store slings in an area where it can be mechanically damaged.



Don't Store on ground or on floors



Never store on direct sunlight, UV or florescent lighting.



Never store near any chemicals or liquids.



LIFTING ACCESSORIES

Chain slings

- Long Life than other types
- Good for wear and abrasion
- Flexible & High rise lift.

Wire Rope Slings

- Good for impact or shock loading
- Heavy lifting
- IWRC is resistance to crushing.

Web Slings

- Light Weight
- Reduces load damage
- Good for loose material because of high contact .

LIFTING ACCESSORIES

SHACKLE



A shackle is a removable metal U-shaped lifting connector secured with a pin or bolt, used to join lifting components such as slings, chains, wire ropes, hooks, or lifting beams during hoisting operations.

It acts as a connection link in a lifting assembly.

LIFTING ACCESSORIES

SHACKLES USES

Bow Shackles Screw Pin Type (Anchor Shackle):

- Bow Shackles are being used with more than 1 Sling.
- Sling Angle must never exceed 45° to the vertical.
- Screw Pin Shackles are being used for temporary applications.



Bow Shackles Safety Pin Type (Anchor Type):

- Bow Shackles are being used with more than 1 Sling.
- Sling Angle must never exceed 45° to the vertical.
- Safety Pin Shackles are being used for permanent applications.



LIFTING ACCESSORIES

SHACKLES USES

Dee Shackles Screw Pin Type (Chain Shackle):

- Dee Shackles are being used with 1 Sling only.
- Could be used to connect Shackle to another item vertically.
- Screw Pin Shackles are being used for temporary applications.



Dee Shackles Safety Pin Type (Chain Shackle):

- Dee Shackles are being used with 1 Sling only.
- Could be used to connect Shackle to another item vertically.
- Safety Pin Shackles are being used for permanent applications.



LIFTING ACCESSORIES

SHACKLES – TYPES



Round Pin Bow Shackle



Screw Pin Type Bow Shackle



Nut & Bolt Type Bow Shackle



Round Pin Dee Shackle



Screw Pin Type Dee Shackle



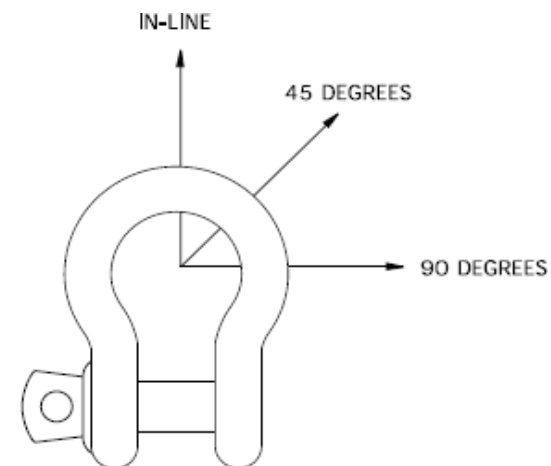
Nut & Bolt Type Dee Shackle

LIFTING ACCESSORIES

SHACKLES – USAGE

Side loads should be avoided as well, as the products are not designed for this purpose. If side loads cannot be avoided, the following reduction factors must be taken into account:

Load angle	Reduction for side loading
0 °	100% of original Working Load Limit
45 °	70% of original Working Load Limit
90 °	50% of original Working Load Limit



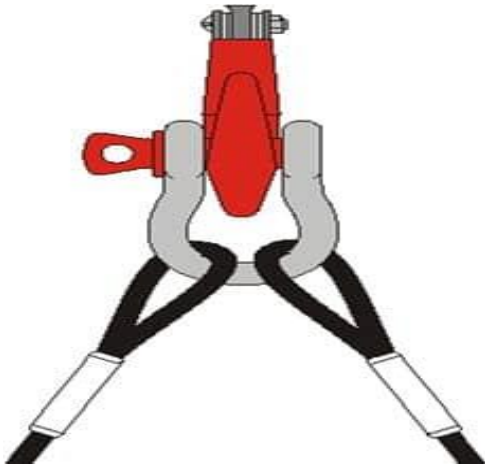
TEMPERATURE:

If extreme temperature situations are applicable, the following load reduction must be taken into account:

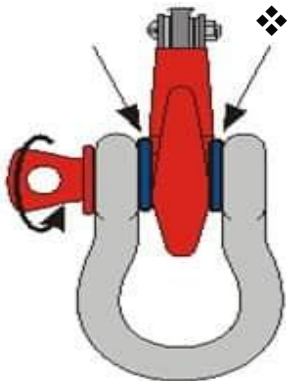
up to 200° C	100% of original Working Load Limit
200 - 300° C	90% of original Working Load Limit
300 - 400° C	75% of original Working Load Limit not
Temp > 400° C	allowed

LIFTING ACCESSORIES

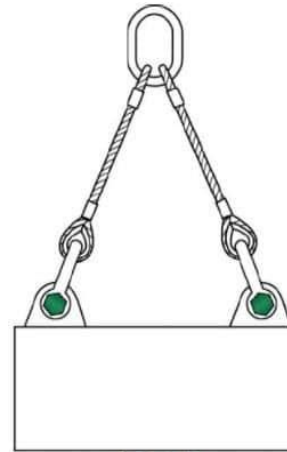
SHACKLES – USAGE



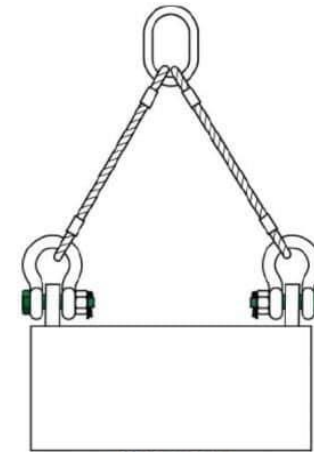
Correct



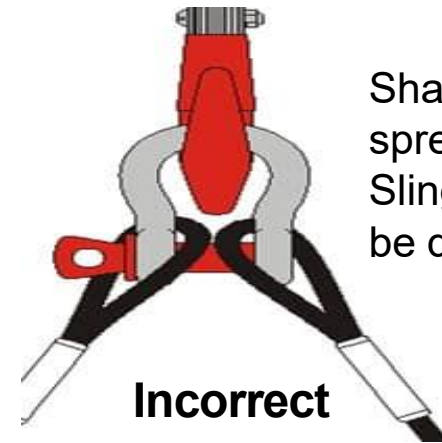
❖ Washers can be placed to take up the space between the shackle and hook.



GOOD



WRONG



Incorrect

Shackle can spread and Sling eyes can be damaged

LIFTING ACCESSORIES

SHACKLES – USAGE



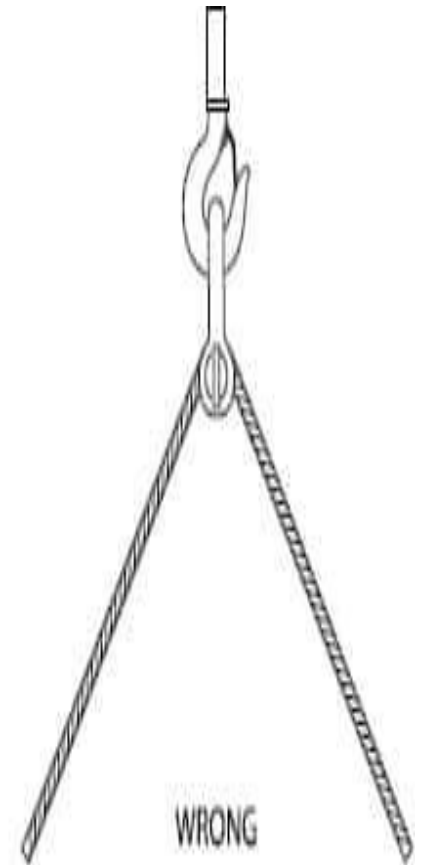
RIGHT



WRONG



RIGHT



WRONG

LIFTING ACCESSORIES

SHACKLES – INSPECTION

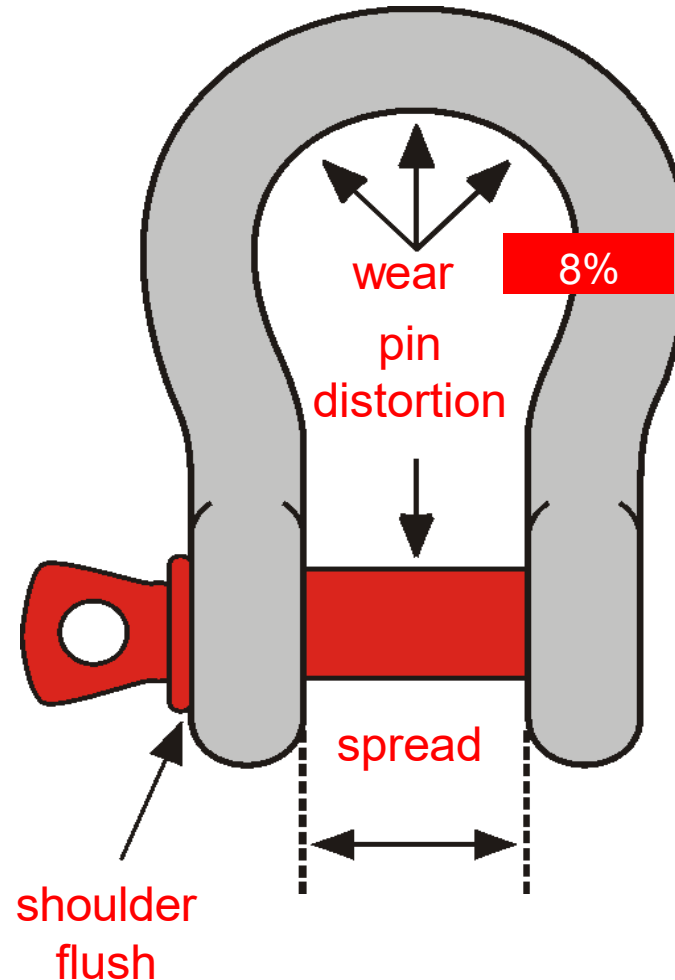
Prior to using a shackle, the following checks should be made:

1. The WLL is adequate for the load.
2. The colour coding (where applicable) is current and the shackle has a plant number/ID mark.
3. Remove shackle pin and examine for wear, deformation and cracking.
4. Ensure it is the correct pin for the shackle (i.e. not a higher tensile pin in an alloy shackle).
5. Check pin threads for wear/deformation
6. Examine shackle body for deformation and cracking and check for wear in the crown and pin holes.
7. Check alignment of pin holes and ensure the pin fits correctly.
8. In the case of safety pin shackles, ensure split pins are fitted.

LIFTING ACCESSORIES

SHACKLES – INSPECTION

- ▶ Bent or distorted pin and/or body
- ▶ Body spread
- ▶ Reduction in diameter of pin and/or body greater than 8%



LIFTING ACCESSORIES

Hook

Hook is a forged steel lifting device with a curved shape and load-bearing throat, designed to attach lifting equipment (such as slings, chains, or wire ropes) to a load or crane during hoisting operations. It is a primary load connection component in lifting assemblies.

Hook could very well be the most used type of rigging hardware. They can be attached to load blocks, slings. Hooks should be embossed with the size, rated capacity and equipped with latches.



LIFTING ACCESSORIES

HOOKS - TYPES



Pipe Hook



Clevis Hook With Latch



Clevis Grab Hook

LIFTING ACCESSORIES

HOOKS - TYPES



Eye Hook with Self Lock



Clevis Hook with Self Lock



Swivel With Self Lock



Swivel Hook With Latch



Eye Hook with latch



Clevis Hook With Latch

CLEVIS HOOKS - USES

Clevis hooks are specialized, high-strength terminal fittings commonly used in lifting and rigging applications to securely connect loads to cranes, hoists, or wire ropes. They are designed with a U-shaped attachment point (clevis) secured by a pin, which allows for direct, in-line attachment to chain slings without the need for additional connecting links.

Uses in Lifting Operations & Industries

- **Construction & Heavy Lifting:** Used for lifting steel beams, prefabricated components, and scaffolding, often with Grade 80 or 100 alloy chains.
- **Manufacturing:** Utilized in factory settings to move heavy machinery, components, and raw materials, enhancing efficiency and safety in production lines.
- **Shipping & Logistics:** Essential for loading/unloading cargo, particularly with chain slings in maritime environments to prevent accidental load disengagement.
- **Oil & Gas (Offshore):** Used for handling equipment in harsh marine environments due to their high-strength and corrosion-resistant properties.
- **Mining & Resource Extraction:** Employed for handling heavy materials and tools, particularly in extraction and processing areas.
- **Forestry & Logging:** Used with chains for securing, towing, or lifting logs.
- **Chain Shortening:** Clevis grab hooks, a subset of this type, are used to adjust the length of chain slings.

LIFTING ACCESSORIES

CLEVIS HOOKS - USES

Advantages

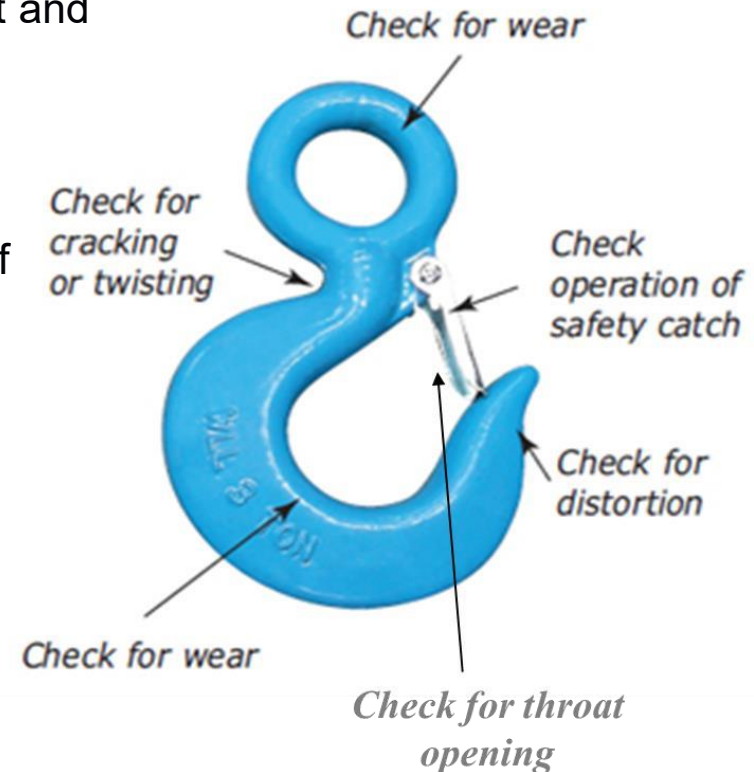
- **Direct Attachment:** Unlike eye hooks, they connect directly to chain links, reducing the number of necessary components and potential points of failure.
- **Interchangeability:** If damaged, they can be easily removed and replaced without replacing the entire chain sling.
- **Safety Features:** Often feature self-locking mechanisms (auto-lock when loaded) or safety latches to prevent unintentional load release.
- **High Load Capacity:** Made from high-strength forged alloy steel (Grade 80/100)

LIFTING ACCESSORIES

HOOKS – INSPECTION

Prior to using a hook, the following checks should be made:

1. The WLL is adequate for the load.
2. The colour coding (where applicable) is current and the hook has a plant number/ID mark.
3. Check for wear on the load bearing points
4. Check for proper operation of the safety catch if fitted
5. Checking for throat opening
6. Check for twisting on the neck
7. Check for distortion or bend
8. Check for excessive corrosion



LIFTING ACCESSORIES

HOOKS - USES

Various Types of Lifting Hooks and Their Uses (Comparison Chart)

Hook Type	Description	Main Features	Typical Uses	Advantages	Limitations
Eye Hook	Hook with a circular eye at the top for connection with shackle or chain.	Fixed connection point	General lifting with slings and chains	Simple design, strong	Cannot rotate
Clevis Hook	Hook with a clevis pin connection used with chains.	Pin type connection	Chain sling assemblies	Easy to assemble with chain	Requires pin inspection
Swivel Hook	Hook that rotates 360° under load.	Swivel bearing mechanism	Cranes and hoists where load rotation is required	Prevents twisting of slings	More expensive
Self-Locking Hook (Safety Hook)	Hook with automatic locking latch that closes under load.	Safety latch locking system	Heavy lifting operations	Prevents load slipping	Needs regular inspection

LIFTING ACCESSORIES

HOOKS - USES

Various Types of Lifting Hooks and Their Uses (Comparison Chart)

Hook Type	Description	Main Features	Typical Uses	Advantages	Limitations
Grab Hook	Narrow throat hook designed to grab a chain link.	Designed for shortening chains	Chain sling shortening and load adjustment	Quick chain adjustment	Not suitable for wire rope
Slip Hook	Wide throat hook allowing chain to slip freely.	Open throat design	Temporary connections	Fast and flexible connection	Less secure
Foundry Hook	Hook with wide opening and flat profile.	Heavy-duty forged design	Steel mills, foundries	Handles hot materials	Specialized use
Sorting Hook	Long narrow hook used for sorting materials.	Extended hook shape	Scrap yards and warehouses	Good for pulling materials	Not for heavy lifting
S-Hook	Hook shaped like the letter S.	Two open ends	Hanging loads, light-duty lifting	Easy to attach/remove	Not secure for heavy loads
Shank Hook	Hook with threaded shank for mounting in equipment.	Threaded connection	Hoists and lifting devices	Strong connection	Needs proper torque

LIFTING ACCESSORIES

HOOKS - USES

Quick Hook Selection Guide for Riggers

Application	Recommended Hook Type
General lifting	Eye Hook / Clevis Hook
Chain sling adjustment	Grab Hook
Crane hook block	Swivel Hook
High safety lifting	Self-Locking Hook
Steel plant operations	Foundry Hook
Temporary light connection	Slip Hook

LIFTING ACCESSORIES

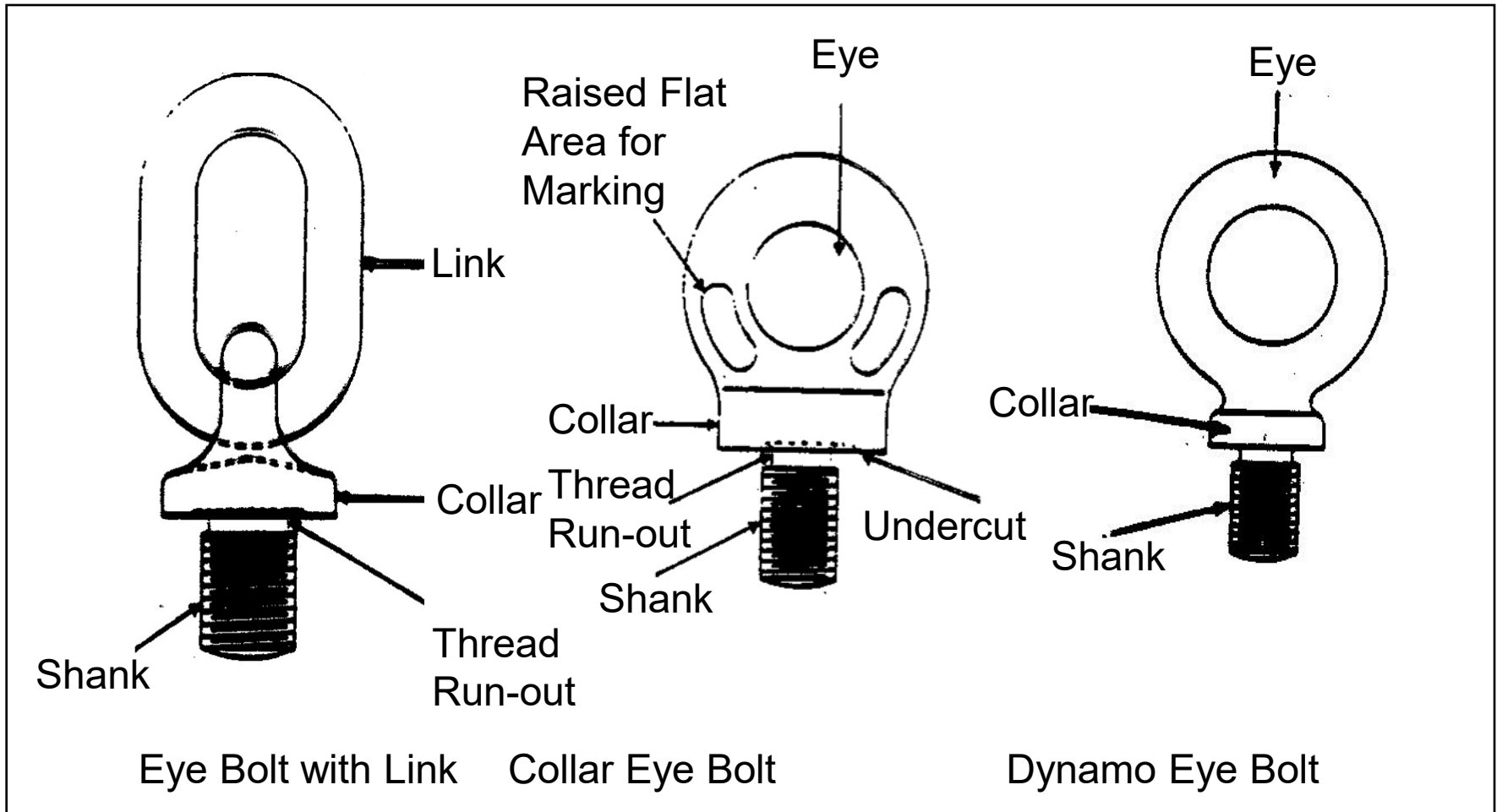
Eyebolts



An **eyebolt** is a threaded lifting attachment with a forged eye (ring) at one end and a threaded shank at the other, designed to be screwed into a load to provide a **secure lifting point**.

LIFTING ACCESSORIES

EYEBOLTS



LIFTING ACCESSORIES

EYEBOLTS - TYPES



EYE BOLT WITH LINK

COLLAR EYEBOLT

DYNAMO EYEBOLT

STAR POINT EYEBOLT

WLL in axial loading is lower but at inclined loads are about double those of collar eyebolts

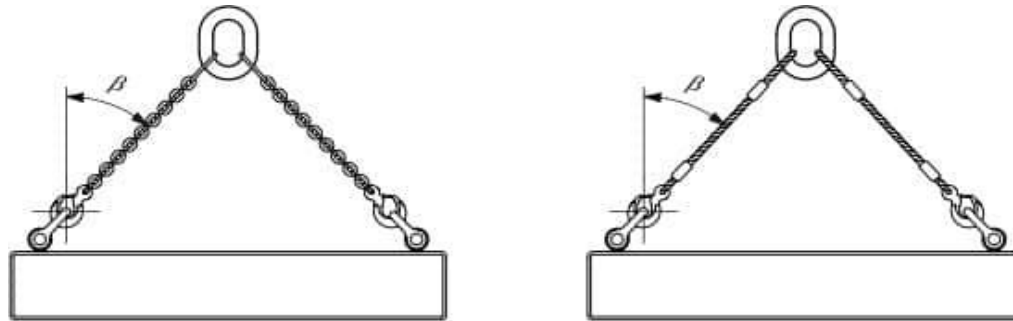
WLL in axial loading is higher but at inclined loads are about half of eyebolt with link

Is extremely limited in its use for lifting purposes (only for electrical industry)

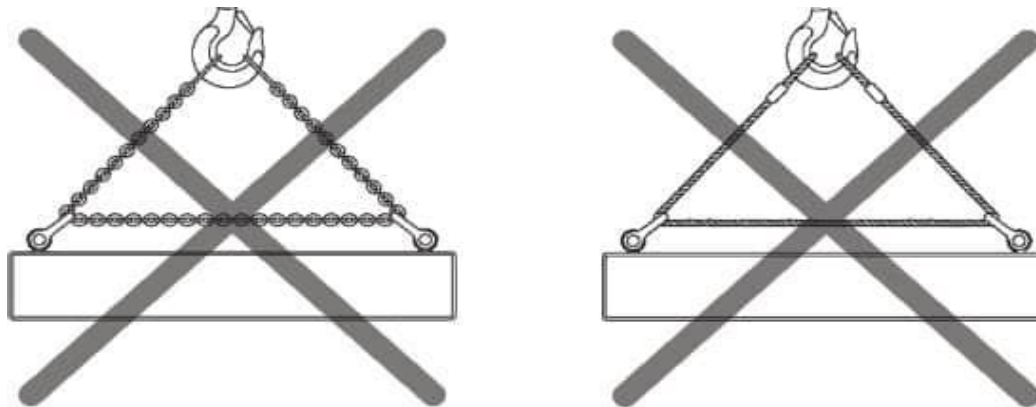
The Star Point swivel eyebolt is the perfect solution to replace the unsafe, rigid style eye bolt because it was designed to adjust to the direction of the pull so that the working load limit (WLL) is never diminished.

LIFTING ACCESSORIES

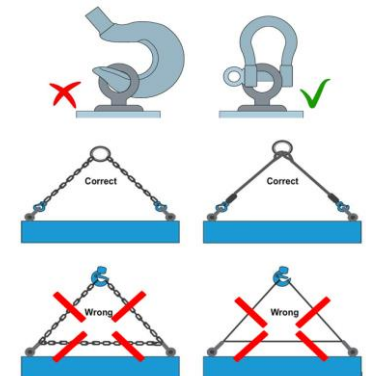
EYEBOLTS - USAGE



Correct Method of Slinging Pairs or Eyebolts



Incorrect Method of Slinging Pairs or Eyebolts

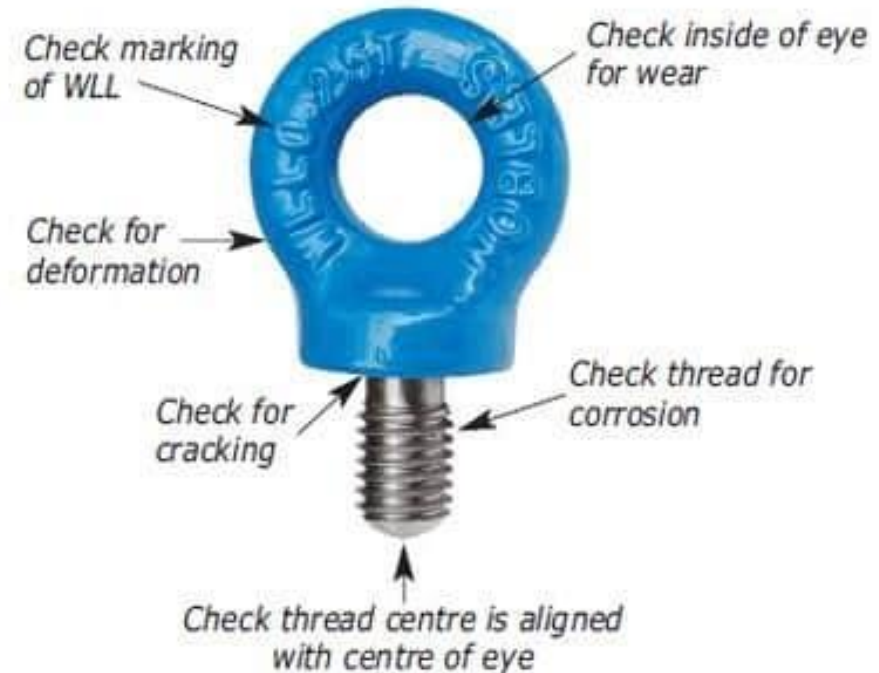


LIFTING ACCESSORIES

EYEBOLTS - INSPECTION

Prior to using the eyebolts, the following checks should be made:

1. The WLL is adequate for the load.
2. The colour coding (where applicable) is current and the eyebolt has a plant number/ID mark.
3. Examine threads and check for wear, stretch or impact damage. The thread must be complete (no broken threads and full i.e. no flats on top).



EYEBOLTS INSPECTION AREAS

ANGLE FACTORS

**Maximum load to be lifted = angle factor x SWL for a pair of eyebolts
Manufactured to BS 4278**

Type of eyebolt	Vertical angle α of the sling legs		
	$0^\circ < \alpha \leq 15^\circ$	$15^\circ < \alpha \leq 30^\circ$	$30^\circ < \alpha \leq 45^\circ$
Collared Eyebolt	0.63	0.4	0.25
Eyebolt with Link	1.0	0.8	0.63



LIFTING ACCESSORIES

TURNBUCKLE



LIFTING ACCESSORIES

TURNBUCKLES (RIGGING SCREW)

Turnbuckles (Rigging screw) can be obtained with various types and combinations of end fittings, the most widely used being the “Jaw and Eye” type.

Turnbuckles (Rigging screw) are used to provide a means for length adjustment and tensioning. It should only be used for in-line mode only, i.e. straight pull only

When using Turnbuckles (Rigging screw) in an area which is susceptible to vibration, wire Lock or some means of positive locking device is required.



Turn buckle – Exposed Threads



Rigging Screw – Closed Threads

LIFTING ACCESSORIES

TURNBUCKLES (RIGGING SCREW) - TYPES



EYE & EYE



JAW & EYE



JAW & JAW



HOOK & EYE



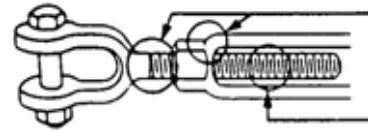
HOOK & HOOK

LIFTING ACCESSORIES

TURNBUCKLES (RIGGING SCREW) – INSPECTION

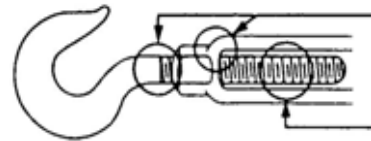
Prior to using any rigging screw, the following checks should be made:

1. The WLL is adequate for the load.
2. The colour coding (where applicable) is current and the rigging screw has a plant number/ID mark.
3. The threads are free from wear, stretch and impact damage
4. The eye/hooks are not worn or stretch.
5. The clevis pin and pin holes are free from distortion/wear.
6. Threads are suitably lubricated.



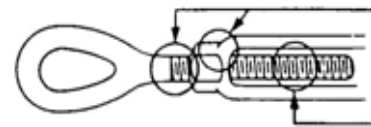
Check for cracks & bends

Check for thread damage & bent rods



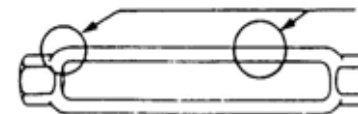
Check for cracks & bends

Check for thread damage & bent rods



Check for cracks & bends

Check for thread damage & bent rods



Check for cracks & deformat

LIFTING ACCESSORIES

SWIVELS

A **swivel** is a forged mechanical lifting component that allows **rotation between two connected lifting parts** (such as hooks, chains, master links, or slings) to prevent twisting during lifting operations. It contains an internal **bearing or rotating mechanism** that enables controlled 360° movement under load.

Purpose of a Swivel

- **Prevent Twisting (Torsion Control)**
Reduces torsional stress in wire rope or chain slings when the load rotates.
- **Improve Load Alignment**
Allows the hook or sling to align naturally with the center of gravity.
- **Increase Safety**
Minimizes shock loading and side loading caused by twisted slings.
- **Protect Lifting Gear**
Prevents damage to:
 - Wire ropes (bird-caging, kinking)
 - Chain slings (link distortion)
 - Hooks (side loading stress)
- **Ease of Handling**
Allows easier positioning of loads during installation or lifting operations.

LIFTING ACCESSORIES

SWIVELS-TYPES

Eye-to-Eye Swivel

A forged lifting accessory fitted with a closed eye at both ends and an internal bearing mechanism that allows 360° rotation under load, used to prevent twisting in lifting assemblies.

Uses: Between master link and hook, or between two lifting components.

Jaw-to-Jaw Swivel (Clevis Type)

A swivel component with clevis (jaw) fittings and removable pins at both ends, designed to connect directly to chain sling components while allowing rotational movement to reduce torsion.

Uses: Chain sling assemblies (Grade 80 / Grade 100).

Eye-to-Jaw Swivel (Mixed Type)

A lifting swivel with one closed eye and one clevis (jaw) end, allowing rotational movement while providing mixed connection compatibility between hooks, master links, and chain slings.

Uses: Versatile rigging assemblies requiring one eye and one clevis connection.

LIFTING ACCESSORIES

SWIVEL - TYPES



Regular Swivel



Jaw & Swivel



Jaw & Jaw Swivel



Jaw & Eye Swivel

LIFTING ACCESSORIES

SWIVELS-INSPECTION

Prior to using any swivels, the following checks should be made:

1. The WLL is adequate for the load.
2. The color coding (where applicable) is current and the swivels has a plant number/ID mark.
3. The Manufacturer's details, traceability code, grade has to be present.
4. The eye/jaws are not worn or stretch.
5. The swivels free from distortion.
6. Must rotate smoothly and free from extra axial excessive play.

LIFTING ACCESSORIES

MASTER LINKS

A master link is a specialized component used to connect chain ends in machinery or secure rigging in lifting, allowing for easy installation or removal without tools. In rigging, it is a durable, forged alloy ring used at the top of slings. It forms the primary suspension point of a lifting assembly

Master Link Assembly

A master link assembly consists of:

- One main master link
- Two intermediate links (sub-links)
- Multiple chain sling legs connected to the intermediates. It distributes load evenly across multi-leg sling assemblies.

LIFTING ACCESSORIES

MASTER LINKS - TYPES



Oblong Type Master Link-Single

Features:

- Single forged oblong ring
- Used for 1-leg sling assemblies
- Must fit crane hook bowl properly



Master Link Assembly

Features:

- Main link + 2 sub links
- Used for 2, 3, 4 leg chain slings
- Allows angular loading

LIFTING ACCESSORIES

MASTER LINKS - TYPES



Features:

- Narrow top section
- Designed for better crane hook seating
- Used where hook throat is small

Pear Shaped Master Link



Features:

- Often welded type
- Used in wire rope bridle slings
- Must meet design load requirement

Welded Master Link

LIFTING ACCESSORIES

MASTER LINKS - INSPECTION

1. Identification & Certification

- Manufacturer name / mark visible
- WLL (Working Load Limit) clearly marked
- Size & grade identifiable
- Valid test certificate available
- Current Color code

2. General Condition

- No corrosion, pitting, or rust scale
- No sharp edges or burrs
- No unauthorized welding or repairs
- Clean and free from excessive dirt, oil, or paint

3. Deformation & Wear

- No elongation or stretching
- No distortion (oval shape, bending, twisting)
- No reduction in cross-section (wear $\leq 10\%$)
- Link sits correctly with connecting slings

4. Cracks & Damage

- No gouges, deep cuts, or nicks
- No heat damage (bluing, discoloration)
- No visible cracks
(especially at crown and weld area)

LIFTING ACCESSORIES

PLATE CLAMPS - TYPES

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



Horizontal Plate Lifting Clamp



Vertical Plate Lifting Clamp

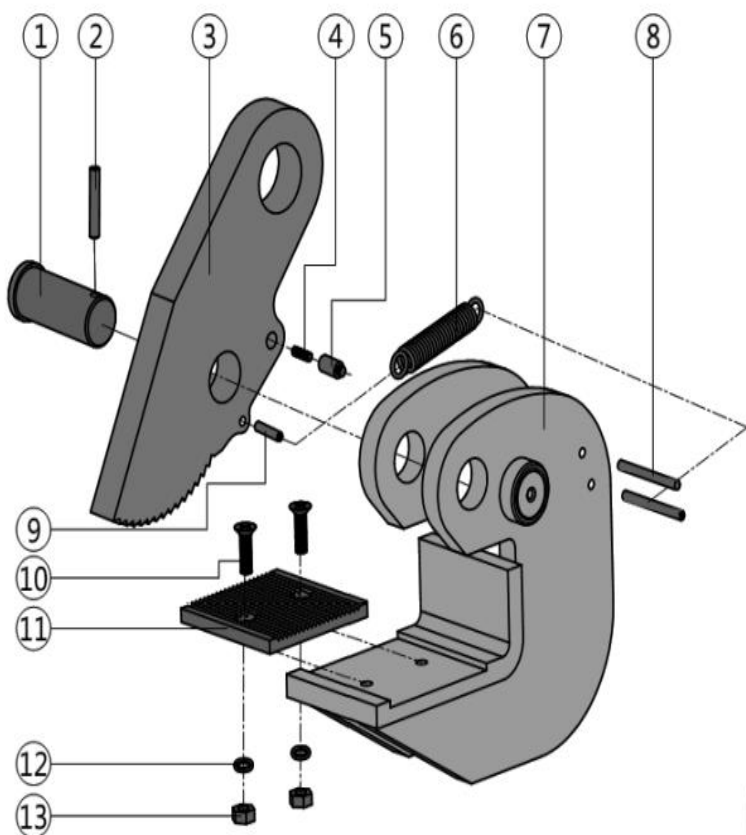


Magnetic Lifting Clamp



LIFTING ACCESSORIES

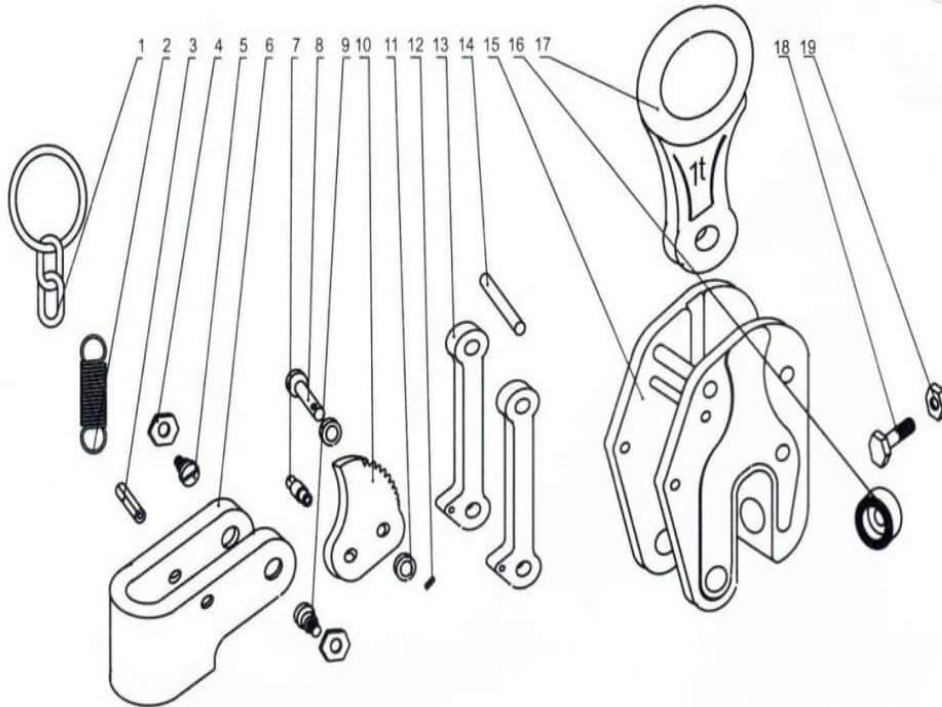
HORIZONTAL PLATE CLAMPS



1. MAIN SHAFT PIN
2. ELASTIC CYLINDRICAL PIN
3. BRAKE KNIFE
4. PRESSURE SPRING
5. ELASTIC PIN
6. TENSION SPRING
7. CASING
8. ELASTIC CYLINDRICAL PIN
9. ELASTIC CYLINDRICAL PIN
10. FLAT HEAD SCREW
11. TOOTHED PLATE
12. SPRING WASHER
13. LOCKNUT

LIFTING ACCESSORIES

VERTICAL PLATE CLAMPS



- | | |
|-------------------|----------------------------|
| 1.PULLING RING | 2.SPRING |
| 3.SPRING PIN | 4.NUT |
| 5.BOLT | 6.SAFETY LATCH |
| 7.LINK PIN | 8.JAW SHAFT |
| 9.BOLT | 10.JAW |
| 11.WASHER | 12.SPRING PIN |
| 13.LINK SHOULDER | 14.SHAFT FOR LINK SHOULDER |
| 15.PLATE ASSEMBLY | 16.JAW HOLDER |
| 17.LIFT RING | 18.BOLT |
| 19.NUT | |

LIFTING ACCESSORIES

PLATE CLAMPS-INSPECTION

BEFORE USE

- Manufacturer Name plate & it's details, ID, WLL ,Range clearly marked and readable;
- Current Color code
- Clamp body free from cracks or deformation
- Jaw teeth clean, sharp, and not worn
- Cam rotates smoothly
- Safety lock working properly
- Shackle and pin free from cracks / wear
- Pins, bolts, and circlips in place
- No oil, grease, or paint on jaws

LIFTING ACCESSORIES

PLATE CLAMPS-INSPECTION

DURING USE

- Correct plate thickness selected
- Load within rated capacity
- Clamp fully engaged before lifting
- Load lifted smoothly (no shock load)
- Plate remains vertical and stable

AFTER USE

- No damage after operation
- Clean clamp before storage
- Store in dry, designated place

LIFTING ACCESSORIES

BEAM CLAMPS

Beam clamps are generally used to provide a ready means of attaching lifting appliances to suitable structural steelwork.

Due to their versatility if designed and tested and stated within the instructions for use then certain types can be used for attaching to the upper flange of the beam to facilitate the lifting of a beam.



LIFTING ACCESSORIES

BEAM CLAMPS-TYPES



LIFTING ACCESSORIES

BEAM CLAMPS-TYPES



Figure 1

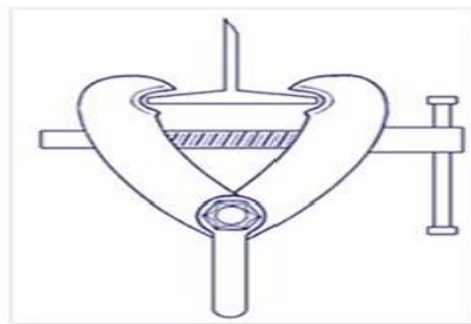


Figure 2



Figure 3

An adjustable type beam clamp, as the name implies, is adjustable to fit beams of various sizes.

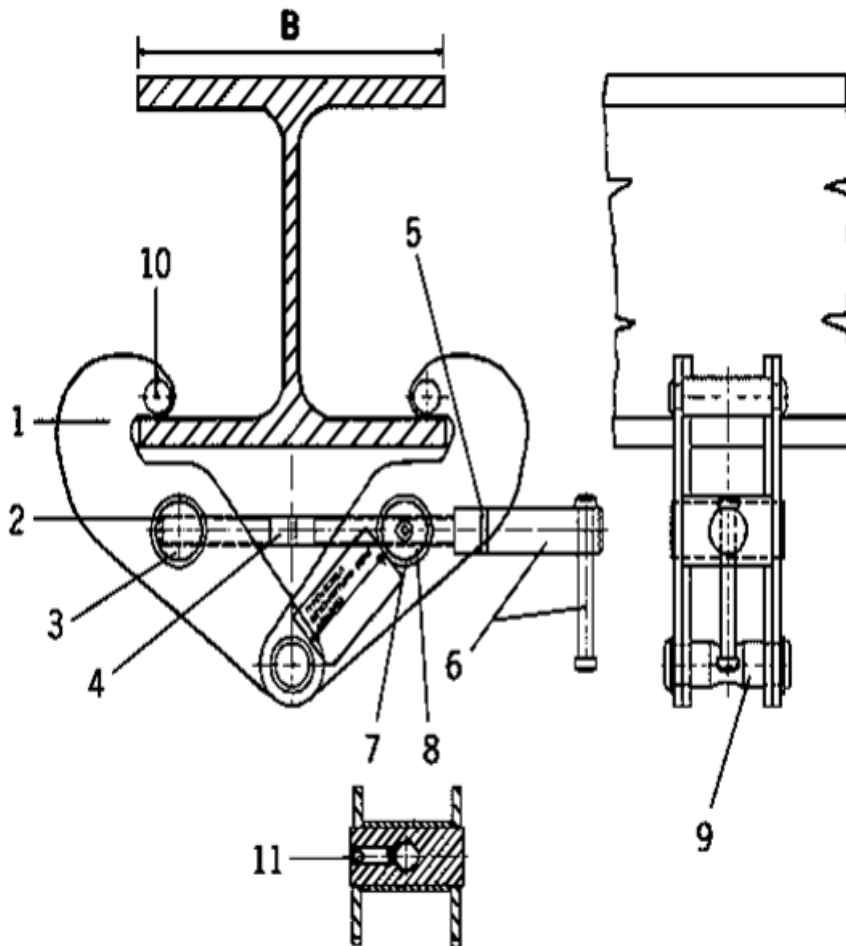
Some, such as the type illustrated in Figure 1 are self-adjusting whilst others, such as the type shown in Figure 2, require the operative to make the adjustment.

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 3.

Depending on the design, adjustable clamps are only capable of adjustment within specific limits and are therefore manufactured in a series of size ranges.

LIFTING ACCESSORIES

BEAM CLAMPS CRITICAL COMPONENTS



1. SLIDE PLATE ASSY.WITH SPACER BOLTS & SUSPENSION BAR
2. SPACER TUBE,SHORT
3. TENSIONING NUT,SHORT
4. SPINDLE
5. ROLL PIN
6. CRANK HANDLE
7. SPACER TUBE,LONG
8. TENSIONING NUT,LONG
9. SUSPENSION BAR
10. SPACER BOLT
11. THREADED PIN WITH COPPER FLAT

LIFTING ACCESSORIES

BEAM CLAMPS INSPECTION

1. Identification & Rating

- Manufacturer name and other details must be visible
- Working Load Limit clearly marked
- Beam size range marked
- Serial / ID number present

2. Clamp Body & Structure

- No cracks or fractures
- No bending or distortion
- No unauthorized welding or grinding
- No excessive corrosion or pitting

3. Jaws / Flanges

- Jaws not worn, chipped, or deformed
- Proper seating on beam flange
- Teeth (if any) intact

LIFTING ACCESSORIES

BEAM CLAMPS INSPECTION

4. Screw / Spindle / Bolt

- Threads clean and undamaged
- Screw turns freely
- Spindle not bent

5. Nut, Washer & Locking Parts

- Correct nut and washer fitted
- Lock nut / safety pin / retaining clip in place
- No loose or missing parts

6. Functional & Fit Check

- Clamp opens and closes fully
- Fits beam size correctly
- Sits square and centered on beam
- Load line vertical (no side loading)

LIFTING ACCESSORIES

LIFTING BEAM AND SPREADER BEAM

- Lifting beam: A beam (below the hook) with a single (or limited) top lifting point(s) that attaches to the crane hook, and multiple lower pick points to attach slings or lifting connectors to the load. The beam is generally loaded in bending (i.e. it behaves like a beam bending under load).
- Spreader beam (or spreader bar): A beam (or bar) that has two or more rigging points at the top ends (angled to the crane hook) and bottom lugs to connect to the load. It is mainly loaded in compression along its axis—the slings force inward push the beam, rather than bending it.



Equalizer Beam



Spreader Beam



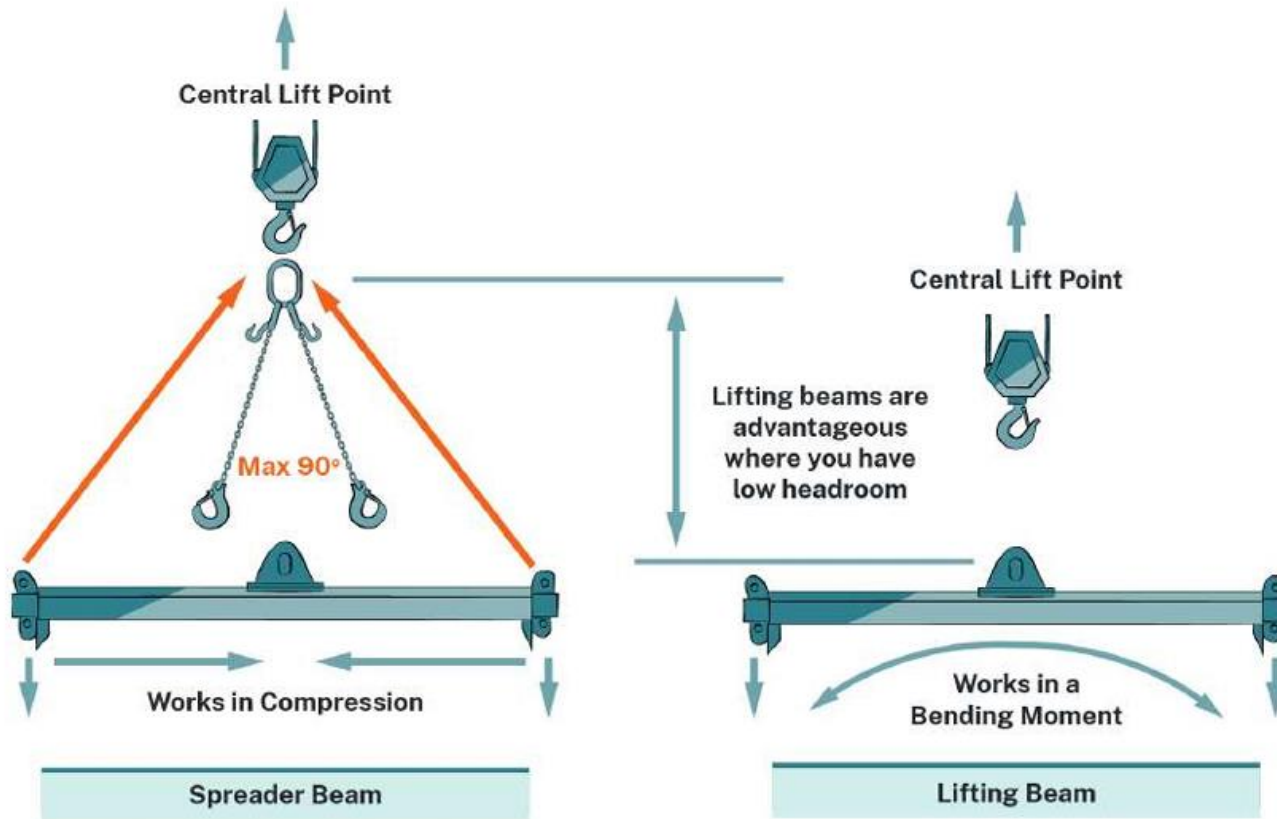
Spreader Frame



Lifting Beam

LIFTING ACCESSORIES

LIFTING BEAM AND SPREADER BEAM



Spreader and lifting beams

LIFTING ACCESSORIES

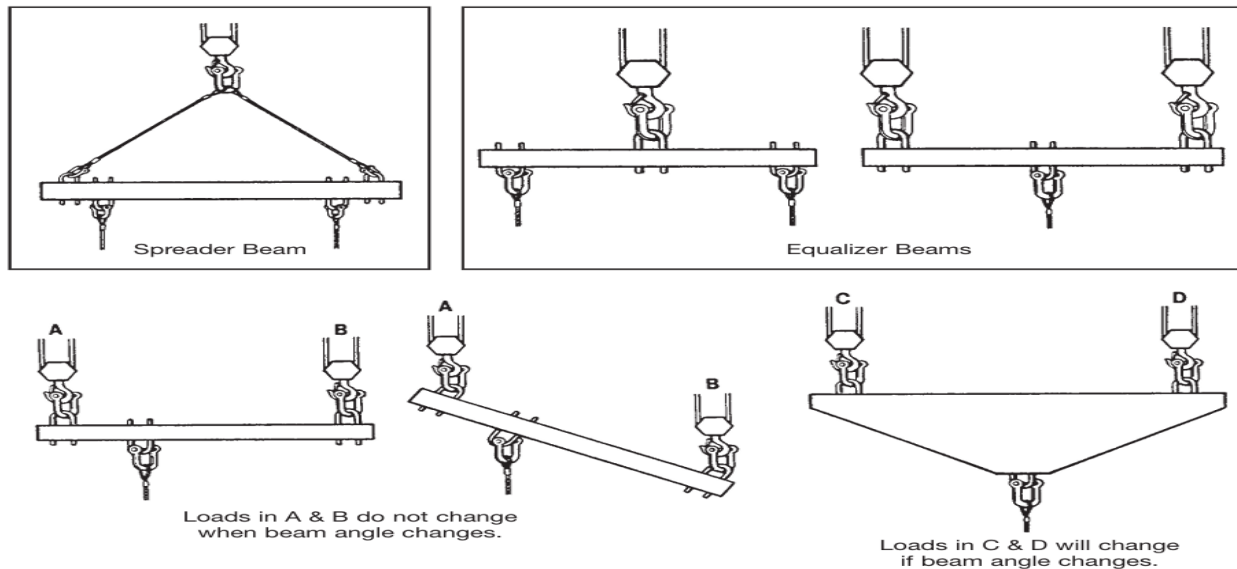
Spreader and Equalizer Beams

Spreader beams are usually used to support long loads during lifts. They eliminate the hazard of the load tipping, sliding, or bending as well as the possibility of low sling angles and the tendency of the slings to crush the load.

Equalizer beams are used to equalize the load in sling legs and to keep equal loads on dual hoist lines when making tandem lifts.

Spreader and equalizer beams are both normally fabricated to suit a specific application. If a beam is to be used which has not been designed for the application, make sure that it has adequate width, depth, length, and material.

The capacity of beams with multiple attachment points depends on the distance between the points. For example, if the distance between attachment points is doubled, the capacity of the beam is cut in half.



LIFTING ACCESSORIES

LIFTING BEAM AND SPREADER BEAM-INSPECTION

Minimum markings are:

- Working load limit and Identification plate present
- Manufacturer's mark
- Serial Number/I.D.
- Current color code
- Check WLL marking visible
- No cracks in beam body or welds
- No bent or distortion for lifting points/lifting lugs
- Shackles and pins secure points
- No severe corrosion
- No missing bolts (adjustable type)

Other markings are:

- Tare weight
- Use instructions
- Manufacture date
- Working load limit at different extensions

LIFTING ACCESSORIES

FULL BODY SAFETY HARNESS WITH LANYARD & SHOCK ABSORBER



Full Body Harness



Double Hook Lanyard



**Full Body Harness With
Double Hook Lanyard**

VIDEO ILLUSTRATION - 1



LIFTING APPLIANCES

LIFTING APPLIANCES

CRANES

LIFTING APPLIANCES

VARIOUS TYPES OF MOBILE CRANE

CRAWLER CRANE



ALL TERRAIN CRANE



ROUGH TERRAIN CRANE



TRUCK MOUNTED CRANE

LIFTING APPLIANCES

VARIOUS TYPES OF LORRY LOADER CRANE



Lorry Front Loading Mobile Crane



Lorry Rear Loading Mobile Crane



Lorry middle Loading Mobile Crane



Crawler Hydraulic Mobile Crane

LIFTING APPLIANCES

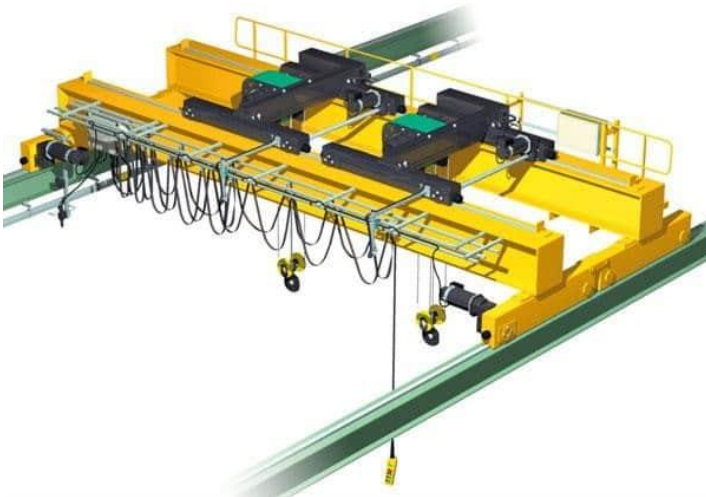
WORKSHOP CRANES



SLEWING JIB CRANE



FLOOR CRANE



OVERHEAD CRANE



GANTRY CRANE

LIFTING APPLIANCES

INDUSTRIAL CRANES



Hammerhead



Luffing Jib



Self-Erecting



Mobile Tower Crane

LIFTING APPLIANCES

FORKLIFT TRUCKS

LIFTING APPLIANCES

FORKLIFTS

**Diesel Powered
Counter Balanced
Forklift**



**Battery
Powered
Forklift**



Reach Stacker



**Pedestrian
Battery
Powered
Pallet Lifter**



LIFTING APPLIANCES

PULLEY BLOCKS (SHEAVE BLOCKS)

LIFTING APPLIANCES

PULLEY BLOCKS (SHEAVE BLOCKS)

A pulley block, also called a sheave block, is a mechanical lifting component consisting of one or more grooved wheels (sheaves) mounted in a frame, designed to guide a rope, wire rope, or chain to transmit mechanical force and lift loads efficiently.

- Converts direction of force
- Reduces effort required to lift a load using mechanical advantage
- Used in cranes, hoists, lifting gear, and rigging assemblies

Common Main Parts of a Pulley / Sheave Block

- 1.Frame / Housing / Flange – Forged or fabricated to hold sheaves
- 2.Sheave(s) – Grooved wheel(s) for rope or chain
- 3.Axle / Pin – Shaft on which sheave rotates
- 4.Hook / Shackle / Swivel Attachment – Connects block to lifting gear
- 5.Bearings / Bushings – Reduce friction in sheave rotation

LIFTING APPLIANCES

PULLEY BLOCKS (SHEAVE BLOCKS)-TYPES



**Single Sheave
Block
With
Hook Head
Fitting**



**Single Sheave
Block
With
Oval Eye Head
Fitting**



**Single Sheave
Snatch Block
With
Shackle head Fitting**



**Multi Sheave Snatch
Block**

LIFTING APPLIANCES

PULLEY BLOCKS (SHEAVE BLOCKS)

Resultant Load on Pulley Block



The right chart indicates the factor to be multiplied by the line pull to obtain the total load on the block.

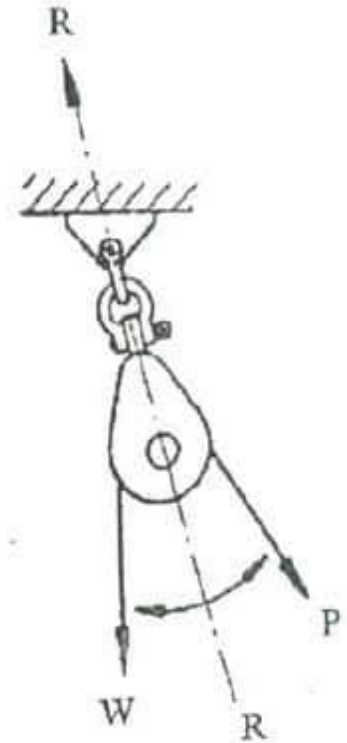
Angle Factor Multipliers			
Angle	Factor	Angle	Factor
0°	2.00	100°	1.29
10°	1.99	110°	1.15
20°	1.97	120°	1.00
30°	1.93	130°	0.84
40°	1.87	135°	0.76
45°	1.84	140°	0.68
50°	1.81	150°	0.52
60°	1.73	160°	0.35
70°	1.64	170°	0.17
80°	1.53	180°	0.00
90°	1.41	--	--

LIFTING APPLIANCES

PULLEY BLOCKS (SHEAVE BLOCKS)

How to calculate the resultant load (R) on pulley blocks

- ▶ W - Weight to be Lifted
- ▶ P - Line pull = (W x % of friction)
- ▶ The percentage to be applied for friction is generally accepted to be:
 - ▶ Sheaves with roller bearings - 4% per sheave i.e. W x 1.04
 - ▶ Sheaves with bronze bushes - 8% per sheave i.e. W x 1.08



Resultant Load (R) = Weight (W) x Frictional Force (F) x Angle Factor

LIFTING APPLIANCES

CHAIN BLOCKS-NON POWERED HOIST

A manual chain hoist is a mechanical lifting device that uses hand power via a hand chain to lift or lower loads through a system of gears and load chains. They are commonly used in workshops, factories, construction, and rigging operations.

Main Components of a Manual Chain Hoist

- Hand Chain – Pulled by operator to lift or lower the load.
- Load Chain – Heavy-duty chain attached to load hook; transmits load to gears.
- Load Hook – Forged hook that carries the load; may have a safety latch.
- Top Hook / Suspension Hook – Connects hoist to beam, trolley, or lifting point.
- Gear Mechanism / Load Sheave – Multiplies hand force to lift heavy loads.
- Brake System – Holds the load when hand chain is released.
- Hoist Body / Housing – Encases the gears and brake mechanism.
- Chain Guide / Chain Container – Keeps chain aligned and prevents jamming.

LIFTING APPLIANCES

CHAIN BLOCKS

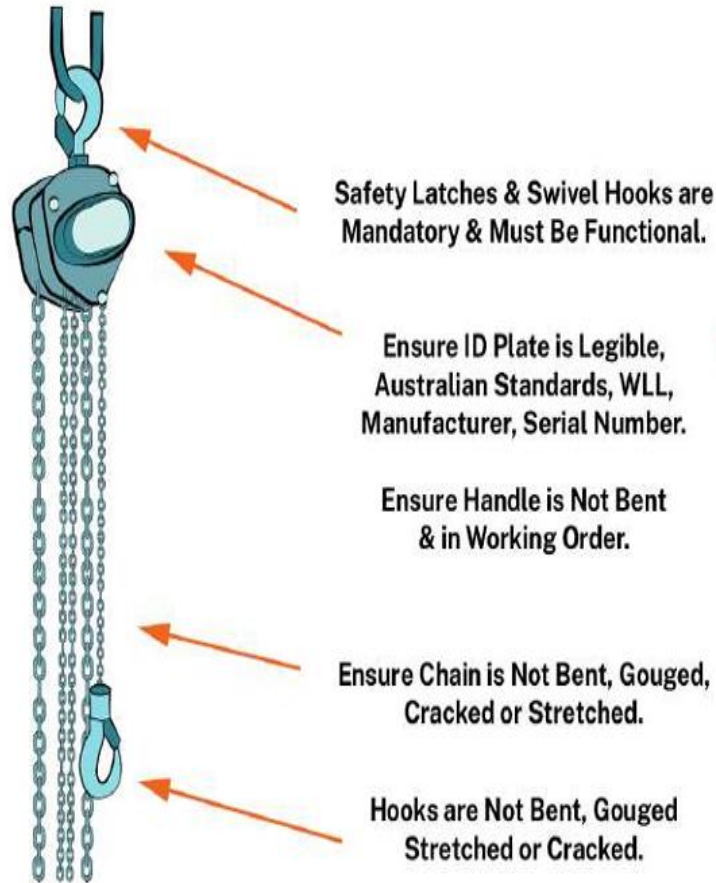


Working Principle:

- Operator pulls hand chain.
- The gearing system multiplies force.
- Load chain moves over load sheave and raises or lowers load hook.
- Brake system automatically holds the load when hand chain is released

LIFTING APPLIANCES

CHAIN BLOCKS INSPECTION



Inspect the chain blocks When inspecting chain blocks you should check:

- Markings (Manufacturer's ID, Working Load Limit (WLL), Serial Number, Size And Grade Of Chain), color code
- The Brake Lining Material For Signs Of Wear. The Brake Should Be Assessed According To Manufacturer's Instructions.
- The Pawl For Sharpness, Alignment And Functionality
- The Ratchet Teeth For Sharpness And Wear
- The Bearing Bushes For Wear And Have Them Renewed If Necessary

LIFTING APPLIANCES

CHAIN LEVER HOIST (PULL-LIFT)



LIFTING APPLIANCES

CHAIN LEVER HOIST (PULL-LIFT)

A ratchet lever hoist (also called a lever block) is a manual lifting and pulling device that uses a ratchet and pawl mechanism to lift, pull, or tension loads. Unlike standard chain hoists, it can operate vertically, horizontally, or at an angle, making it extremely versatile in rigging operations.

Main Components

- Lever / Handle – Operated by the user to move the load incrementally.
- Load Chain – Heavy-duty chain that carries the load.
- Load Hook – Forged hook with safety latch for the load.
- Suspension Hook / Top Hook – Connects hoist to anchor point or trolley; may swivel.
- Ratchet & Pawl Mechanism – Converts lever motion into load movement; prevents backsliding.
- Brake System – Automatically holds the load in position when lever is released.
- Hoist Body / Frame – Forged steel or cast body encasing gears and brake.
- Load Chain Guide / Sheave – Ensures smooth movement of load chain

LIFTING APPLIANCES

CHAIN LEVER HOIST (PULL-LIFT)



Working Principle

1. Operator moves the lever back and forth.
2. Ratchet & pawl mechanism converts lever motion to rotate the load sprocket.
3. Load chain moves, lifting, pulling, or tensioning the load.
4. Automatic brake holds load in position when lever is released.

LIFTING APPLIANCES

CHAIN LEVER HOIST (PULL-LIFT) INSPECTION

Inspect the chain blocks When inspecting chain blocks you should check:

- Markings (Manufacturer's ID, Working Load Limit (WLL), Serial Number, Size And Grade Of Chain) and color code
- The Brake Lining Material For Signs Of Wear. The Brake Should Be Assessed According To Manufacturer's Instructions.
- The Pawl For Sharpness, Alignment And Functionality
- The Ratchet Teeth For Sharpness And Wear
- The Bearing Bushes For Wear And Have Them Renewed If Necessary

Pre-Use Inspection Checklist

- Load chain: Check for wear, kinks, corrosion, elongation
- Load hook: Check for cracks, deformation, functional latch
- Top hook: Check for cracks, deformation, secure attachment
- Ratchet lever: Smooth operation; pawl engages properly
- Hoist body: No cracks, deformation, or weld defects
- Markings: WLL, serial number, manufacturer visible
- Chain guide / sheave: No jamming, rotates freely

LIFTING APPLIANCES

JAW WINCH (TIRFOR)



A Tirfor (also called a jaw winch, cable puller, or wire rope hoist) is a manual mechanical lifting and pulling device that uses a wire rope and a mechanical jaw mechanism to lift, pull, or tension heavy loads without the need for a drum or electric motor.

It is widely used in rigging, construction, forestry, and maintenance operations where portable, versatile lifting/pulling is needed.

LIFTING APPLIANCES

JAW WINCH (TIRFOR)



Tirfor kit



Components of the Tirfor



Main body of the Tirfor

A - Reverse operating lever
B - Forward operating lever



Application of the Tirfor

LIFTING APPLIANCES

BEAM TROLLEYS

A beam trolley is a mechanical device that runs along an overhead I-beam or H-beam, allowing loads to be moved horizontally. It is commonly used with lifting hooks, chain hoists, wire rope hoists, or manual hoists to provide smooth, controlled horizontal movement of suspended loads

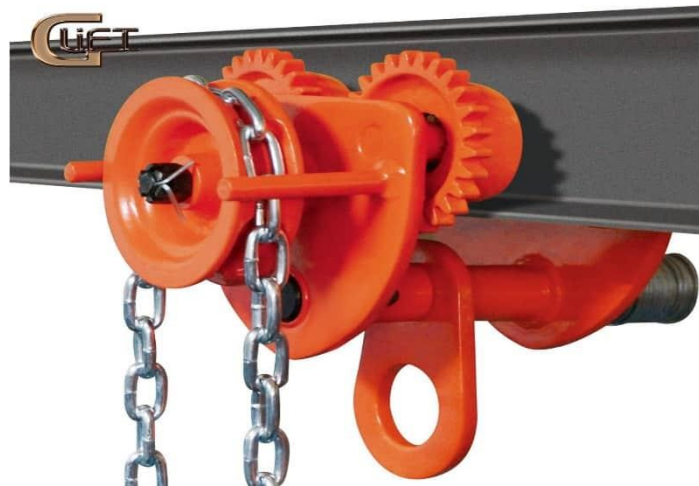
A beam trolley is a wheeled device that travels along the flange of an I-beam or H-beam and is used to carry a hoist or lifting hook, providing horizontal positioning of the load

Main Components

1. Trolley Wheels / Rollers – Fit the beam flange and allow smooth rolling.
2. Side Plates / Frame – Holds wheels and connects to hoist attachment.
3. Load Attachment Point / Hook – Connects to hoist or sling.
4. Adjustment Mechanism – For spreader beams / flange width adjustment.
5. Bearings – Reduce friction in trolley wheels.
6. Safety Stop / End Stops – Prevent trolley from falling off beam ends

LIFTING APPLIANCES

BEAM TROLLEYS



LIFTING APPLIANCES

BEAM TROLLEYS - TYPES

Push Trolley



Push Trolley on the Beam



Gear Trolley on the Beam



LIFTING APPLIANCES

BEAM TROLLEYS TYPES

Types of Beam Trolleys

A) Manual Push Trolley

- Wheels roll along beam flange
- Load is moved by hand
- Simple, low-cost

B) Geared Trolley

- Hand chain or gear mechanism moves trolley
- Allows precise positioning of load

C) Motorized / Electric Trolley

- Integrated electric motor drives wheels
- Controlled by pendant or remote
- Used in industrial or high-capacity applications

D) Adjustable / Universal Trolley

- Side plates adjustable for different beam widths
- Can fit a range of I-beams or H-beams

LIFTING APPLIANCES

BEAM TROLLEYS INSPECTION

Working Principle

- Trolley wheels sit on the beam flanges.
- Load hook or hoist is attached to trolley bottom plate.
- Trolley moves along beam by manual push, geared chain, or motor.
- Ensures smooth horizontal positioning of the load

◆ Pre-Use Inspection

- ✓ Wheels free of cracks or wear
- ✓ Side plates not bent or cracked
- ✓ Load attachment secure
- ✓ Bearings rotate freely
- ✓ Safety stops in place
- ✓ Markings visible (WLL, manufacturer, serial number)
- ✓ Wheel flange thickness check; reject if worn >10%
- ✓ Frame / side plate for deformation or cracks
- ✓ Bearings / axles lubricated and free from wear
- ✓ End stops functional
- ✓ Load attachment point: no cracks, deformation, or wear
- ✓ Proof load testing optional based on WLL and usage

LIFTING APPLIANCES

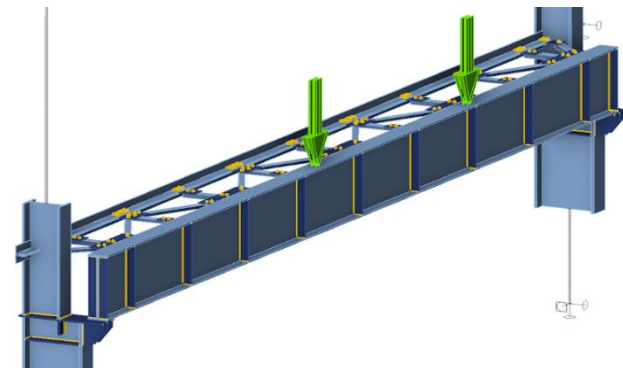
RUNWAY BEAMS & JIB CRANE

A runway beam is a horizontal, longitudinal beam installed at height to support and guide the movement of a bridge crane, gantry crane, or trolley along a fixed path.

- Typically an I-beam, H-beam, or box section.
- Supports crane end trucks and allows horizontal travel.
- Must be properly aligned and leveled to ensure smooth crane operation.

Key Components

- Beam / Rail – Main supporting structure.
- Crane Rail / Track – Top flange or mounted rail for crane wheels.
- Support Columns / Bracing – Supports runway beam span.
- End Stops / Bumpers – Prevent crane overtravel.



LIFTING APPLIANCES

RUNWAY BEAMS & JIB CRANE

A slewing jib is a rotating crane arm (horizontal or inclined) mounted on a pivot or vertical column that allows the hook or lifting device to move in an arc.

- Provides rotational coverage for a fixed base.
- Can be mounted as a tower crane jib, shipyard crane arm, or workshop jib crane.
- Rotation typically powered manually, electrically, or hydraulically.

Key Components

- Jib Arm / Boom – Main load-carrying beam.
- Slewing Mechanism / Bearing – Allows horizontal rotation.
- Counterweight (if required) – Balances load.
- Load Hook / Hoist Attachment – Suspends load from jib.
- Support Column / Mast – Vertical pivot for rotation.



LIFTING APPLIANCES

POWERED HOISTS - TYPES

A powered chain hoist is an electrically, pneumatically, or hydraulically driven lifting device that uses a load chain and hook to lift, lower, or move heavy loads automatically, reducing operator effort and increasing efficiency in industrial operations.

A powered chain hoist is a lifting device with:

- A load chain passing over a load sprocket
- A powered drive (electric motor, hydraulic motor, or compressed air)
- A hook or lifting attachment for the load
- Optional trolley system for horizontal movement

It automatically lifts and lowers loads with minimal human effort, providing precise load control.



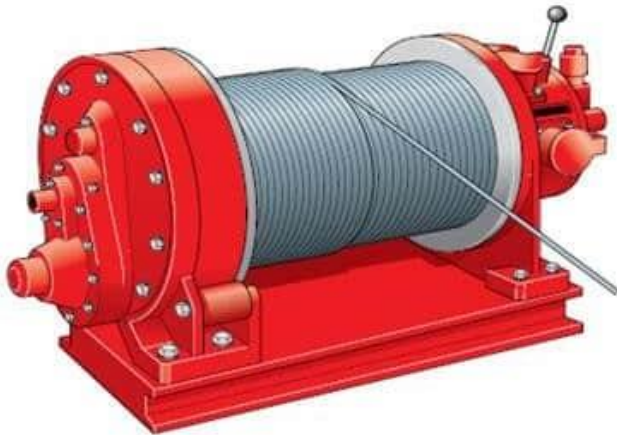
Electrical Chain Hoist



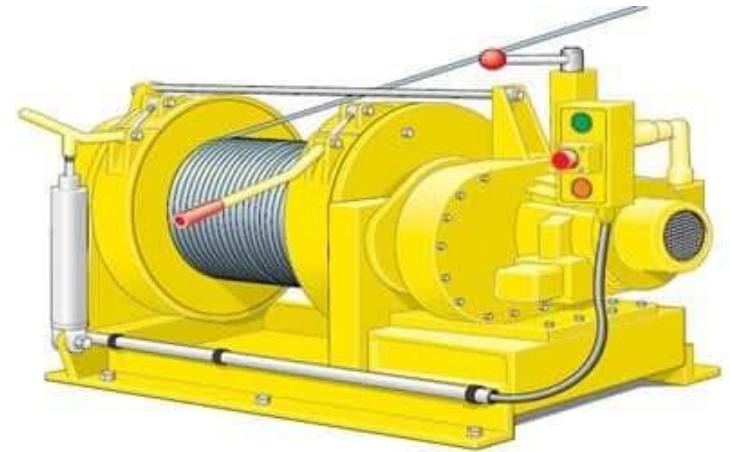
Pneumatic Chain Hoist

LIFTING APPLIANCES

WINCHES - TYPES



General Purpose Winch



Man Riding Winch



Mooring / Anchor Winch

LIFTING APPLIANCES

MOBILE ELEVATED WORK PLATFORM (MANLIFT)



Scissor Type



Articulating Boom Type



Telescopic Boom Type



Vertical Type

LIFTING APPLIANCES

JACKS - TYPES



Mechanical Jacks



Typical Hydraulic Jacks

LIFTED EQUIPMENT

LIFTED EQUIPMENT

CARGO CARRYING UNITS (CCU'S)

Baskets, Containers and Personnel Carriers

The lifting set shall be selected as per BS EN ISO 10855



LIFTED EQUIPMENT SHIPPING CONTAINERS



ISO Containers are not designed for offshore use, because they can not withstand the normal sea forces encountered in offshore operations

LIFTED EQUIPMENT

SHIPPING CONTAINERS

ISO containers are the backbone of global shipping, they are essentially "lightweight" structures designed for predictable, stable transport.

In contrast, Offshore Containers are engineered for the "dynamic" world of open-sea transfers.

1. Static vs. Dynamic Loading

The primary reason ISO containers fail offshore is how they handle weight and movement.

ISO Containers: Designed for static or quasi-static loads. They are meant to be stacked 10-high in a ship's hold where they are protected by cell guides or lashed down. The forces are mostly vertical.

Offshore Containers: Designed for dynamic loading. When a crane lifts a container from a heaving supply vessel to a platform, the "snatch" of the crane and the movement of the sea can double or triple the effective weight of the load. This is known as a Dynamic Amplification Factor (DAF), which ISO containers are not built to survive.

LIFTED EQUIPMENT SHIPPING CONTAINERS

2. Structural Integrity & Impact Resistance

Offshore environments involve frequent collisions that would crumple a standard shipping box.

The "Slam" Factor: During transfer, containers often bang against the ship's hull or the platform's legs.³ Offshore containers have a reinforced primary structure (heavy steel frames) and a secondary structure (the panels).⁴ An ISO container relies on its corrugated skin for much of its strength; if that skin is dented or pierced, the entire box can fail.

Material Toughness: Offshore standards require steel that remains "tough" at low temperatures (typically down to -20°C).⁵ Standard ISO steel can become brittle in extreme cold, leading to catastrophic cracks under impact.

LIFTED EQUIPMENT

SHIPPING CONTAINERS

3. Lifting Points and Hardware

Standard ISO containers are lifted via **twist-locks** in the four corner castings. This works in a calm port but is dangerous in high seas.

Pad eyes vs. Corner Castings: Offshore containers use **integrated pad eyes** (welded lifting lugs) connected to a permanent wire rope sling set. This allows for a single-point lift that can sway and rotate safely.

Prohibition of Corner Lifting: Most offshore regulations explicitly **forbid** lifting a container by its corner castings in open sea because the twist-locks could shear off or fail to engage properly while the vessel is pitching.

Using an ISO container for offshore operations is considered a major safety violation. If an ISO container were used, the "normal sea forces" could cause:

1. **Buckling:** The frame collapsing during a high-speed "snatch" lift.
2. **Shearing:** The corner castings tearing away from the thin-walled frame.
3. **Piercing:** Floating debris or vessel contact puncturing the shell and compromising the load.

LIFTED EQUIPMENT

CONTAINERS WITH ISO LIFTING POINTS



As per ADNOC Group Standard “HSE-PSW-CP19”

Containers with ISO lifting points shall not be lifted by using shackles. However, it is accepted temporarily, if a dedicated spreader bar with vertical slings and anti-twist block (cam lock) are supplied with the equipment.

LIFTED EQUIPMENT

CONTAINERS WITH ISO LIFTING POINTS

The Sling Problem: we cannot safely lift a loaded ISO container with a standard 4-leg sling (angled) attached to the top corners. The inward "pinching" force of the angled slings would crush the roof and top rails.

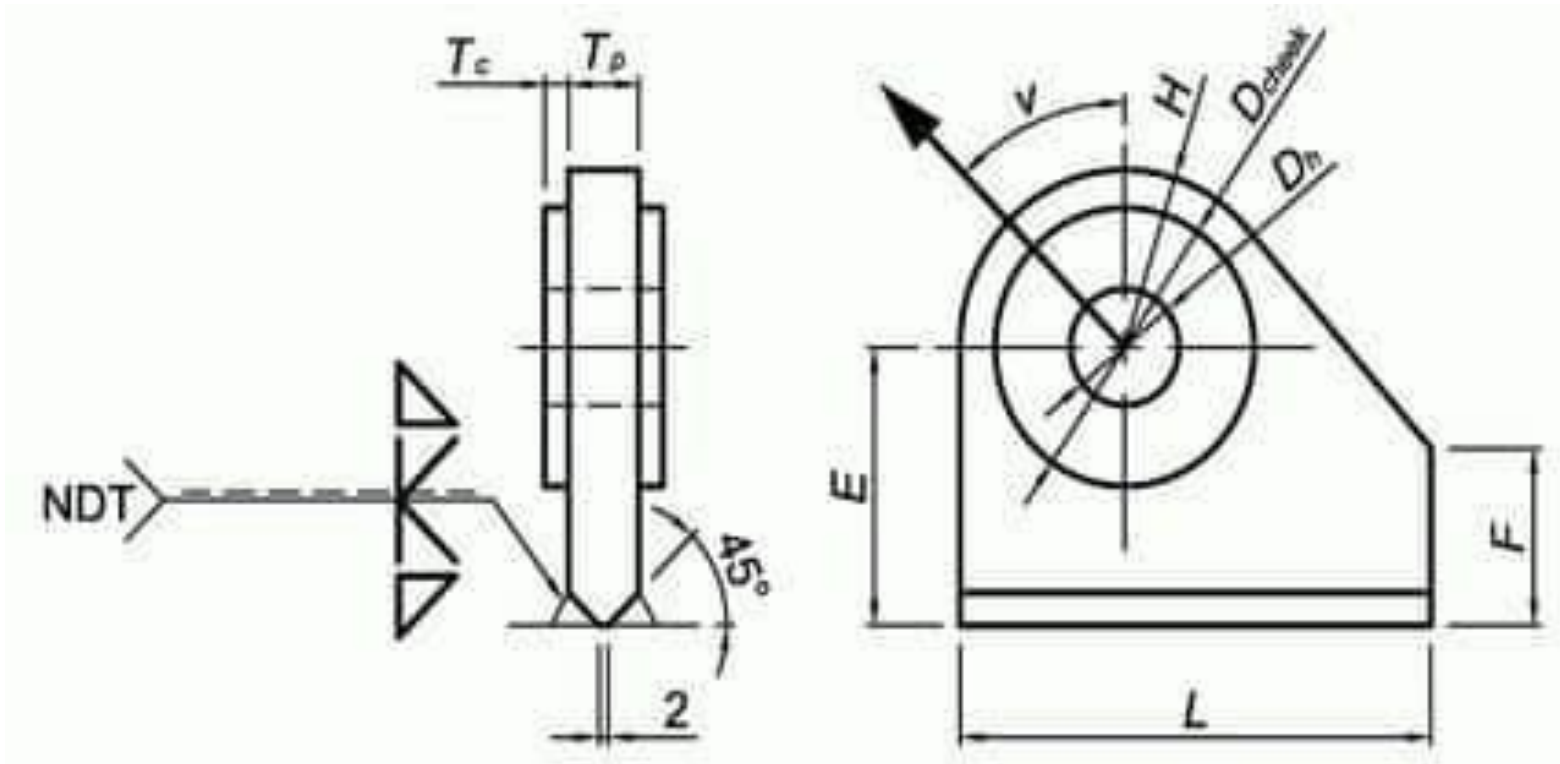
Offshore Difference: Offshore containers are designed specifically to be lifted by angled slings because their top frames are reinforced to handle that inward compression

Offshore Containers: These have a heavy Primary Structural Frame made of thick steel beams. The panels are just "skin." Even if the side panels are completely crushed or removed, the frame remains structurally sound.

When a crane lifts a container from a ship in the open ocean, the ship is moving up and down on waves. If the crane "snatches" the container while the ship is dropping into a trough, the force can suddenly spike. An ISO container's frame would likely buckle or the corner castings would tear out under that sudden "snatch" load.

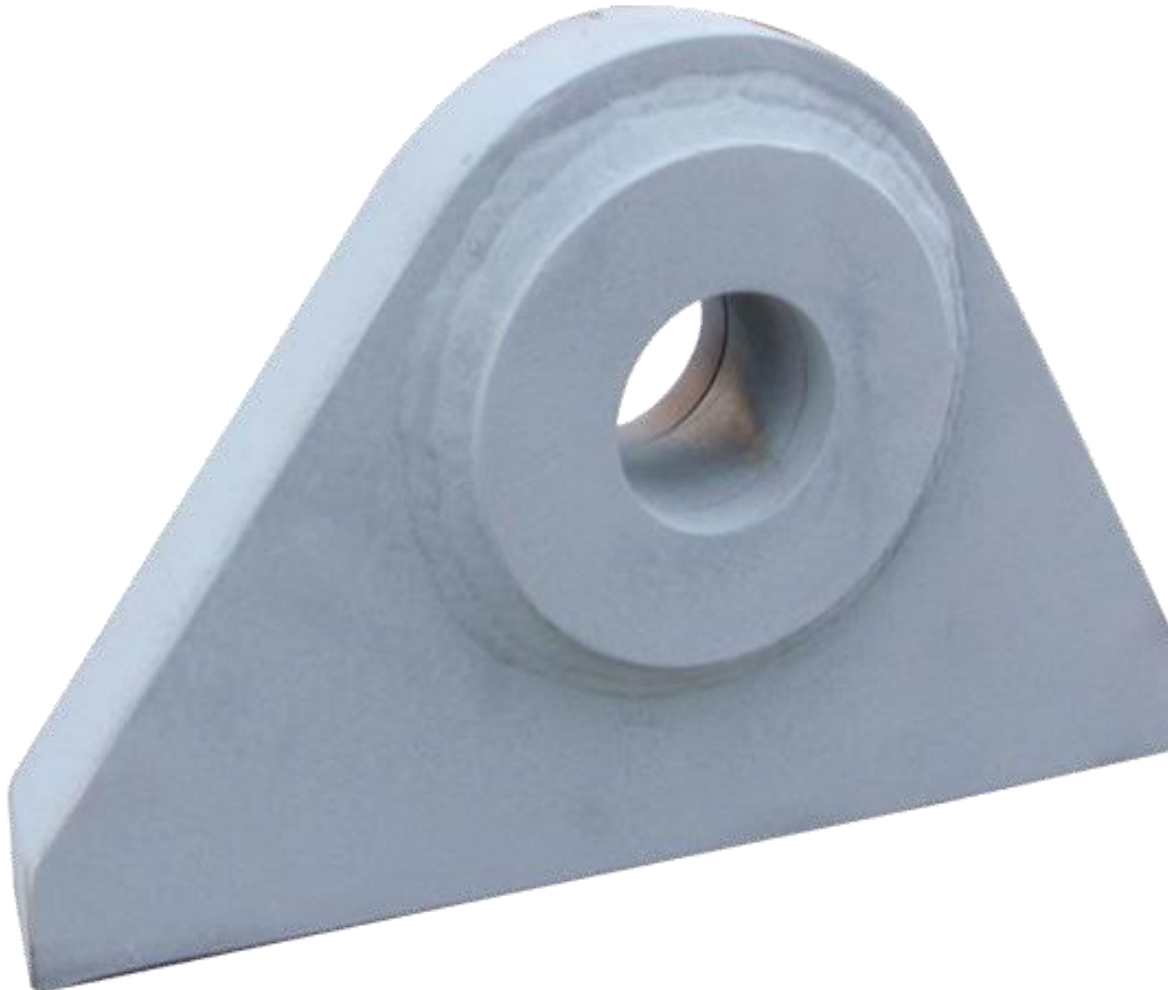
LIFTED EQUIPMENT

BS CONTAINERS (CCU) – PAD EYES



LIFTED EQUIPMENT

BS CONTAINERS (CCU) – PAD EYES



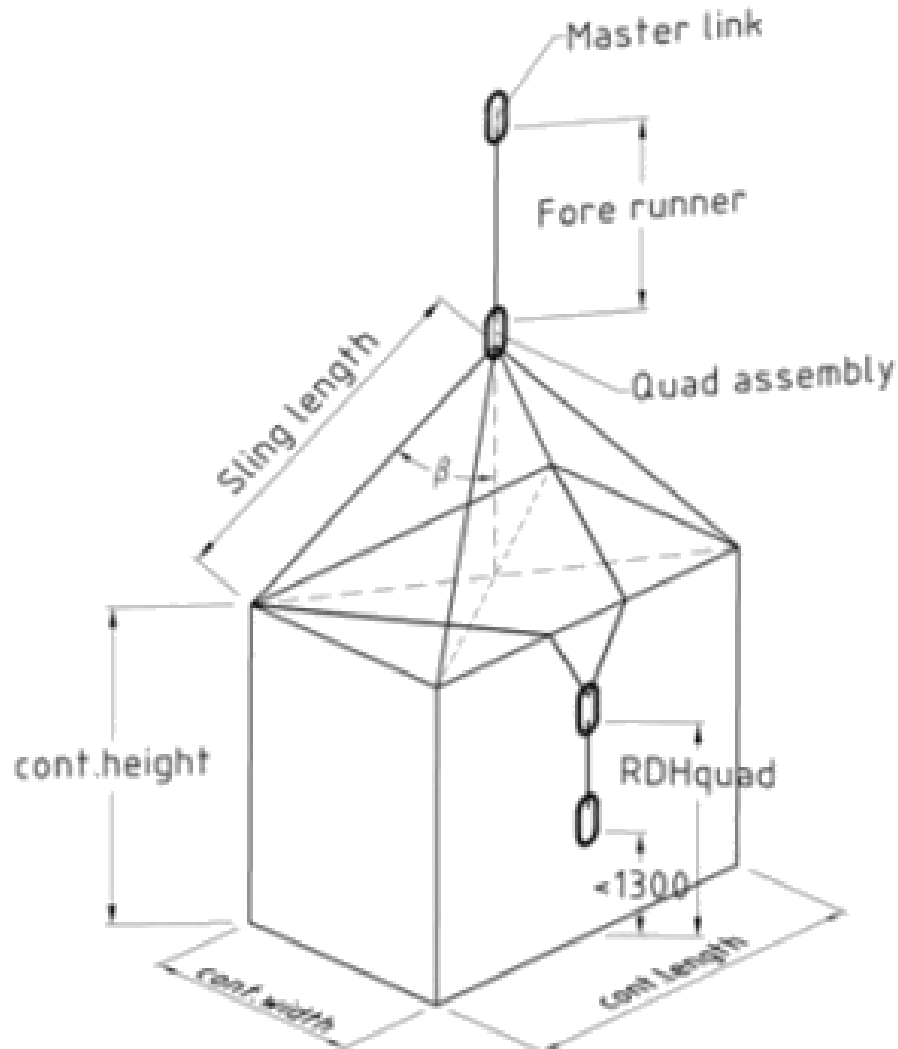
LIFTED EQUIPMENT

ISO CONTAINERS LIFTING POINT & PAD EYE



LIFTED EQUIPMENT

BS CONTAINERS (CCU) – SLING



LIFTED EQUIPMENT

RELATIONS BETWEEN BS EN ISO 10855, DNV-ST-E271, DNV-ST-E272 & DNV-ST-E273

In the offshore industry, specialized standards ensure that equipment can survive the "dynamic" environment of the open sea, where a crane on a moving ship lifts a container off a moving supply boat.

The relationship between these standards is a hierarchy: BS EN ISO 10855 is the global baseline, while the DNV-ST-E271-2 series provides more specialized, high-tier certification for different types of equipment.

1. BS EN ISO 10855: The Global Baseline

This is the international "parent" standard for Offshore Containers. It was developed from the older European EN 12079 standard. It is divided into three parts:

Part 1: Design, manufacture, and marking of the container.

Part 2: Design and manufacture of the Lifting Sets (slings and shackles).

Part 3: Periodic inspection and testing.

Uses: Use this for standard cargo-carrying units (CCUs) like baskets, toolboxes, and dry-goods containers with a Max Gross Mass (MGM) up to 25,000 kg.

LIFTED EQUIPMENT

2. DNV-ST-E271 (formerly DNV 2.7-1)

This is the most famous standard in the offshore world. It is a proprietary certification from DNV that is harmonized with ISO 10855 but is often considered more rigorous.

- Relation to ISO: If a container meets DNV-ST-E271, it almost always automatically meets ISO 10855.
- Difference: DNV-ST-E271 requires Type Approval and mandatory third-party verification by a DNV surveyor. It is a "Design by Code" philosophy (you follow strict, pre-set rules).
Uses: The "Gold Standard" for any container intended for repeated use in the harsh North Sea

or international offshore oil and gas fields.

3. DNV-ST-E272 (formerly DNV 2.7-2)

This standard moves away from "boxes" and focuses on Service Modules. These are units that people work inside or that contain complex machinery.

- Difference: Unlike E271 (which is about the steel box), E272 is about internal safety. It covers fire protection, gas detection, electrical safety in hazardous zones (ATEX), and ventilation.
- Relation: The "shell" (the container) must usually meet E271, but the "insides" and the "system" must meet E272.

Uses: Offshore laboratories, workshop cabins, control rooms, and accommodation modules.

LIFTED EQUIPMENT

4. DNV-ST-E273 (formerly DNV 2.7-3)

This standard covers Portable Offshore Units (POUs). These are items that don't fit the definition of a "standard container".

- Difference: While E271 is "Design by Code" (standard boxes), E273 is "Design by Analysis." It allows engineers to design unique shapes, such as skids for pumps, subsea templates, or large generators.
- Weight: It covers units much heavier than the 25,000 kg limit of E271. It also includes units designed for subsea lifting (lowering equipment to the seabed).

Uses: Heavy machinery skids, subsea equipment, or single-use transport frames for massive components.

Note: Units certified to DNV-ST-E272 shall also be approved and certified by using DNV-ST-E271 or DNV-ST-E273 for Offshore Containers.

LIFTED EQUIPMENT

Relationships:

- Start with ISO 10855 for any basic offshore box.
- Most Oil & Gas majors will demand DNV-ST-E271 instead because of the third-party survey requirement.
- If you put a person or a generator inside that box, you must also comply with DNV-ST-E272.
- If the unit is an odd shape or very heavy (over 25 tons), you move to DNV-ST-E273.

Standard	Subject	Key Focus	Requirements
ISO 10855	General Containers	Global harmonization	Global Minimum Standard
DNV-ST-E271	Offshore Containers	Structural integrity/Lifting	Design by Code (Rigid)
DNV-ST-E272	Service Modules	Fire, Gas, Electrical safety	Safety of Personnel inside
DNV-ST-E273	Portable Units (POUs)	Unique shapes / Subsea	Design by Analysis (Flexible)

LIFTED EQUIPMENT

PERSONNEL LIFTING BASKET



LIFTED EQUIPMENT

PERSONNEL LIFTING BASKET

The following requirements shall be adhered for Personnel Work Basket:

- ▶ The Personnel work basket shall have valid certificate of inspection from an ADNOC Approved Third Party using Approved Lifting Surveyor and a Unique Identification Number / Asset Number, maximum number of persons that can be carried and the maximum load that can be carried shall be marked.
- ▶ The doors in the personnel Work Basket shall not open outwards and shall be securely fastened and be self-locking (closes automatically).
- ▶ The Personnel Work Basket shall have handrails to provide security for persons, mounted in positions that do not trap hands.
- ▶ The Personnel Work Basket sides shall have a proper protection to prevent persons or materials falling from the basket.
- ▶ Any attachment points for safety devices such as harnesses shall be secured and free from damage.
- ▶ The Personnel Work Basket shall be free from damage, corrosion, cracks and other imperfections.

LIFTED EQUIPMENT

PERSONNEL LIFTING BASKET

- ▶ The Personnel Work Basket shall be fitted with suitable edge protection.
- ▶ The floor area of any Carrier on which persons need to be present shall be slip resistant
- ▶ The Personnel Work Basket shall have proper roof to provide security for persons against drop objects.
- ▶ Check the Wire rope sling for any defect. The wire rope shall be having a minimum Factor of Safety of 10:1 & Manufacturer conformity Certificate/ test Certificate shall always be kept in file for review.
- ▶ There shall be appropriate methods to prevent persons from falling out of the Carrier.
- ▶ Carriers should be fitted with suitable devices or other effective measures, to prevent the carrier from falling in the event of the failure of the primary means of support.
- ▶ The lifting equipment used for personnel lifting operations shall be adhered in accordance with **Appendix-1 of ADNOC Group Standard “HSE-PSW-CP19”**
- ▶ The lifting accessories used for lifting personnel work basket shall have minimum factor of safety of 10:1

COLOR CODE SYSTEM

COLOR CODING

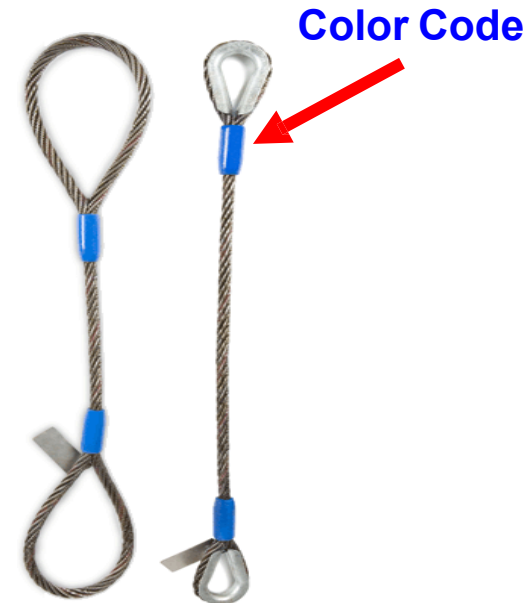
- ▶ Colour coding is important to identify that the lifting equipment have been tested and certified by a competent person.
- ▶ Each company has its own colour coding system for all lifting equipment.
- ▶ All lifting equipment is subject to a six monthly inspection as per article 20 of UAE ministerial order no. 32 of 1982.
- ▶ Remember do not use lifting equipment if there is:

- No WLL / SWL
- No ID Number
- No Colour Code

Do Not Use







Color Code tag



COLOR CODING

ADNOC group of companies have the following colour coding system:

Odd Numbered Years 2025, 2027, 2029 etc.												Even Numbered Years 2026, 2028 2030 etc.											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WHITE						BLUE						ORANGE						GREEN					

-  Pastel Orange RAL 2003
-  Grass Green RAL 6010
-  Traffic White RAL 9016
-  Signal Blue RAL 5005

A method of marking Lifting Equipment (with paint or colored tie wraps) to give a visual indication of its Certification status. The color coding is changed periodically (6 monthly) in accordance with a Color Coding System

Note: Color code (Red- RAL-3028) shall be used to mark rejected items.

SAFE WORKING LOAD (SWL) & WORKING LOAD LIMIT (WLL)

WLL & SWL

WLL (WORKING LOAD LIMIT)

It is the maximum load that an item of lifting equipment is **designed** to lift or lower as determined by the manufacturer.



SWL (SAFE WORKING LOAD)

It is the maximum load (as assessed by the competent person) that an item of lifting equipment **may** raise, lower or suspend under particular service conditions.



Differences Between Working Load Limit and Safe Working Load

A clear understanding of WLL and SWL is essential for everyone involved in lifting and hoisting operations. Because these terms directly influence safety, compliance and decision-making in lifting plans

What Are WLL and SWL?

The **Working Load Limit (WLL)** is the maximum load a component, lifting accessory or machine is designed and certified to handle under normal conditions.

The **Safe Working Load (SWL)** is an older, derived value historically used to indicate a permissible load, often based on an additional safety factor applied by the operator or organisation rather than the manufacturer and assessed by competent person.

Modern standards (EN, ISO, OSHA, ASME) have phased out the term **Safe Working Load (SWL)** because it was ambiguous and the word “safe” could be misleading. It suggested that operators or organisations could determine an extra safety margin themselves, leading to inconsistent interpretations.

Correct interpretation and application of WLL values require sound technical judgement in lifting operations. Working Load Limit (WLL) replaced SWL because it provides a precise, manufacturer-defined maximum load under specified conditions. WLL is:

- calculated and certified by the manufacturer
- traceable and verifiable
- aligned with conformity assessment and CE-marking requirements
- objective and not open to interpretation
- the standard terminology used across modern ISO and OSHA-related guidance

As a result, all contemporary lifting operations, lifting plans, and hoisting accessories must use WLL as the reference limit.

OFFICIAL SOURCES

1. EU Machinery Directive (2006/42/EC)

The Machinery Directive requires manufacturers to define and declare the maximum permissible load of lifting machinery and accessories. This declared value — the **Working Load Limit (WLL)** — forms the legal and technical basis for safe use within the EU. The directive explicitly requires that equipment must not be operated beyond its declared limits and that these limits must be clearly marked and verifiable.

2. EN Standards (European Norms)

Several harmonised EN standards specify how WLL must be determined, verified, marked and used in lifting operations.

3. ASME B30 Series (United States)

Although focused on the US market, ASME B30 standards use comparable concepts to WLL, providing requirements for rated loads, marking, testing and safe use. They contribute to global industry alignment replacing older concepts such as SWL with precise, defined load limits.

FACTOR OF SAFETY (FOS): ratio between the failure load (MBL) and the allowable working load (WLL).

$$\text{FOS} = \text{MBL} / \text{WLL}$$

(CONSIDER 75-80% OF THE WLL)

- **UTILIZATION FACTOR (75-80%)**

the safety factor in the context of rigging and slinging is crucial to ensuring safe lifting operations

- **SAFETY FACTORS CAN BE MISLEADING**

- **Overconfidence in Ratings:**

- Relying solely on safety factors can lead to overloading. If personnel assume that because a sling has a high safety factor, they can exceed the WLL without consequence, it poses a significant risk.

- **NOTE: FOS is a safety margin for Manufacturer and not to be taken in account by the user or planner. You can maximum use any lifting equipment up to rated SWL/WLL**

- **MBL (Minimum Breaking Load) is the minimum load at which a lifting component will fail (break) when tested under controlled laboratory conditions.**

CALCULATING THE WORKING LOAD LIMIT (WLL) BENEFITS

- Knowing the WLL helps prevent overloading, reducing the risk of equipment failure, accidents, and injuries.
- Adhering to WLL standards ensures compliance with safety regulations, protecting both the rigger and the organization from legal liabilities
- Operating within the WLL helps extend the life of rigging equipment, reducing wear and tear and the need for frequent replacements
- Accurate WLL calculations enable better planning of lifts, including the selection of appropriate equipment and rigging methods.
- By considering WLL, can anticipate and manage risks associated with lifting operations, contributing to a safer work environment and Increased confidence

LOAD WEIGHT CALCULATIONS

LOAD WEIGHT CALCULATIONS

If you do not know the load weight, what will you do?

How to find Load Weight:

- ▶ Check markings on the load.
- ▶ Check shipping manifest
- ▶ Using a load cell
- ▶ Calculate load weight

Never Rig A Load If You Do Not Know How Much It Weighs.

Calculating Load Weight:

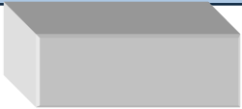



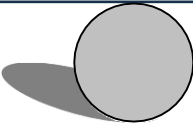
If you cannot find the weight listed, Appointed Person can estimate the weight by:

- ▶ Calculating the volume in cubic meter.
- ▶ Multiplying the volume by the density of the material.

Net Weight = Volume x Density

LOAD WEIGHT CALCULATIONS

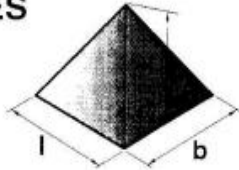
STANDARD LOAD SHAPES

LOAD SHAPE	FORMULA FOR CALCULATION OF VOLUME	SHAPES
RECTANGULAR SOLID	LENGTH X WIDTH X HEIGHT	
SOLID CYLINDER	3.14 X LENGTH X (RADIUS) ²	
THICK WALLED PIPE	$\pi \times (R_1^2 - R_2^2) \times \text{LENGTH}$	
SPHERE	4.19 X (RADIUS) ³	
PYRAMID	1/3 X LENGTH X BASE X HEIGHT	

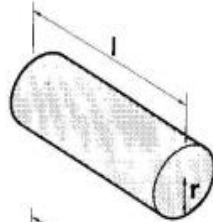
LOAD WEIGHT CALCULATIONS

VOLUME OF COMMON SHAPES

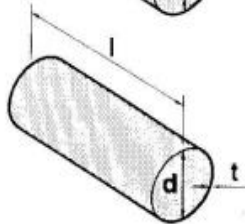
Pyramid = $\frac{1}{4} l b h$



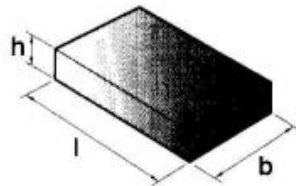
Solid Cylinder = $\pi r^2 l$



Thin Walled Pipe = $\pi d l t$

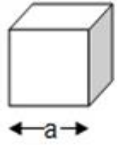

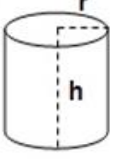
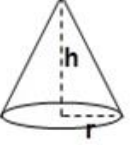



Rectangular Solid = $l b h$



Sphere = $\frac{4}{3} \pi r^3$

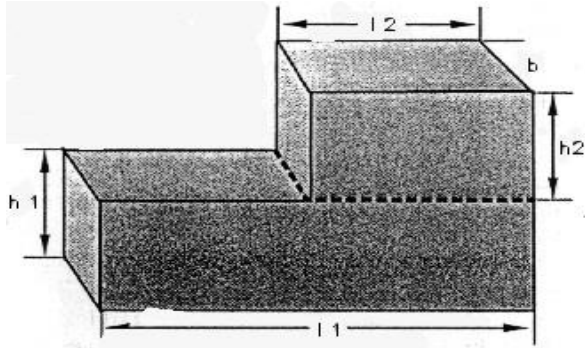


Figure	Formula	Variables
Cube 	a^3	a = length of edge
Rectangular prism 	$l \times w \times h$	l = length w = width h = height
Cylinder 	$\pi \times r^2 \times h$	r = radius of circular face h = height
Cone 	$\frac{1}{3} \times \pi \times r^2 \times h$	r = radius of circular base h = height from tip to base
Sphere 	$\frac{4}{3} \times \pi \times r^3$	r = radius

LOAD WEIGHT CALCULATIONS

COMPLEX SHAPES

For irregular shaped loads several calculations may be required to determine the total weight.

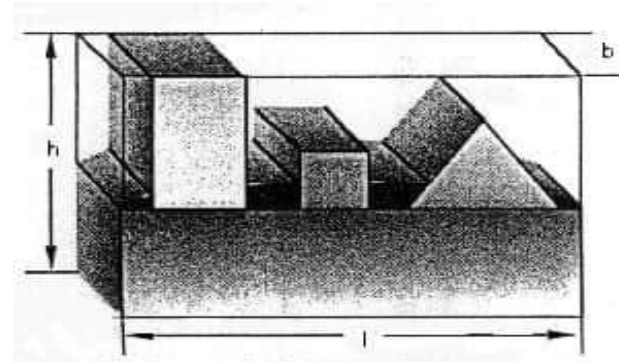


For the load shown on left side, add the calculated volumes of each of the two rectangular solids to determine the weight of the load.

$$\text{Total volume} = (l_1 \times b \times h_1) + (l_2 \times b \times h_2)$$

In some cases as shown in the picture on right side, it is best to imagine the whole shape enclosed by a rectangle and calculate the volume of the rectangle.

$$\text{Assumed total volume} = l \times b \times h$$



LOAD WEIGHT CALCULATIONS

MATERIAL DENSITY

MATERIAL	POUNDS / CUBIC FOOT	KILOGRAMS / CUBIC METER
Aluminum	170	2700
Brass	530	8500
Brick	130	2100
Coal	90	1450
Copper	550	8800
Concrete	150	2400
Earth	100	1600
Iron - Steel	480	7700
Lead	700	11200
Magnesium	110	1750
Oil	50	800
Paper	70	1120
Water	62	1000
Wood	50	800

LOAD WEIGHT CALCULATIONS

LOAD CELL (DYNAMOMETER)

When you have to calculate the load weight, it is safer to over- estimate. Better to check the load weight by load cell (weighing scale)



CENTRE OF GRAVITY

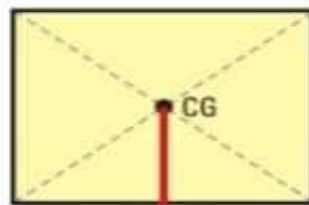
CENTRE OF GRAVITY

WHAT IS CENTER OF GRAVITY “COG”?

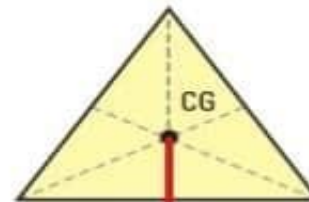
The point in any body or object where whole body mass is concentrated.

The center of gravity (CoG) is the center to an object's weight distribution, where the force of gravity can be considered to act. This is the point where the object is in perfect balance, no matter how turned or rotated around that point.

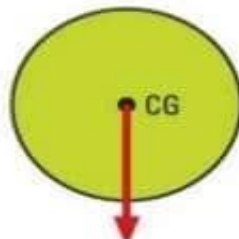
EXAMPLES OF CENTER OF GRAVITY FOR REGULAR-SHAPED OBJECTS



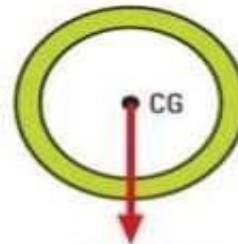
weight of card



weight of triangle



weight of disc



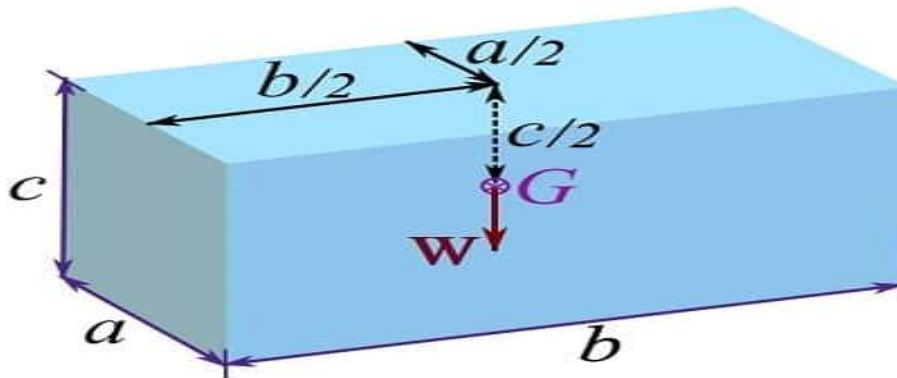
weight of ring

REGULAR SHAPES
CoG in the MIDDLE

CENTRE OF GRAVITY

COG–Center of Gravity

- Center of Gravity is that the C of G is the point about which the parts of a body exactly balance each other.
- With a regularly shaped load the C of G is at the mid point in each direction plane.
- For complex shapes, it may be necessary to estimate the center of gravity of various parts and then combine them to get a center of gravity as a whole.



REGULAR SHAPES

CoG in the MIDDLE

CENTRE OF GRAVITY

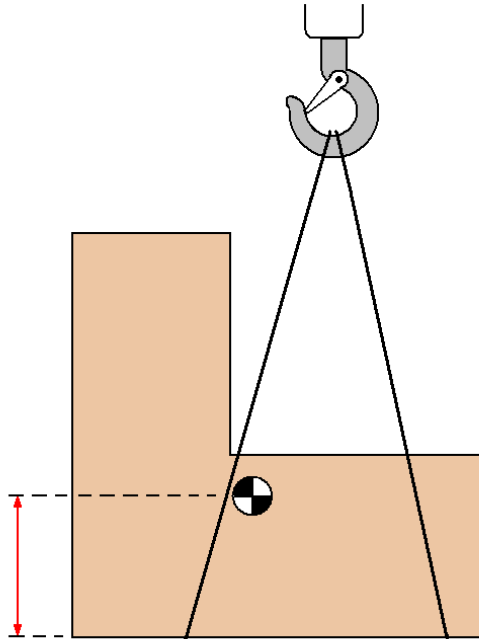
IRREGULAR SHAPES



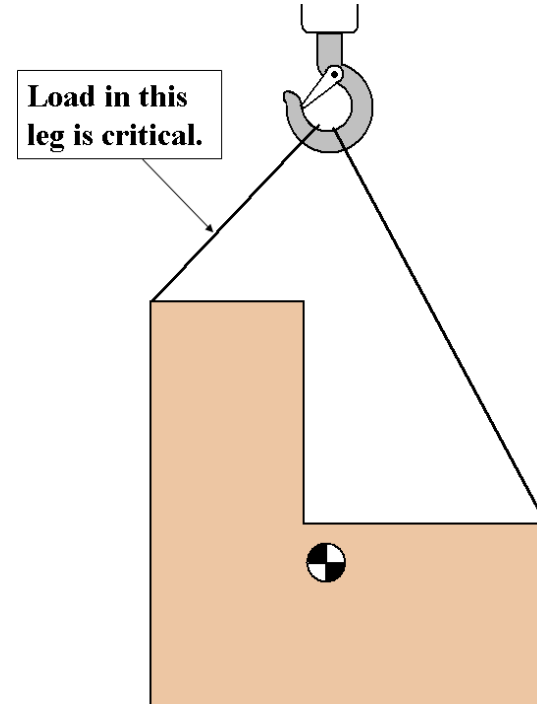
IRREGULAR SHAPES COG NOT IN THE MIDDLE

CENTRE OF GRAVITY

CENTER OF GRAVITY VS. LOAD STABILITY



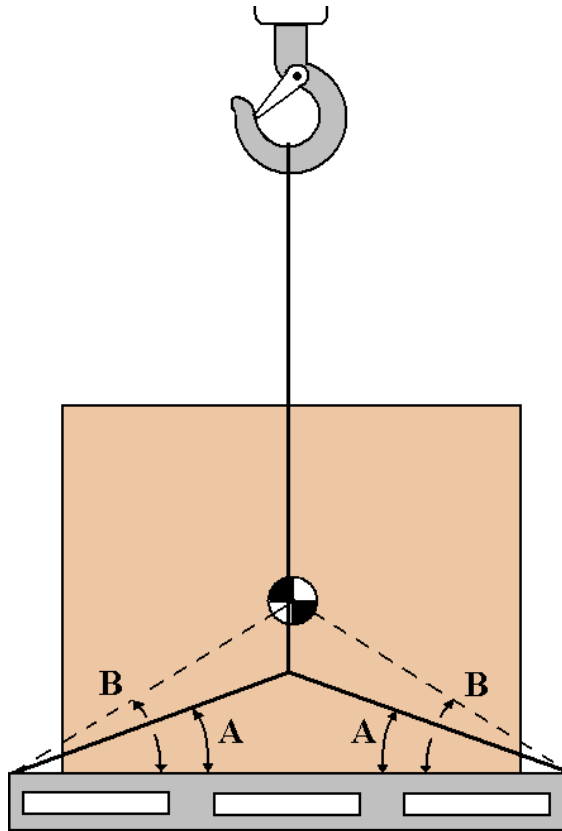
Load is **UNSTABLE!**
The load can topple
because the attachments
are **BELOW** the center
of gravity.



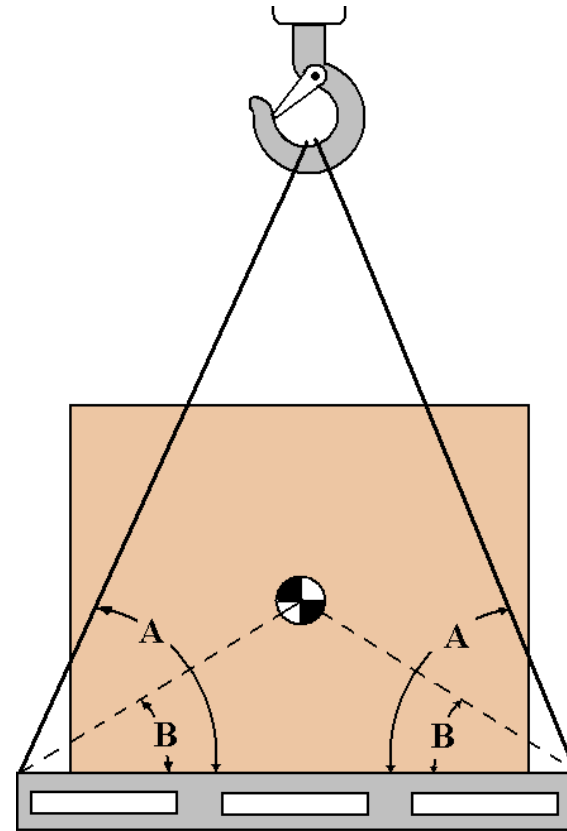
Load is **STABLE!**
Attachments are
ABOVE the center
of gravity.

CENTRE OF GRAVITY

CENTER OF GRAVITY VS. LOAD STABILITY



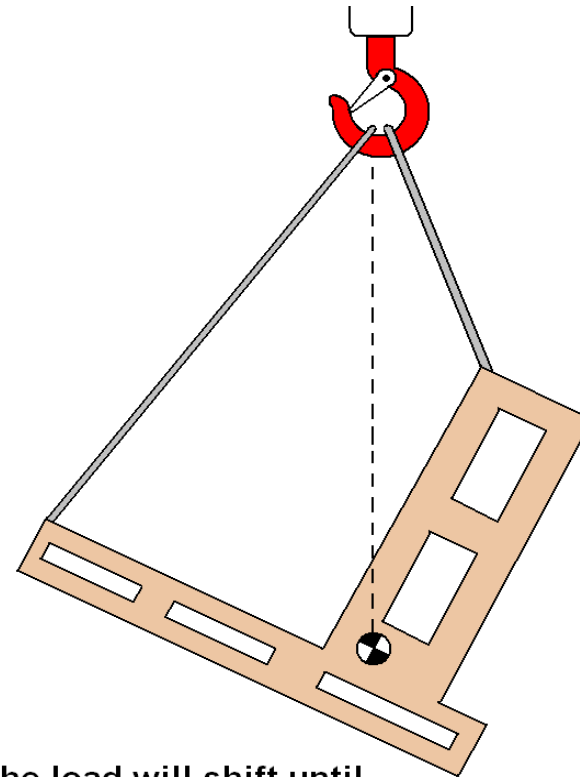
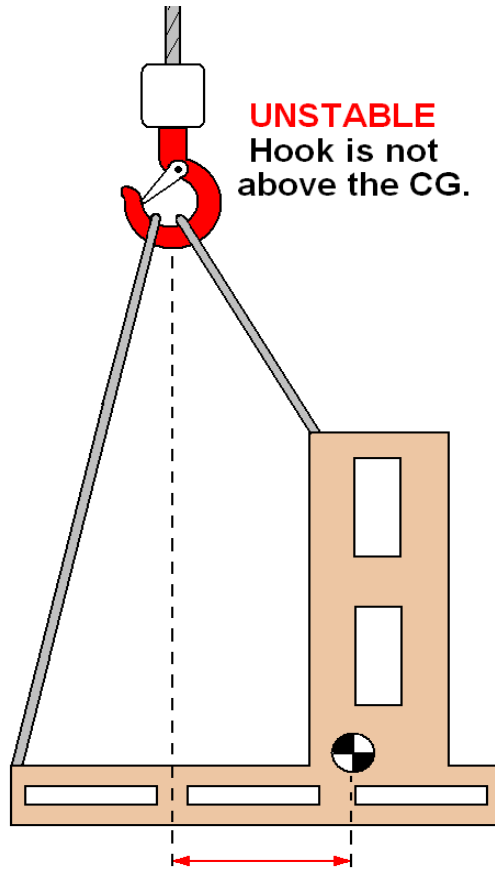
Load is **UNSTABLE!**
Sling angle (A) is LESS than angle (B).



Load is **STABLE!**
Sling angle (A) is much LARGER than angle (B).

CENTRE OF GRAVITY

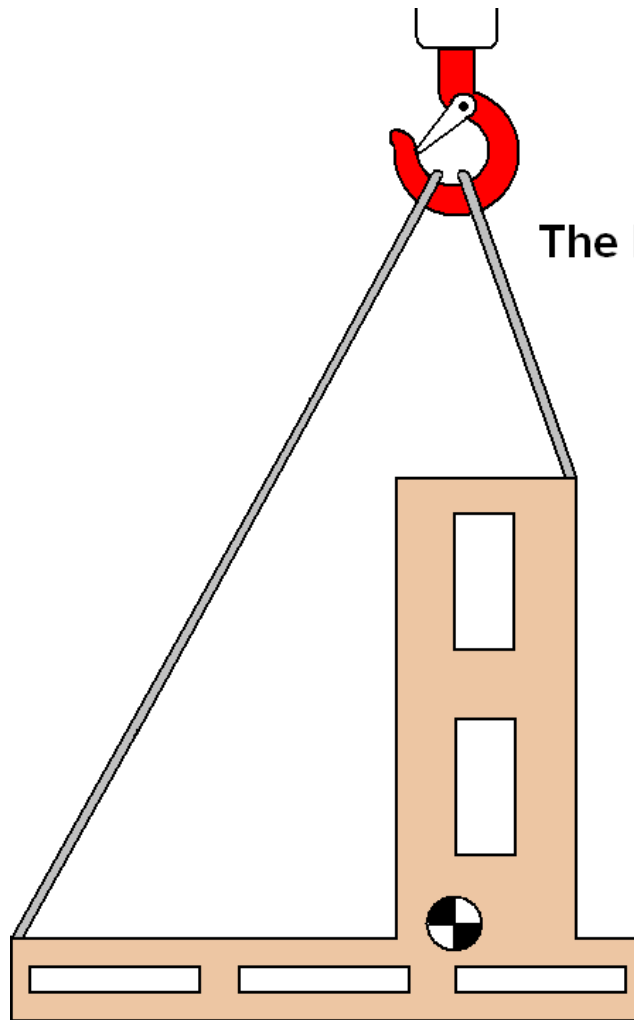
CENTER OF GRAVITY VS. LOAD STABILITY



The load will shift until the CG is below the hook.

CENTRE OF GRAVITY

CENTER OF GRAVITY VS. LOAD STABILITY

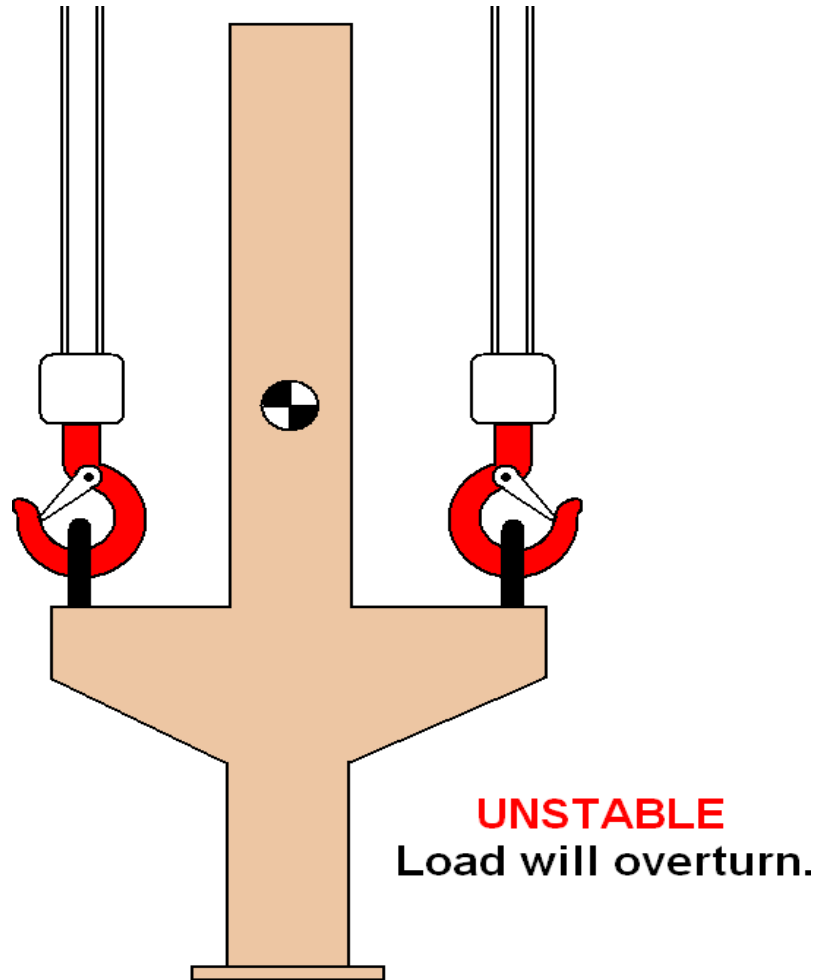


STABLE

The hook is positioned above the CG.

CENTRE OF GRAVITY

CENTER OF GRAVITY VS. LOAD STABILITY

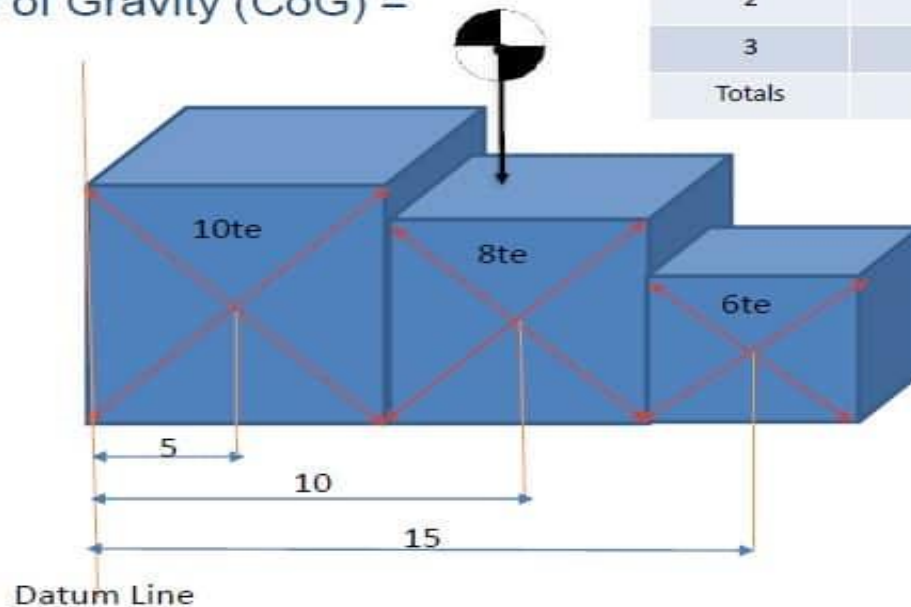


CENTRE OF GRAVITY

EXAMPLE

Weights and Measures- Basics

- Centre of Gravity (CoG) =



Section	Weight (WT)	X Distance (d)	(WT) X (d)
1	10	5	50
2	8	10	80
3	6	15	90
Totals	24		220

$$\text{Answer} = 220 \div 24 = 9.16$$



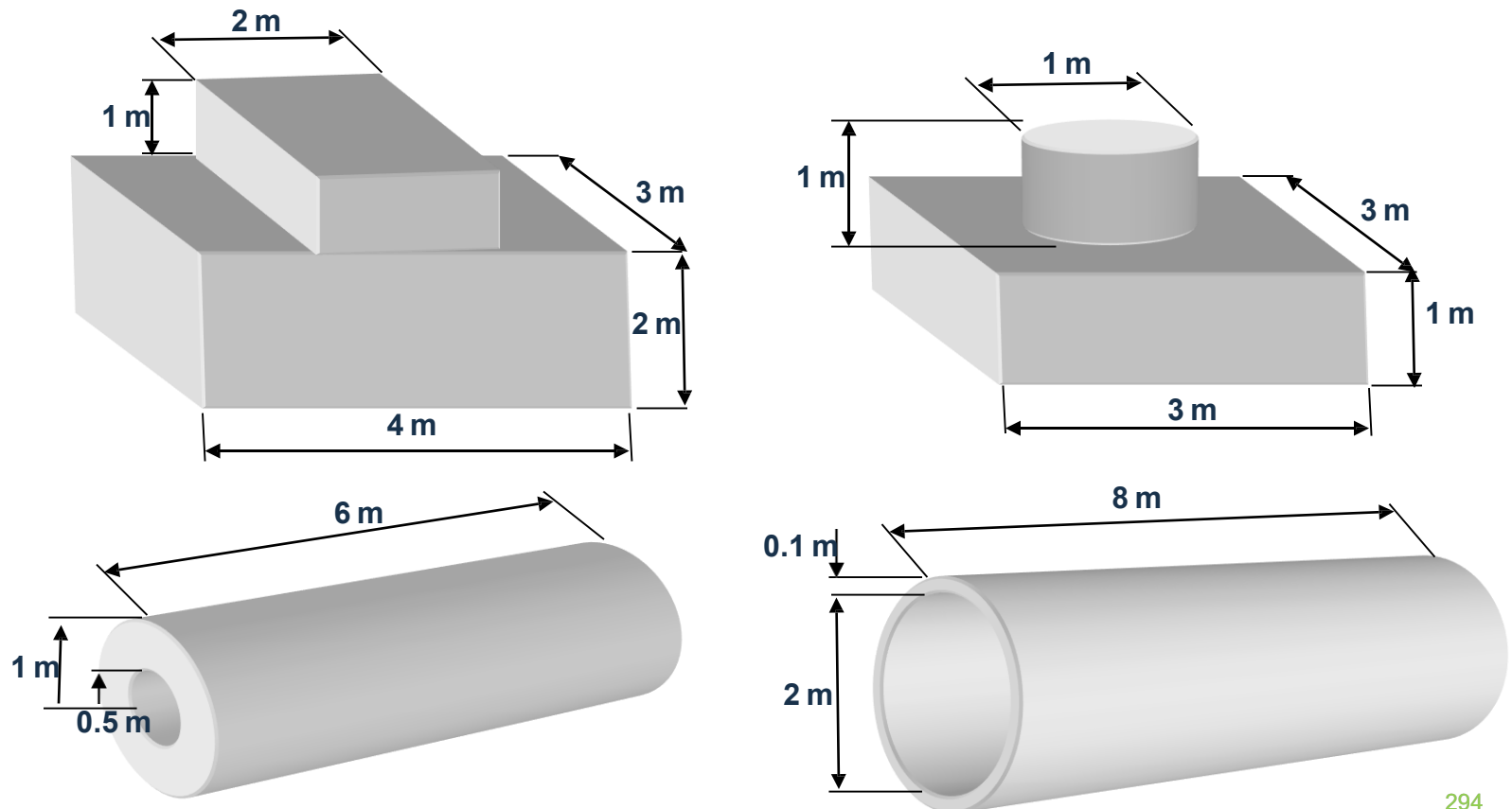
Point of the load, around which all weight is evenly concentrated

Note: The calculation is for X axis. Do the same in the Y & Z axis

CENTRE OF GRAVITY

EXERCISES

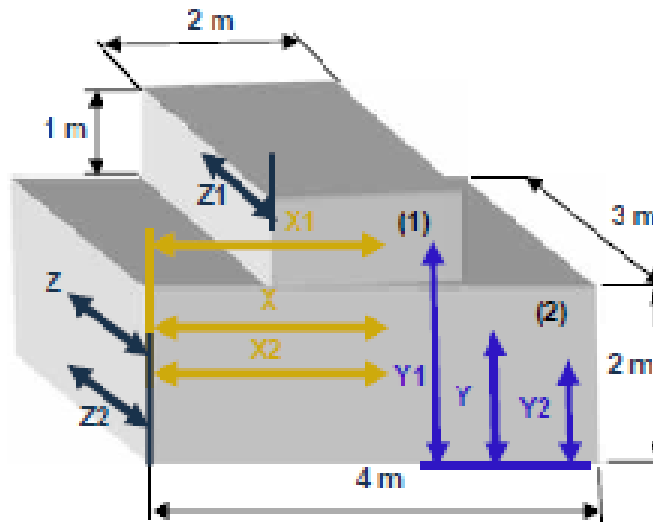
Calculate the centre of gravity of the following shapes:



CENTRE OF GRAVITY

EXERCISES

Calculate the centre of gravity of the following shapes:



W = TOTAL WEIGHT OF THE BODY

X = CENTRE OF GRAVITY DISTANCE IN X-DIRECTION

Y = CENTRE OF GRAVITY DISTANCE IN Y-DIRECTION

Z = CENTRE OF GRAVITY DISTANCE IN Z-DIRECTION

$$W = W1 + W2$$

$$X = \frac{X1 + X2}{2}$$

$$Y = \frac{Y1 + Y2}{2}$$

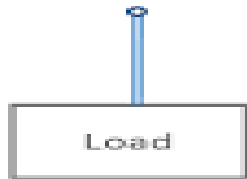
$$Z = \frac{Z1 + Z2}{2}$$

SOLUTION:

$$X = \frac{2 + 2}{2} = 2 \text{ m} \quad Y = \frac{2.5 + 1}{2} = 1.75 \text{ m} \quad Z = \frac{1.5 + 1.5}{2} = 1.5 \text{ m}$$

TYPE OF HITCHES

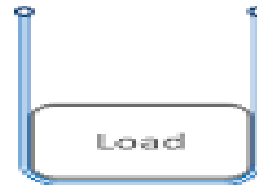
Diagram: Basic types of hitches



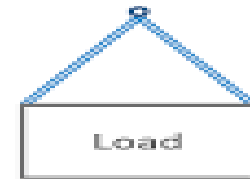
Vertical Hitch



Choker Hitch



Basket Hitch

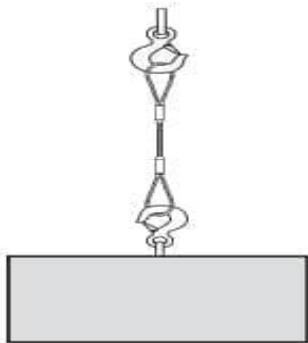


Bridle Hitch

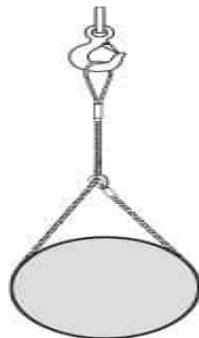
TYPES OF HITCHES

The following hitches are used during lifting operations

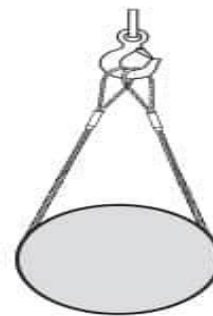
- ▶ Single Vertical Hitch
- ▶ Choker Hitch
- ▶ Basket Hitch
- ▶ Bridle Hitch(Multiple leg sling assembly)



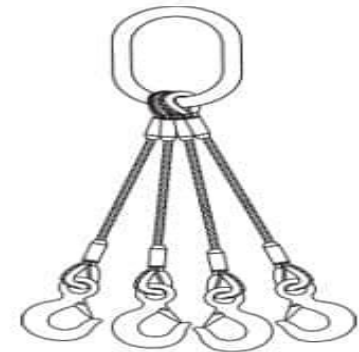
Vertical Hitch



Choker Hitch



Basket Hitch

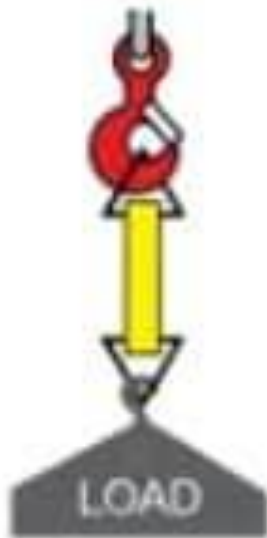


Multiple Leg Sling Assembly (Bridle Hitch)

TYPES OF HITCHES

SINGLE VERTICAL HITCH

Vertical, or straight, attachment is simply using a sling to connect a lifting hook to a load. Full rated lifting capacity of the sling may be utilized, but must never be exceeded. A tagline should be used to prevent load rotation which may damage a sling.



Vertical Hitch

A sling used in a vertical hitch can lift 100% of SWL.

Mode factor = 1

Max. Load that can be lifted = SWL of Sling x Mode Factor

TYPES OF HITCHES

CHOKER HITCHES

Choker hitches reduce the lifting capability of a sling, since this method of rigging affects the ability of the wire rope components to adjust during the lift. A choker is used when the load will not be seriously damaged by the sling body - or the sling damaged by the load - and when the lift requires the sling to snug up against the load.



A sling in a choker hitch can only lift 80% of SWL.

Mode factor = 0.8

Max. Load that can be lifted = SWL of Sling x Mode Factor

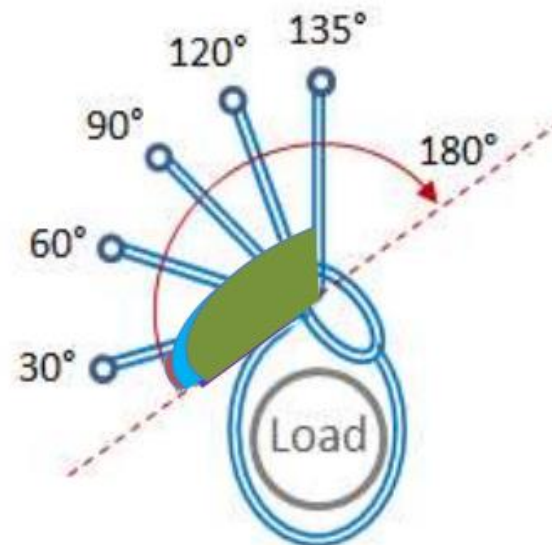
The more you beat down the choke lesser the capacity. Tension increases on the choke point.

TYPES OF HITCHES

CHOKER HITCHES

The capacity is reduced as the angle of use declines.

Angle of choke	Capacity %
Over 120°	100
90-120°	87
60-89°	74
30-59°	62
0-29°	49



Angle of Choke

Note : capacity reduction from the choker hitches,

TYPES OF HITCHES

Load Diameter D to Sling Diameter d

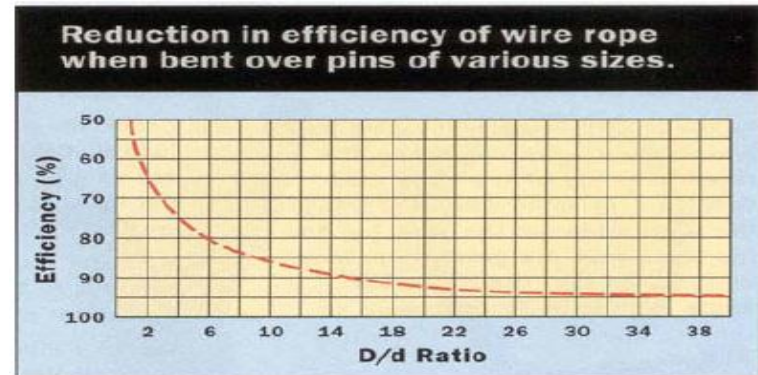
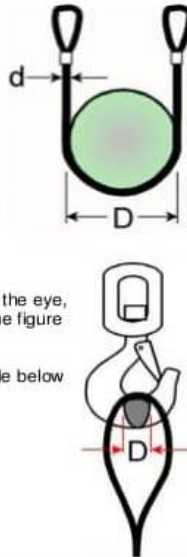
D/d Ratio

When a wire rope sling is used in a basket hitch, the diameter of the load where the sling contacts the load can reduce sling capacity. The method used to determine the loss of strength or efficiency is referred to as the *D/d Ratio*.

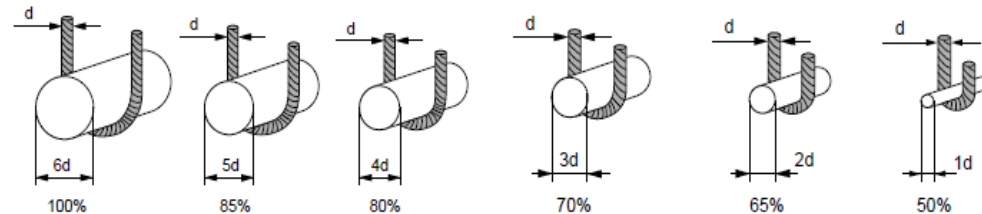
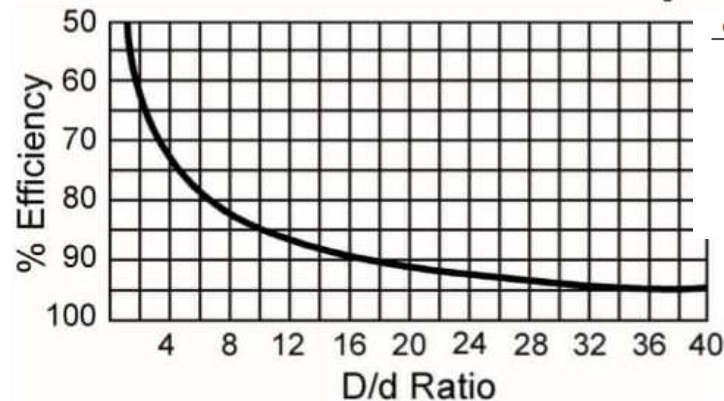
The "D" refers to the diameter of the object being lifted, while the "d" refers to the diameter of the wire rope sling, as shown in the figure at the upper right. For example, when a 1-inch wire rope sling is used to lift an object that measures 25 inches in diameter, the D/d Ratio is 25-to-1 (written 25/1).

Alternatively, the "D" can refer to the cross-sectional diameter of the eye, hook, or other object being used to hoist the load, as shown in the figure at right.

In both cases, the effective strength of the sling results. The table below shows the D/d Ratio and corresponding efficiency percentage.

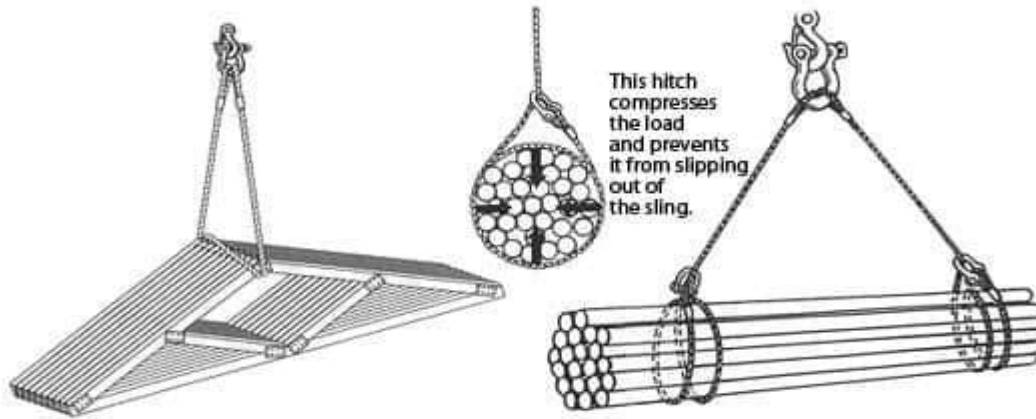


Note: This graph refers to bending wire rope over pins. Any time a wire rope sling is bent around sharp corners additional reductions in efficiency will occur. Sharp corners should always be padded to prevent damage to the sling.

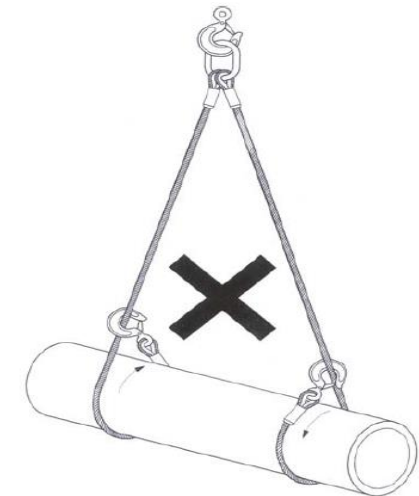


TYPES OF HITCHES

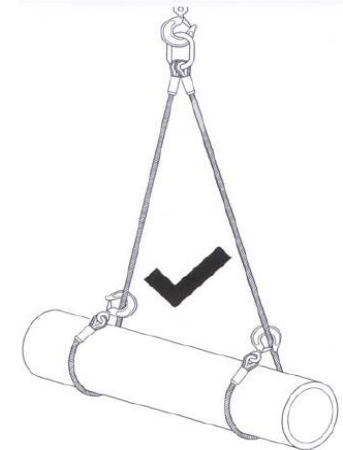
CHOKER HITCHES



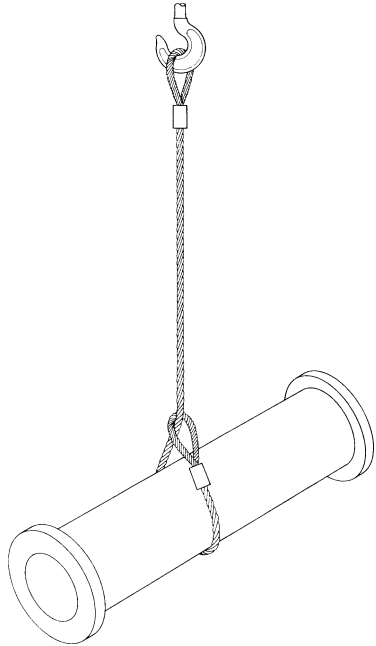
When lifting bundle of pipes with choker hitch, the pipes shall always be in odd number and the tag line shall be tied on the sling



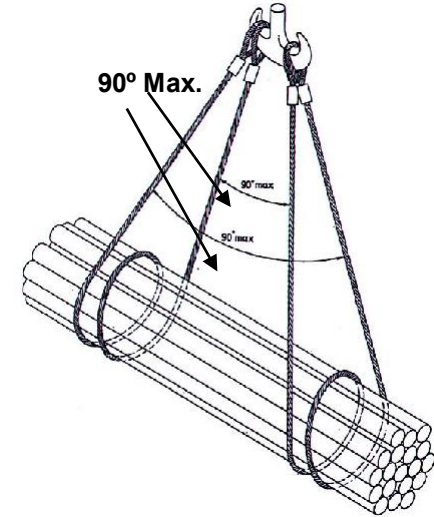
Incorrect use causes twisting of the load



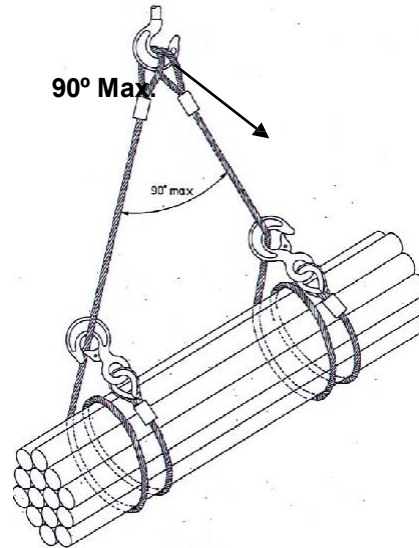
TYPES OF HITCHES



ANGLE FACTOR = 0.8(choker hitch)



ANGLE FACTOR = 2.1(acts as 4 leg)



ANGLE FACTOR = 1.4(acts as 2 leg)

TUBULARS

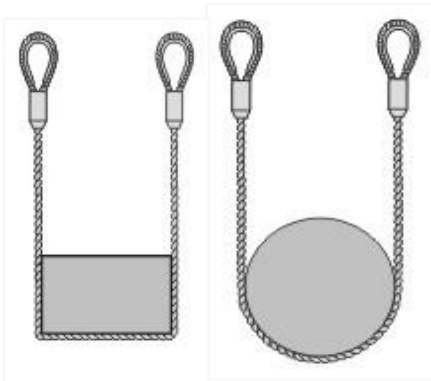
As per **ADNOC Group Standard “HSE-PSW-CP19”** The following applies to both individual and bundled tubular.

1. Each tubular lift shall always be slung with two slings, each of them same length and of the same SWL.
2. The SWL of each sling should be equal to or greater than the Gross Weight of the load.
3. Every tubular shall lift level. Slings should be placed at equal distance (approximately 25%) from the ends of the load with the internal angle at the hook not greater than 90° .
4. They should be double wrapped and choked around the tubular.
5. When it is necessary to bundle tubulars of different lengths, the shortest tubular should be no less than 75% of the length of the longest tubular.

TYPES OF HITCHES

BRIDLE HITCHES

Basket hitches distribute a load equally between the two vertical legs of a sling.

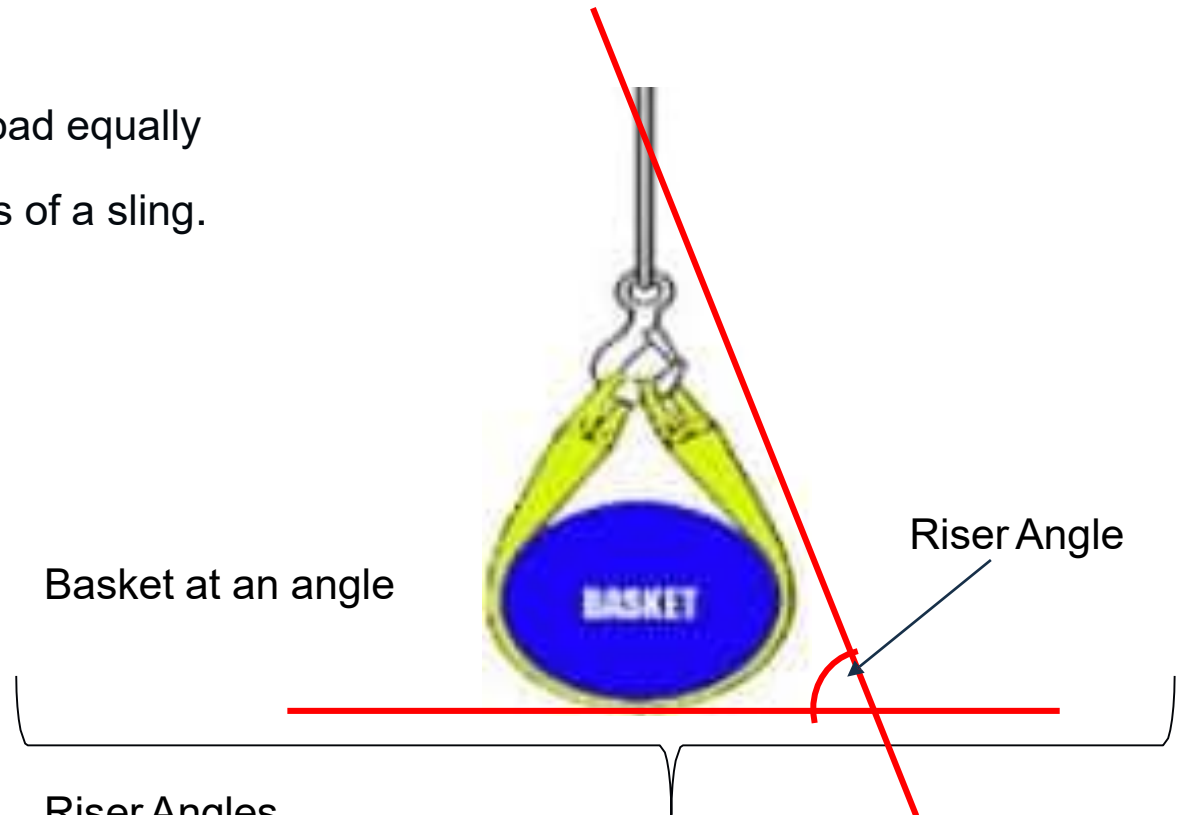


Vertical Basket -90°

This will lift 200% of SWL

Mode Factor = 2

Max. Load that can be lifted =
SWL of Sling x Mode Factor



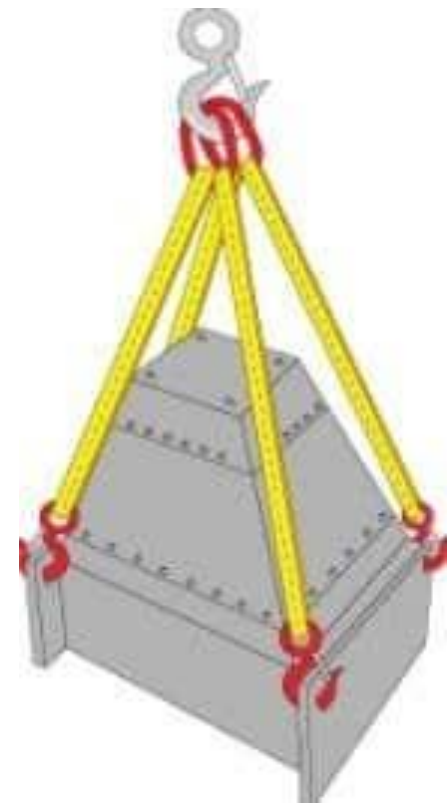
Riser Angles

- 60° Angle – will lift 170 % of SWL (Mode Factor – 1.7)
- 45° Angle – will lift 140 % of SWL (Mode Factor – 1.4)
- 30° Angle – will lift 100 % of SWL (Mode Factor – 1)

TYPES OF HITCHES

BRIDLE HITCHES

- ▶ Are made of 2, 3 or 4 single leg hitches.
- ▶ Are used for hoisting an object that has lifting lugs or attachments.
- ▶ Position the hook over the centre of gravity of the load.
- ▶ Adjust sling leg lengths with turnbuckles to level raised load.
- ▶ Check each sling leg angle to ensure sling is not overloaded.



TYPES OF HITCHES

BRIDLE HITCHES

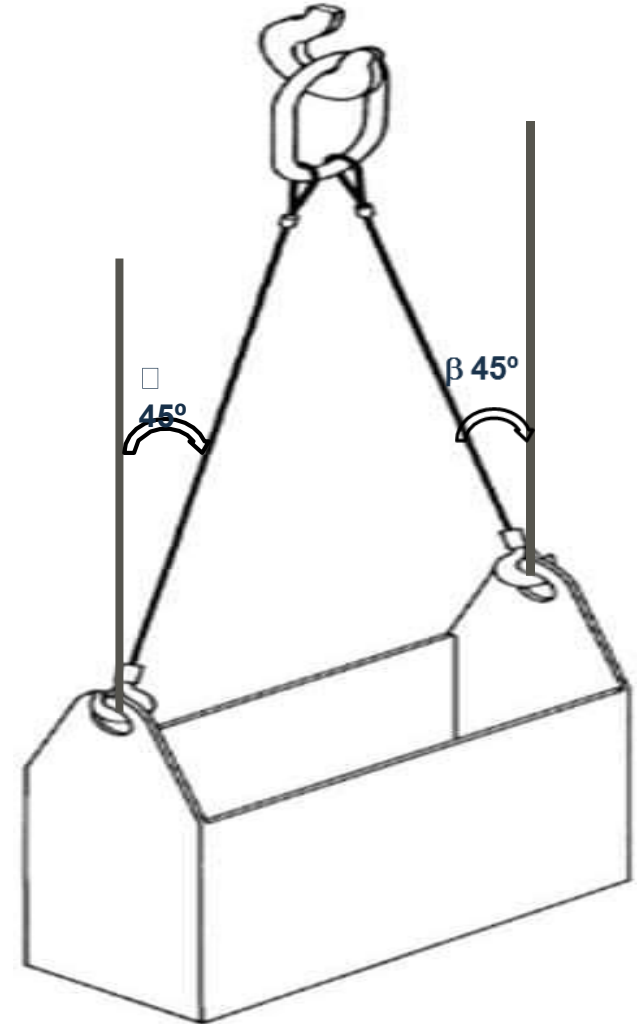
When two or more slings are used at an angle, the tension on the sling legs will increase, therefore decreasing the lifting capacity of the slings.

$$\text{Cos } 45^\circ = 0.7$$

- ▶ Mode factor for 2 slings = $2 \times 0.7 = 1.4$
- ▶ Mode factor for 3 slings = $3 \times 0.7 = 2.1$
- ▶ Mode factor for 4 slings = $3 \times 0.7 = 2.1$

Noted:

In 4-slings load are supported by only 3 legs and the 4th leg act as a balancing leg.









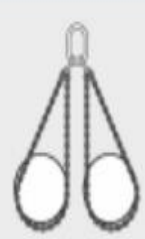



Effective WLL

working load limit (WLL) of a lifting accessory to account for the specific lifting configuration and conditions. It helps adjust the WLL based on factors like the type of load, lifting method, and environmental conditions.

Calculating Effective WLL:

$$\text{Effective WLL} = \text{Nominal WLL} \times \text{Mode Factor}$$

I-leg chains		II-leg chains				III- + IV- leg chains		Endless chain sling	Single lifting sling		Double lifting sling		U-Shape
													
-	-	0°-45°	45°-60°	0°-45°	45°-60°	0°-45°	45°-60°	-	0°-45°	45°-60°	0°-45°	45°-60°	-
1	0,8	1,4	1	1,12	0,8	2,1	1,5	1,6	1,4	1	2,1	1,5	2

Terminologies in Lifting Industry

Mode Factor (or Load Configuration Factor) is a coefficient that accounts for the entire geometry of a multi-leg sling arrangement, including the number of legs and their angles, to determine the adjusted Working Load Limit (WLL) of the entire sling assembly.

In simple words:

Mode Factor: factor applied to the WLL of 1 leg sling by taking into account the geometry of the slinging (number and angles of the legs) and the consequence of bending some components.

An **Angle Factor (or Tension Factor)** is a specific multiplier for a single sling or leg, calculated for a given angle from the vertical, to determine the increased tension on that individual leg due to the angle.

Effective Working Length(EWL):Effective Working Length Internal distance from one contact point to other contact point of a lifting gear.

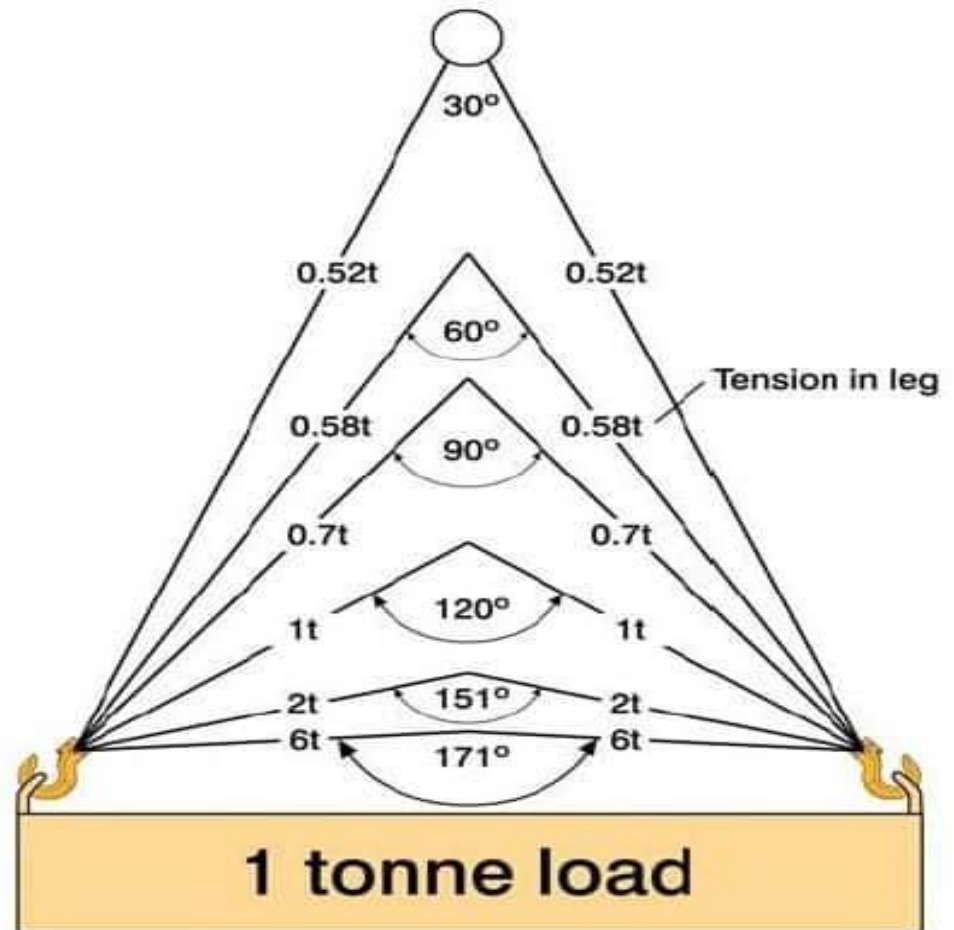
ANGLES OF LIFTING

ANGLES OF LIFTING

SLING ANGLES

Two common angles referenced during lifting operations are included angle and Vertical angle

Included Angle – Angle between sling legs

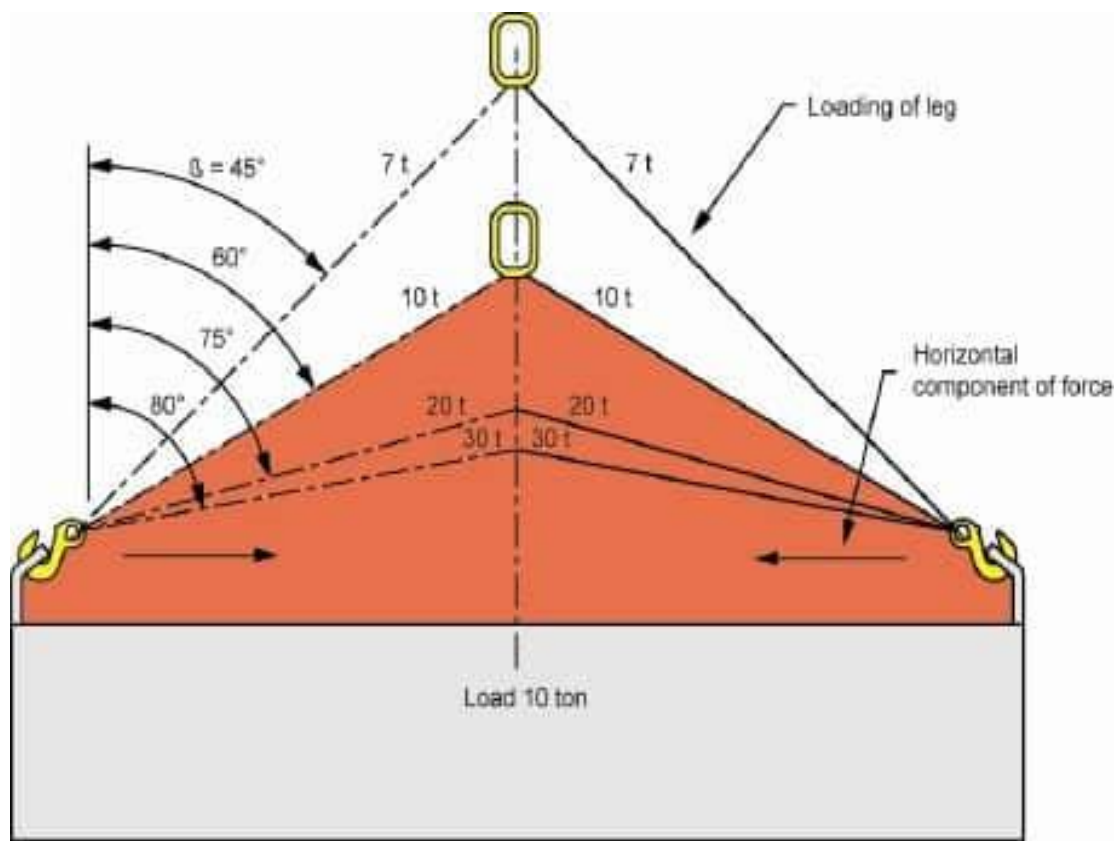


RELATIONSHIP OF SLING INCLUDED ANGLE AND SWL

ANGLES OF LIFTING

SLING ANGLES

Vertical Angle – Angle made by the sling leg with respect to vertical



RELATIONSHIP OF SLING VERTICAL ANGLE AND SWL

ANGLES OF LIFTING

SLING ANGLES

Note the followings:

- ▶ Half of the included angle is equal to the vertical angle

90° included angle = 45° vertical angle

- ▶ Recommended sling angles are between 0-45 ° Vertical (0 - 90° Included)
- ▶ The sling angle must not be greater than 60° Vertical (120° Included)
- ▶ This also applies to chains, ropes and hoisting units

ANGLES OF LIFTING FROM HORIZONTAL

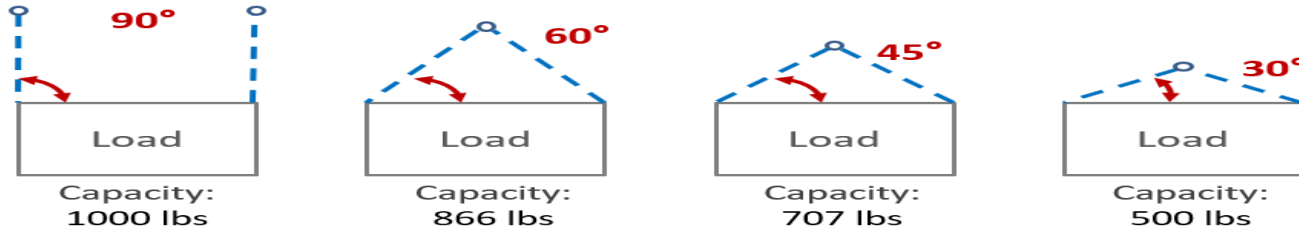
The best suitable angle for a sling lifting operation is 60 degrees or greater from the horizontal

Key Considerations for Lifting Operations:

- **Optimal Angle:** A 60-degree angle is considered the ideal, safe, and stable benchmark for multi-leg slings.
- **Minimum Preferred Angle:** Sling angles should always remain above 30 degrees from the horizontal
- **Maximum Tension Warning:** As the angle decreases, the tension on the sling increases. An angle of 30 degrees doubles the tension, creating a high risk of overloading and failure.
- **Best Practice:** The most desirable angle of lift approaches 90 degrees (vertical), as it carries the load directly.
- **Action for Shallow Angles:** If a sling angle falls below 30 degrees, it is considered a critical lift, and a Critical Lift Plan approved by a qualified person is required.
- **Sling Length:** To maintain a safe 60-degree angle, the horizontal distance between attachment points should be roughly equal to the sling length.

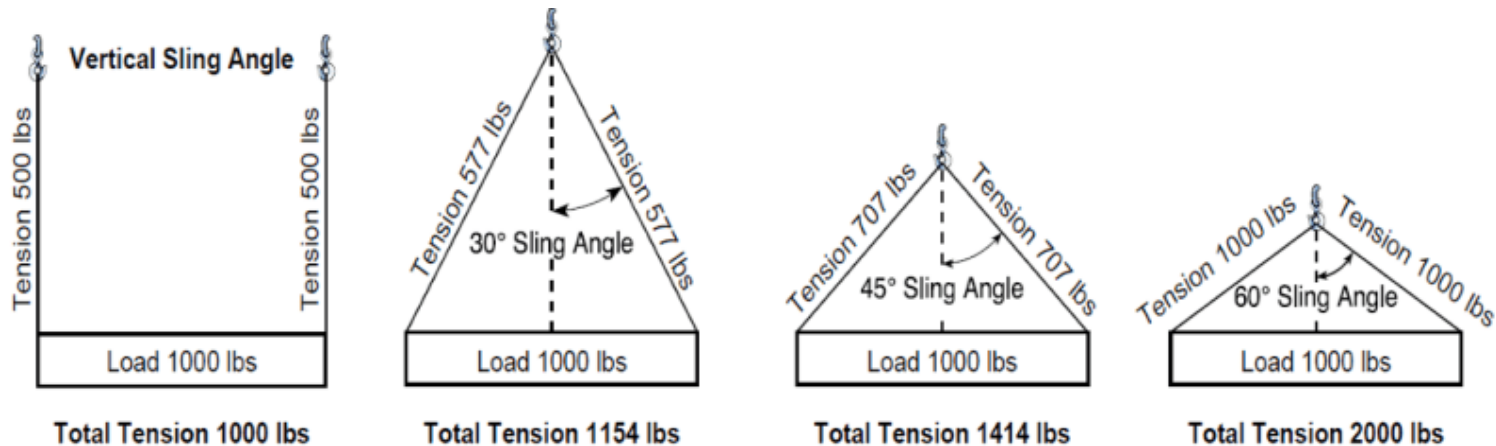
SLING ANGLES

Horizontal Angle – Angle made by the sling leg with respect to Horizontal



Angle of use	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°
Capacity %	100	99.6	98.5	96.6	94.0	90.6	86.6	81.9	76.6	70.7	64.3	57.4	50.0

Vertical Angle – Angle made by the sling leg with respect to vertical



ANGLES OF LIFTING

SLING TENSION

$$\text{Tension on each leg} = \frac{\text{Gross Load}}{\text{Number of legs} \times \text{Cos (Angle of Sling with respect to Vertical)}}$$

TWO SLINGS:

$$\text{Tension on each leg (0-45 ° Vertical)} = \frac{\text{Gross Load}}{1.4}$$

THREE OR FOUR SLINGS:

$$\text{Tension on each leg (0-45 ° Vertical)} = \frac{\text{Gross Load}}{2.1}$$

NOTE: As per ADNOC, apply a consequence factor of 1.3

SLING SWL for each sling = Tension per Leg x Consequence Factor

MULTI-LEG SLING METHOD OF RATING

MULTI-LEG SLING METHOD OF RATING

THERE ARE TWO METHODS OF RATING SLINGS:

1. Uniform Load Method
2. Trigonometric Method

Uniform Load Method: Rate slings for a range of angles.

Examples:

- ▶ Sling rated for use at $0-45^{\circ}$ ($0-90^{\circ}$ included angle) by uniform load method will have the same rating as a sling rated for use at 45° (90° included angle) by the trigonometric method.
- ▶ **In Trigonometric method of rating**, slings are rated for a specific angles. Therefore, calculations are done for a specific angle to the vertical that the sling will be used at.

MULTI-LEG SLING METHOD OF RATING

UNIFORM LOAD METHOD:

Two Leg sling at 0-45° (0-90° included angle) = 1.4 x WLL of a single leg
Three and Four Legs Sling at 0-45° (0-90° included angle) = 2.1 x WLL of a single leg

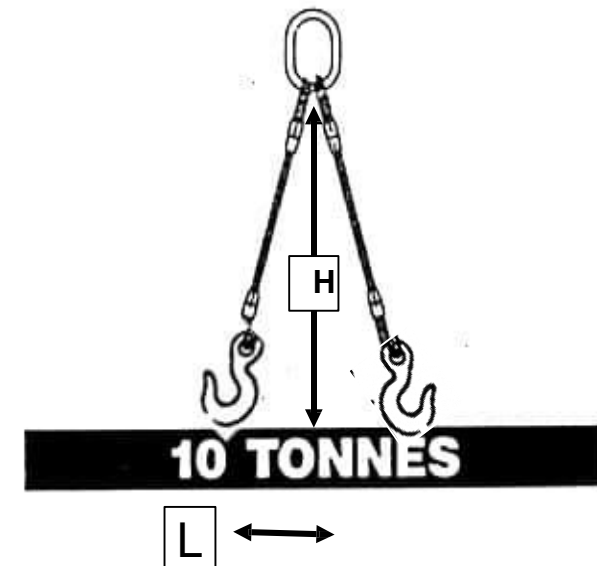
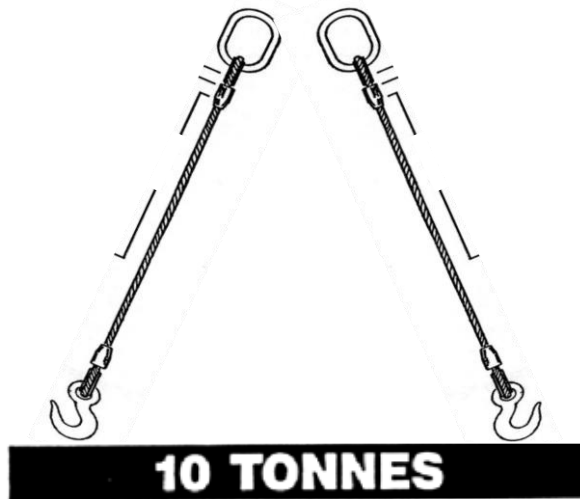
NOTE:

For four leg slings, the Uniform Load Method of Rating assumes that only three of the legs will effectively carry the load and that the fourth leg will only serve to balance the load. Therefore the rating for three and four leg slings is the same.

MULTI-LEG SLING METHOD OF RATING

UNIFORM LOAD METHOD:

Exercise 1 ... (2 – Leg sling)



A) Choose 2-leg sling capacity if the gross weight of load 10 ton ?

13 tonnes Minimum
(0-45°)

B) Choose 2- single leg slings capacities if the gross weight of load 10 ton ?

9.29 tonnes each leg
(0-45°)

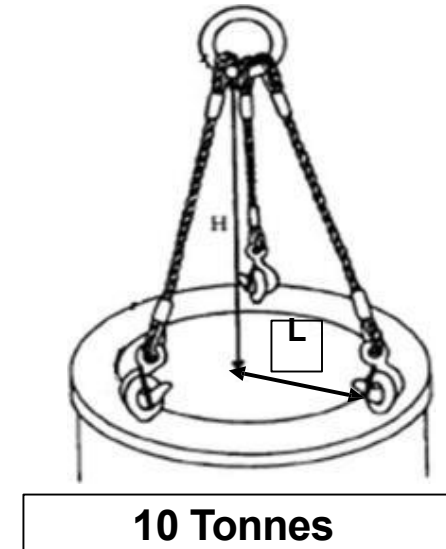
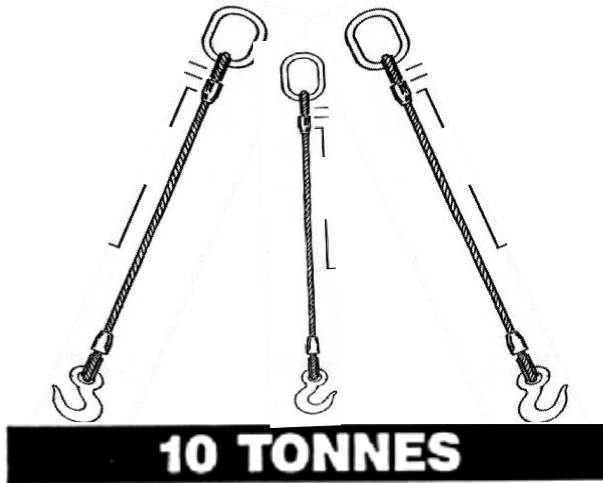
C) How much the length of slings in both above cases ?

$H \geq L$

MULTI-LEG SLING METHOD OF RATING

UNIFORM LOAD METHOD:

Exercise 2 ... (3 – LEG SLING)



A) Choose 3-leg sling capacity if the gross weight of load 10 ton ?

**13 tonne Minimum
(0-45°)**

B) Choose 3- single leg slings capacities if the gross weight of load 10 ton ?

**6.19 tonnes each leg
(0-45°)**

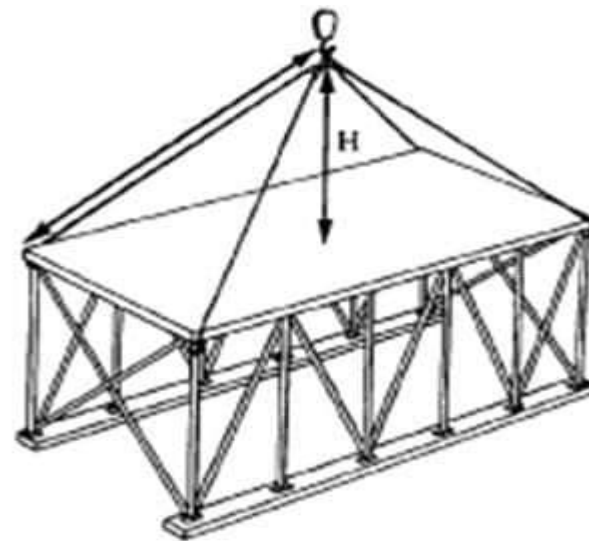
C) How much the length of slings in both above cases ?

$H \geq L$

MULTI-LEG SLING METHOD OF RATING

UNIFORM LOAD METHOD:

Exercise 3 ... (4 – LEG SLING)



A) Choose 4-leg sling capacity if the gross weight of load 10 ton ?

13 tonnes Minimum
(0-45°)

A) Choose 4-single leg sling capacity if the gross weight of load 10 ton ?

6.19 tonnes Minimum
(0-45°)

C) How much the length of slings in both above cases ?

$H \geq L$

RIGGING EQUIPMENT

“GOOD & BAD PRACTICES”

GOOD AND BAD RIGGING PRACTICES

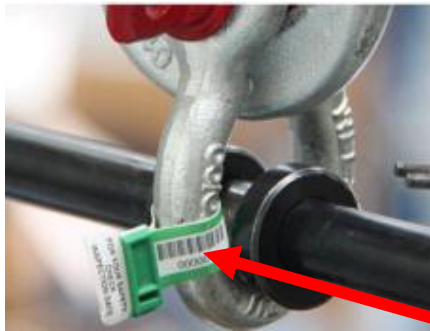
GOOD PRACTICE



CONDUCT PRE-USE INSPECTION OF LIFTING GEARS

GOOD AND BAD RIGGING PRACTICES

GOOD PRACTICE



Color Code with tag

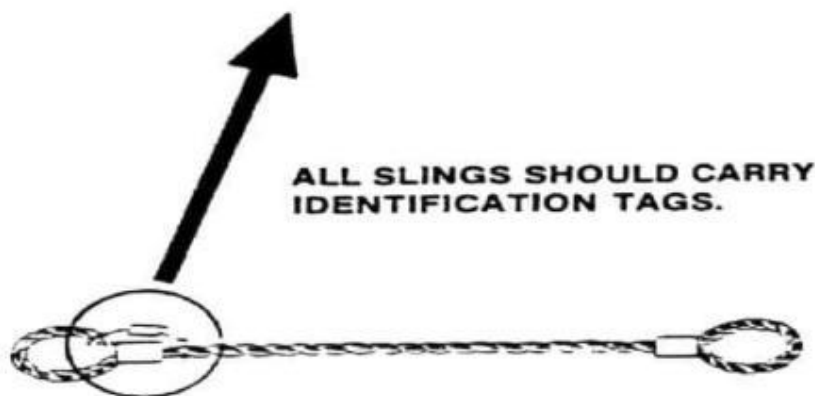
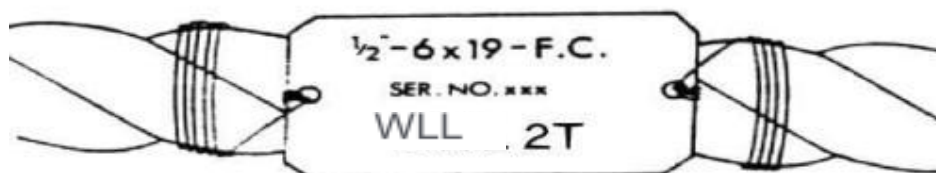


Color Code with paint

USE ONLY COLOR CODED LIFTING GEARS

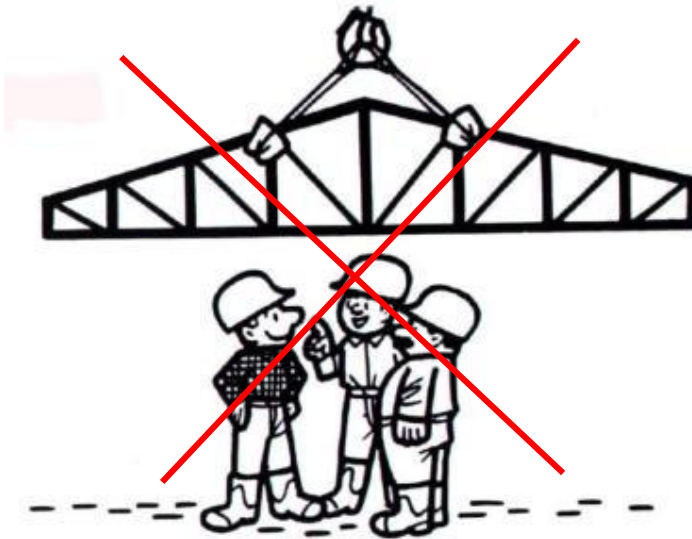
GOOD AND BAD RIGGING PRACTICES

NEVER USE A LIFTING GEAR THAT IS NOT STAMPED WITH WLL

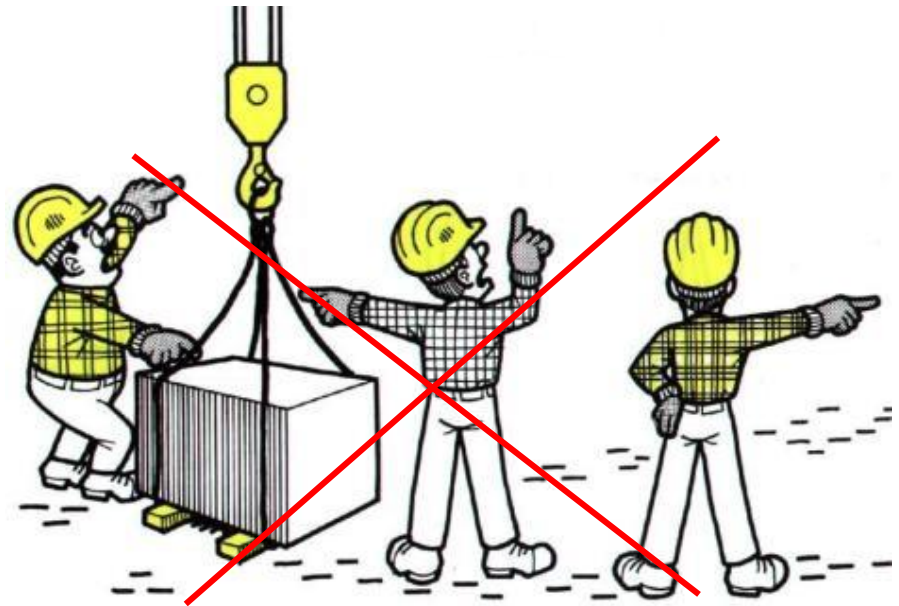


ALL SLINGS SHOULD CARRY IDENTIFICATION TAGS.

GOOD AND BAD RIGGING PRACTICES



Never swing the load on personnel



One BANKSMAN should guide the operator

GOOD AND BAD RIGGING PRACTICES

BAD PRACTICE



Never Stand under a suspended load

GOOD AND BAD RIGGING PRACTICES



BAD – Cutting action of eye splice on running line



GOOD – No cutting action on running lines



BAD – Bolt on running line can work loose



GOOD

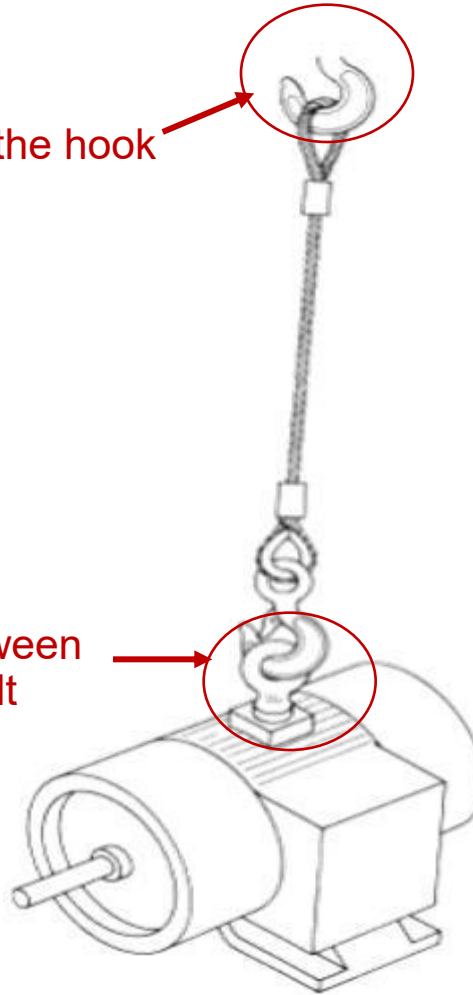
USE OF CHOKERS

GOOD AND BAD RIGGING PRACTICES

BAD PRACTICE

Missing safety latch on the hook

Missing shackle between the hook and eye bolt

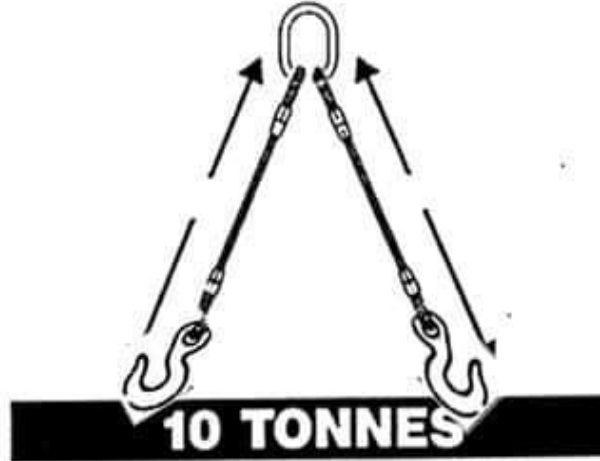


Check that the load is proper rigged prior to lifting

GOOD AND BAD RIGGING PRACTICES

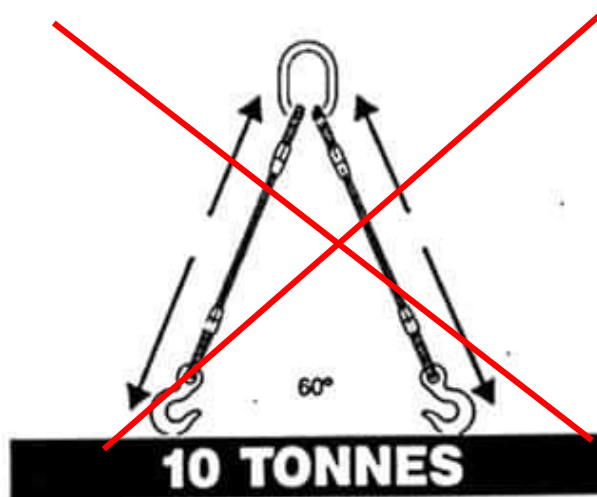
GOOD – Hooks
Are turned out

YES



BAD – Hooks
Opening are turned in

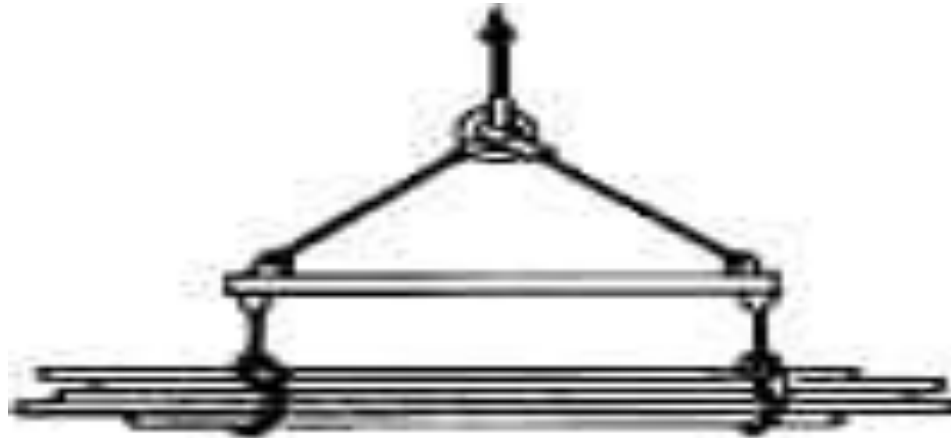
NO



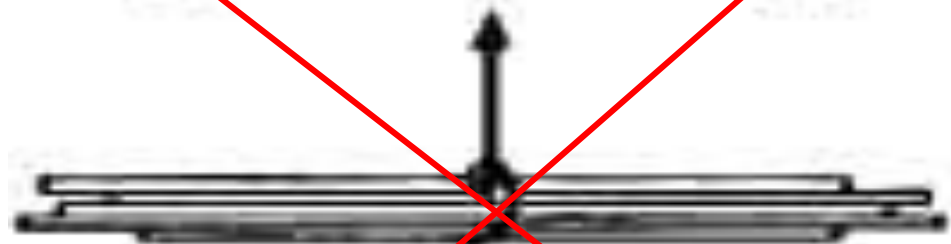
HOOKS' DIRECTION

GOOD AND BAD RIGGING PRACTICES

Double slings shall be used when hoisting two or more pieces of material over 12 ft long



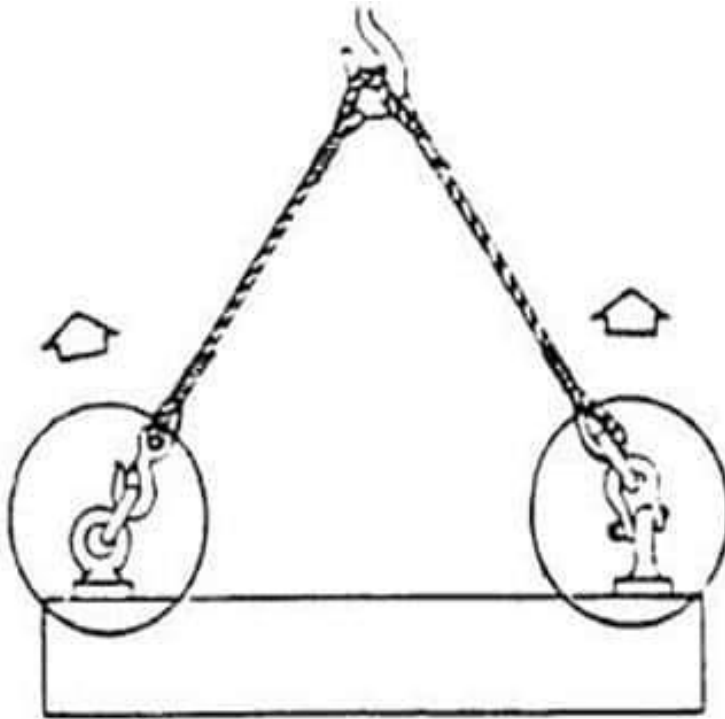
RIGHT – Load over 12 ft long



WRONG – Load over 12 ft long

LIFTING OF BUNDLES

GOOD AND BAD RIGGING PRACTICES

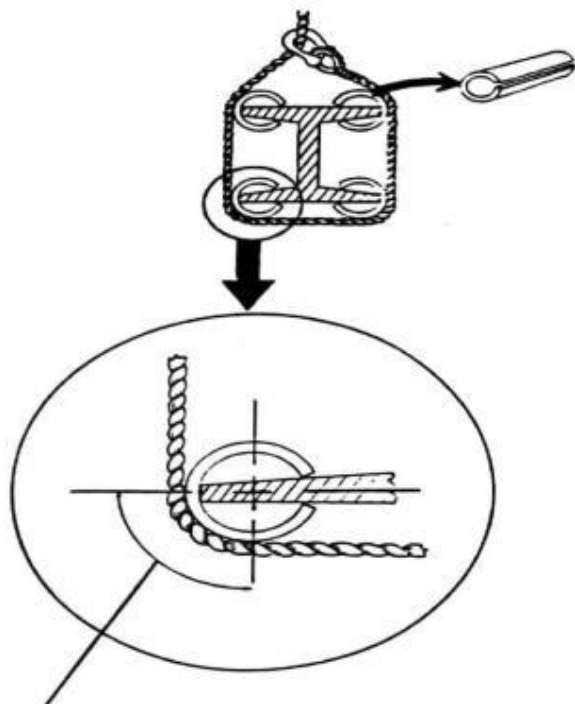


GOOD PRACTICE

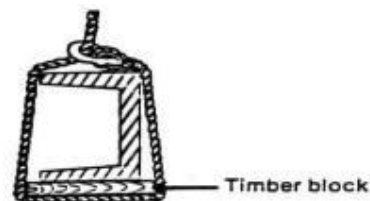
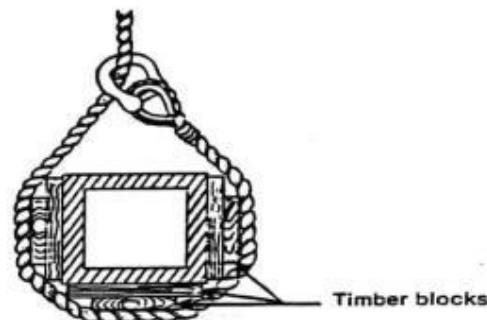


BAD PRACTICE

GOOD AND BAD RIGGING PRACTICES



Contact radius should be equal to 1 rope lay or 6 times rope diameter

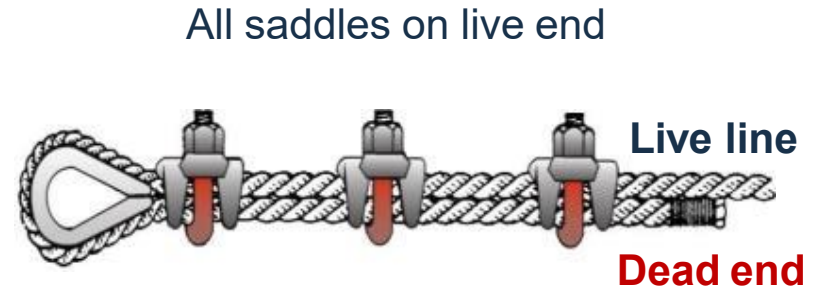
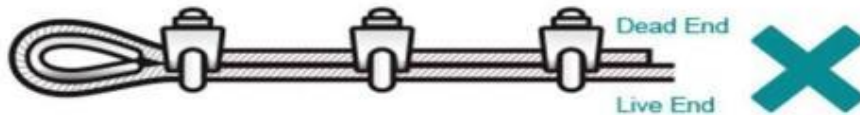
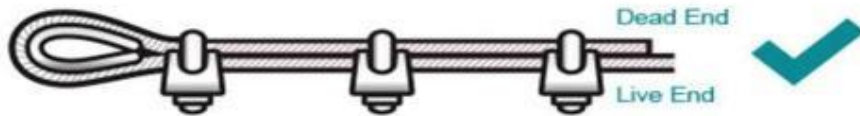


ENSURE THAT SLINGS ARE PROTECTED FROM SHARP CORNERS

GOOD AND BAD RIGGING PRACTICES



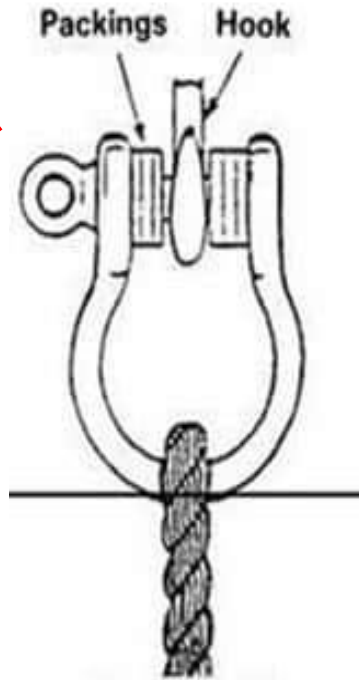
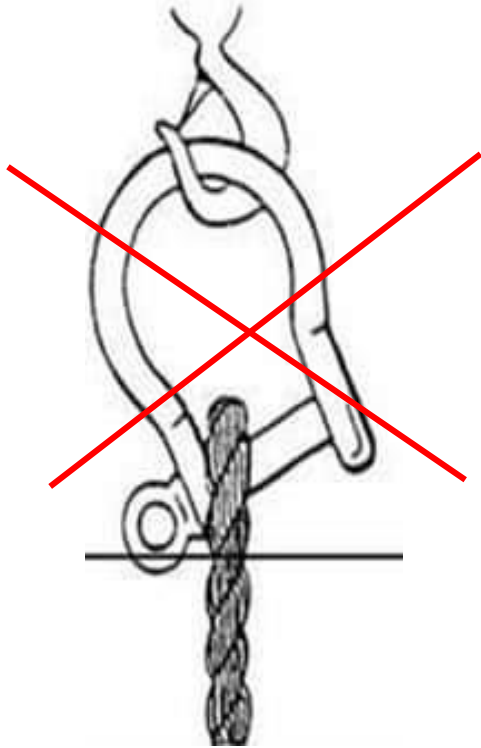
The correct installation method



Never saddle a dead horse!

WIRE ROPE CLIPS

GOOD AND BAD RIGGING PRACTICES



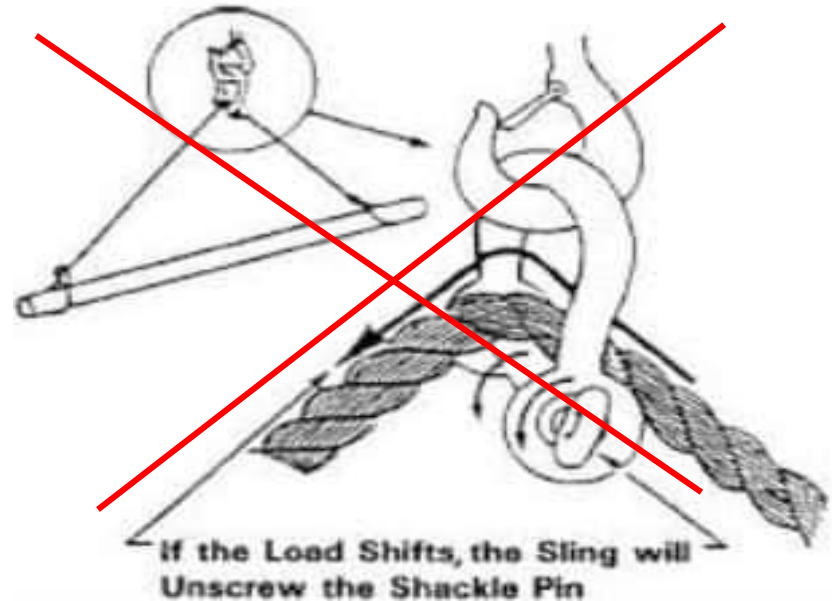
Poor practice never allow shackle to be pulled at an angle – the jaw will open up

Good practice pack the pin with washers to centralize the shackle

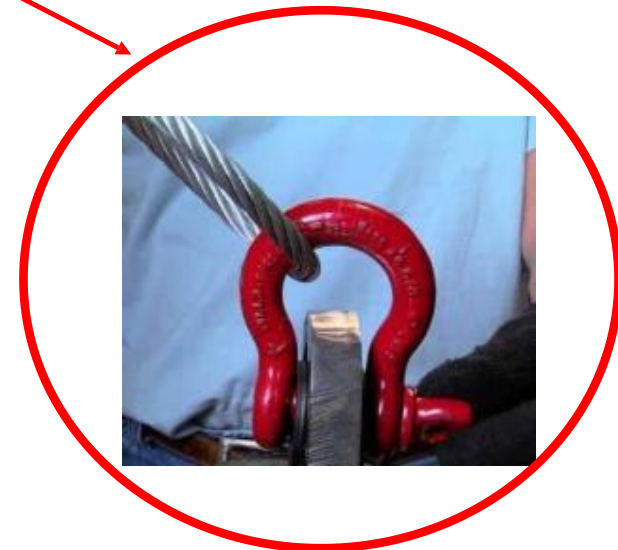
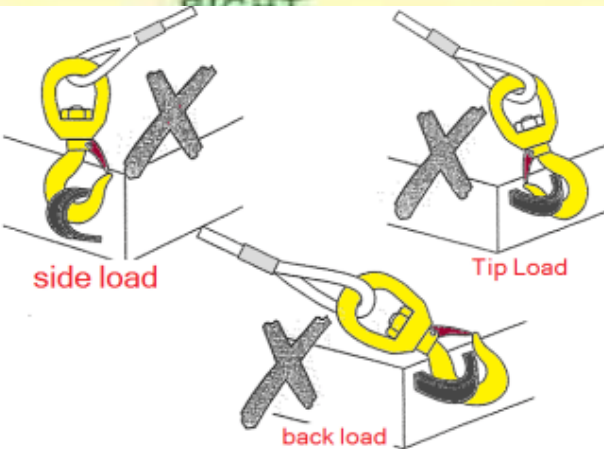
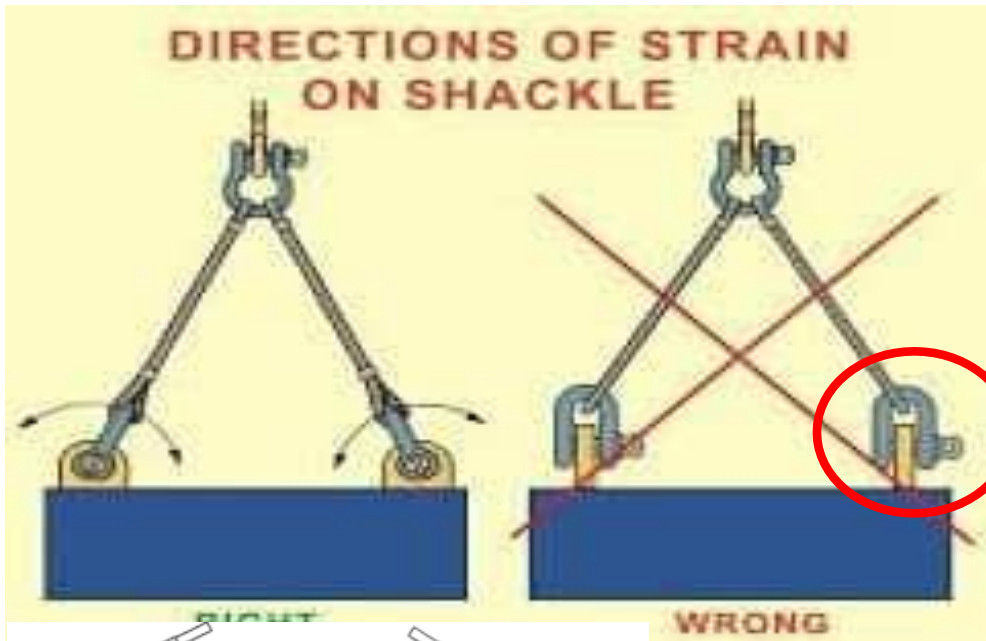


Never replace shackle pin with bolt

Do not use screw pin shackles if the pin can roll under load and unscrew

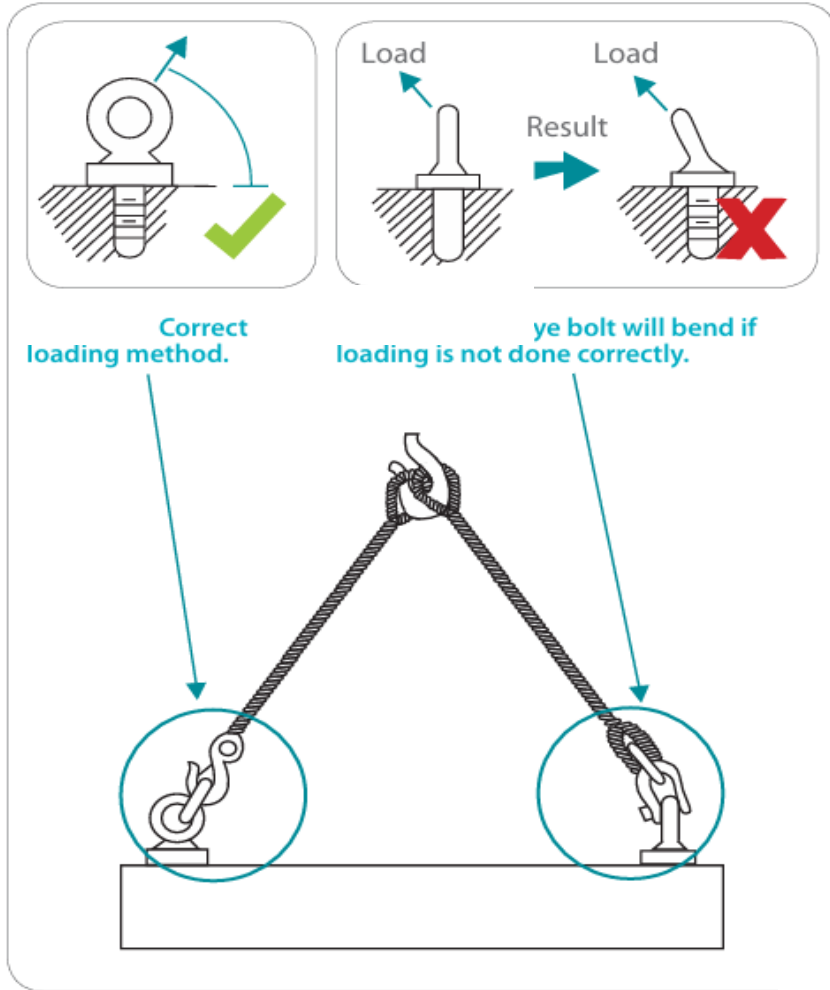


GOOD AND BAD RIGGING PRACTICES

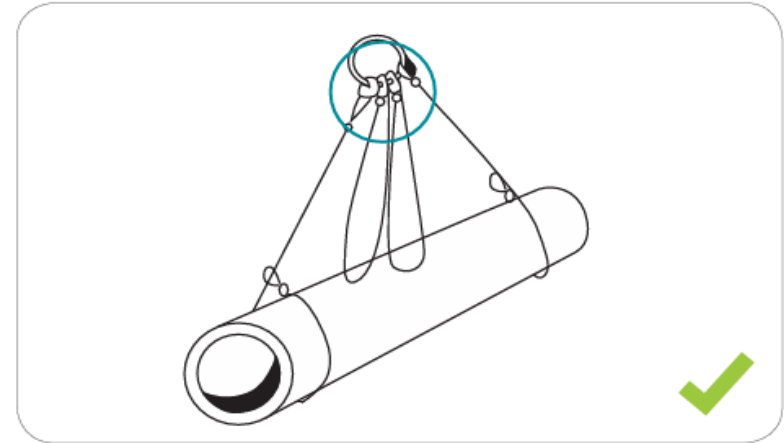


GOOD AND BAD RIGGING PRACTICES

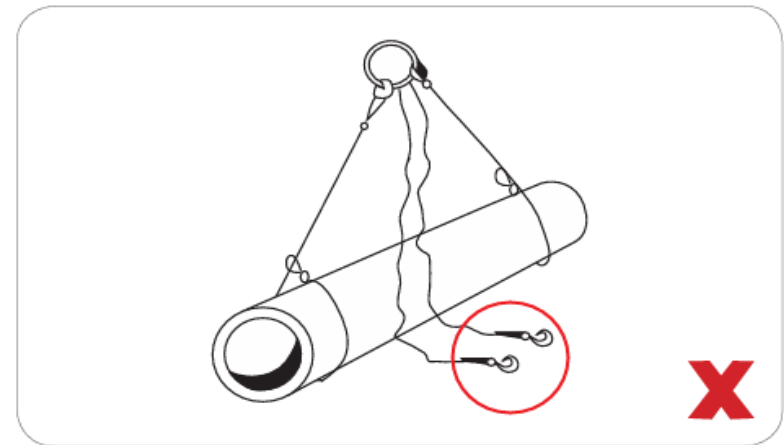
Correct loading method



Hook up unused slings



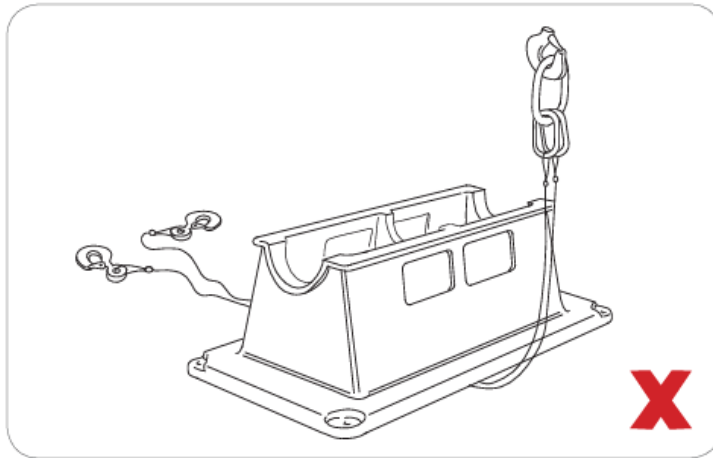
Make sure any unused slings are hooked up properly.



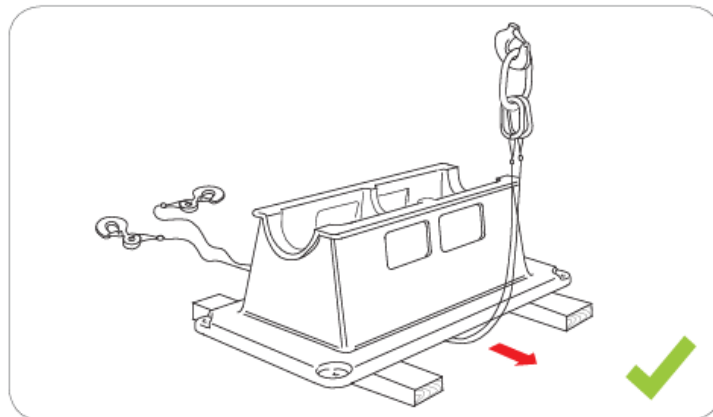
Do not leave unused slings unhooked.

GOOD AND BAD RIGGING PRACTICES

Correct method of unloading



Do not pull out the sling from underneath the load because it will damage the sling.



Put the load down onto supports and then pull out the sling by hand.

30. Good Communication Practices

Practise good communication within the Lifting Team



GOOD AND BAD RIGGING PRACTICES

Check lifting gears



Make sure the lifting gears such as hooks, slings and shackles are well-maintained and in good working condition.

Ensure load lifted is stable, balanced and secured



Make sure the load is stable, balanced and secured before any lifting operation.



GOOD AND BAD RIGGING PRACTICES

Check slings



✓ Check the slings and ensure that the rigging angle is correct.

5

Check load



Make sure the load is properly secured and inform the Crane Operator of the weight of the load.

✓

6

GOOD AND BAD RIGGING PRACTICES

Ensure loose loads are secured



Make sure any loose items are placed in a proper receptacle or container to prevent any items from falling during the lifting operation.

Report defective lifting gear to Lifting Supervisor



Immediately report any defective or faulty lifting gear to the Lifting Supervisor.



GOOD AND BAD RIGGING PRACTICES

Check with the rigger that the load is ready to be lifted



Give correct crane hand signals



GOOD AND BAD RIGGING PRACTICES

Use paddings on the load edges



Place adequate paddings on the edges of the load to prevent the sling from damage.

Correct rigging method

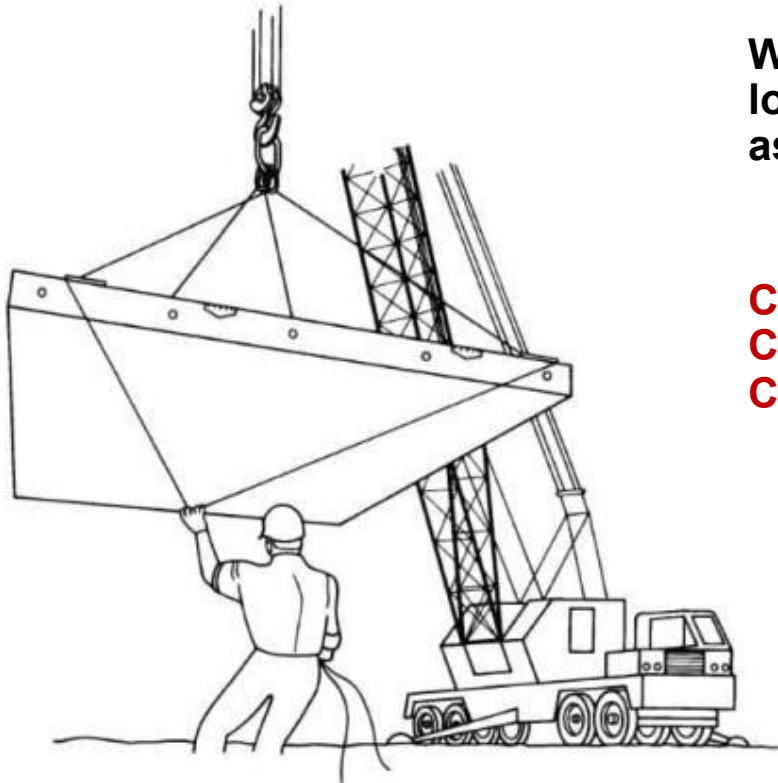


GOOD AND BAD RIGGING PRACTICES



Ensure load lifted is safe and balanced

GOOD AND BAD RIGGING PRACTICES



Use Tag Lines to prevent load from rotating
Or put the load in proper position/orientation

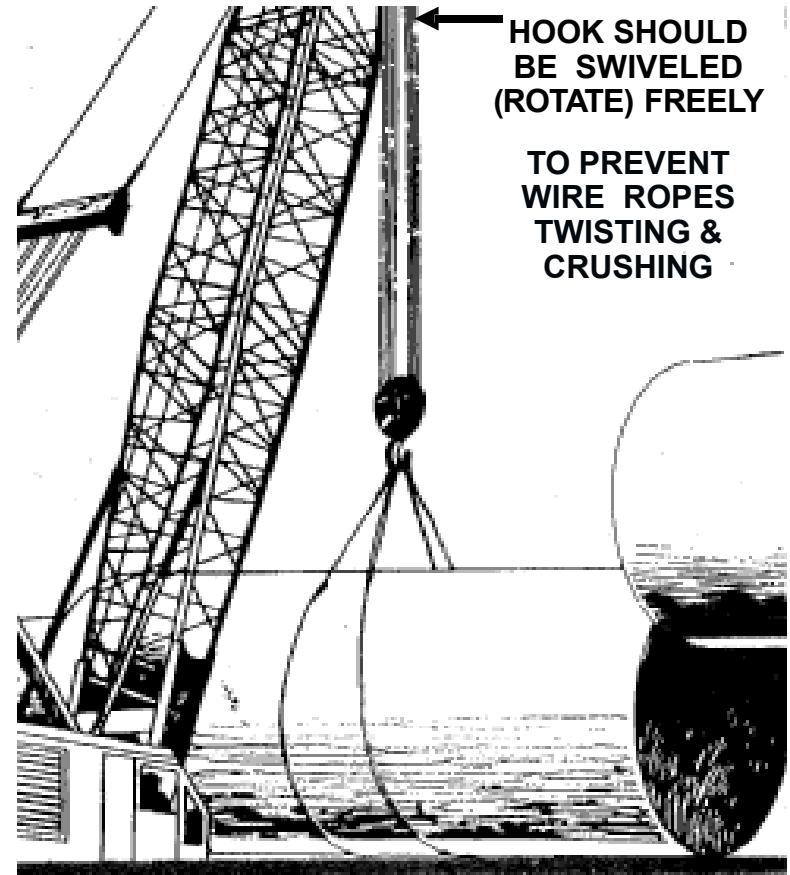
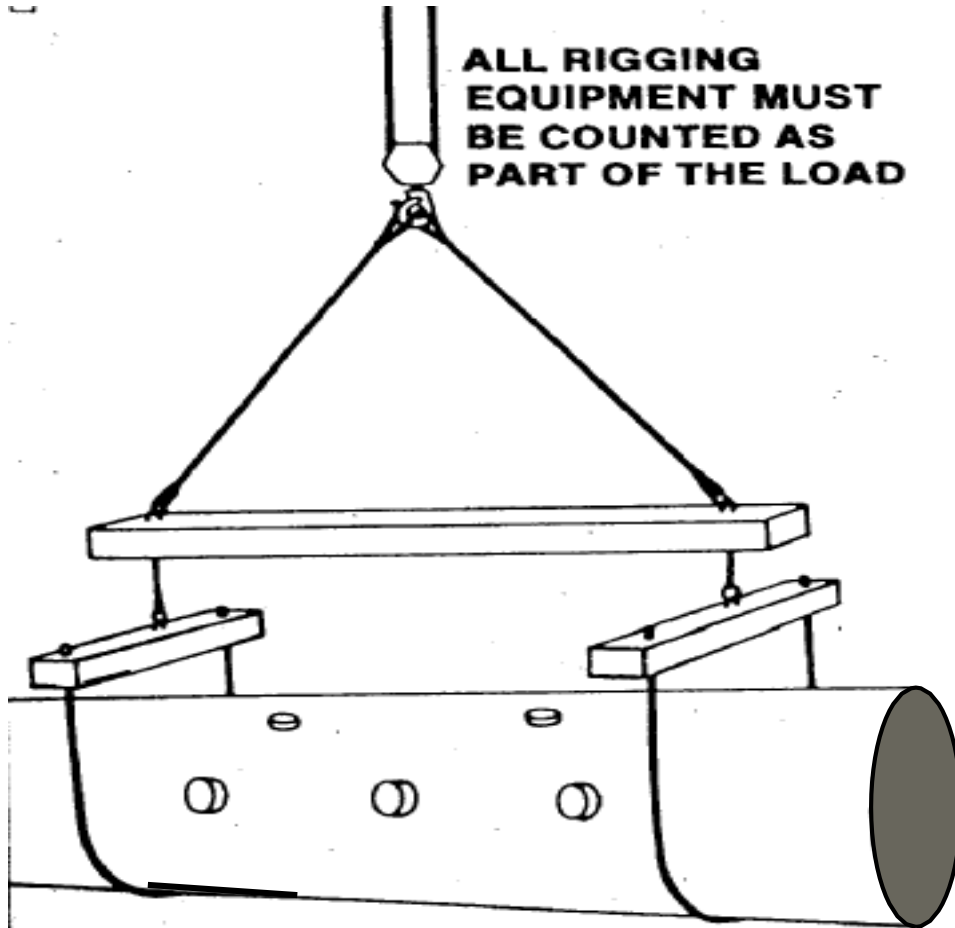
Use tagline to control bulky loads

When you lift heavy bulk loads keep it close to Ground as much as possible

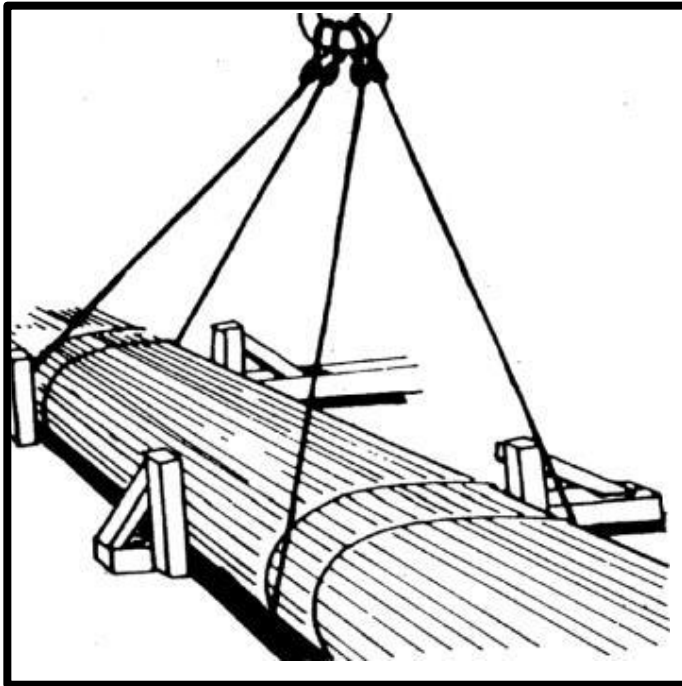
Check your crane
Check your sling
Check your load balance



GOOD AND BAD RIGGING PRACTICES



GOOD AND BAD RIGGING PRACTICES



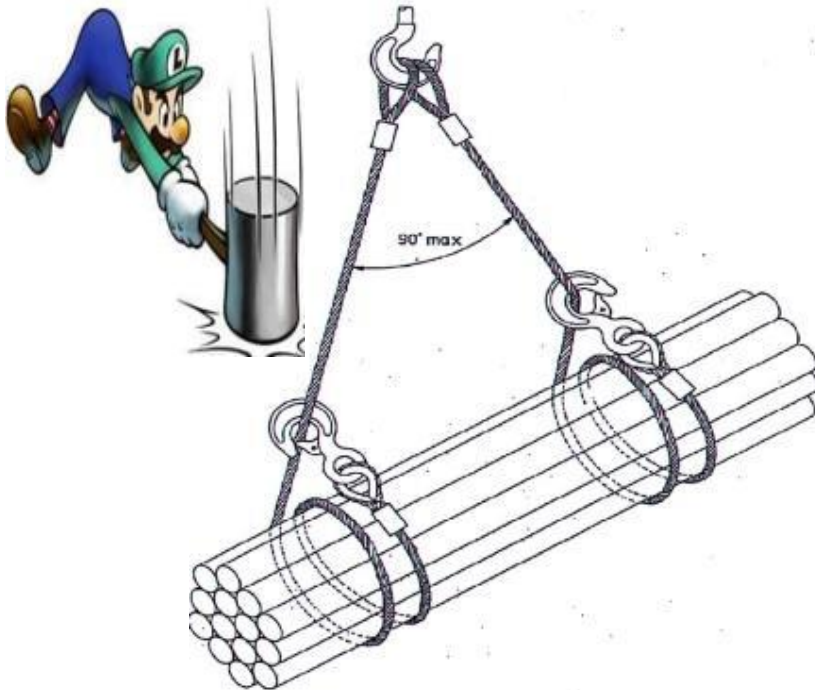
Land your load on wooden blocks to:

- ▶ Remove your slings easier
- ▶ Protect your slings

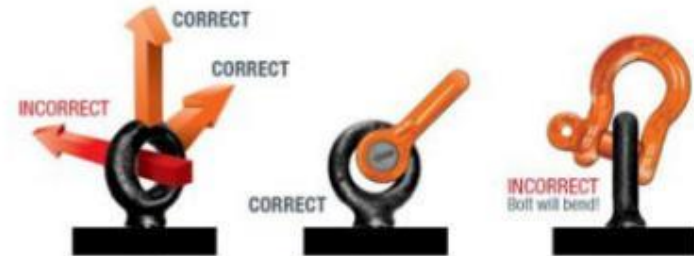


USE APPROVED MAN BASKET

GOOD AND BAD RIGGING PRACTICES



ALWAYS PULL LOAD IN THE PLANE OF THE EYE
Never go below 45° side pull



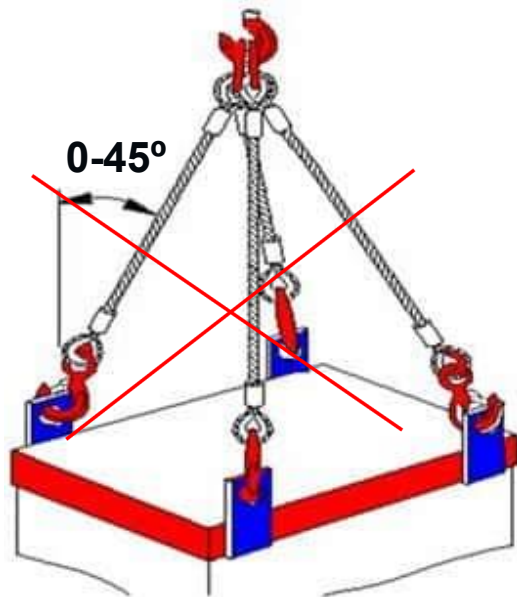
Do not hammer the hooks to get tightness (Inch the load)

GOOD AND BAD RIGGING PRACTICES

Use your 4-leg or 5-leg sling with max. sling angle of 0-45°

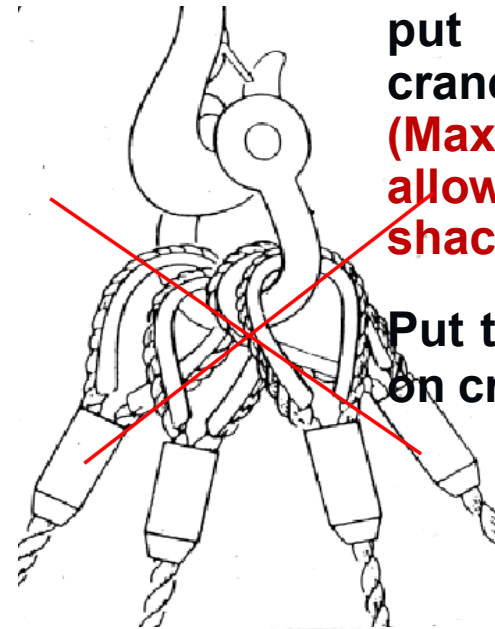
REMEMBER

WLL marked on your sling between 0-45°

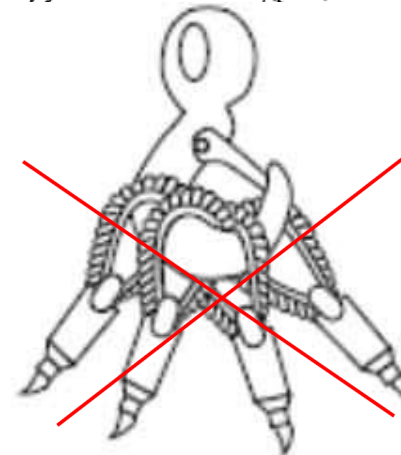


- ▶ Hooks shall not be connected directly into pad eyes – use shackles
- ▶ Pad should be diagonally placed

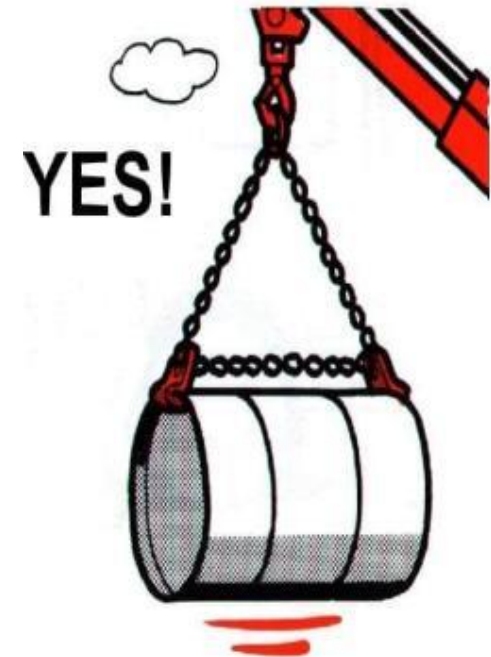
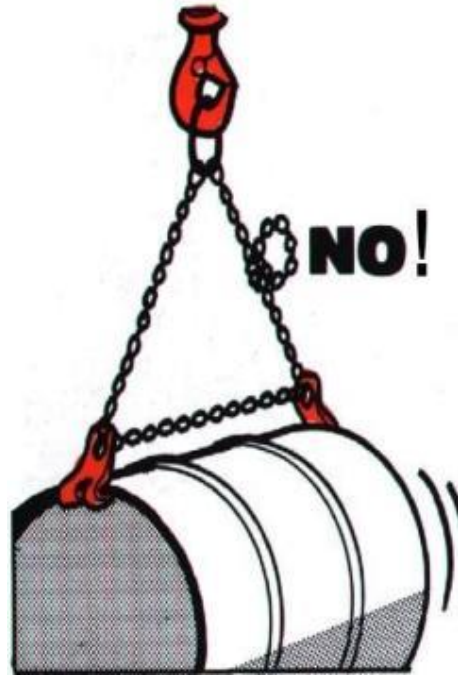
Use shackle if you put 2 slings on crane hook
 (Maximum 2 slings allowed in a shackle)



Put the shackle pin on crane hook

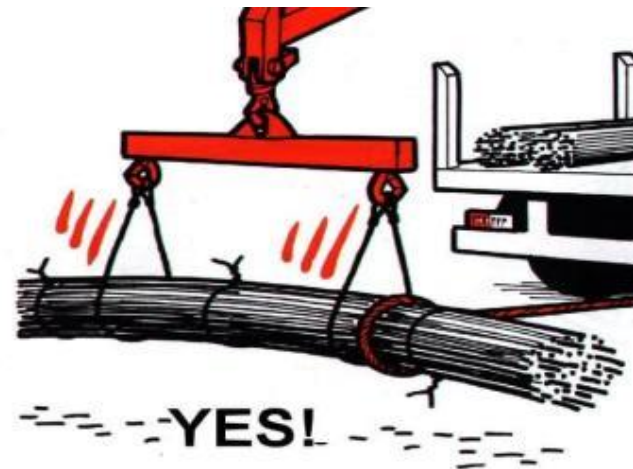
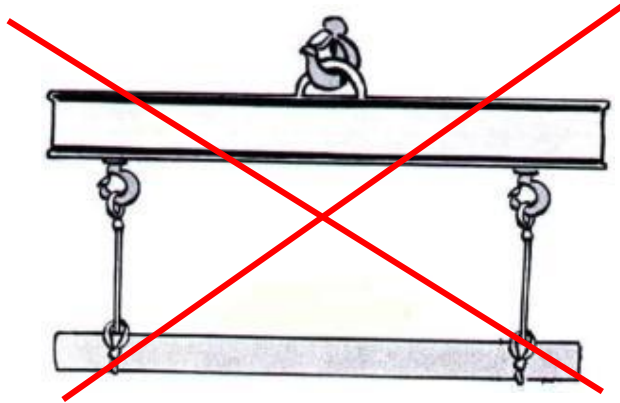


GOOD AND BAD RIGGING PRACTICES



HANDLING DRUMS

GOOD AND BAD RIGGING PRACTICES



USE SPREADER BEAM TO DISTRIBUTE THE LOAD

GOOD AND BAD RIGGING PRACTICES

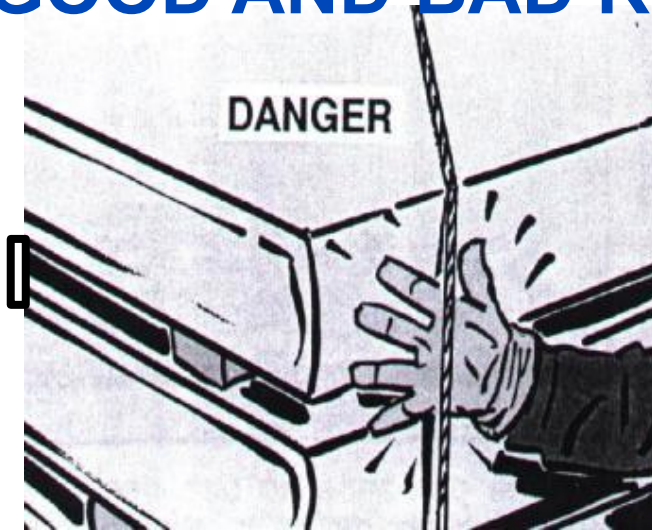


**WATCH YOUR HAND WHILE
HANDLING CASING**

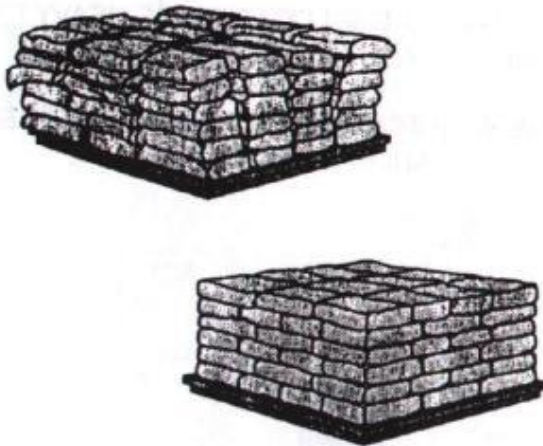


**BE CAREFUL WHILE OPENING
CASING BUNDLE**

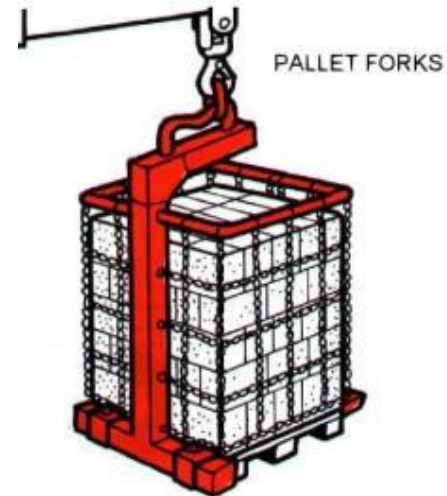
GOOD AND BAD RIGGING PRACTICES



WATCH
YOUR
HANDS

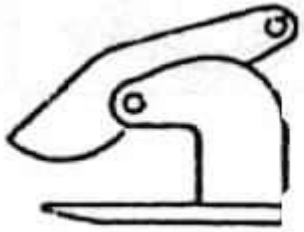


**BE SURE THE LOAD
PROPERLY OVERLAPPED**

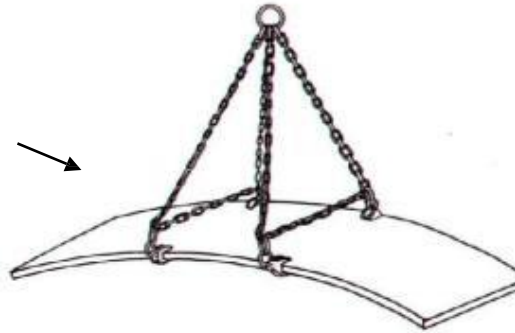


USE PALLET FORKS

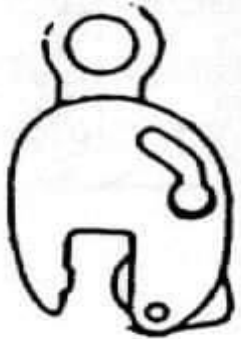
GOOD AND BAD RIGGING PRACTICES



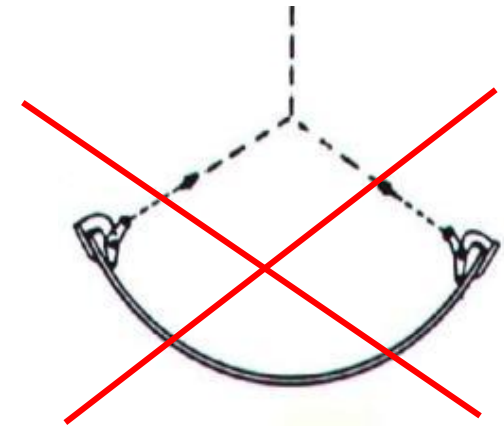
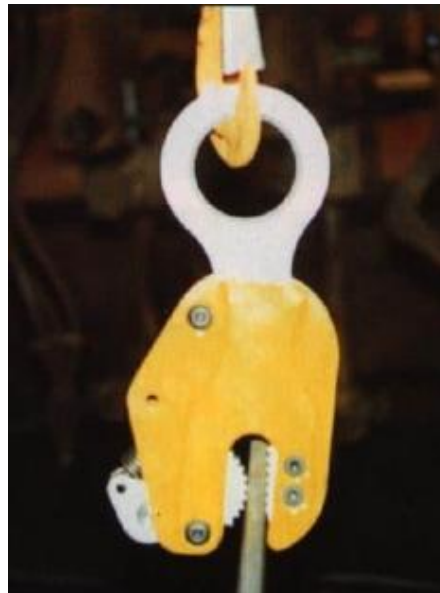
LIFTING PLATE WITH HORIZONTAL CLAMPS



GOOD HANDLING



LIFTING PLATE WITH VERTICAL CLAMPS

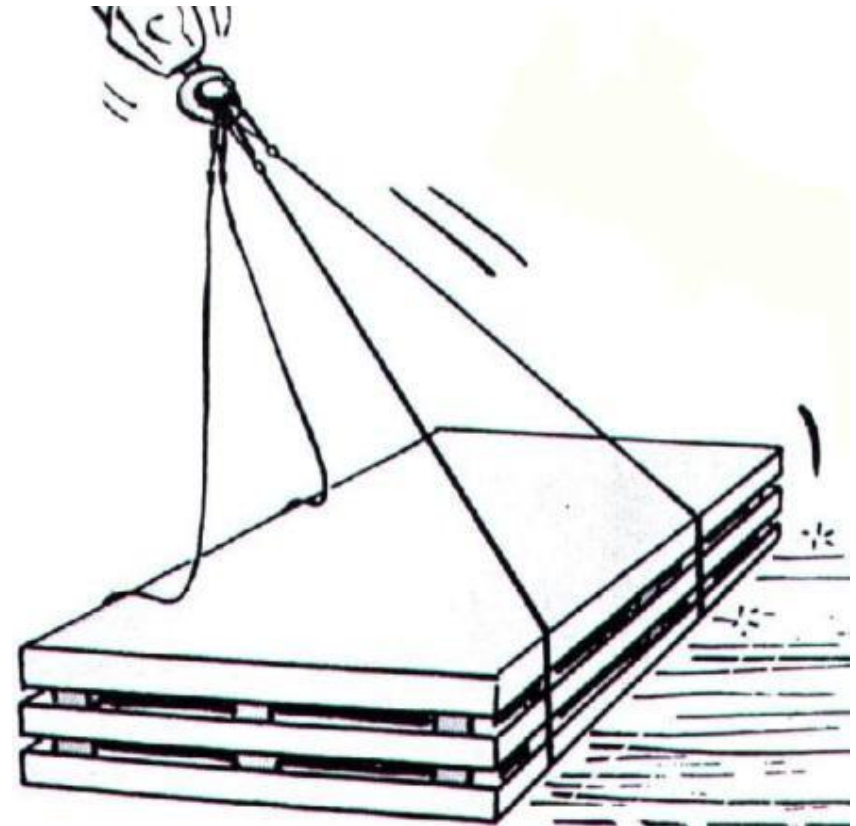
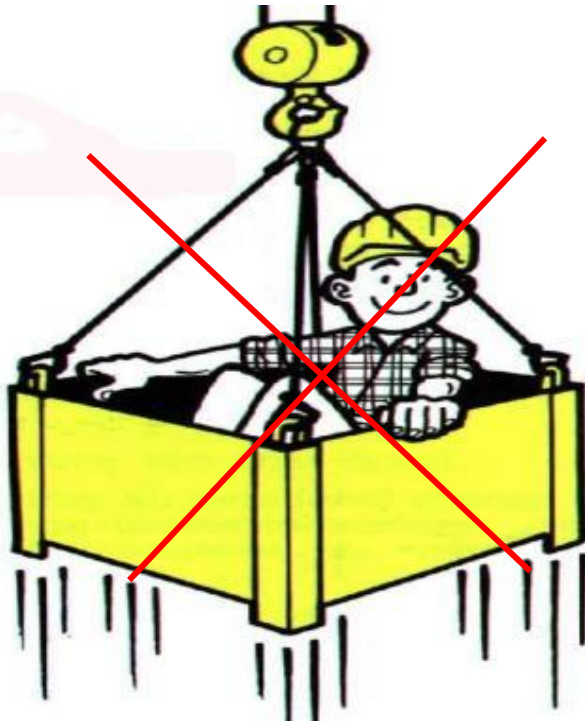


DANGEROUS HANDLING

HANDLING PLATES

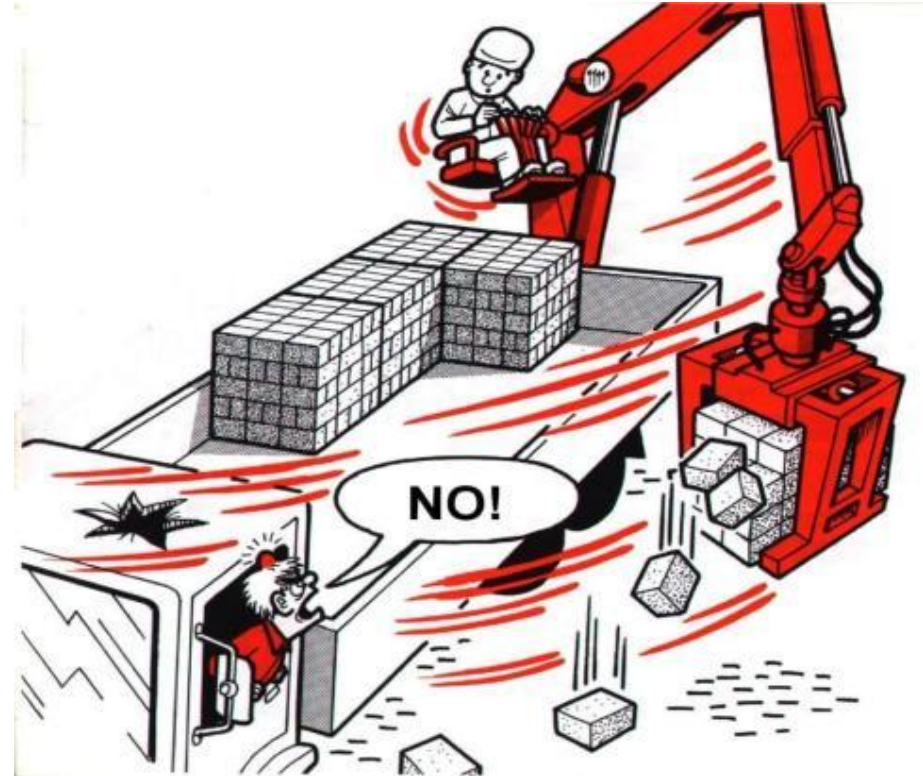
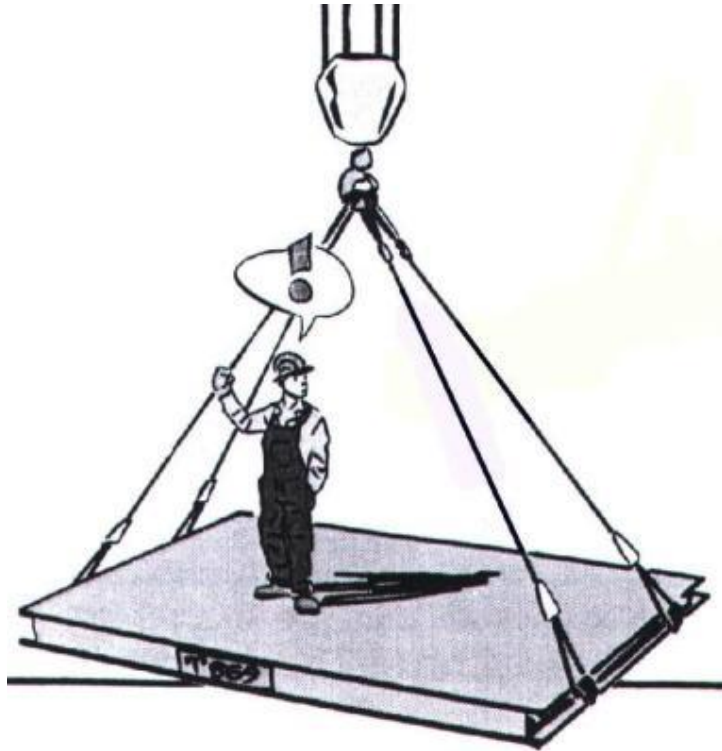
BAD LIFTING PRACTICES

DO NOT LIFT PERSONNEL IN HALF HEIGHT CONTAINERS



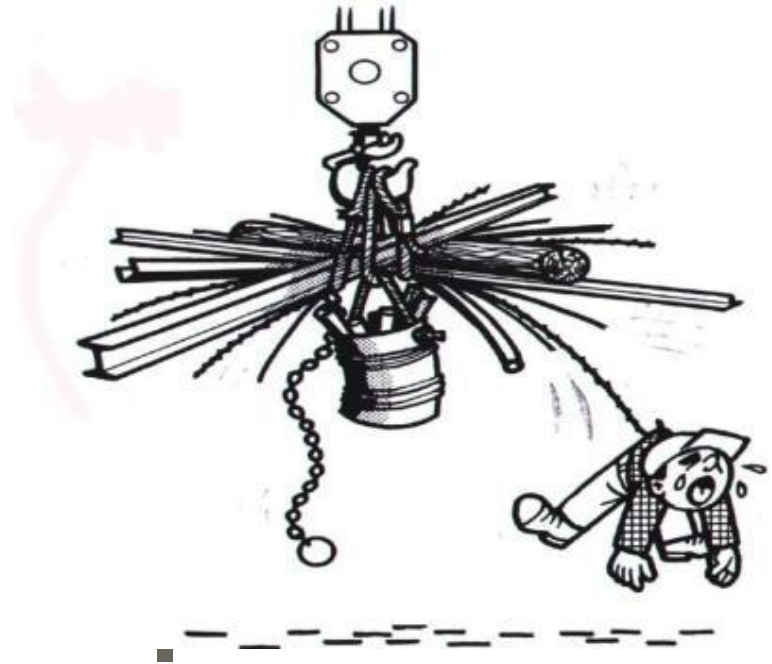
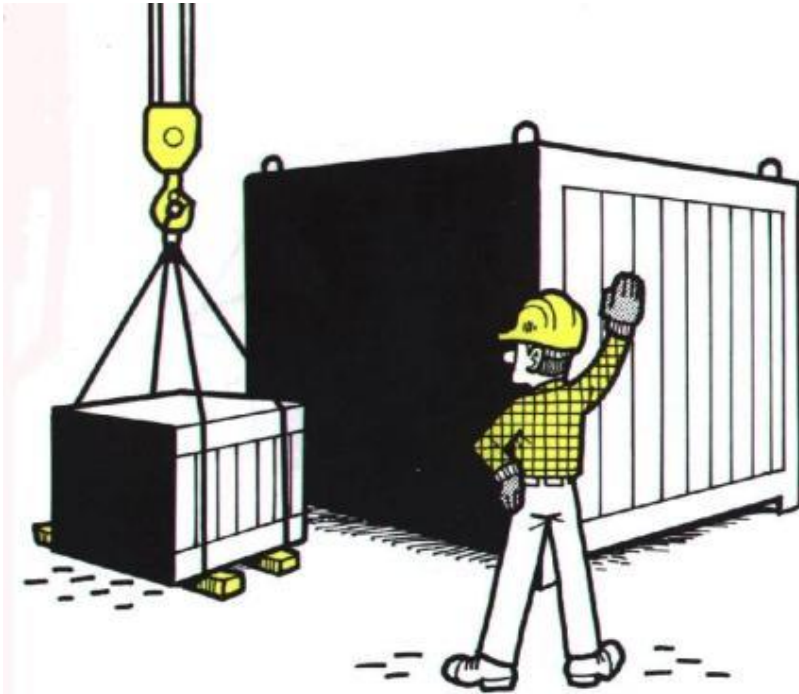
BAD LIFTING PRACTICES

DO NOT LET PERSONNEL STANDING ON LOAD WHILE LIFTING



BAD LIFTING PRACTICES

SECURE YOUR LOAD BEFORE LIFTING



GOOD AND BAD RIGGING PRACTICES



POOR HOUSE-KEEPING

GOOD AND BAD RIGGING PRACTICES



GOOD HOUSE-KEEPING

GOOD AND BAD RIGGING PRACTICES



GOOD HOUSE-KEEPING

USE OF TAGLINES

TAGLINES

Freely suspended loads are subject to dynamic and wind forces that can cause them to swing or rotate (wind vane) during lifting. These tendencies need to be managed and controlled. To mitigate these risks, it is a requirement that persons conducting a lifting operation are in control of the load at all times ensuring that it does not make unintended and uncontrolled movements.

A tagline is a rope of suitable strength, construction and length attached with an appropriate recognized bend or hitch to a load during a lifting operation to allow a rigger to control swinging and/or rotation of a suspended load during lifting or positioning.

Multiple taglines may be required to exercise full control. Taglines are otherwise known as a guide line, guide rope, end line, strap line, or pay off line, depending on which part of the world you are in but the most common term for the use of this piece of rope is “tagline”.

TAGLINES

PURPOSE OF A TAGLINE

Taglines are used to:

- oppose uncontrolled rotation of a freely suspended load as it is lifted and/or maneuvered/relocated under the influence of forces such as wind acting on it
- alter the rotational attitude of a suspended load as it is guided along a path or to position it in a particular attitude
- assist controlling swinging induced in lifting
- avoid the need for persons to put their hands directly on a load to control it where that would pose a hazard, allowing safe distance between them and the load

Taglines are not to be used to:

- pull a load out of its natural suspended line inducing in-haul or out-haul of the load lines
- hold a load against wind forces trying to push it out of line
- contribute to supporting the load

TAGLINES

Types of taglines:

Ropes used for taglines should be manufactured from suitable soft fibres, i.e. non rotating synthetic or natural fibers that don't present the manual handling hazards of wire rope. Preferably they should be of a 100% polyester braid on braid (braided core covered with braided cover) rope. Using a regular rope of polypropylene, nylon or sisal has some inherent problems when used as tagline:

1. They tend to wrap around objects
2. They get caught in pinch points
3. The bottoms fray and are then knotted to stop the fraying causing the line to catch
4. They get slick when worn, wet or dirty with grease

Taglines of choice can also be semi-stiff or coated so as not to easily tangle and be in single lengths (continuous without joins). The end of the rope shall be secured against fraying, but knots shall not be used at the free end of the rope.

TAGLINES

When to use taglines and when not to

1. OSHA requires taglines on any load “where hazards to employees exist” in order to keep the loads under control.
2. LOLER: “Appropriate measures should be taken to prevent a freely suspended load from moving in an uncontrolled manner where the risks justify it. Taglines may be necessary to stop the load swinging (example overhead crane).”
3. BS 7121: “If one or more hand-lines/taglines are required to give more control of the load, the appointed person should designate persons to handle the lines.” i.e. A common theme is that where taglines are required to control a load they must be used. On the other hand where they are not required to control a load, they are not required to be used. It is recommend that they are used unless they would serve no useful purpose and could potentially create a snagging hazard. How many taglines you would need, where they should be located and what their purpose is needs to be evaluated as part of the lift planning exercise and should come out of the risk assessment. Taglines may for instance not be required to stop rotation but may be required to receive, steady and finally position the load, keeping people at a distance.

Taglines should be used unless they would serve no purpose and could create a hazard!

TAGLINES

Where to attach a tagline

Taglines should be attached:

- As close to the end of the load as feasible for ease of control as explained earlier; also for ease of retrieval when accepting a load .
- To the rigging assembly when setting loads with complex rigging arrangements at heights for control of the rigging assembly back to the ground. Shorter taglines may be needed for the personnel at heights to take over the control of the load once near the setting point. This would also be advantageous when setting loads over power lines (this would need to be planned carefully).
- At the corners of loads with large sail areas and pieces of equipment that may require more than two taglines .
- To a lug, nozzle, structural member or other substantial and solid member capable of taking a significant force without being deformed or damaged or moving

Taglines should not be attached to:

- the rigging supporting the load (unless that is the only option and is assessed to be safe to do so)
- door handles, valves or items of equipment
- where they could slip off as the operation proceeds

TAGLINES

How to attach taglines to the load

1. Use of a bowline or mechanical hook to a fixed point Attachment point to be:
 - 1. Structural and sufficiently substantial for the forces envisaged;
 - 2. Secure such that the tagline will not slip and come off in use or the attachment point move relative to the load;
 - 3. Not likely to be damaged by this use;
 - 4. Not likely to significantly damage the tagline
2. Use of a clove hitch (without and with a stopper knot)
3. Use of a choked loop (with a tied bowline, a braided eye and a mechanical hook)
4. Connected to the rigging assembly or the rigging assembly and the load for control by personnel at heights

Where to stand when using taglines

As noted earlier, taglines are most effective if their line of action forms a 90 degree angle (in plan view) to an imaginary line from the C of G to the attachment point. Tagline handlers should aim to position themselves as close to that as possible, consistent with being in sight of each other. As a load is turned (rotated), this angle will depart from 90 degrees and the pull becomes less effective. It may be necessary for handlers to relocate to regain better on the load.

TAGLINES

How long should the tagline be

You first need to decide what control is required:

- Is it required only during uplift and receipt?
- Is control required throughout the entire operation?
- Will control have to be handed off to (say) height during a lifting operation?
- Will I have to let go of the tagline(s) at some point? If so, will they be a hazard?

The lines need to be:

- Long enough to keep your body parts out of harm's way
- Long enough to reach the load from where it will be to where the handler has to stand (with some reserve) considering the load height
- Long enough so that the handler can be positioned so that the angle of the tagline to the
- horizontal does not get so steep that control becomes impossible as the lift proceeds
- Not so long as to create a snagging hazard

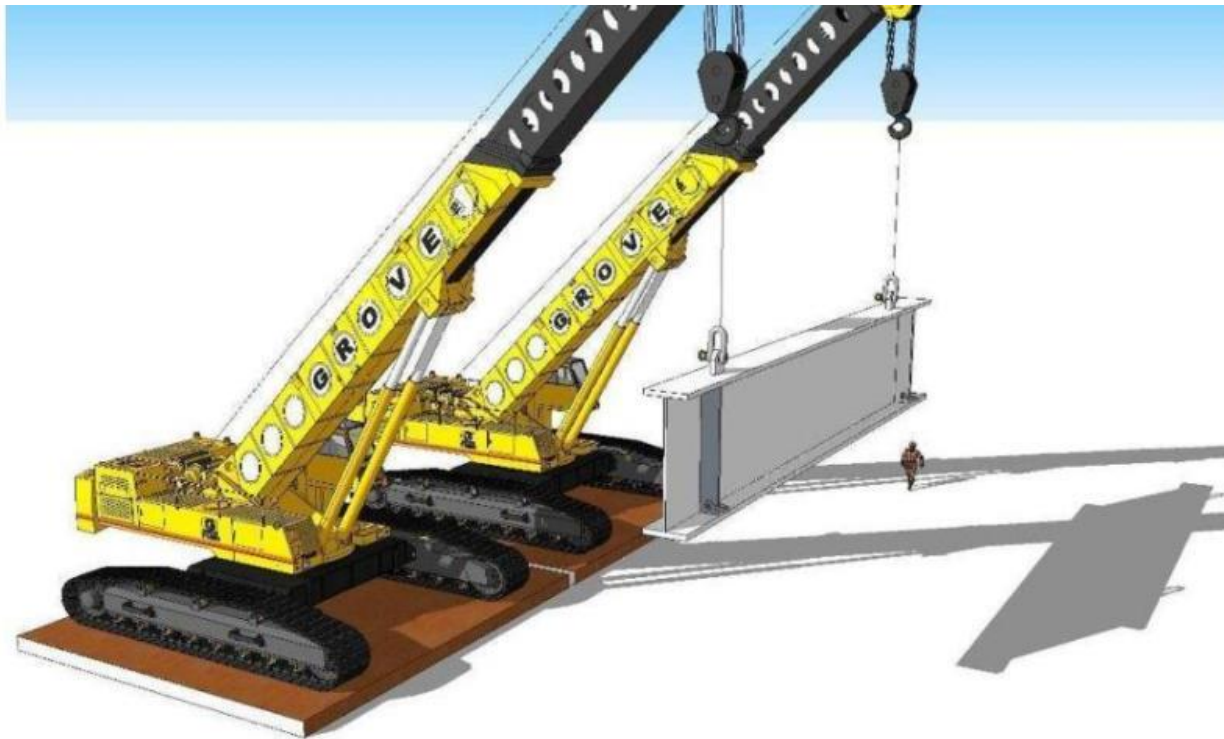
There should always be a clear line from the handler to the point of attachment so that the tagline does not have to pass over or under or around parts of the load as the operation proceeds.

- Use taglines to control loads when their use is practical and will not create additional hazards
- Always use a rope intended and recommended for tagline use
- Use a tagline that has the appropriate length
- Wear gloves when handling the tagline
- After securing the load with taglines, stay clear of the load and well forward of the load
- Never wrap the tagline around an arm or leg in an attempt to stop a load's swing
- Keep the “spare” end of the tagline tidy so as not to be a tripping or snagging hazard and to allow unimpeded “paying out” as required
- Do not tie knots in the tagline
- Assess the path of the lift and remove any obstructions prior to commencing the lift

- If it's necessary to guide the load, stay well away from the wheels or tracks of the crane
- When guiding load, remain clearly visible to the crane operator at all
- Ensure the lifting area is barricaded off and appropriate tags are affixed informing other workers of the operations
- Never step into a loop in a tagline
- Never place yourself between an immovable object and a load that is not firmly on the ground
- Do not position yourself where you could be trapped as the operation proceeds
- If you must, you should release the tagline to avoid becoming trapped or pinched
- Be very aware of power lines in the proximity of the lifting operation. Even synthetic slings can conduct an electrical charge if damp.

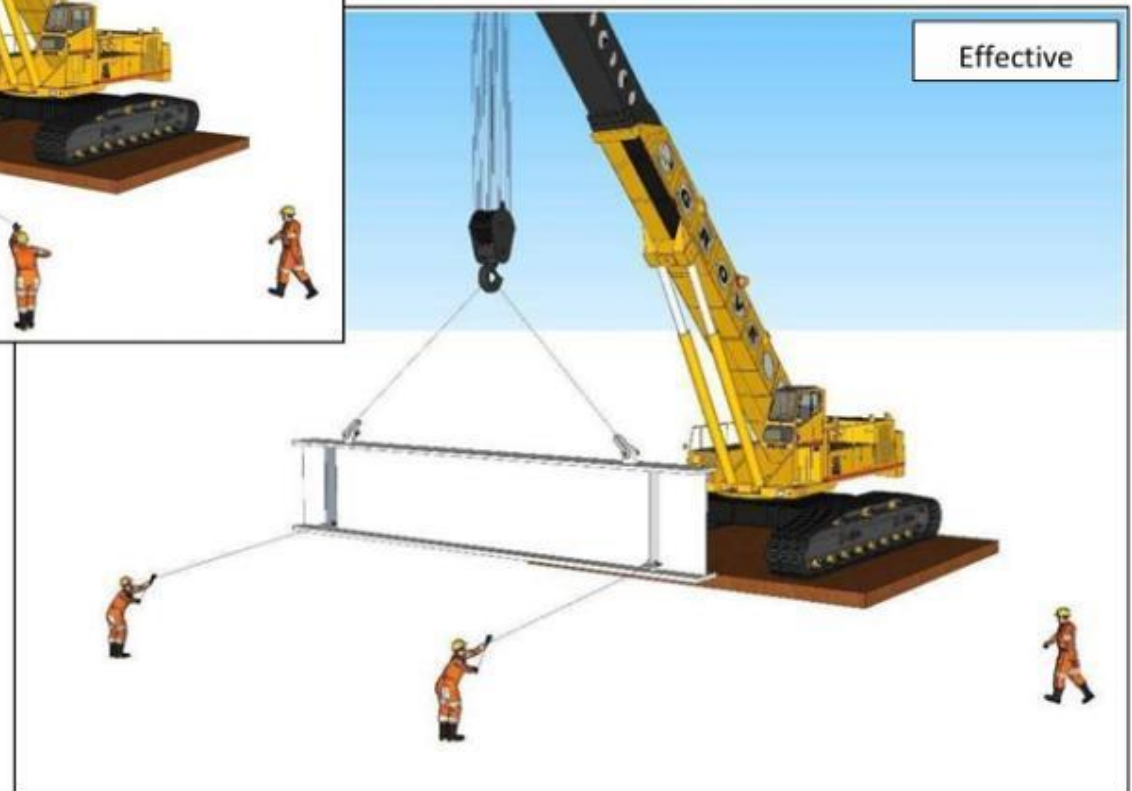
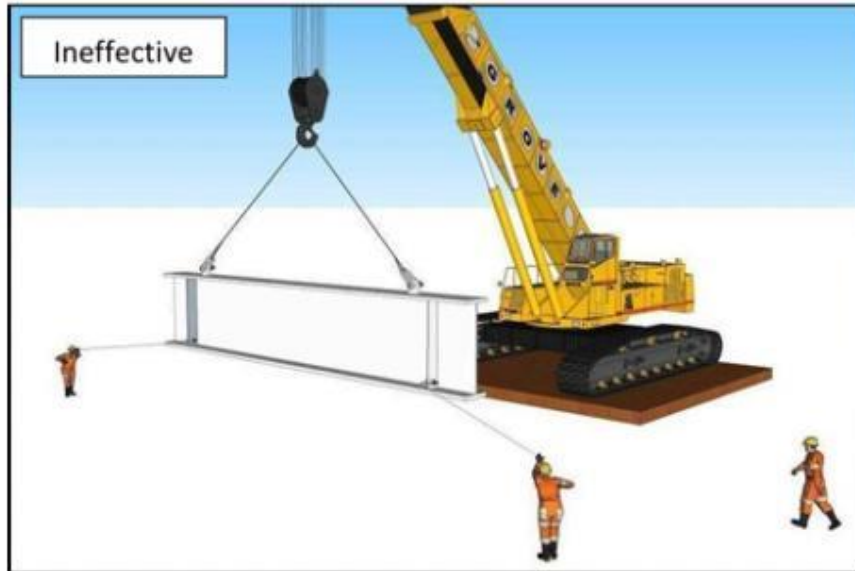
USE OF TAGLINES

Loads suspended from two or more lifting devices (tandem lifts) will not freely rotate in the wind but may swing a little. Trying to use taglines to rotate a load suspended from two cranes is a bad idea.

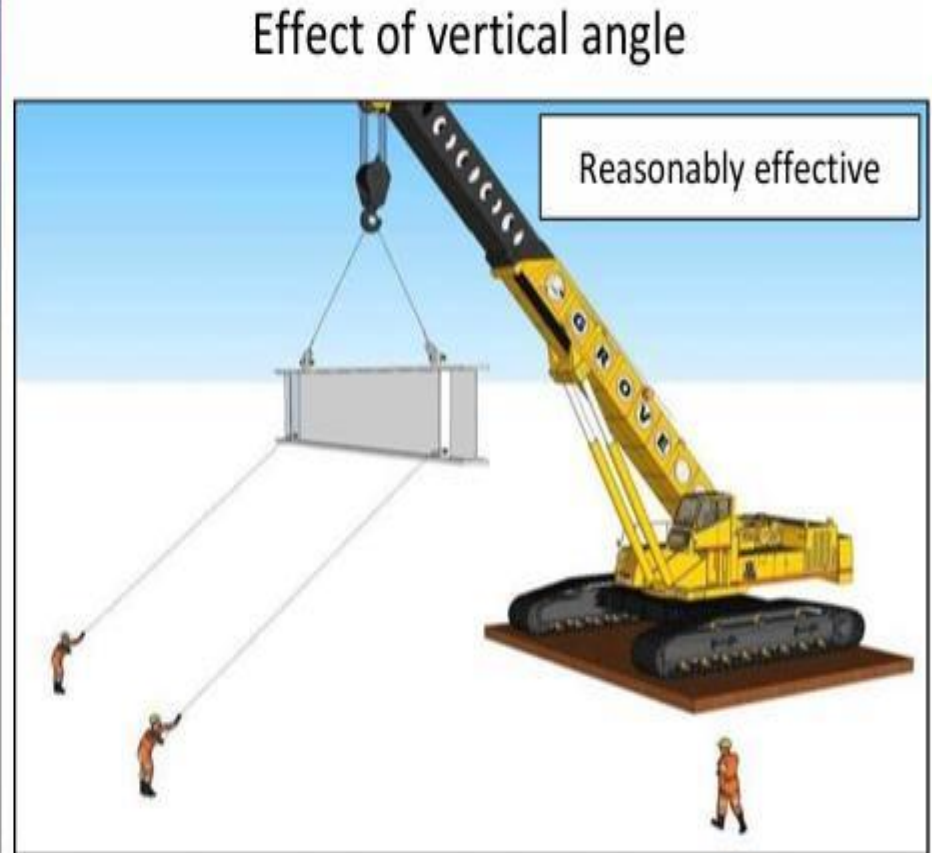


This tandem lift will not need to be controlled against rotation but taglines may be required to control swinging of the suspended load.

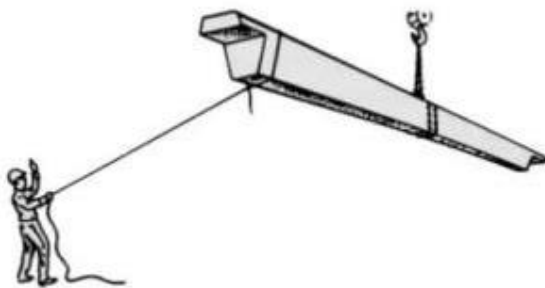
USE OF TAGLINES



USE OF TAGLINES



USE OF TAGLINES

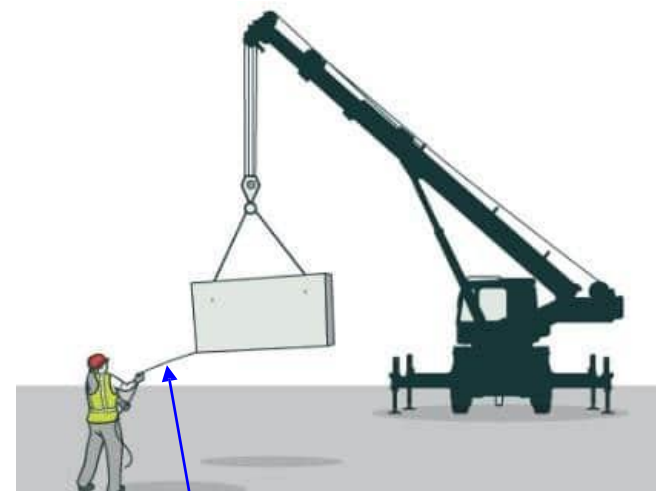


Tagline is normally connected to the Load except in case of Pipes bundle to avoid Pipe slippage.
 Tagline length shall be at least $1.5 \times$ Load Height or appropriate as per conditions(TRA)
 Rope must never be extended behind the Rigger.
 Tagline must never be wrapped around the hand.

TAG LINE USES AND RISKS

Tag lines shall only be used after a risk assessment has been undertaken to ensure all involved personnel standing in safe positions.

In certain circumstances light, soft lines may be used to assist in the handling of long and/or fragile items of cargo. These are often referred to as tag lines. It shall be recognized that, whilst such aids may assist operations, their use does introduce some additional risks, as described below.



Tag Line



TAG LINE USES AND RISKS

- a) Additional risks associated with the use of tag lines include the following:
1. Potential injuries from dropped objects as a result of personnel handling cargo having to work in closer proximity to suspended loads than would normally be the case.
 2. Potential injuries result from personnel handling cargo being dragged across the handling area, through a heavy load rotating in an uncontrolled manner and the tag line being fouled in limbs or clothing.
 3. Potential injuries resulting from tag lines being secured to adjacent fixed structures parting and whipping back as a result of a heavy load rotating in an uncontrolled manner.

TAG LINE USES AND RISKS

- b) Make-up of lines includes the following:
1. Tag lines shall be made up from single, continuous lengths of rope.
 2. Apart from the knot attaching the line to the cargo, there shall be no other joints or knots in the line.
 3. Tag lines shall be of sufficient length to allow personnel handling cargo to work in a safe position well clear of the immediate vicinity of the load. In this regard it is recommended that the length of the line should be not less than one and a half (1.5) times the maximum height above the handling area at which the arrangements will be used.
 4. The tag line should be attached with a minimum 5/8 in. (15.9 mm) bolt type anchor shackle.

TAG LINE USES AND RISKS

- c) Whilst in use, precautions should be observed as follows:
1. Tag lines are an aid to positioning the load when landing, and as such shall only be used when weather conditions would permit the lifting of the item without the use of such arrangements. It shall not be assumed that, in conditions more severe than this, the use of tag lines will allow the operation to be completed safely.
 2. At all times personnel handling tag lines shall work at a horizontal distance from the load equivalent to its height above the handling area, maintaining an angle between the line and the horizontal of not more than 45°
 3. All sections of the line, including slack, shall be kept in front of the body, between the handler and the load.

TAG LINE USES AND RISKS

- c) Whilst in use, precautions should be observed as follows:
 - 4. Where two or more persons are handling the same line, ALL shall work on the same side of the line. Any slack shall be kept in front of the group.
 - 5. Tag lines shall be held in such a manner that they can be quickly and totally released. They shall not be looped around wrists, or other parts of the body.
 - 6. Particular care shall be taken when using tag lines whilst wearing gloves to ensure that the line does not foul the glove.

VIDEO ILLUSTRATION



COMMUNICATIONS

COMMUNICATIONS

Effective communication is at the heart of safe and efficient lifting operations. The signaller / banksman is responsible for maintaining clear, constant, and correct communication with the lifting equipment operator as well as involve team for lifting operations. Especially when the operator does not have full visibility of the load or lifting area.

KEY PRINCIPLES OF EFFECTIVE COMMUNICATION

Principle	Explanation
Clarity	Messages/signals must be simple, specific, and unambiguous.
Consistency	Use standardized signals; no improvisation.
Confirmation	Instructions must be acknowledged by the operator.
Continuity	Maintain constant communication during the lift.
Control	Signaller is the only person giving instructions (unless otherwise agreed).

COMMUNICATIONS

PURPOSE OF COMMUNICATION IN LIFTING OPERATIONS

- Ensure operator awareness of the load's position and movement.
- Prevent misunderstandings that can lead to accidents or damage.
- Coordinate movement between multiple personnel (e.g., riggers, slingers, crane operator).
- React to hazards or changing conditions in real-time.
- Control the operation to follow the lift plan and safety rules.

SIGNALLER'S CHECKLIST BEFORE COMMUNICATION BEGINS:

- Confirm the method of communication (hand signal, radio, both)
- Agree on signals/phrases with the lifting team
- Check radios are working, charged, and on correct channel
- Ensure clear line of sight if using hand signals
- Make sure the operator knows you are the only signaller giving commands
- Know the emergency stop signal and ensure all parties do too

COMMUNICATIONS

MEANS OF COMMUNICATION

Ensure that there is an agreed and recognized means of communication between the operator of the lifting equipment and the banksman as appropriate. The agreed means of communication shall be documented in the lifting plan and followed by all those involved in lifting operations.

Where hand signals are used as the means of communication, they shall be common for particular site and uniformly understood by all involved in control of lifts.

The banksman shall be within easy viewing distance of the crane operator. The banksman shall be clearly identified, preferably by distinctive high visibility vest.

Where there is no clear line of site between the signaller and the crane operator, radio communication shall be used.

COMMUNICATIONS

BLIND LIFT

Blind lifts should be avoided as much as reasonably possible. All laydown, storage and lifting areas should be planned with no blind zones and thus minimizing the need for blind lifts. But in the case where blind lifts are unavoidable, communications should be given the highest attention during the risk assessment and site authority approval.

In connection with blind lifts, there shall always be at least two persons (Banksman and Rigger) who have visual contact with the load and each other; and have radio contact with the lifting appliance operator. Any closed-circuit television that monitors the work area is considered to be an aid and not a replacement for either of these persons.

The banksman shall place himself in a position where he has clear visual contact with the lifting appliance operator and can give the stop signal manually in the event of radio equipment failure. Communication from the banksman to the crane operator should be continuous, two way and confirmative by repeating the command. This is particularly important during “blind lifts”.

COMMUNICATIONS

TYPE OF COMMUNICATIONS:

- Hand Signals (Visual)
- Radio Communication (Verbal)
- Audible Signals

For lifting operations using various communications, the person directing lifting operations shall consider the complexity of the lift, the capabilities of the particular crane, the experience and skill of the operator, riggers and signalperson, and the ability to communicate the necessary signals before permitting multiple simultaneous crane function signals.

COMMUNICATIONS

1. HAND SIGNALS (VISUAL)

The primary method when the signaller is in direct line of sight with the operator. Must follow standardized protocols such as:

- BS 7121
- OSHA standard signals

COMMON HAND SIGNALS INCLUDE:

Action	Signal Description
Hoist (Lift Up)	Arm extended upward, finger pointing up, circular motion
Lower	Arm extended downward, finger pointing down
Stop (Emergency)	Both arms outstretched horizontally, palms facing down
Slew Left/Right	Arm extended, pointing in the desired direction
Travel Forward/Back	Arm motions mimicking the desired vehicle movement

COMMUNICATIONS

2. RADIO COMMUNICATION (VERBAL)

Used when line of sight is not possible or in noisy environments.

Requirements:

- Two-way radios or headsets
- Pre-agreed radio channel and call signs
- Clear protocols for issuing and acknowledging instructions

3. AUDIBLE SIGNALS

- Sometimes used in special cases (e.g., with tower cranes or poor visibility).
- Involves whistles, horns, or alarms.
- Usually for alerting personnel of lift initiation or emergency stop.
- Must be agreed in advance and recognized by all on-site.

COMMUNICATIONS

RADIO COMMUNICATION (VOICE)

Prior to beginning lifting operations using voice signals, the signals shall be discussed and agreed upon by the person directing lifting operations, the crane operator, and the appointed signalperson.

- Telephones, radios, or equivalent, if used, shall be tested before lifting operations begin. If the system is battery powered, extra batteries should be available at the job site.
- Prior to commencing a lift, the operator and signalperson shall contact and identify each other.
- All directions given to the crane operator by the signalperson shall be given from the operator's direction perspective (e.g., swing right).
- Each series of voice signals shall contain three elements stated in the following order:
 - function and direction
 - distance and/or speed
 - function stop

COMMUNICATIONS

RADIO COMMUNICATION (VOICE)



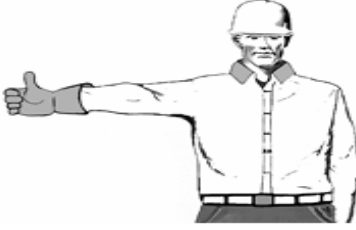
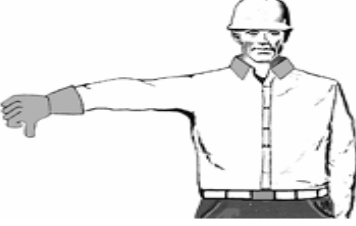
When initiating a function, articles such as “the” or “a” may be used as well as a combination of the acceptable terms (e.g., “Hoist the load” or “Hoist up the load hook” are both considered correct).

When terminating a function, the signalperson must communicate to the operator using only “[**Function**] stop” to ensure the operator ends the operation. Any additional words are considered incorrect signals. See the following table for the correct terminology to stop each function.






Some voice signal functions inherently give a direction as well (e.g., “Hoist” or “Lower”). For those that are simply a function, be sure to include a direction when initiating the function (e.g., “Swing RIGHT” or “Trolley OUT”).

NOTE: “SLOWLY” can be used at any time with any signal. “SLOWLY” is always at the end of the command (e.g., “Hoist load SLOWLY”).






COMMUNICATIONS

Corresponding Hand Signal	Function	Initiate Function	Terminate Function
	HOIST	"Hoist" "Hoist up" "Hoist load" "Hoist hook" "Raise load" "Raise hook"	"Hoist stop"
	LOWER	"Lower" "Lower down" "Lower load" "Lower hook"	"Lower stop"
	BOOM UP	"Boom up" "Raise boom"	"Boom stop"
	BOOM DOWN	"Boom down" "Lower boom"	"Boom stop"

COMMUNICATIONS

Corresponding Hand Signal	Function	Initiate Function	Terminate Function
	SWING	"Swing right" "Swing left"	"Swing stop"
	TRAVEL	"Travel forward" "Travel reverse"	"Travel stop"
	DOG EVERYTHING	"Dog everything"	N/A
	USE MAIN HOIST (Mobile Crane ONLY)	"Use main hoist" "Use main drum"	N/A
	USE WHIPLINE (AUXILIARY HOIST) (Mobile Crane ONLY)	"Use whipline" "Use auxiliary hoist" "Use auxiliary drum"	N/A

COMMUNICATIONS

Corresponding Hand Signal	Function	Initiate Function	Terminate Function
	TRAVEL (BOTH TRACKS) (Mobile Crawler Cranes ONLY)	"Travel both tracks forward" "Travel both tracks reverse"	"Travel stop"
	TRAVEL (ONE TRACK) (Mobile Crawler Cranes ONLY)	"Travel left track forward" "Travel left track reverse" "Travel right track forward" "Travel right track reverse"	"Travel stop"
	TELESCOPE OUT (Mobile Telescopic Boom Cranes ONLY)	"Telescope out" "Extend boom"	"Telescope stop" "Extend stop"
	TELESCOPE IN (Mobile Telescopic Boom Cranes ONLY)	"Telescope in" "Retract boom"	"Telescope stop" "Retract stop"
	TROLLEY TRAVEL (Tower Cranes ONLY)	"Trolley in" "Trolley out"	"Trolley stop"

COMMUNICATIONS

IMPORTANCE OF COMMUNICATIONS

Aspect	Why It Matters
Safety of Persons, property etc.	Clear communication ensures that everyone knows what is going to happen, when, where, and how. It prevents people being under a load, hit by a swinging load, or being in the path of danger.

Aspect	Why It Matters
Prevent Damage to Equipment / Load / Surroundings	Proper signals help avoid collisions with structures, improper hook placements, or dragging/slamming of loads that can damage both load and rigging gear.

Aspect	Why It Matters
Coordination Among Crew (Riggers, Slingers, Banksman, Crane Operator, etc.)	Lifts often involve multiple actors: the rigger/signer attaches load; the banksman/signalman directs; the crane operator moves it. Misalignment in their understanding causes errors.

COMMUNICATIONS

IMPORTANCE OF COMMUNICATIONS

Aspect	Why It Matters
Handling Complexity / Blind Spots / Unexpected Conditions	When visibility is poor (blind lifts), or when there are obstacles, or during changes (wind, shifting load), having agreed and tested communication (hand/radio or both) is essential.

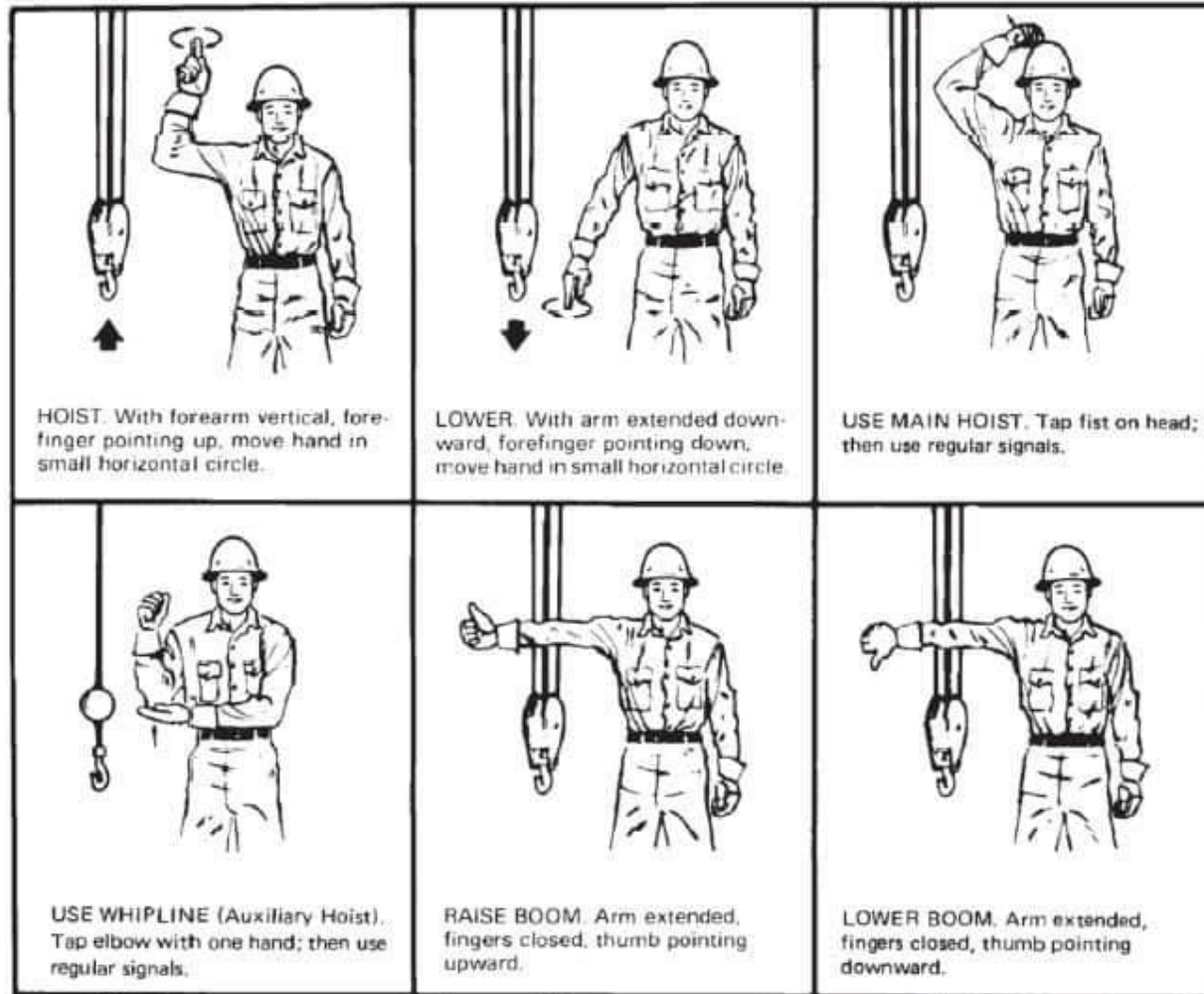
Aspect	Why It Matters
Emergency Response & Stop Situations	If something goes wrong or an unsafe condition arises (slackness, hitting an obstacle, possible collapse), any team member needs a way to stop the operation immediately. Clear commands/signals needed.

Aspect	Why It Matters
Efficiency & Clarity	Good communication shortens misunderstandings, reduces delays, prevents incorrect moves, and ensures that lifts are smooth. Reduces rework and downtime.

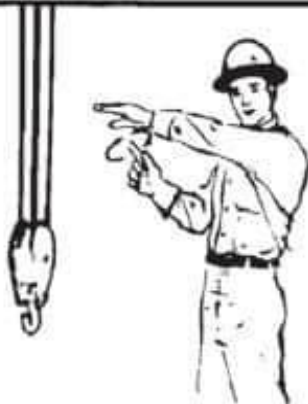


HAND SIGNALS



ADNOC Group is using American signals according to ADNOC Group Standard “HSE-PSW-CP19”

BASIC HAND SIGNALS




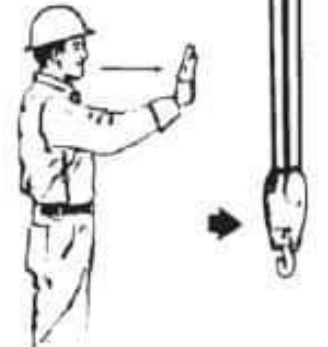
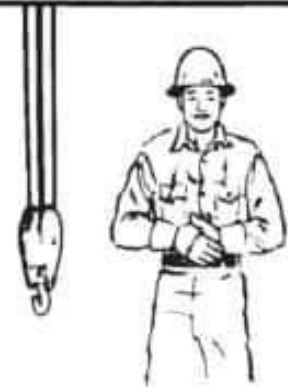
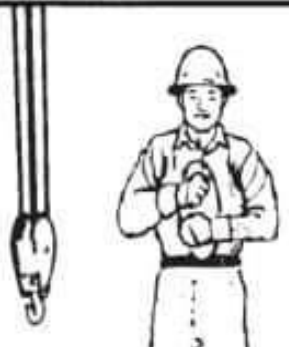


BASIC HAND SIGNALS

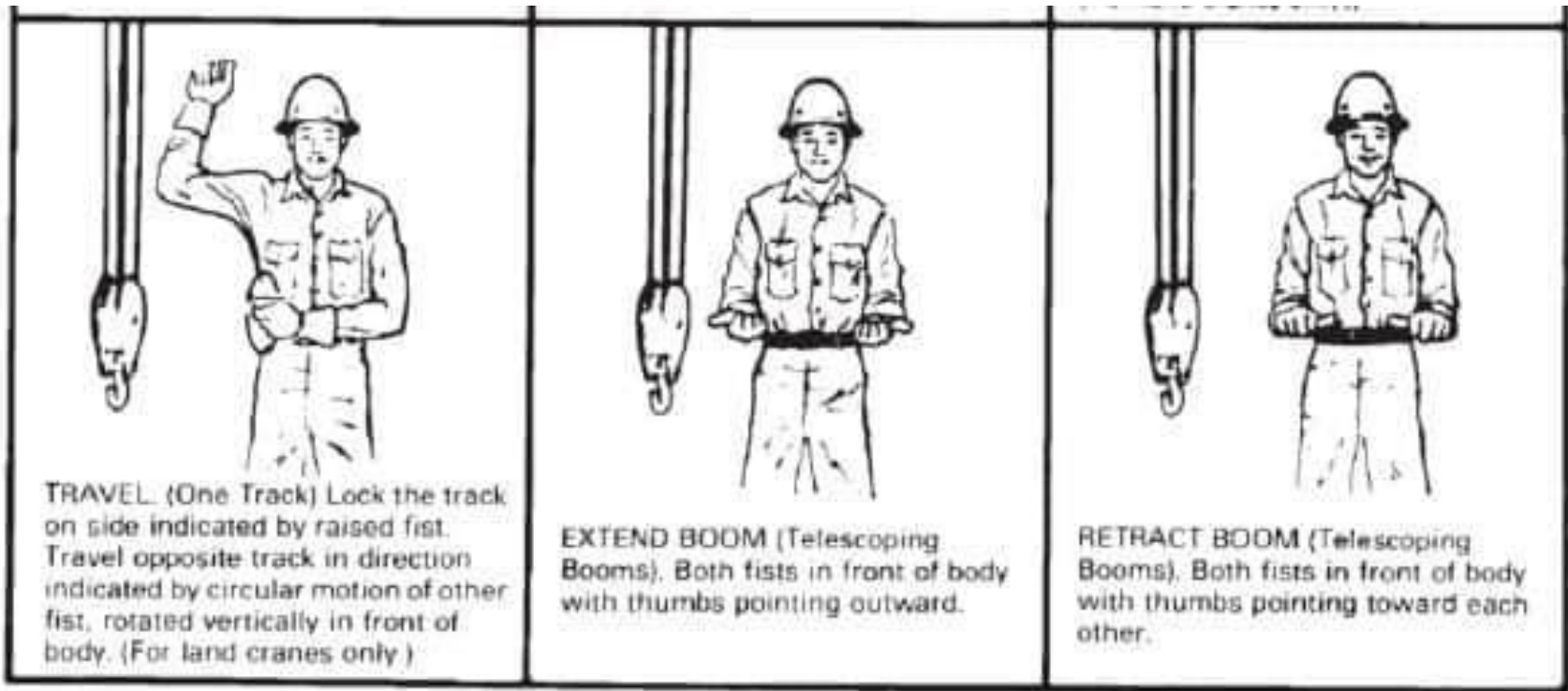
 <p>MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)</p>	 <p>RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up. Flex fingers in and out as long as load movement is desired.</p>	 <p>LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>
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 <p>EXTEND BOOM (Telescoping Boom). One Hand Signal. One fist in front of chest with thumb tapping chest.</p>	 <p>RETRACT BOOM (Telescoping Boom). One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>
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BASIC HAND SIGNALS

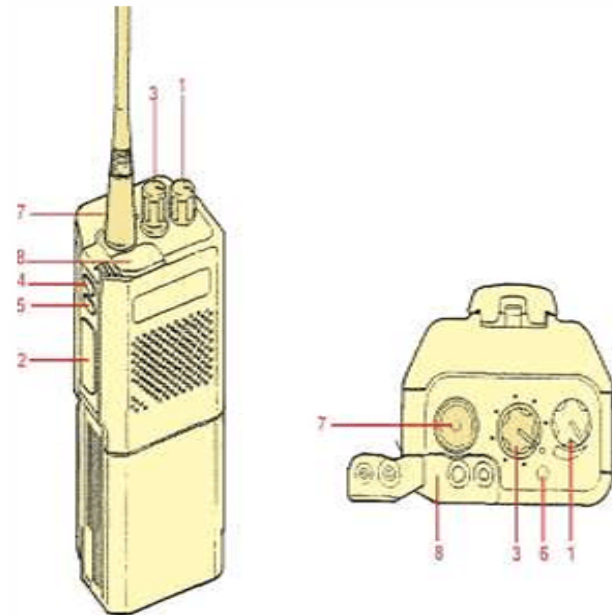
 <p>SWING Arm extended, point with finger in direction of swing of boom</p>	 <p>STOP Arm extended, palm down, move arm back and forth horizontally.</p>	 <p>EMERGENCY STOP Both arms extended, palms down, move arms back and forth horizontally.</p>
 <p>TRAVEL Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>	 <p>DOG EVERYTHING Clasp hands in front of body.</p>	 <p>TRAVEL (Both Tracks) Use both fists in front of body, making a circular motion about each other, indicating direction of travel, forward or backward. (For land cranes only.)</p>

BASIC HAND SIGNALS



RADIO SIGNALS

1. On-Off/Volume Control
2. Transmit Button-Push to talk, release to listen.
3. Channel/Scan Selector.
4. Control Button-Volume Set or Scan Nuisance Delete.
5. Monitor Button-Selects the mode for operation.



RADIO SIGNALS

6. Three-Color Indicator.

Red, continuous=Radio Transmits

Red, flashing during transmit=Low battery

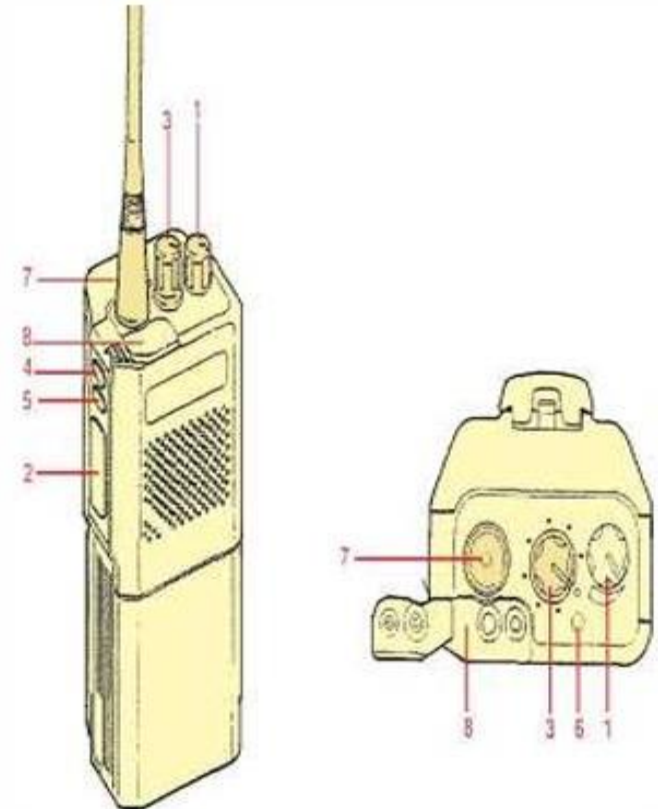
Red, flashing during receive=Channel busy

Green flashing=Scanning

Yellow, continuous=Channel monitor active

7. Antenna Connector

8. Accessory Connector



RADIO SIGNALS

- Identify the station you are calling e.g. Port crane
- Ensure that transmission button is fully depressed
- Speak clearly & slowly at all times
- Finish with word OVER.

RADIO SIGNALS

Radio Signals.....Remember

- Do not use profane language
- Ensure the battery is fully charged
- Do not carry radio in pockets
- Take care & store properly

VIDEO ILLUSTRATION



Hand Signals

2

MOBILE CRANE

MOBILE CRANE TYPES

MOBILE CRANE TYPES

ROUGH TERRAIN CRANE

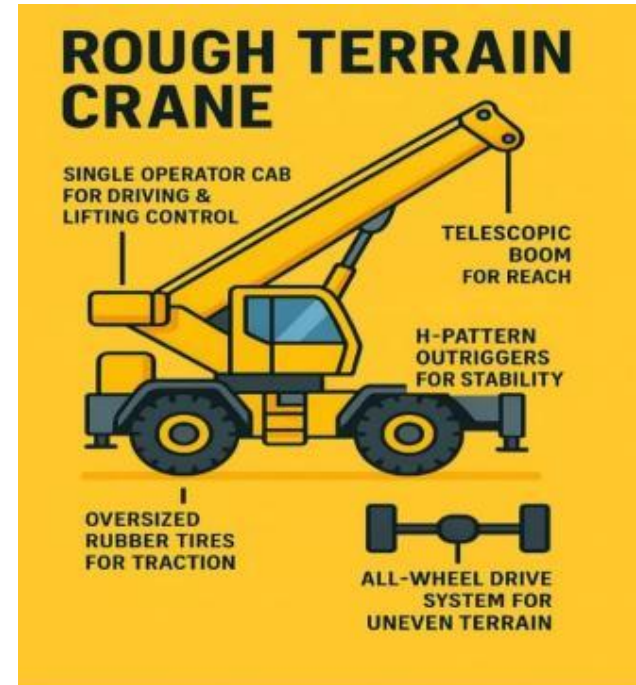
A crane mounted on an undercarriage with four rubber tires that is designed for pick- and-carry operations and for off-road and "rough terrain" applications. Outriggers are used to level and stabilize the crane for hoisting. These telescopic cranes are single- engine machines, with the same engine powering the undercarriage and the crane.



MOBILE CRANE TYPES

Rough Terrain Crane:

- ▶ One Cab for Driving & Crane Operation;
- ▶ One Engine powering both (Driving & Operation);
- ▶ Best Operating Sector is (Over Front) as engine is back side;
- ▶ Four Rubber Tires on all drive Wheels;
- ▶ Outriggers are used to level and stabilize the Crane;
- ▶ Counterweight is normally fixed type;
- ▶ Can be supplied in Single or Double Hook Blocks;
- ▶ Can be supplied with Fly Jib to reach higher elevated buildings;
- ▶ Suitable for Rough Terrain (Off-road);
- ▶ Designed for Pick & Carry (Lift and Travel with Load);
- ▶ Driver cannot drive it on street as per UAE Traffic Department;
- ▶ Gaps between all Tires & Ground shall be maintained as per Crane's Manufacturer's Recommendation "Thumb Rule 2-3 inches".



MOBILE CRANE TYPES

Rough terrain (RT) crane, specifically because these machines are designed for, and limited to, off-road, rugged, or job site environments rather than highway travel. While they are not intended for public road use, managing RPM is vital for on-site performance and safety.

Role of RPM in Rough Terrain Cranes

Optimal Hydraulic Performance: RT cranes rely on a single engine to power both the undercarriage and the hydraulic crane functions. To prevent poor hydraulic pressure, overheating, and sluggish movement, these cranes often require operation within a specific, high RPM range (e.g., 1800–2200 RPM for certain models) during lifting.

Precision and Control: When performing tasks like lifting or swinging (often at speeds around 1.9–2.0 RPM), consistent engine speed is necessary to ensure smooth hydraulic operation.

Controlled Movements: Light RPMs are typically needed to handle loads gently, whereas too low an RPM can cause hydraulic inefficiency, and too high can cause excessive, dangerous movement.

Power and Torque: These cranes are designed with engines that prioritize high torque at lower speeds to navigate uneven, soft, or muddy ground.

MOBILE CRANE TYPES

Rough Terrain (RT) cranes are designed to be "site-specific" machines. While they look like they could drive anywhere, they are structurally and legally restricted from public roads for several practical reasons.

Speed and Engine Design:

A Rough Terrain crane is essentially a "slow-moving vehicle.

- "Low Top Speed: Most RT cranes have a maximum speed of only 40–50 km/h (25–30 mph). On a public road or highway, this creates a major traffic hazard and would lead to significant congestion.
- Single Engine Limitation: Unlike All-Terrain cranes that often have two engines (one for travel, one for lifting), RT cranes usually have a single engine optimized for high torque at low speeds to crawl through mud and over rocks. Running this engine at high RPMs for long-distance road travel would cause overheating and premature wear.

MOBILE CRANE TYPES

Axle Weight and Road Damage:

Road legality is often determined by how much weight is pressing down on each axle.

- **Concentrated Weight:** An RT crane typically has only two axles (4 wheels). Because the entire weight of the crane is concentrated on just these two points, it often exceeds the maximum axle weight limits allowed on public asphalt.
- **Tire Pressure:** They use massive, low-pressure "earthmoving" tires designed for grip on soft soil. On hard pavement at higher speeds, these tires generate immense heat and can actually damage the road surface.

Suspension and "Galloping":

Standard trucks have sophisticated suspension to stay stable at 100 km/h. RT cranes do not.

- **Rigid/Locking Suspension:** RT cranes often have very simple or hydraulic locking suspensions designed to provide a stable "on-rubber" lift capacity.
- **The "Gallop" Effect:** If driven at high speeds, the combination of a short wheelbase and large tires causes a phenomenon called "galloping," where the crane begins to bounce rhythmically. This can lead to the operator losing control or the crane literally hopping off the road.

MOBILE CRANE TYPES

Visibility and Safety Equipment

The cab of an RT crane is designed for a crane operator, not a road driver.

- **Single Cab Design:** The operator sits in the same cab to both drive and work. This cab is usually positioned for a clear view of the boom and the load, which often results in massive blind spots for road traffic.
- **Missing Features:** Most RT cranes lack the standard safety equipment required for road registration, such as side-view mirrors that meet highway standards, turn signals visible from all angles, and braking systems designed for high-speed emergency stops.

Why They Are Not Used on Public Roads

Speed Limitations: Rough terrain cranes are optimized for low-speed, high-torque work (often 1–3 mph) and are not equipped to travel at road speeds.

Design & Safety: They have wide, rugged tires and high centers of gravity, making them dangerous for high-speed highway travel.

Transportation: Due to their inability to travel efficiently or legally on roads, they are transported to jobsites via trailers or flatbed trucks.

MOBILE CRANE TYPES

TRUCK MOUNTED CRANE

A crane mounted on a truck carrier provides the mobility for this type of crane. Generally, these cranes are able to travel on highways, eliminating the need for special equipment to transport the crane.

When working on the jobsite, outriggers are extended horizontally from the chassis then vertically to level and stabilize the crane while stationary and hoisting.



MOBILE CRANE TYPES

Truck Mounted Crane:

- ▶ Two Cabs; One for Driving & One for Crane Operation;
- ▶ One Engine powering both (Driving & Operation);
- ▶ Best Operating Sector is (Over Rear) as engine is front side;
- ▶ Multi Axels with Rear drive and front Steer only;
- ▶ Outriggers are used to level and stabilize the Crane;
- ▶ Counterweight is either fixed type or detachable;
- ▶ Can be supplied in Single or Double Hook Blocks;
- ▶ Can be supplied with Fly Jib to reach higher elevated buildings;
- ▶ Suitable for Paved Road (City-road);
- ▶ Not Designed for Pick & Carry (Lift and Travel with Load);
- ▶ Driver can drive it on street as per UAE Traffic Department;
- ▶ Gaps between Rear Tires & Ground only shall be maintained as per Crane's Manufacturer's Recommendation "Thumb Rule 2-3 inches".



MOBILE CRANE TYPES

ALL TERRAIN CRANE

A mobile crane with the necessary equipment to travel at speed on public roads, and on rough terrain at the job site using all-wheel and crab steering. AT's combine the road ability of Truck-mounted Cranes and the manoeuvrability of Rough Terrain Cranes.



MOBILE CRANE TYPES

All Terrain Crane:

- ▶ Two Cabs; One for Driving & One for Crane Operation;
- ▶ One Engine powering both (Driving & Operation);
- ▶ Best Operating Sector is (360°) as engine is in the middle;
- ▶ Multi Axels with All Wheel drive and All Steer also;
- ▶ Outriggers are used to level and stabilize the Crane;
- ▶ Counterweight is normally detachable type;
- ▶ Can be supplied in Single or Double Hook Blocks;
- ▶ Can be supplied with Fly Jib to reach higher elevated buildings;
- ▶ Suitable for All Terrain i.e. (Off-road) & (City-road);
- ▶ Not Designed for Pick & Carry (Lift and Travel with Load);
- ▶ Driver can drive it on street as per UAE Traffic Department;
- ▶ Gaps between Tires & Ground only shall be maintained as per Crane's Manufacturer's Recommendation.



MOBILE CRANE TYPES

YARD CRANE

This type of crane is designed for use in yards where it is not always convenient or possible to deploy outriggers and where a rough terrain crane is too large. The yard crane has “free on rubber” capabilities and a strong platform where rated loads (e.g. pumps, motors, valves) as per the rated capacity chart may be transported.



MOBILE CRANE TYPES

CITY CRANE

The city crane has a very short boom with more sections than a normal mobile crane to allow greater maneuverability while still retaining boom length . It is all wheel steering & the boom is kept low to avoid overhead obstructions prevalent in an urban area.



MOBILE CRANE TYPES

CRAWLER CRANE

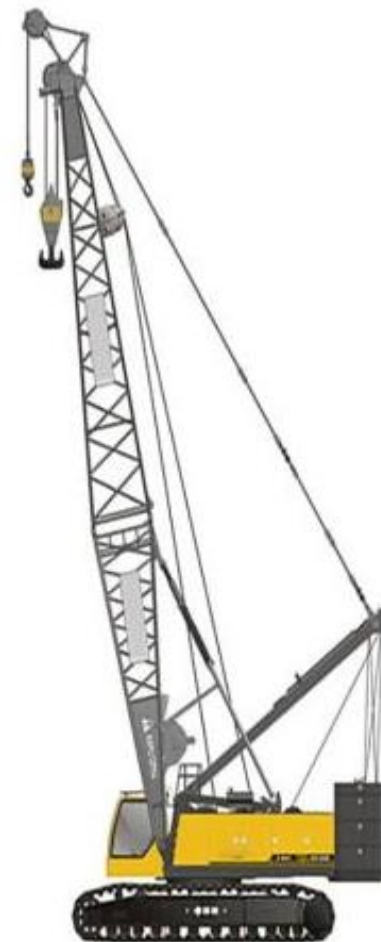
A crawler is a crane mounted on an undercarriage with a set of tracks (also called crawlers) that provide stability and mobility. Crawler cranes range in lifting capacity from about 40 US tons to 3500 US tons. Crawler cranes have both advantages and disadvantages depending on their use. Their main advantage is that they can move around on site and perform each lift with little set-up, since the crane is stable on its tracks with no outriggers. In addition, a crawler crane is capable of traveling with a load. The main disadvantage is that they are very heavy, and cannot easily be moved from one job site to another without significant expense.



MOBILE CRANE TYPES

Crawler Crane:

- One Cab; for Driving & Crane Operation;
- One Engine powering both (Driving & Operation);
- Best Operating Sector is (Over-front) & (Over-rear);
- Mounted on Tracks with ability to expand & maneuver;
- Normally Outriggers are not available except for Heavy Lift Cranes;
- Counterweight is either fixed or detachable type;
- Can be supplied in Single or Double Hook Blocks;
- Extension Jib with or without Fly Jib is available;
- Suitable for Rough Terrain i.e. (Off-road) only;
- Designed for Pick & Carry (Lift and Travel with Load);
- Driver cannot drive it on street as per UAE Traffic Department.



MOBILE CRANE TYPES

Feature	Rough Terrain Crane	Crawler Crane
Mobility	High on rough, uneven terrain; pick-and-carry	Low on job site; requires disassembly for transport
Ground Preparation	Minimal; handles challenging surfaces	Requires more stable, level ground; ground pressure distribution
Setup Time	Relatively quick	Significant; requires assembly/disassembly
Lifting Capacity	Moderate to high (30-165 tons)	Very high to extreme (hundreds to thousands of tons)
Ideal Job Site	Remote, uneven, confined, frequently changing	Large, long-term, stable ground, heavy lifts

MOBILE CRANE TYPES

TYPICAL JIB CONFIGURATIONS



Latticed cantilever jib



Cantilevered telescopic jib



Latticed jib extension



Latticed jib extension



Telescopic jib fitted with lattice extension & fly jibs

MOBILE CRANE TYPES

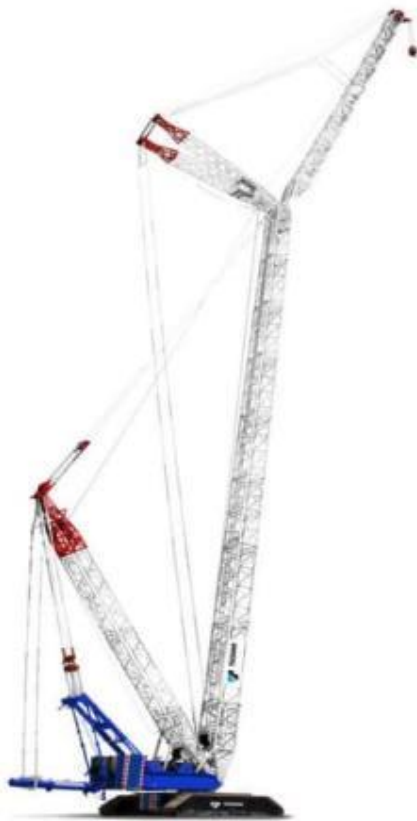
TYPICAL JIB CONFIGURATIONS



Telescopic jib fitted with latticed extension & fly jibs

MOBILE CRANE TYPES

TYPICAL JIB CONFIGURATIONS



Latticed tower and luffing jib configuration



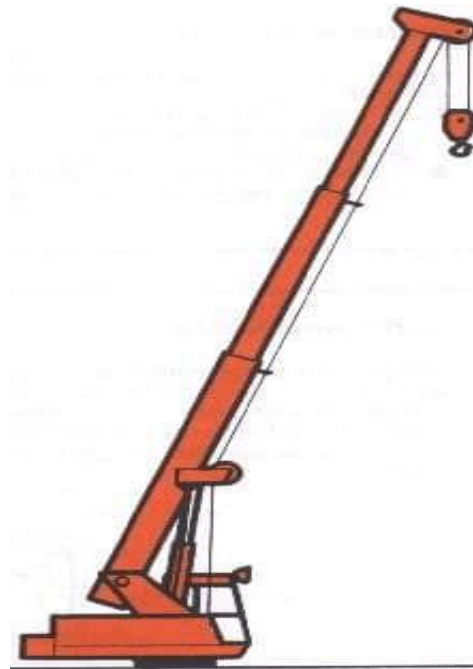
Latticed jib with mast and auxiliary counterweight

MOBILE CRANE TYPES

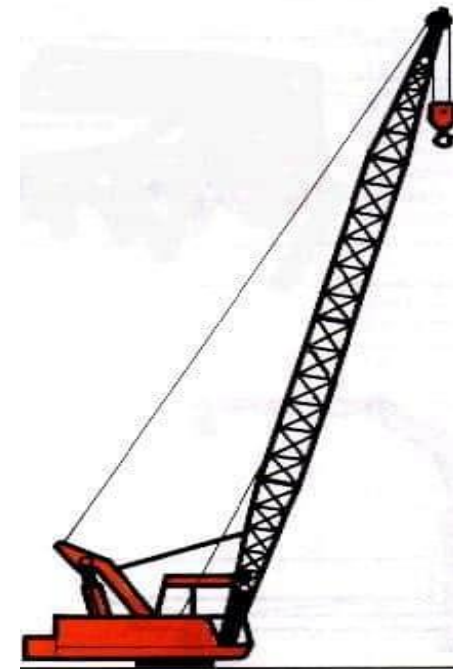
LATTICE BOOM & TELESCOPIC BOOM

The telescopic boom can adjust boom length rapidly enabling minimum space for road displacement .The crane capacity varies with boom length.

The fixed lattice boom requires site assembly work for each configuration of the lifting job to be performed . The capacity of the crane will vary with each lattice boom assembly configuration.



**TELESCOPIC
BOOM**



**LATTICE
BOOM**

MOBILE CRANE TYPES

Luffing Jibs

Luffing Jibs are used in conditions where it is impractical to boom the main boom up or down , e.g. in close proximity to a buildings and to offer a greater radius as well as height for the crane.

The luffing jib is attached for extra height and extended to clear all obstructions then it can be 'luffed' up & down covering a larger horizontal area than a fixed boom.



MOBILE CRANE TYPES

Side-Supported Lifts

Old style super lifts normally consisted of additional weights on a platform or wheeled trolley, which then had to be attached to the crane.

Modern technology has evolved a method of supporting the boom by rigging extendable boom side-mounted wings which can increase the crane capacity significantly.

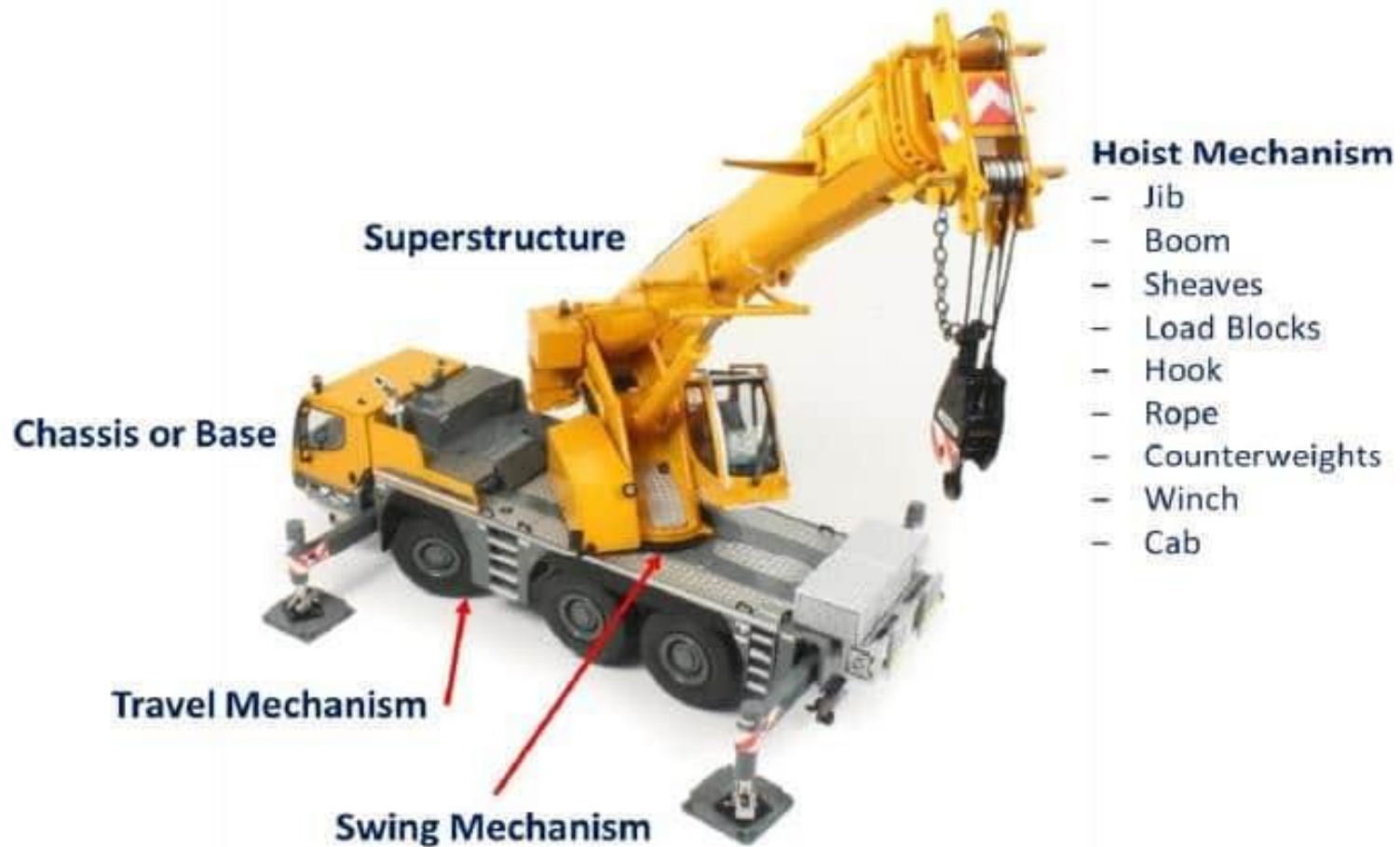
Some cranes have the side mounted super lift assembly permanently mounted; on others it comes as a separate attachment for road weight restrictions.

The images below show a detachable version:



MOBILE CRANE TYPES

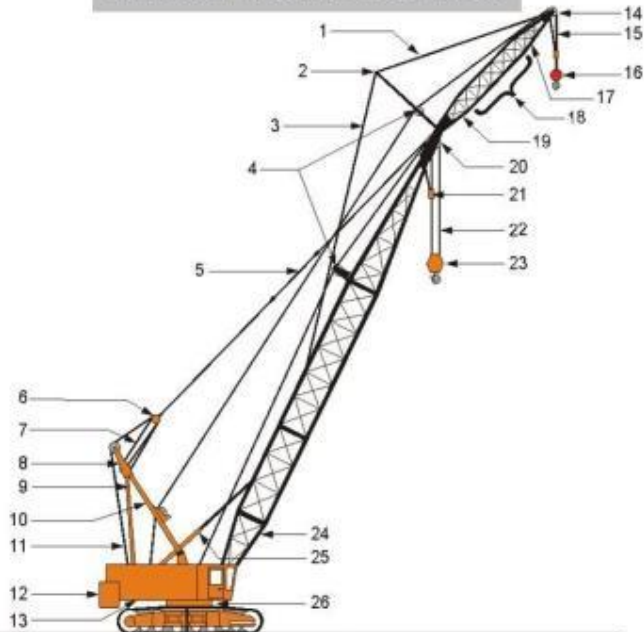
CRANE COMPONENTS



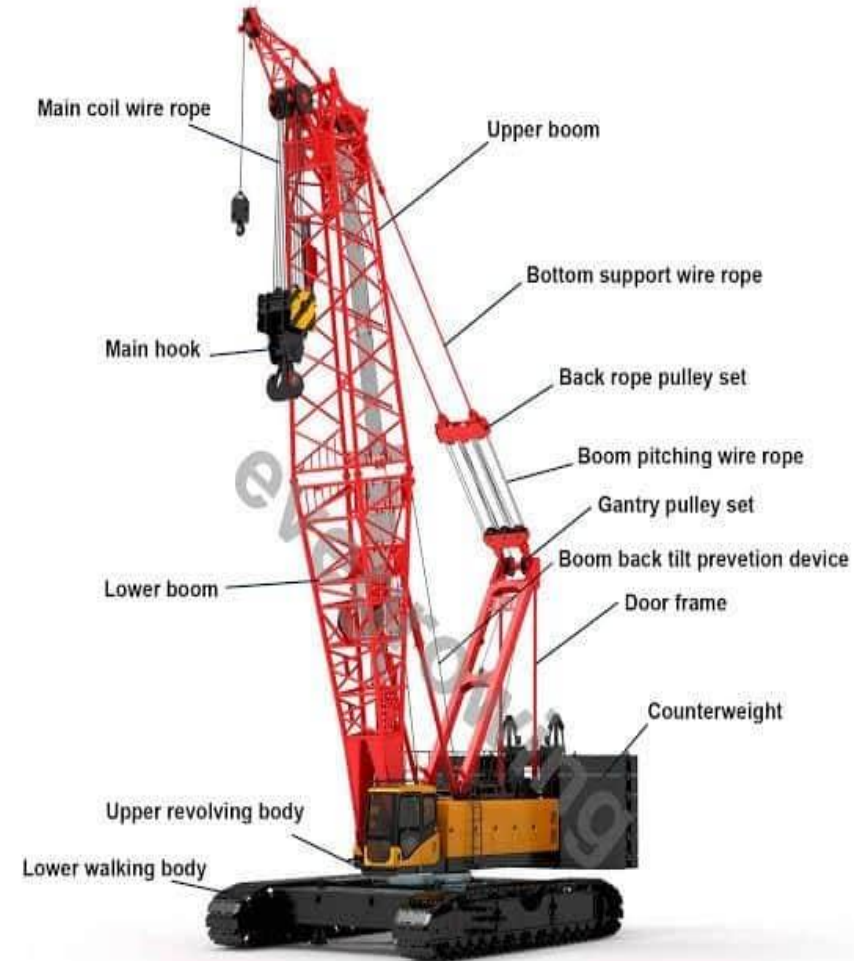
MOBILE CRANE TYPES

CRANE COMPONENTS

Crawler-Mounted Cranes



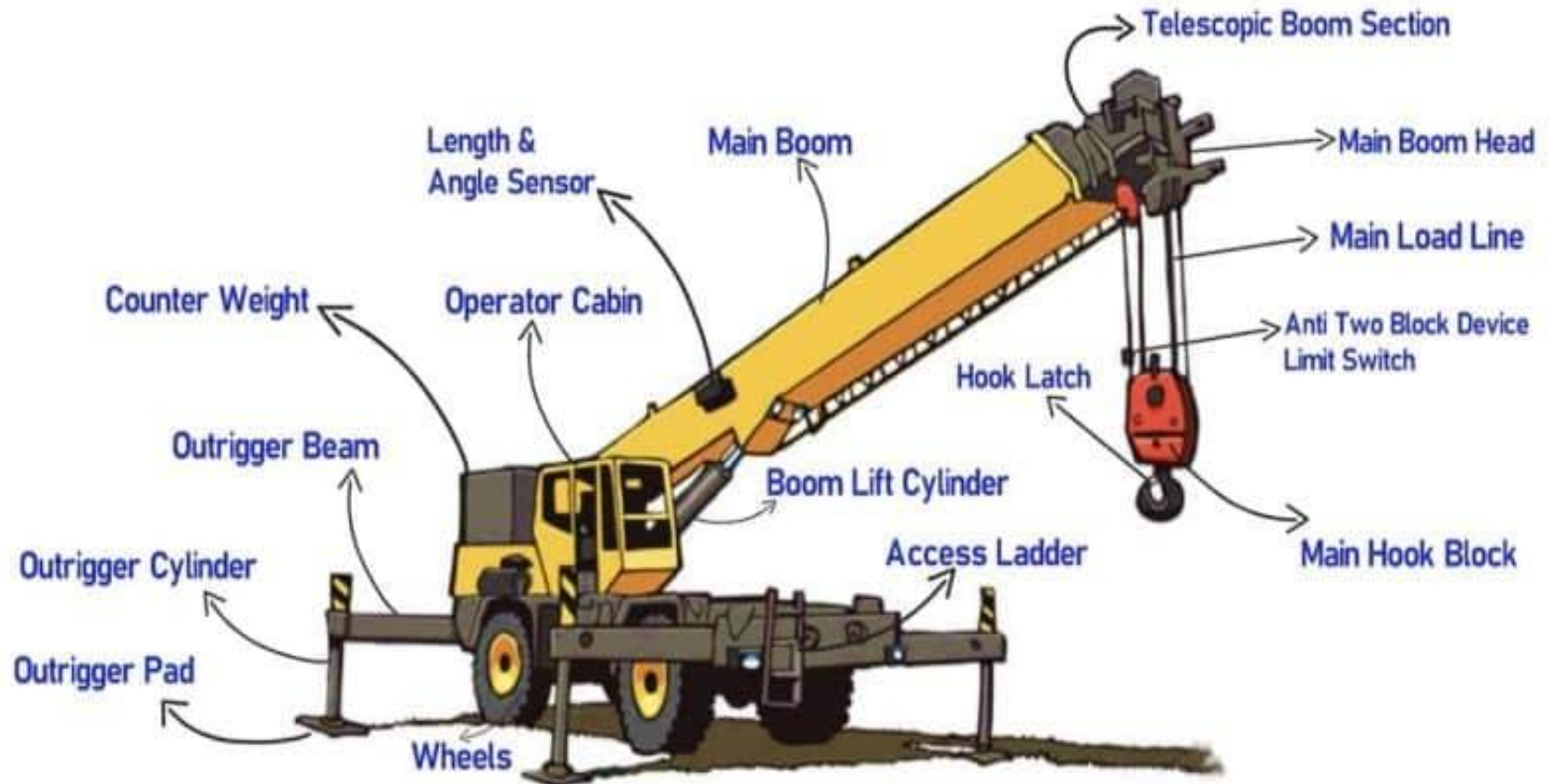
- | | |
|-----------------------------------|-------------------------------------|
| 12 Counterweight | 19 Jib Heel Section |
| 23 Main Hook Block | 5 Boom Pendants |
| 1 Jib Forestay Pendant | 9 Backhitch |
| 7 Boom Hoist Reeving | 15 Auxiliary Hoist Line |
| 14 Jib Tip Sheave | 6 Outer Bail |
| 26 Turntable, Swing Circle | 17 Jib Tip Section |
| 18 Jib Mid Section | 8 Inner Bail |
| 10 Gantry | 16 Headache or Overhaul Ball |
| 2 Jib Mast (Gantry) | 13 Machine Deck |
| 11 Boom Hoist Line | 4 Deflector (Idler) Sheaves |
| 22 Main Hoist Line | 20 Boom Tip Sheaves |
| 3 Backstay Pendant | 21 Anti-Two-Blocking Device |
| 24 Boom Heel Section | 25 Boom Stop |



MOBILE CRANE TYPES

CRANE COMPONENTS

Mobile Crane Parts



MOBILE CRANE TYPES

SERVICE LIFE OF LIFTING EQUIPMENT

As per ADNOC Group Lifting And Hoisting Operations Standard (HSE-PSW-CP19)

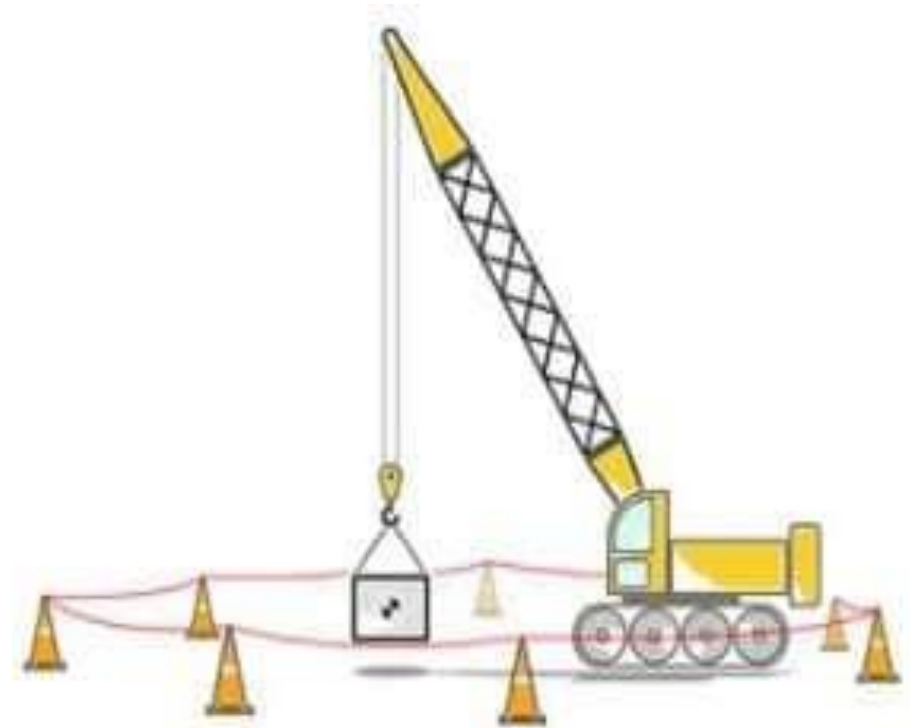
- ▶ For Pedestal, Overhead and Jib Cranes: 25 years from the date of put-into- service for the first time. A condition assessment shall be carried out before life span completion in order to determine the extension of life span.
- ▶ For Mobile Cranes: 25 years from the date of put-into-service for the first time (25 years life span specified in latest regulation of Abu Dhabi Traffic department). Condition assessment shall be carried out by the Crane's Manufacturer or Local Authorized dealer only prior to renew the annual Mobile Crane License and in order to determine the extension of the life span.
- ▶ For Tower Cranes and Forklifts: 20 years from the date of put-into-service for the first time. A condition assessment shall be carried out before life span completion in order to determine the extension of life span.

LIFTING OPERATION

MOBILE CRANE TYPES

WHAT IS LIFTING OPERATION

Transfer of load / personnel from one place to the other place with the help of lifting equipment.



WHAT IS LIFTING OPERATION ?

WHAT IS SAFE LIFTING OPERATION:

No damage to:

- ▶ Personnel
- ▶ Property
- ▶ Lifting Equipment (Crane / Load / Lifting Accessories),
- ▶ Environment.
- ▶ Site



OPERATIONS MANUAL, LOG BOOK AND PRE USE INSPECTIONS (DAILY PRE USE CHECK LIST)

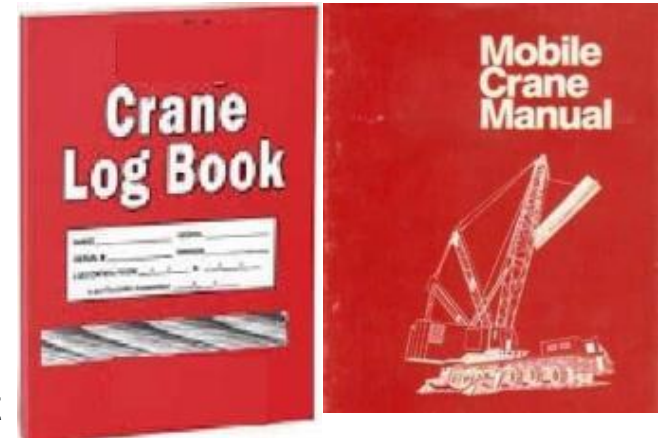
CRANE OPERATIONS MANUAL & LOG BOOK

Every crane should have the crane operating manual, daily pre start check list and log book.

It is the responsibility of the crane operator to ensure that each shift pre start check shall be performed and all the necessary information is recorded in the log book.

A log book should be issued for all cranes and kept within easy reach in the operator's cab. This is the machine diary and all repairs and maintenance should be entered neatly on a daily basis and as they occur. This is very helpful for a new man on the machine, as it gives him crane life history. It will assist him greatly in assessing equipment condition.

ALL LOG BOOK ENTRIES SHOULD BE INITIATED BY CRANE SUPERVISOR.



Cranes



CRANE OPERATIONS MANUAL & LOG BOOK

Crane Operation Manual

- Operator to read & understand the Crane's Manual
- Copy to be kept in Operator's Cab.
- Lifting Supervisor to read & understand the Manual
- To understand Crane's limitation.
- Support various inspection duration daily/monthly/quarterly etc. Checks.
- Support as per OEM's instructions Major Overhaul

Log Book(Crane's History)

- To be issued for each Crane.
- Kept in Operator's Cab.
- Log any Maintenance.
- Log any Repair.
- Log any Break-down.
- Log any Test & Inspection.
- Will help in 2nd Operator Shift.
- Provide full Crane's History.
- Assess current Crane's Condition.

PRE USE INSPECTIONS

CRANE USAGE(As per BS 7121)

INFREQUENT USAGE

Infrequent Usage applies to those cranes that are used for 10 hours or less per month, based on the averaged use over a quarter.

These cranes will be subject to a:

- ▶ Pre-use Inspection &
- ▶ Annual Inspection

Crane usage categories will be reviewed on a periodic basis by the Owner to ensure proper inspection intervals.

PRE USE INSPECTIONS

CRANE USAGE

MODERATE USAGE

Moderate Usage applies to those cranes that are used for more than 10 hours but for less than 50 hours per month, based on the averaged use over a quarter.

These cranes will be subject to

- ▶ Pre-use,
- ▶ Quarterly
- ▶ Annual Inspection.

Crane Usage Categories will be reviewed on a periodic basis by the Owner to ensure proper inspection intervals.

PRE USE INSPECTIONS

CRANE USAGE

HEAVY USAGE

Heavy Usage applies to those cranes that are used for 50 hours or more per month.

These cranes shall be subjected to:

- ▶ Pre-use Inspection,
- ▶ Monthly Inspection,
- ▶ Quarterly Inspection, and
- ▶ Annual Inspections.

Cranes assigned this category usage need not be reviewed to determine the number of hours used each month.

PRE USE INSPECTIONS-MOBILE CRANE

NO.	MOBILE CRANE DAILY CHECKLIST	SATISFACTORY (YES/NO)	REMARKS
1.	OPERATOR CABIN		
1.1	Cab Access-Steps/Handles		
1.2	General Condition-Cabin Body/Door/Window/Roof		
1.3	Visibility		
1.4	Operator's Seat		
1.5	Heating/AC System		
1.6	Operation Manual/Dily Check List/Log Book/Registration Document		
1.7	Full Rane Capacity Chart		
1.8	Control Levers/Pedals & Markings		
1.9	Level Indicator		
1.10	Emergency Stop/Reset		
1.11	Gauges & Indicators-Oil, Air, Temp. Etc.		
1.12	Horn/Communication Equipment		
1.13	RCI/SLI/LMI		
1.14	Anemometer		
1.15	Fire Extinguisher		

PRE USE INSPECTIONS-MOBILE CRANE

NO.	MOBILE CRANE DAILY CHECKLIST	SATISFACTORY (YES/NO)	REMARKS
2.	BOOM ASSEMBLY		
2.1	Boom Chords/Lacings for Lattice Type Boom		
2.2	Boom Extensions/Sections for Telescopic Booms		
2.3	Boom Pendant Rope/Ties		
2.4	Boom Harness/Bridle/Equalizer		
2.5	Boom Foot Pin & Fastening		
2.6	Boom Back Stops		
2.7	Gantry/Mast or A Frame		
2.8	Boom Extensions/Sections		
2.9	Boom Hoist Ram/Boom Extension Ram & Fastening		
2.10	Boom Angle Indicator		
2.11	All Sheaves		
2.12	Main Hook Block/Aux . Hook Block & Safety Latches		

PRE USE INSPECTIONS-MOBILE CRANE

NO.	MOBILE CRANE DAILY CHECKLIST	SATISFACTORY (YES/NO)	REMARKS
3.	HOIST/BOOM HOIST SYSTEM		
3.1	Main Hoist/Aux . Hoist/Boom Hoist Wire Rope		
3.2	All Ropes' Spooling on Drums		
3.3	All Ropes' Live end/Dead end Anchoring		
3.4	Main Hoist/Aux . Hoist/Boom Hoist Clutch/Brake		
3.5	Boom Hoist Lock Pawl		
3.6	All Chains/Sprockets		
3.7	Boom Upper/Lower Limit Function		
3.8	Anti-Two Block System(Main/Aux)		
3.9	All Sheaves		
4.	SLEW SYSTEM		
4.1	Fasteners		
4.2	Slew System Lubrication		
4.3	Slew Clutch/Brake Function		

PRE USE INSPECTIONS-MOBILE CRANE

NO.	MOBILE CRANE DAILY CHECKLIST	SATISFACTORY (YES/NO)	REMARKS
5.	CHASIS		
5.1	Chassis Condition		
5.2	Tires/Crawlers		
5.3	Outriggers		
5.4	Outrigger Sole(Shoe or Pad)		
5.5	Non-Return Valve on Outriggers		
5.6	Outrigger Controls at Chassis		
5.7	Level Indicator at Chassis Outrigger Control Station		
5.8	Outrigger Hydraulic Hoses		
5.9	Locking of Suspension		
5.10	Locking of Outriggers Rest Position		

PRE USE INSPECTIONS-MOBILE CRANE

NO.	MOBILE CRANE DAILY CHECKLIST	SATISFACTORY (YES/NO)	REMARKS
6.	OTHERS		
6.1	Platform & Walkways		
6.2	Machinery/Engine House		
6.3	Counterweight/Fastening		
6.4	Engine Performance		
6.5	Traffic Lights/Direction Indicators		
Any Other Comments/Recommendations:			
Signature:		Date:	
Key : Satisfactory - Yes: Suitable for Service No.: Not Suitable for Service or Repair Required			

PROXIMITY HAZARDS

PROXIMITY HAZARDS

Proximity hazards are risks that arise when lifting equipment, the load, or the crane operations are in close physical proximity to other objects, structures, persons, or systems. The “hazard” comes from possible contact, interference, entrapment, collision, snagging, or other unintended interaction due to that proximity.

Cranes frequently operate in high risk environments in close proximity to people and other equipment. It is essential that such factors are to be taken into account while preparing a Lift plan for any lifting Operation or thorough Examination to eliminate or control these hazards within acceptable limits specified in their HSE requirements.

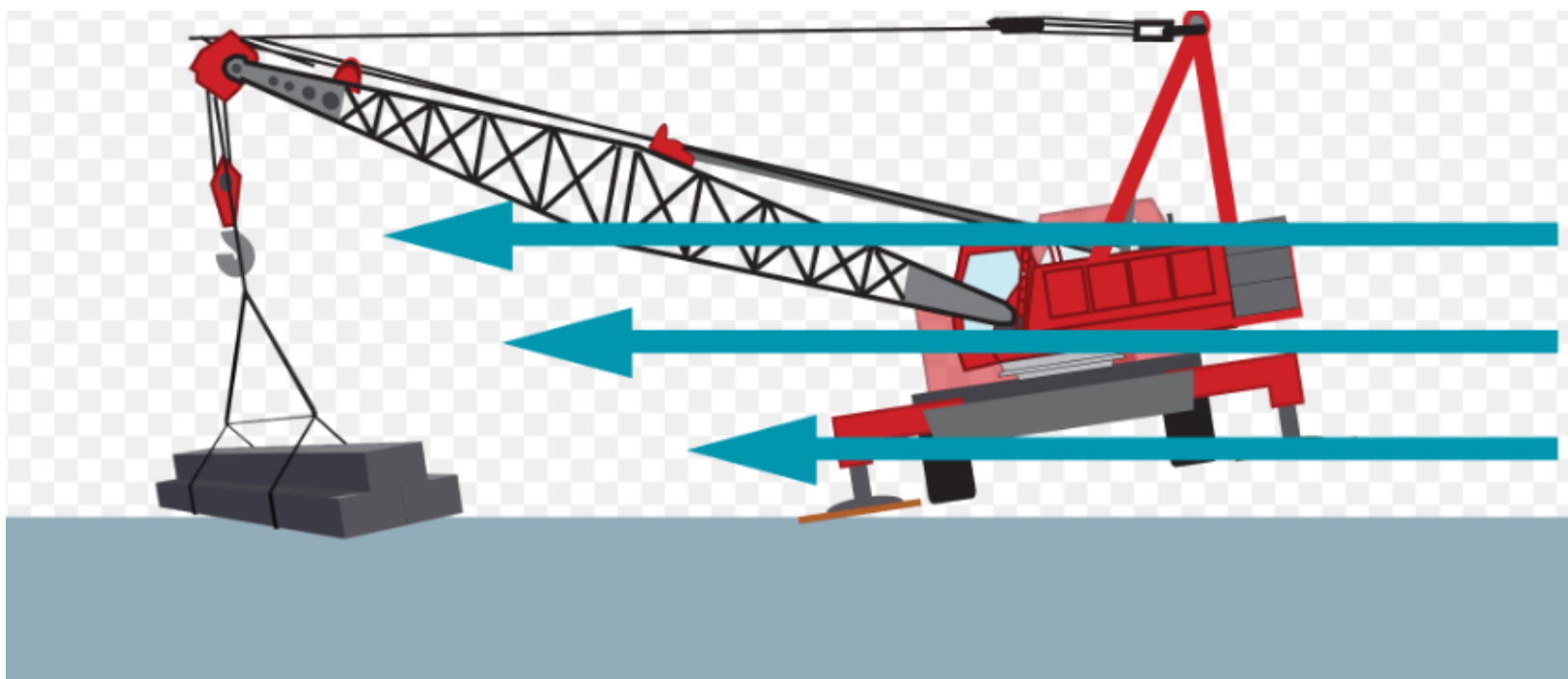
Some various Proximity Hazards:

- ▶ **ENVIRONMENTALS**
- ▶ **POWER LINES,**
- ▶ **UNDERGROUND SERVICES,**
- ▶ **NEARBY STRUCTURES,**
- ▶ **OTHER CRANES,**
- ▶ **STACKED GOODS,**
- ▶ **HIGHWAYS, RAILWAYS & RIVER.**

PROXIMITY HAZARDS

ENVIRONMENTAL CONDITIONS

- Depending on the location of the crane, (offshore or onshore) the most common adverse weather condition is high winds.
- In such conditions, the size and shape of the loads being lifted must be carefully examined to determine if a safety hazard is presented by the high winds.
- In high winds keep clear of swinging hooks.



PROXIMITY HAZARDS

ENVIRONMENTAL CONDITIONS

- Hot weather will have an impact on the crane, its components, and the personnel involved.
- In hot conditions, keep the crane engine at or near maximum governed speed during operations.
- This will ensure the crane does not overheat and boil hydraulic oil.
- It is important in these conditions that personnel take regular breaks and are not over worked.
- Ensure each worker has access to refreshments, and if necessary, there is an area designated for rest should it be needed.



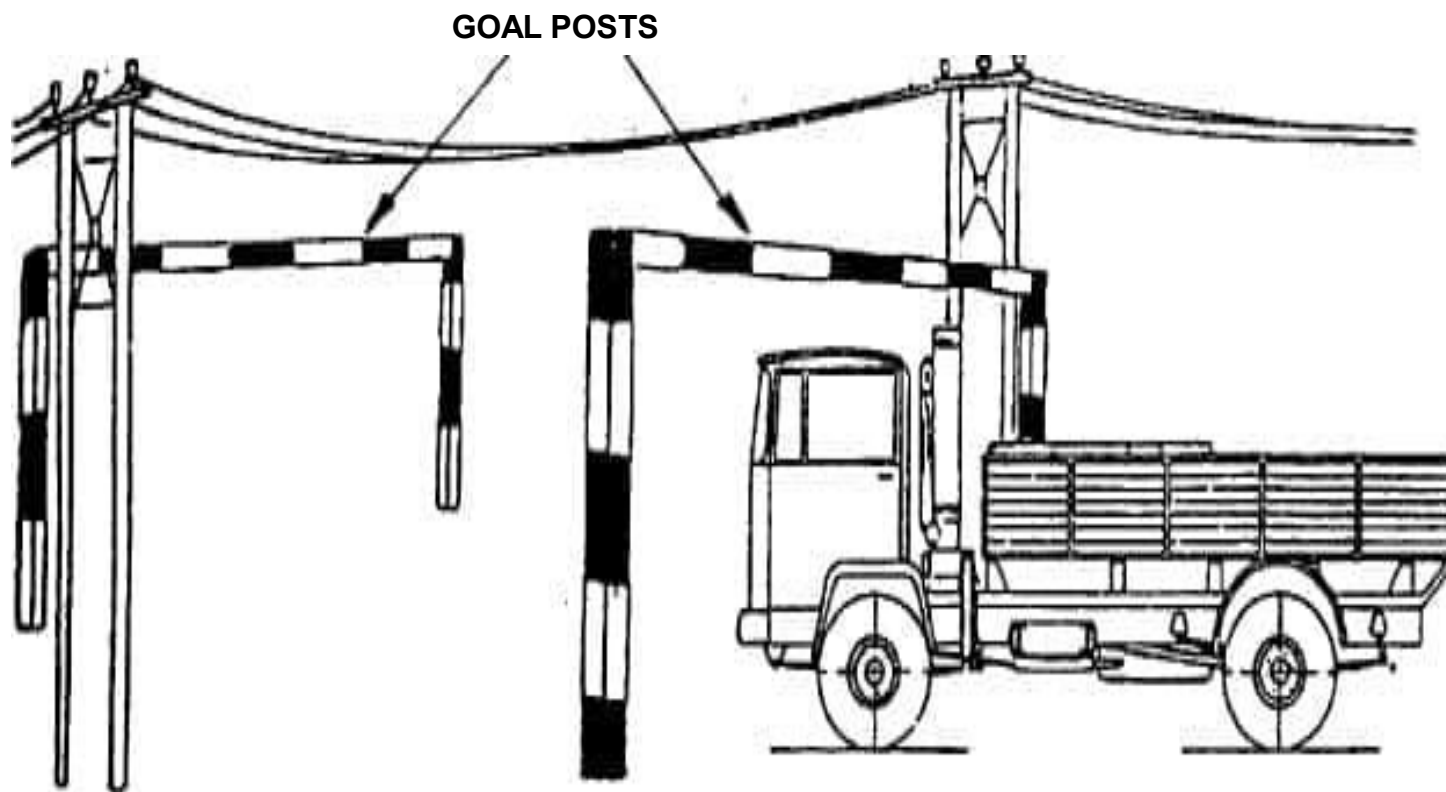
PROXIMITY HAZARDS

WORKING & MOVING NEAR POWER LINES



PROXIMITY HAZARDS

WORKING & MOVING NEAR POWER LINES

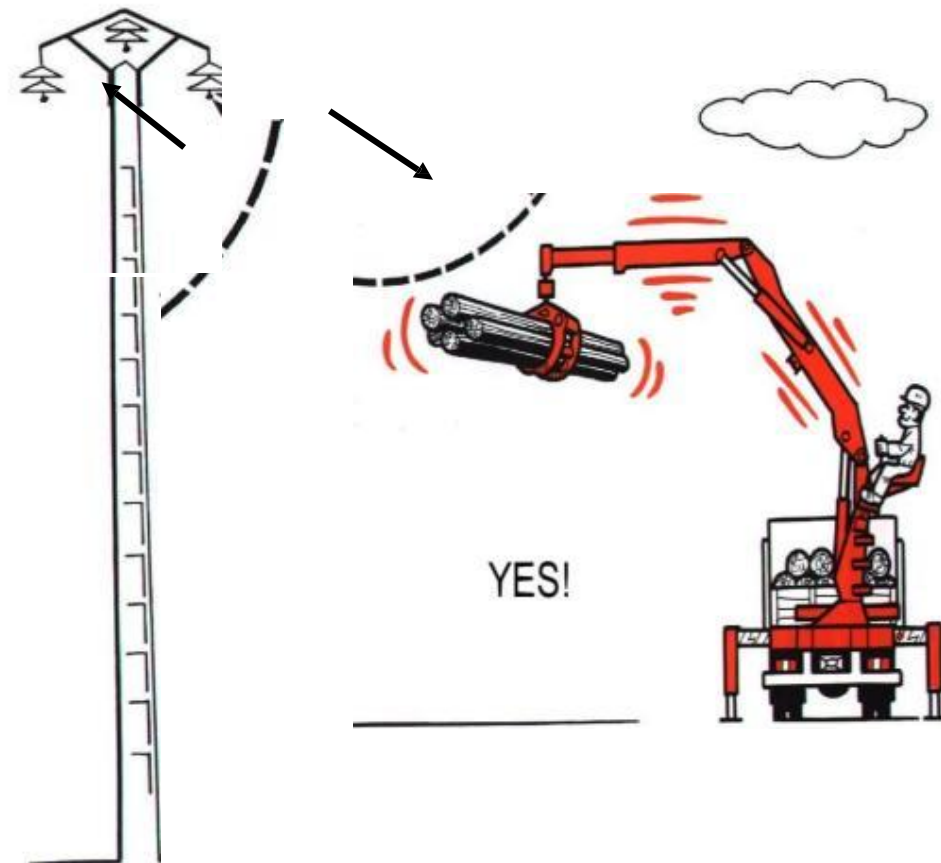


SAFE MOVING DISTANCE FROM POWER LINES

PROXIMITY HAZARDS

WORKING & MOVING NEAR POWER LINES

- ▶ Overhead protection (barrier and goal posts) shall be placed at least 1 ½ jib lengths on either side of power line both during lifting or travelling time.
- ▶ When passing under overhead lines, warning notices shall be placed on either side of the road.

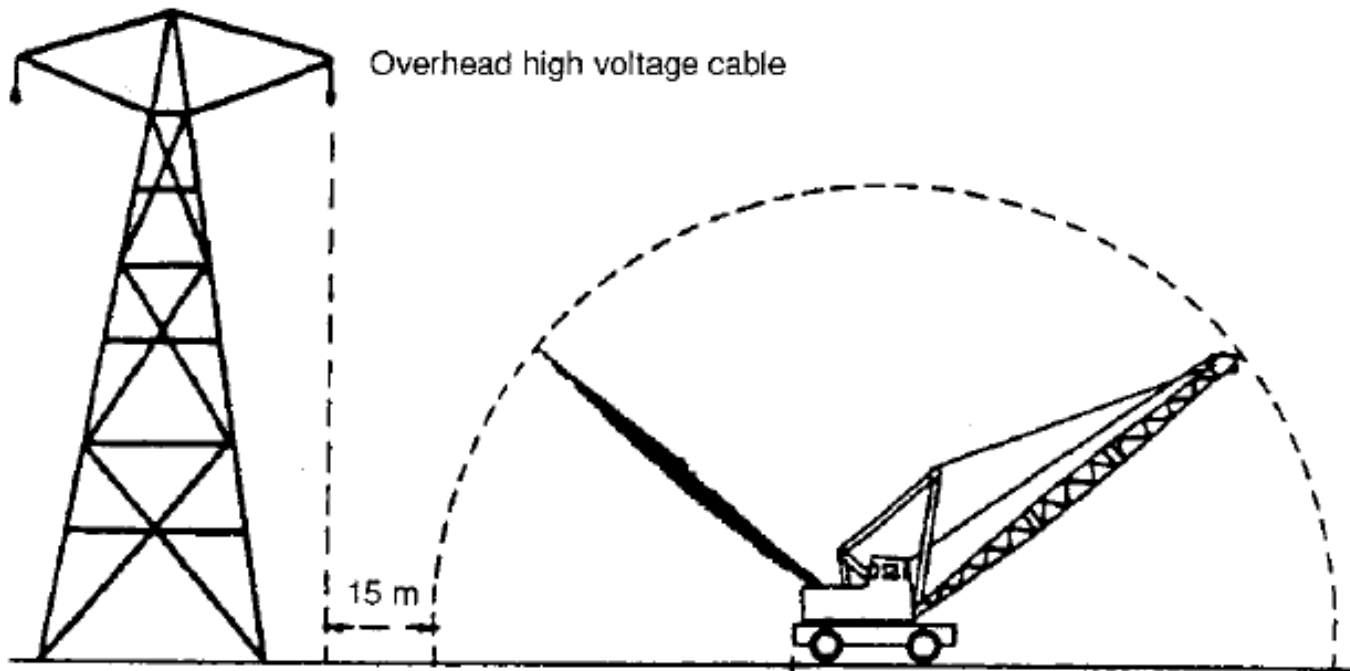


**SAFE WORKING DISTANCE FROM
POWER LINES**

PROXIMITY HAZARDS

Overhead Powerlines- As per CITB-U.K.

Working near overhead high voltage cables.



Minimum safe distance fully extended jib plus 9 m for wooden poles and 15 m for metal pylons

Maintaining a safe working distance

PROXIMITY HAZARDS

WORKING & MOVING NEAR POWER LINES

Minimum Safe Clearance for Onshore Cranes from Overhead Powerlines
 (ADNOC Group Standard “HSE-PSW-CP19” & OSHA)

Power line voltage phase to phase (kV)	Minimum safe clearance Feet (m)
50 or below	10 (3.05)
Above 50 to 200	15 (4.60)
Above 200 to 350	20 (6.10)
Above 350 to 500	25 (7.62)
Above 500 to 750	35 (10.67)
Above 750 to 1,000	45 (13.72)

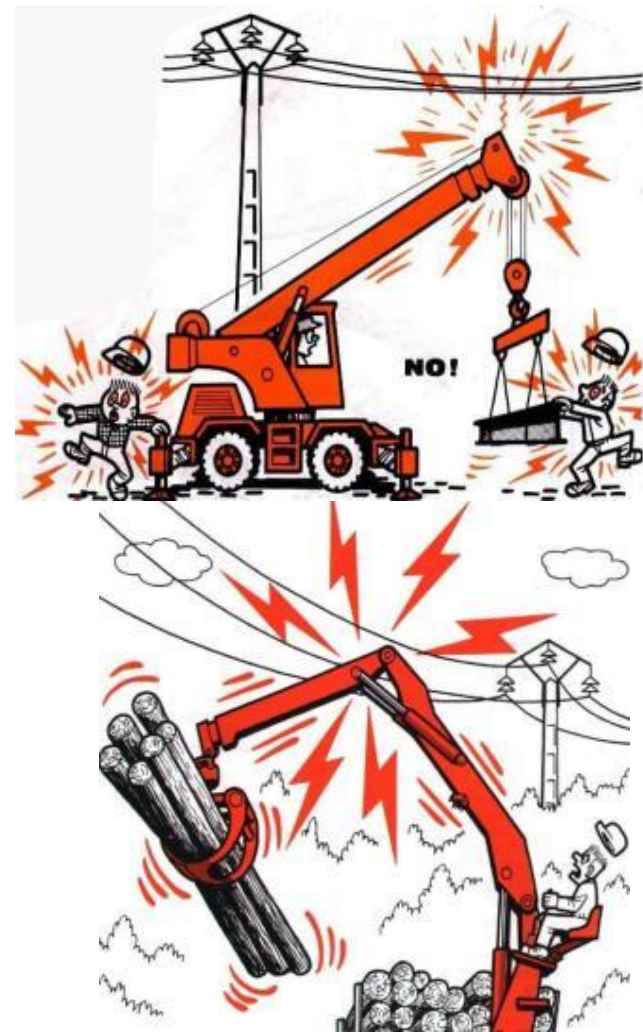
Note: Environmental conditions such as fog, smoke, or precipitation may require increased clearances.

PROXIMITY HAZARDS

WORKING & MOVING NEAR POWER LINES EMERGENCY DRILL

If crane does come into contact with high voltage overhead cables, there is every chance the operator can escape injury and prevent danger to others by:

- ▶ Remain in the cabin,
- ▶ Keep still and touch nothing,
- ▶ Warn other persons to keep away and not to touch any part of the crane, load or ropes;
- ▶ Send for competent assistance,
- ▶ Do nothing more until power is switched off,
- ▶ If the crane catches fire, the operator should jump and bunny hop.



PROXIMITY HAZARDS

WORKING & MOVING NEAR POWER LINES

ACCIDENT



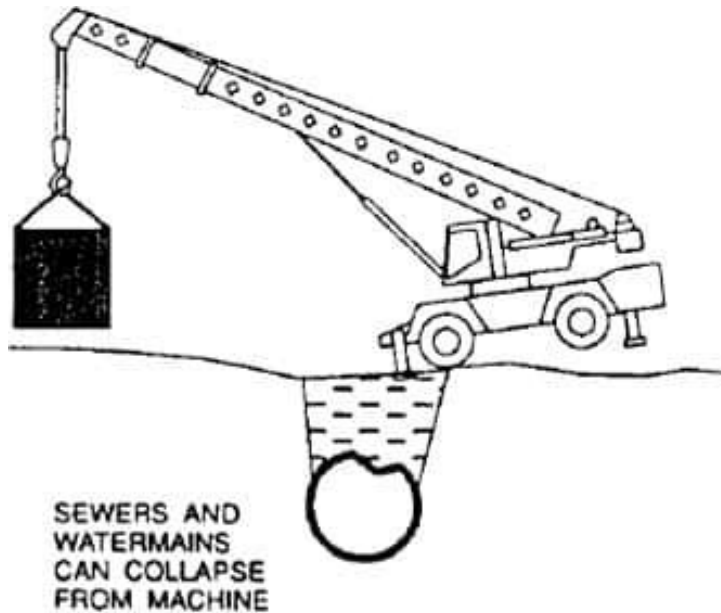
Crane in salt lake city explodes in flames when it touches a power line.



Crane hits Portland power lines; crane operator rescued

PROXIMITY HAZARDS

UNDERGROUND SERVICES



Sewers And Water Mains Can Collapse From Machine Weight And Vibration

TRY TO AVOID SEWERS AND WATER LINES

PROXIMITY HAZARDS

NEARBY STRUCTURE



PROXIMITY HAZARDS

NEARBY STRUCTURE



ACCIDENT

Crane has struck the side of a 25-story building in lower Manhattan.

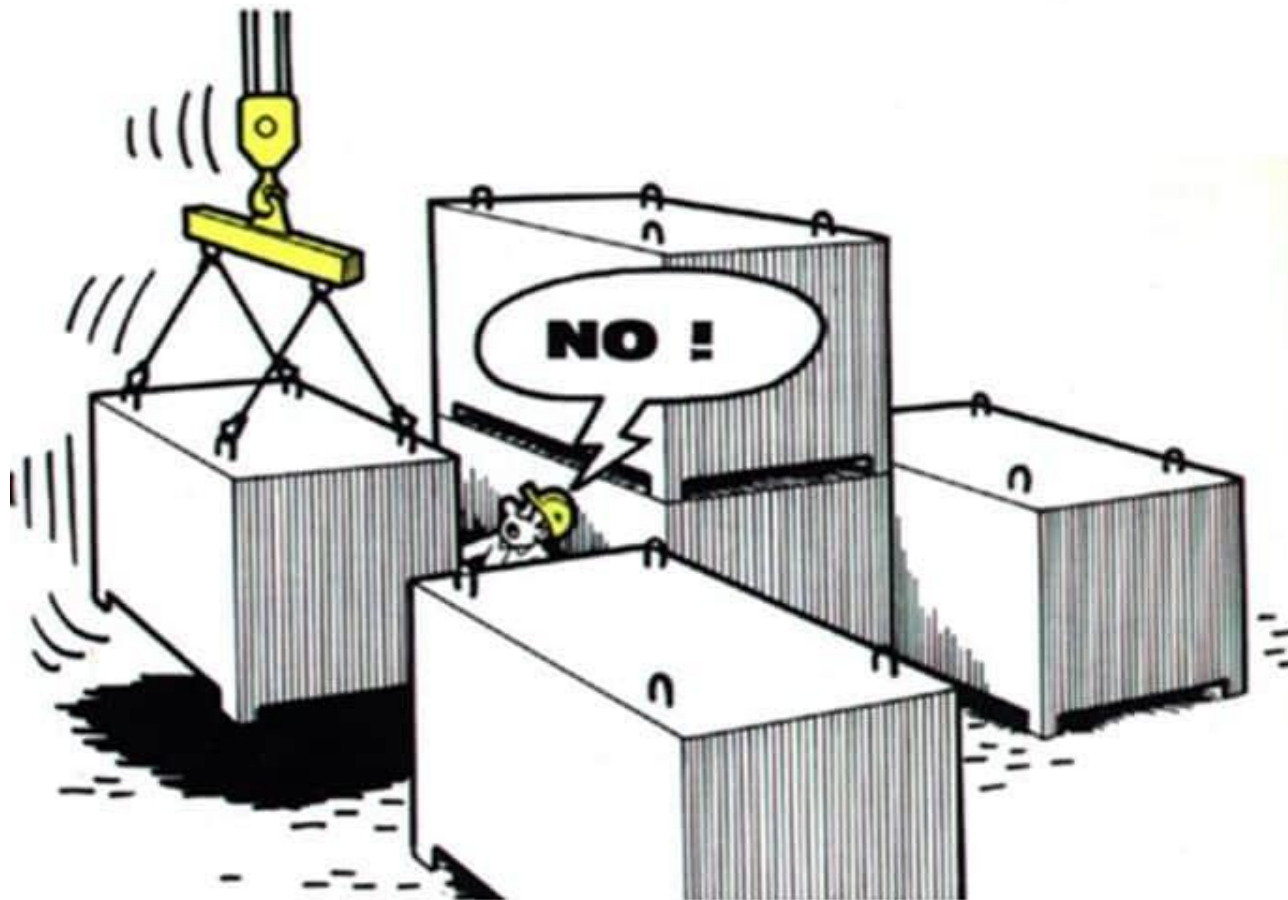
PROXIMITY HAZARDS

OTHER CRANES



PROXIMITY HAZARDS

STACKED GOODS



PROXIMITY HAZARDS

STACKED GOODS



WORKING WITH CRANE / OPERATOR DUTIES

The crane operator shall be familiar with

Operation Manual (Specification)

Maintenance Log book

Certificates

Load chart

WORKING WITH CRANE

CRANE OPERATOR DUTIES

- ▶ Ensure correct selection of duties.

- ▶ Ensure correct setting for the number of parts of rope reeved at the hook block;

- ▶ Acknowledge overloads and over moments and report any serious overloads and over moments immediately,

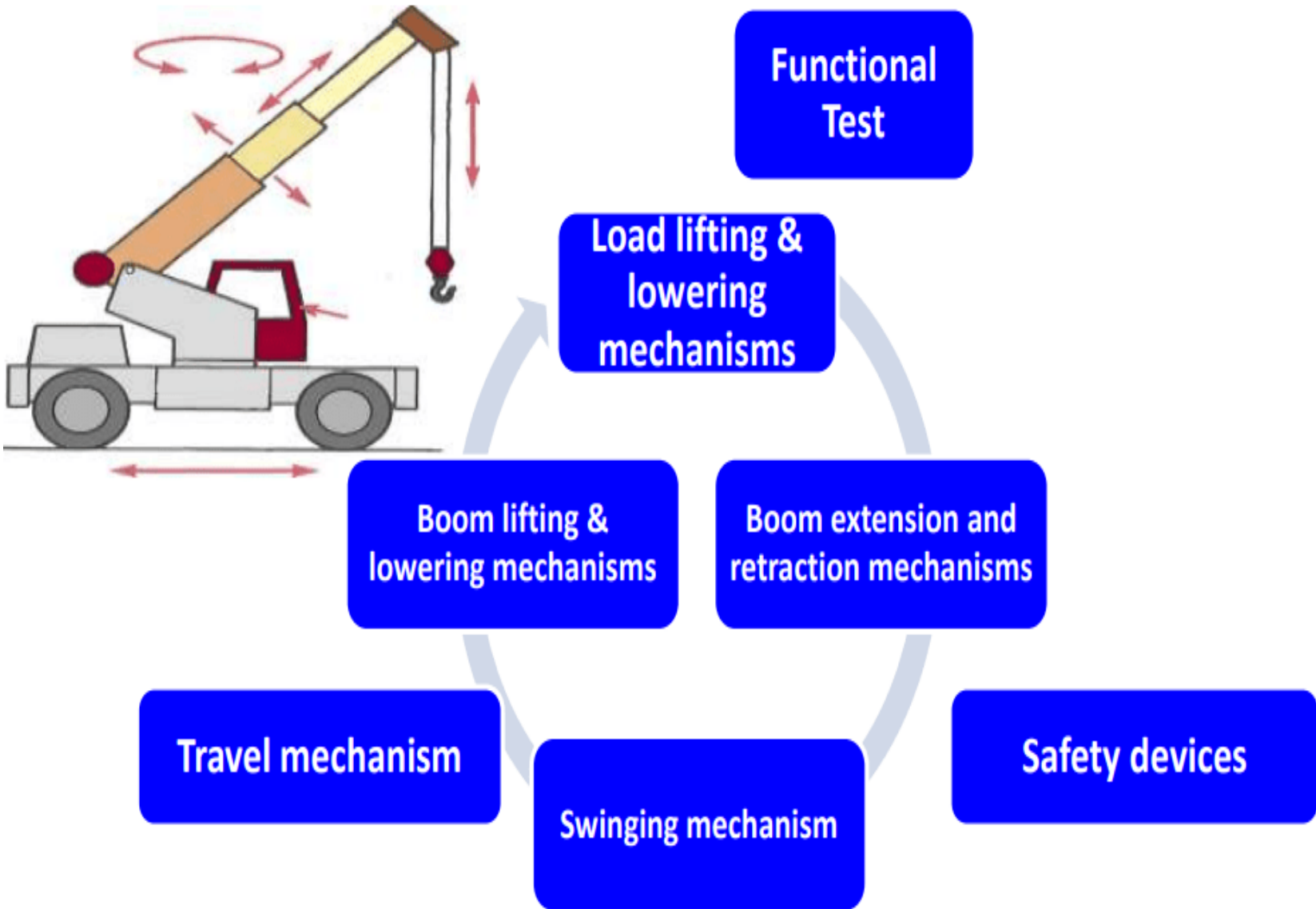
- ▶ Report all errors or any malfunction of the “RCI”,

- ▶ Operational check (visually) should be carried out as per the pre start checklist according to company policy and manufacturer recommendations.

WORKING WITH CRANE

CRANE OPERATOR DUTIES

- ▶ Not using the crane's safety devices as a routine means of stopping its motions,
- ▶ All personnel standing clear of any load being lifted,
- ▶ Exercising care when lifting hoses or bulk materials handling, and directing this activity by a clear radio communications system,
- ▶ Remain with signaller on station if the crane is used in support of critical activities required for certain diving or drilling operations, and responding to instructions from the appointed person during the activities,
- ▶ Remain at the control when a load is suspended from a crane.



Visual Inspection:

A visual check and, where necessary, a function check of the lifting equipment by a competent person before each use. In determining the suitability and scope of the inspection, reference shall be made to information such as manufacturer's instructions and relevant industry standard.

Functional Test:

Operation of each motion of a Lifting Appliance without a load being applied in order to determine whether the Lifting Appliance performs as the OEM intended. It might be necessary to include the lifting of a suitable load once the Lifting Appliance has been tested without a load applied.

Thorough Examination:

An assessment carried out by a sufficiently independent Competent Person (Third Party Lifting Equipment Inspector) in such depth and details as the competent person considers necessary to enable him to determine whether the equipment being examined is safe to continue in use. This may include Visual Inspection, Dimensional Measurement, Functional Testing, Load Testing and Non-Destructive testing where deemed appropriate by the Competent Person. These examinations are performed at specified intervals; before putting the crane into service for the first time, following major refurbishment, repair or alteration and following an exceptional occurrence which may have affected the safety and integrity of the crane.

WORKING WITH CRANE

Daily Check:

Prior to travel the Crane; Operator to check:

- Oil Levels- Engine, Transmission, Hydraulic;
- Fuel Levels, Anti-freeze (Coolant), Fan Belts;
- Air Tanks filled, Suspension raised;
- Head Lights, Tail Lights, Indicators;
- Brake Lights, Flashing Beacon Lights;
- Horn, Windshields Wipers;
- All Glass Clear and in Good Condition;
- Wheels, Tires Condition, Correct Pressure;
- Outrigger Beams, Cylinders and Pontoons;
- Fly Jib is properly stowed.

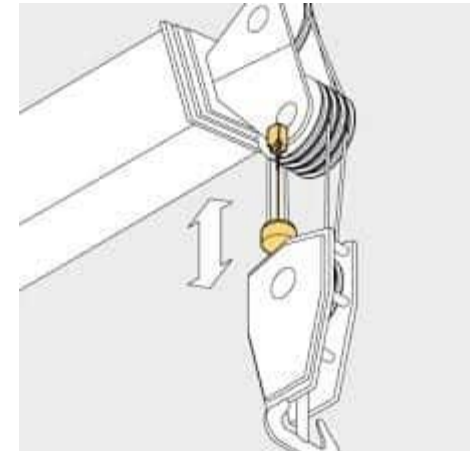


WORKING WITH CRANE

Daily Check:

Prior to travel the Crane; Operator to ensure:

- Air Brakes engaged and hold;
- Air tanks drained, suspension lowered & locked;
- Outriggers fully extended;
- Crane is leveled in both direction;
- Locking pin is engaged;
- Ballast Ram is operational + hold;
- Wire Rope is checked from end to end (Spooling);
- Hydraulic Telescopic Boom Sections Pads for worn;
- Lattice Boom Sections (Main Chords & Struts) for bent;
- Hook Blocks for proper swivel & Safety Latch;
- Anti-two Block Hoist Limit is functioning.



WORKING WITH CRANE

Daily Check:

Crane Operator:

- Must be seated during Operation;
- All commands in neutral before you start engine;
- Check Brakes;
- Check Engine Throttle;
- Start the Engine;
- Check the display for normal indicators;
- Do not start the engine in closed area.



WORKING WITH CRANE

BEFORE YOU START - CHECK & REPORT !



WORKING WITH CRANE

BEFORE YOU START - CHECK & REPORT !



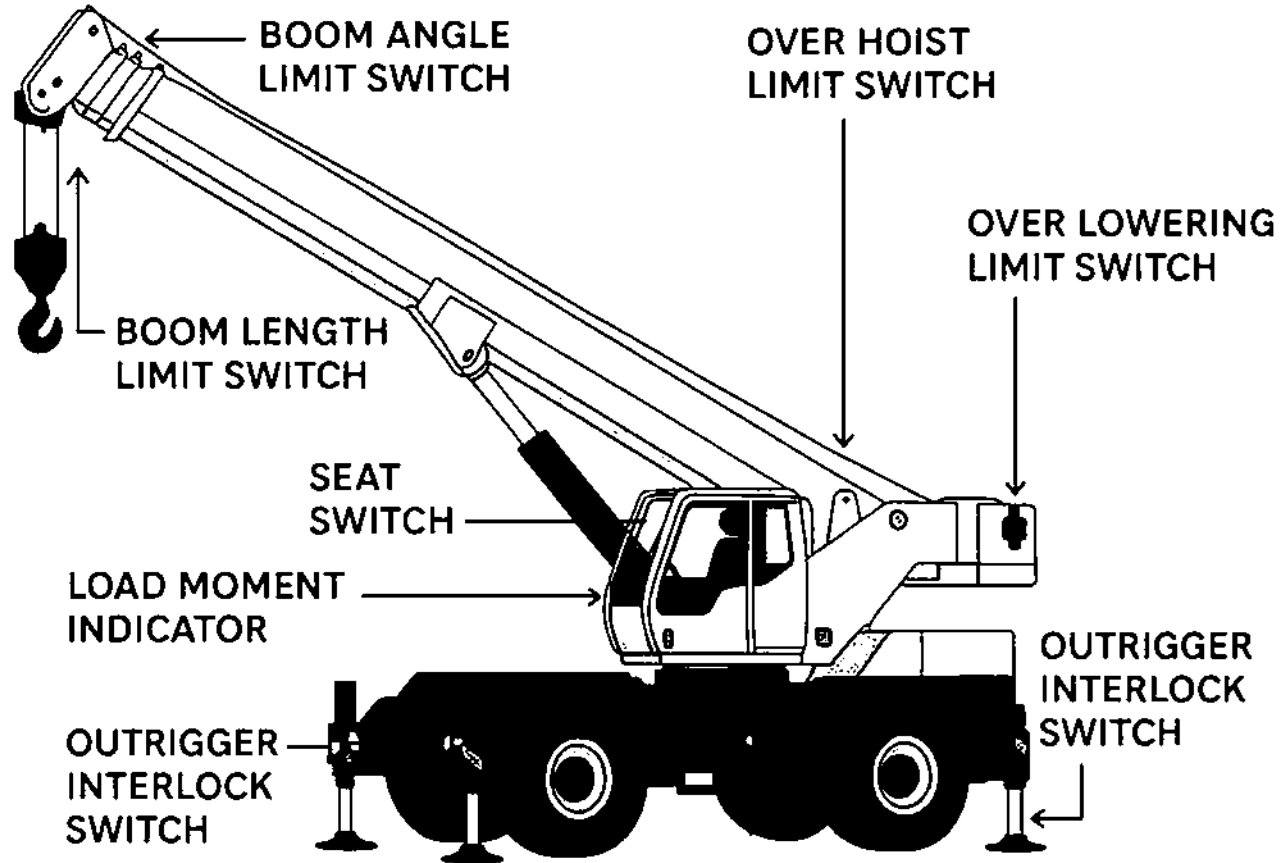
WORKING WITH CRANE

BEFORE YOU START - CHECK & REPORT !



WORKING WITH CRANE

CHECK LIMIT SWITCHES



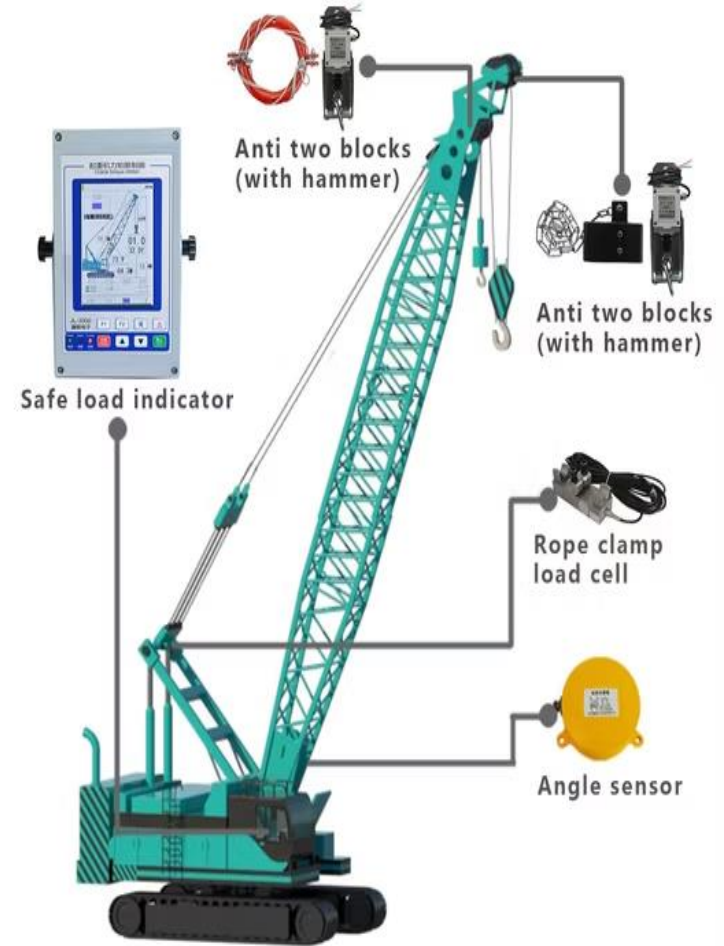
WORKING WITH CRANE

CHECK LIMIT SWITCHES

typical application:schematic diagram of tire crane moment limiter



Safety solutions of different lifting equipment will vary

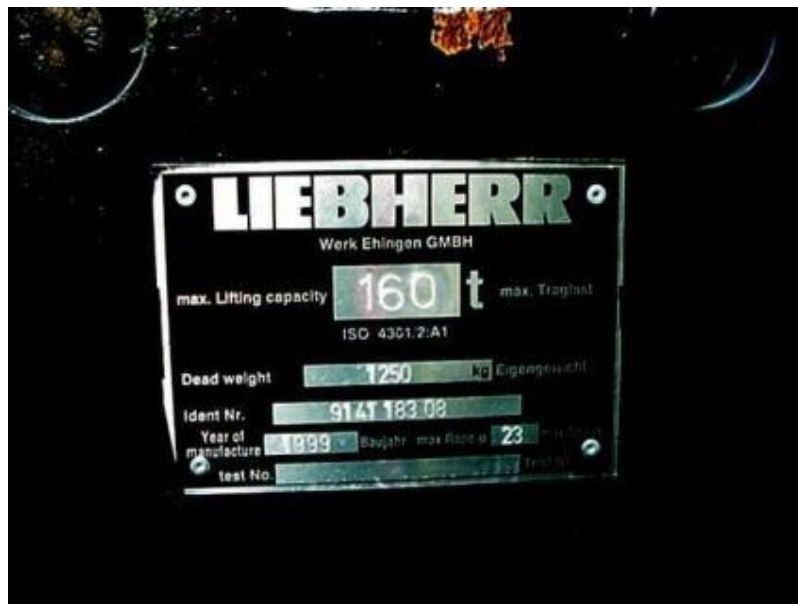


WORKING WITH CRANE

HOOK BLOCK ASSEMBLIES



Hook Block Data Plate



WORKING WITH CRANE

BEFORE YOU START - CHECK & REPORT !



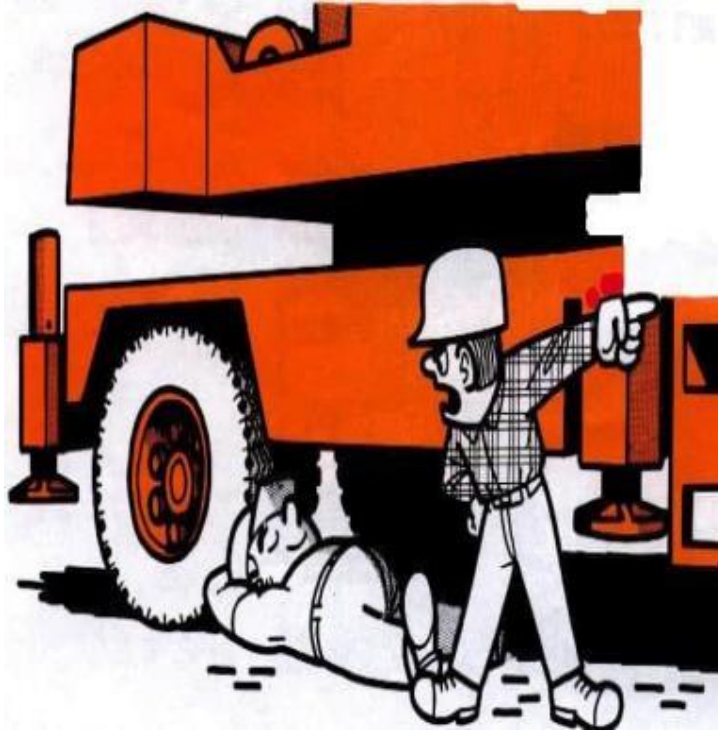
Check clearance around the crane



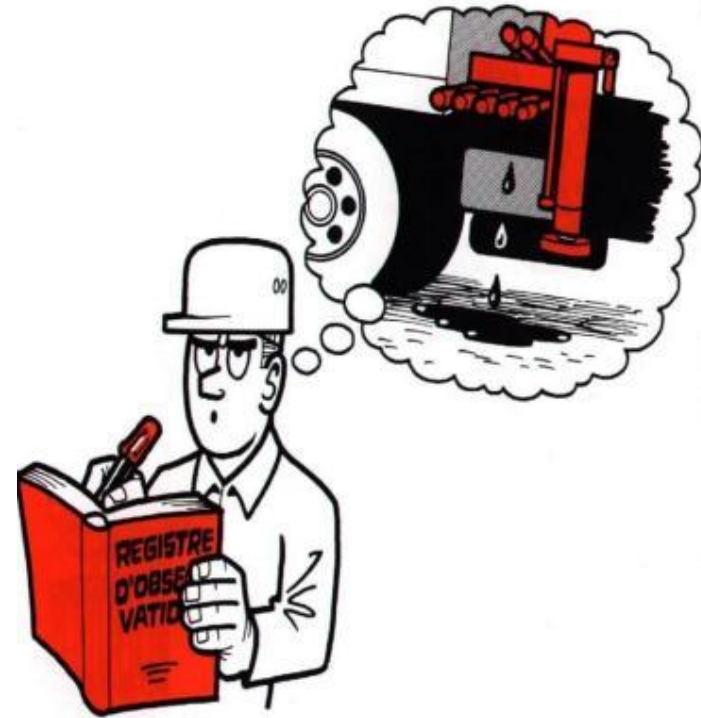
Remove all dusters, oil, grease, mud ...etc. To avoid fire initiation

WORKING WITH CRANE

BEFORE YOU START - CHECK & REPORT !



Check clearance around the crane



Report any defects

WORKING WITH CRANE

BEFORE YOU START - CHECK & REPORT !



WORKING WITH CRANE

SAFE ACCESS / EGRESS !!!



Follow manufacturer's instructions:

- ▶ Sit down during operations
- ▶ Put all commands on free position
- ▶ Check brakes
- ▶ Check engine throttle pedal
- ▶ Start the engine
- ▶ Check for the display of normal indications.

DO NOT START THE
ENGINE IN CLOSED AREA

WORKING WITH CRANE

SAFE ACCESS / EGRESS !!!



Safe Access and Egress for the Operator
during Daily Checks

WORKING WITH CRANE

TRANSPORT PERSON/LEAVING CRANE



Be careful:

- ▶ Do not transport any passenger without proper seat;
- ▶ Nobody is authorized to jump from the crane;
- ▶ Move slowly in crowded areas;
- ▶ Safety is for you and for others also.



When you leave your crane,

- ▶ Stop the engine
- ▶ Pull parking brake
- ▶ With load landed.

WORKING WITH CRANE

DRUM SPOOLING



SPOOLING OF WIRE ROPE ON DRUM

WORKING WITH CRANE

WIRE ROPE SPOOLING ON DRUM



WORKING WITH CRANE

WIRE ROPE DRUM TERMINATION

Minimum 3.0 round
for onshore cranes.



WORKING WITH CRANE

WIRE ROPE TERMINATION

- Crane's Wire Rope Termination either on Boom or on Hook Block;
- Crane Operator shall check the Wire Rope from end to end;
- Follow Manufacturer's Recommendation for Wire Rope Termination;



WORKING WITH CRANE

VISIBILITY / ACCESS & EGRESS !!!



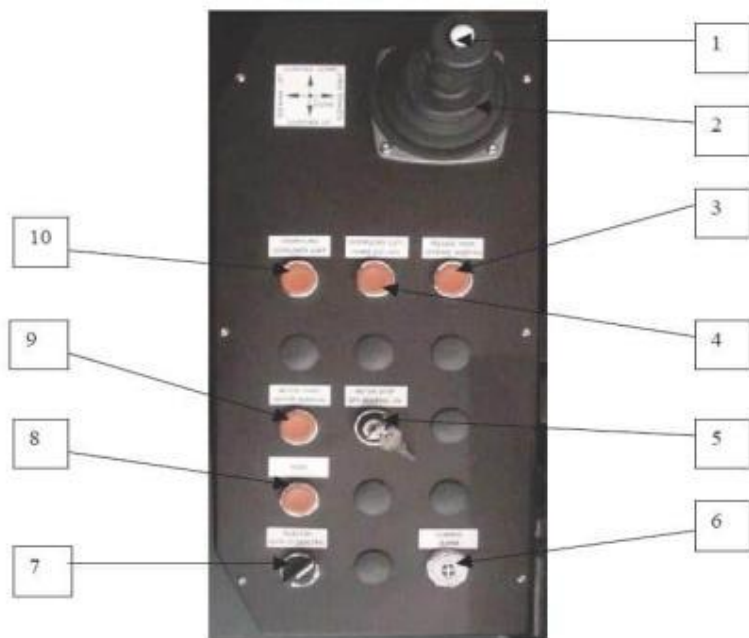
- ▶ Clean front glass,
- ▶ Remove any oil/water & obstruction items from walkways.



- ▶ Remove all unnecessary things that could obstruct operation,
- ▶ Access/egress should be illuminated at all times.

WORKING WITH CRANE

CONTROL DESK !!!

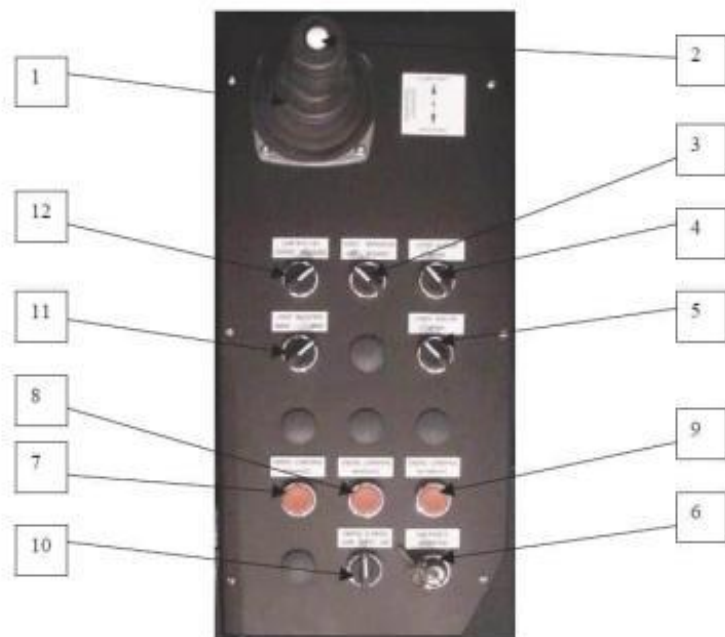


Main Components of the Left Hand Control Pannier

- 1.Warning Horn Push-Switch
- 2.Luffing Up/Down & Left/Right
- 3.Release Hook Storage Hoisting
- 4.Luff Down Cut-Out Override
- 5.Motor Stop Off-Control On
- 6.Common Alarm
- 7.Selector Deck-lift/Sea-state
- 8.Reset
- 9.Motor Start/Motor Running
- 10.Over-Lower Limit Override

WORKING WITH CRANE

CONTROL DESK !!!



Main Components of the Right Hand Control Pannier

1. Lowering & Hoisting
2. Constant Tensioning Push-Button
3. Constant Tensioning Off/Standby
4. Upper Window Wiper
5. Lower Window Wiper
6. Emergency Lowering Boom-Hoist
7. Emergency Operation
8. Emergency Slewing CCW/OFF/CW
9. Emergency Lowering Main-hoist
10. Emergency Lowering Whip-hoist
11. Hoist Selector Whip/Main
12. Controllers Locked/Released

WORKING WITH CRANE CONTROL DESK !!!



WORKING WITH CRANE CONTROL DESK !!!



WORKING WITH CRANE

CONTROL DESK !!!

Operating a mobile crane involves several different control interfaces, depending on the age of the machine and the specific task being performed (such as setup versus lifting). Here are the primary ways an operator interacts with a mobile crane:

1. Multi-Axis Joysticks (In-Cab)

In modern cranes like Liebherr, Tadano, or Grove, the primary controls are two electronic joysticks located on the armrests.

- **Left Joystick:** Usually controls **Slewing** (swinging the crane left/right) and **Telescoping** (extending/retracting the boom).
- **Right Joystick:** Usually controls the **Main Hoist** (raising/lowering the hook) and **Luffing** (raising/lowering the boom angle).
- **Deadman Switch:** Most joysticks have a trigger or touch-sensor that must be held for the controls to remain active, ensuring the crane stops if the operator lets go.

2. Remote Control / Wireless Belly Pack

Many modern mobile cranes come with a wireless remote control. This allows the operator to stand outside the cab, closer to the load or the outriggers during setup.

- **Setup:** Used to extend outriggers and level the crane from the ground to ensure a clear view of the pads.

WORKING WITH CRANE

CONTROL DESK !!!

Blind Lifts: Useful when the operator needs to move to a position where they can see the signalman or the load more clearly.

3. Foot Pedals

Foot controls are used to free up the operator's hands for the joysticks:

- **Telescope Pedal:** On some models, the boom extension is controlled by a foot pedal.
- **Swing Brake:** A pedal used to lock or slow the rotation of the upper structure.
- **Engine Accelerator:** Similar to a car, used to increase RPM for faster hydraulic response.

4. LMI Touchscreens (Control Desk)

The "Control Desk" isn't just for movement; it's for data. The **Load Moment Indicator (LMI)** screen is where the operator:

- Inputs the configuration (counterweight amount, outrigger spread, parts of line).
- Monitors "Percent of Capacity" to prevent tipping.
- Sets "Virtual Walls" or work area limits to prevent hitting power lines or buildings.

5. Outrigger Control Panels (External)

On the side of the crane carrier, there are usually physical toggle switches or small digital screens. These are used specifically for the initial setup—deploying the "legs" (outriggers) and leveling the chassis before the operator ever climbs into the cab.

WORKING WITH CRANE CONTROL DESK !!!



WORKING WITH CRANE

CONTROL DESK !!!

While modern cranes use electronic joysticks, many "classic" or rough-terrain mobile cranes use mechanical or hydraulic levers. These are often referred to as "piano controls" because of how they are lined up in a row.

Unlike a joystick that moves in multiple directions (360°), a lever usually moves in a linear path (forward and backward). To perform multiple actions at once, the operator has to use several fingers or both hands across the bank of levers.

The Standard Lever Layout (Left to Right)

In a typical 4-lever setup, the functions are usually mapped like this:

Lever	Action (Push Forward)	Action (Pull Backward)
1. Swing (Slew)	Swing Left	Swing Right
2. Telescope	Extend Boom	Retract Boom
3. Luff (Boom)	Lower Boom (Down)	Raise Boom (Up)
4. Hoist (Winch)	Lower Hook	Raise Hook

WORKING WITH CRANE

CONTROL DESK !!!

Key Differences: Levers vs. Joysticks

- Tactile Feedback:** Levers are often linked directly to hydraulic valves. You can "feel" the pressure and resistance of the oil, allowing for very smooth, manual feathering of the controls.
- Physical Coordination:** With joysticks, you use two hands for four functions (X and Y axis). With levers, you often have to "play" them like a musical instrument, moving three or four levers simultaneously to keep a load level while swinging.
- Safety Locks:** Levers often have a physical "lock" or a foot-operated "Deadman pedal" that must be depressed to send hydraulic fluid to the control bank.

Visualizing the Lever Control Desk

Imagine a row of tall, thin handles protruding from the floor or a console in front of the seat.

- Older Liebherr/Kato/Tadano:** These often featured a "split" console where some levers were on the left and some on the right, or a central bank.

Modern Hybrid: Some cranes use "Electronic Levers"—they look like old-school tall handles but send digital signals instead of moving hydraulic fluid directly.

WORKING WITH CRANE

CONTROL DESK !!!

Integration into your Log Book

If you are operating a lever-controlled crane, your **Daily Checklist** needs to be more specific about:

- Linkage Inspection:** Checking for "slop" or play in the pins and bushings of the levers.
- Hydraulic Seepage:** Checking the "boots" at the base of the levers for oil leaks (common in older hydraulic-over-hydraulic systems).

Key Features of Lever Controls:

- Linear Movement:** Unlike joysticks that move in all directions, these levers move strictly forward and backward.
- Multi-Lever Operation:** Operators often use their fingers to move two or three levers at once to coordinate complex movements like "catching the swing" (stopping a load from wobbling while rotating).
- Mechanical Feedback:** These provide a very direct "feel" for the hydraulics, which many veteran operators prefer for precision work.
- Console Placement:** You will typically see 4 to 6 main levers centered in front of the operator, or split into two banks on either side of the seat.

In your **Operation Manual**, these levers will be labeled with icons (the "Hook" for hoisting, the "Boom" for luffing, and "Circular Arrows" for slewing). Always ensure these icons are clearly visible and not worn away, as this is a common safety inspection requirement

WORKING WITH CRANE

CONTROL DESK !!!



WORKING WITH CRANE

CONTROL DESK !!!



Functions of Crane Joystick Controls

Left Joystick (Common Configuration)

- Slew left/right
- Boom up/down
- Horn button
- Dead-man safety switch

Right Joystick

- Hoist up/down
- Telescope in/out
- Auxiliary winch
- Function selector buttons

WORKING WITH CRANE

CONTROL DESK !!!

Joystick Safety Features

- ✓ Dead-man switch (must be pressed to operate)
- ✓ Proportional control (smooth movement)
- ✓ Emergency stop nearby
- ✓ Function lockout with LMI

Daily Inspection of Joysticks

- Check smooth movement (no stiffness)
- Ensure no oil leakage around base
- Verify buttons working
- Confirm neutral position returns automatically
- No abnormal noise during operation



WORKING WITH CRANE CONTROL DESK !!!



WORKING WITH CRANE

CRANE MAIN MOTIONS !!!

- ▶ Boom Up,
- ▶ Boom Down,
- ▶ Boom Extend,
- ▶ Boom Retract,
- ▶ Hoist Raise,
- ▶ Hoist Lower,
- ▶ Slew Left,
- ▶ Slew Right,
- ▶ Travelling.

Mobile Crane Limit Switches - Checking & Confirmation



1 Anti-Two Block (ATB)

- ✓ Hoist Stop Test
- ✓ "ATB Tested - OK"
- ✓ Alarm & Light Confirmed

2 Boom Angle Limit

- ✓ Max Angle Check
- ✓ Angle Marked
- ✓ Limit Alarm Verified

2 Overload / LMI

- ✓ Load Test
- ✓ LMI Calibrated
- ✓ Cut-Off Checked

3 Winch Limit Switches

- ✓ Upper & Lower Test
- ✓ "Upper/Lower Limit Tested"
- ✓ Rope Safe

4 Slew & Travel Limit

- ✓ Swing Test
- ✓ Danger Zone Marked
- ✓ Auto Stop Confirmed

Daily Checklist

- ✓ ATB: OK
- ✓ Boom Limit: OK
- ✓ LMI: OK
- ✓ Winch Limits: OK
- ✓ Slew Limit: OK

Inspector: _____ Date: _____



WORKING WITH CRANE

CRANE LIMIT SWITCHES CONFIRMATION

ANTI-TWO BLOCK TEST



- ✓ Hoist Cut-Off
- ✓ Alarm Activated
- ✓ ATB Tested - OK

BOOM ANGLE TEST



- ✓ Boom Stops
- ✓ Angle Correct
- ✓ Boom Limit - OK

LMI OVERLOAD TEST



- ✓ Overload Alarm
- ✓ Cut-Off
- ✓ LMI Calibrated - OK

WINCH LIMIT TEST



- ✓ Upper Limit
- ✓ Lower Limit
- ✓ Drum Tested - OK



SLEW LIMIT

- ✓ Auto Stop

DAILY CHECKLIST

- ✓ All Limits OK ✓



WORKING WITH CRANE

PRE-OPERATIONAL CHECKS

Below mentioned checks shall be made by the crane operator;

- ▶ Control functions, communication system and all safety devices (rci, ...etc.),
- ▶ Oil/fuel pressure & oil/fuel temperature for diesel engines,
- ▶ Hydraulic leaks,
- ▶ Pumps & motors for undue noise or high temperature,
- ▶ Air pressure and filters,
- ▶ Brakes & clutches,
- ▶ Hooks, blocks condition & function of safety latch,
- ▶ Winch drum for rope abrasion and mechanical damage,
- ▶ Gear and chain drive for wear & tear,
- ▶ Cabin door locks.

WORKING WITH CRANE

Mobile Cranes for Man-riding

- ▶ The Factor of Safety required for lifting personnel by a crane shall be “Normally 2:1”.
- ▶ The crane selected to lift personnel shall have a configuration in the Safe Load Indicator for “Personnel Lifting” which is of at least twice the minimum rated capacity for Material Lifting.
- ▶ Cranes and lifting accessories used to lift persons, should undergo a thorough examination by a competent person prior to usage and at least once every 6 months by a TPIA unless the competent person specifies a shorter interval.
- ▶ Cranes, when used for lifting personnel, shall be equipped with brakes that are operable under all load conditions.
- ▶ The brakes should be automatically applied when the drive is in the ‘OFF’ or ‘NEUTRAL’ position, and, upon failure of the power supply to the motor and/or control device.
- ▶ Any gearbox should be of constant mesh type.

WORKING WITH CRANE

Mobile Cranes for Man-riding(cond.)

- ▶ Clutches or other means of disengaging the drive train are prohibited for personnel lifting operations unless a fail-safe interface exists such that it is not possible to disengage the clutch when the drive train is in motion or there is a load on the hook.
- ▶ Free fall operation is not permitted.
- ▶ A second brake should be provided for emergency use by the operator, located as near to the winch as possible.
- ▶ The crane should be fitted with an emergency stop in close proximity to Crane Operator.
- ▶ In the event of failure to re-start the prime mover, it should be possible to readily recover the carrier by manual means.
- ▶ The crane should be equipped with a motion control system that brings motion to rest automatically when the controls are released.
- ▶ The crane should be equipped with power loss/emergency lowering.



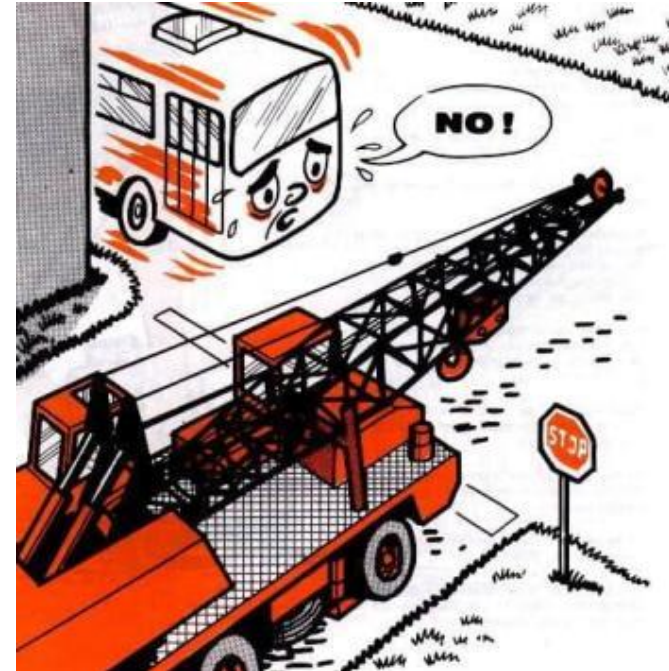
WORKING WITH CRANE

Mobile Cranes for Man-riding

- ▶ Load bearing hydraulic cylinders should be fitted with a device to stop movement in case of hose rupture or pipe fracture.
- ▶ The crane control system should be able to provide a smooth transition of the carrier.
- ▶ The travelling speed of the carrier should be limited to a maximum of 0.5 m/s on all motions.
- ▶ The crane should be fitted with an anemometer or other device to monitor in-service wind speeds.
- ▶ The wind speed shall not exceed 15 knots (7 m/s) when lifting personnel or as per Crane Manufacturer's recommendations whichever lesser.
- ▶ Lifting of persons during daylight only.
- ▶ The design factor of load hoist wire rope when handling personnel shall not be less than 10:1

TRAVELLING WITH CRANE

TRAVELLING WITH CRANE !!!



- ▶ Take care of the boom
- ▶ Follow all road signals and instructions

TRAVELLING WITH CRANE

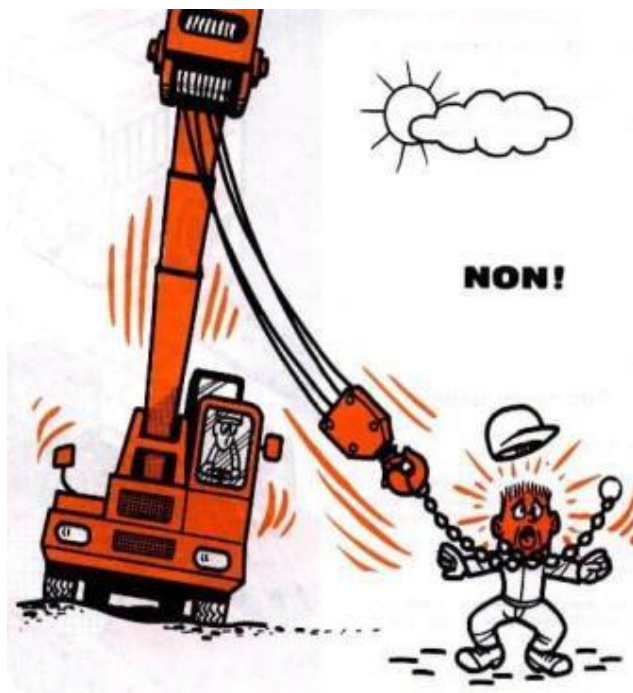
TRAVELLING WITH CRANE !!!



- ▶ Take care of the boom
- ▶ Follow all road signals and instructions

TRAVELLING WITH CRANE

TRAVELLING WITH CRANE !!!



- ▶ Give way to loaded vehicles,
- ▶ Keep clear distances with other obstructions **(600 mm)**,
- ▶ Check all working areas,
- ▶ Use guide if necessary when going backward,
- ▶ Secure hook block before moving,
- ▶ Drive within the speed limit.

VIDEO ILLUSTRATION



CRANE SET UP

CRANE SETUP-CRANE SELECTION CRITERIA

Weight and dimensions of load

Height of lift and load movement areas

Number and frequency of lifts

Length of time for which the crane will be required

Site conditions (ground conditions, access for erection, operation, dismantling)

Any dynamic load involved

Capability of making all its lifts in its standard configuration

If the crane basic characteristics do not match the jobs requirement, unsafe condition can be created and accidents are prone to happen

CRANE SET UP

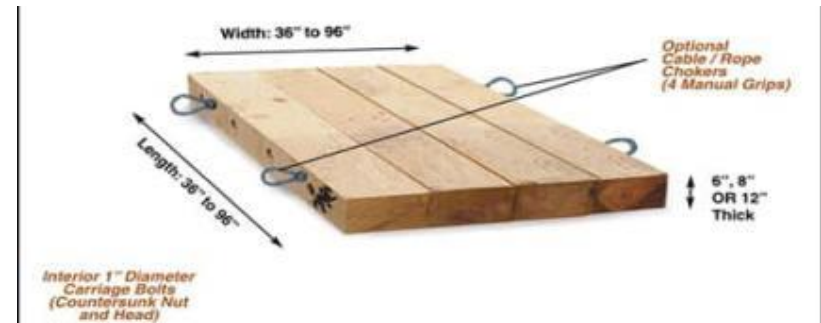


Never Set-up Your Crane on bad condition
Ground; High Risk of Accident

CRANE SET UP



Never place many wooden pieces as a Mat; instead One suitable size Mat to be placed under Crane's Outrigger Pontoons following Engineering Calculation



CRANE SET UP



CRANE SET UP



If Crawler Crane is placed on unknown Ground Condition without Mat then the Crane might topple and overturn.

CRANE SET UP



Crawler Crane Mat shall be calculated properly for Complex Lifts & as per Crane's Manufacturer's Recommendations.

CRANE SET UP

FOLLOW YOUR CRANE MANUFACTURER INSTRUCTIONS

GENERAL

- ▶ Modifications to the machine or use of optional equipment other than that specified can result in a reduction of capacity. (Consult the manufacturer first!)
- ▶ Operate and maintain your crane as per manuals provided with the machine.
- ▶ You must fully acquaint yourself with all applicable national rules and regulations.

SET UP

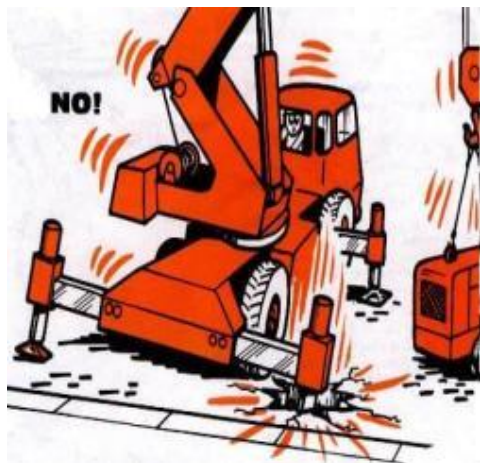
- ▶ The machine must be leveled on a firm supporting surface and you may need extra blocking under the outrigger floats to distribute the weight to a larger bearing surface.
- ▶ You must fully extend the outriggers with all tires raised free of the crane weight before operating the boom or lifting any load.

CRANE SET UP

SITTING & STABILITY

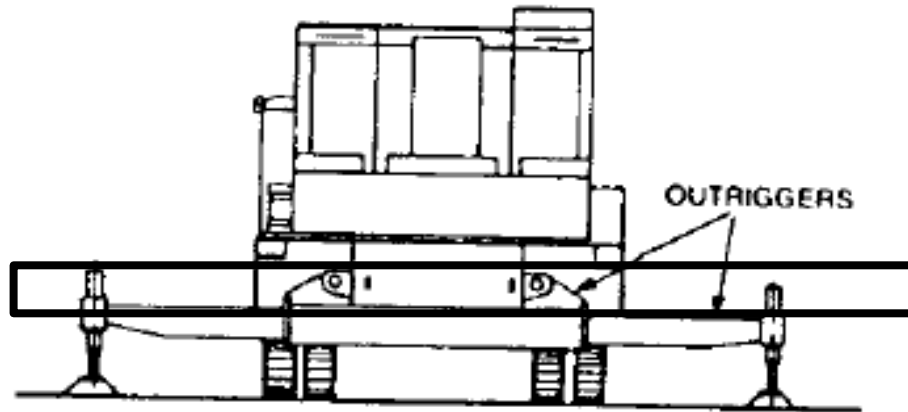
POSITIONING OF THE CRANE

- ▶ The appointed person or crane supervisor should inform crane operator about the safe & suitable location for the crane,
- ▶ Check the ground capacity,
- ▶ Use extra packing as advised by appointed person,
- ▶ If soil capacity is doubtful, A.P. Should be advised by soil specialist,
- ▶ Operator to jack-up outriggers,
- ▶ Wheels should be free,
- ▶ Secure outriggers.



CRANE SET UP

FULLY EXTEND YOUR OUTRIGGERS



FULLY EXTEND ALL OUTRIGGERS

Note: Mobile Cranes can be used with half extended outriggers (if approved by OEM and specific load chart is available)

CRANE SET UP

Tipping is the condition when a crane loses stability and begins to rotate (overturn) around its tipping axis due to excessive load or improper setup.

In simple words:

Tipping happens when the overturning moment becomes greater than the stabilizing moment.

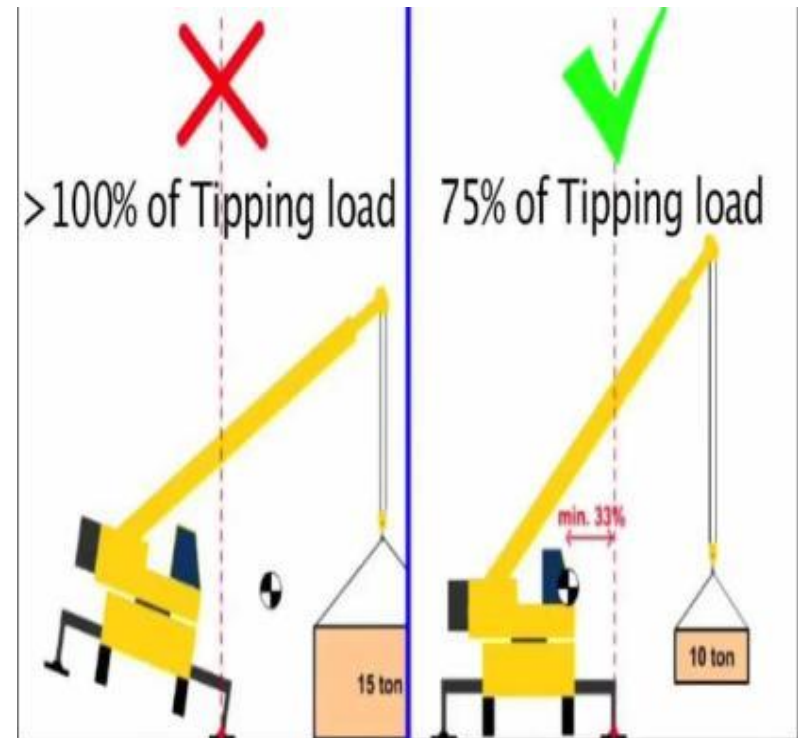
◆ Two Main Forces Acting on a Crane

Stabilizing Moment

- Created by:
 - Crane self-weight
 - Counterweight
 - Outriggers
- Acts downward through the crane's center of gravity.

Overturning Moment

- Created by:
 - Load weight
 - Load radius (distance from crane center)



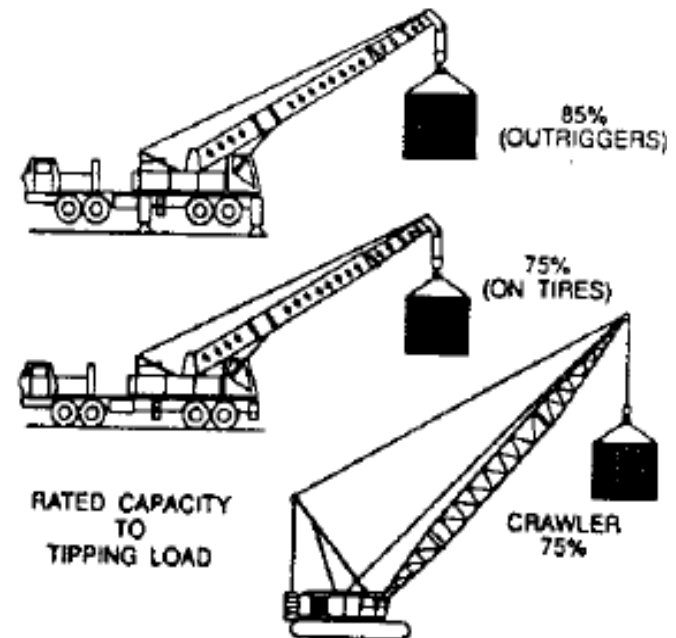
CRANE SET UP

Tipping Condition

$$\text{Load} \times \text{Radius} > \text{Crane Weight} \times \text{Stability Distance}$$

When this happens → Crane starts lifting outriggers → then tips over.

CAPACITY CHART RATING BASED ON PERCENTAGE OF TIPPING	
TYPE OF CRANE	PERCENTAGE
LOCOMOTIVE	85%
CRAWLERS	75%
MOBILES ON ROUGH TERRAIN	
on outriggers	85%
on tires	75%
COMMERCIAL BOLLARD TRUCKS	
on stabilizers	85%
Check your crane – above percentages not used by all manufacturers	
ANSI B 30.5 & CSA Z150.	



Load charts are NOT based on 100% tipping load.

Typical standards:

- **85% of tipping load** → Crane on outriggers
- **75% of tipping load** → Crane on rubber (no outriggers)

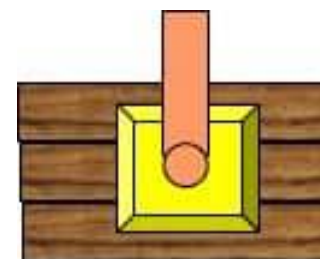
That means manufacturers add a safety margin.

CRANE SET UP

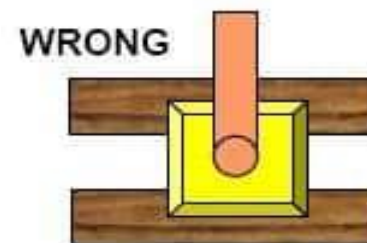
USE OF MATS



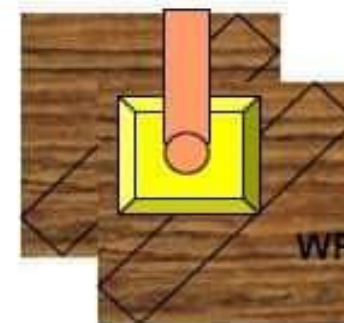
The use of mats under outrigger pads greatly increases the safety of an operation. By increasing the size of the footprint, the concentrated load on the ground decreases thus decreasing the potential for a tip over. The size of the mats varies according to the soil bearing strength of the ground. mats need to be strong enough to withstand the load.



RIGHT



WRONG

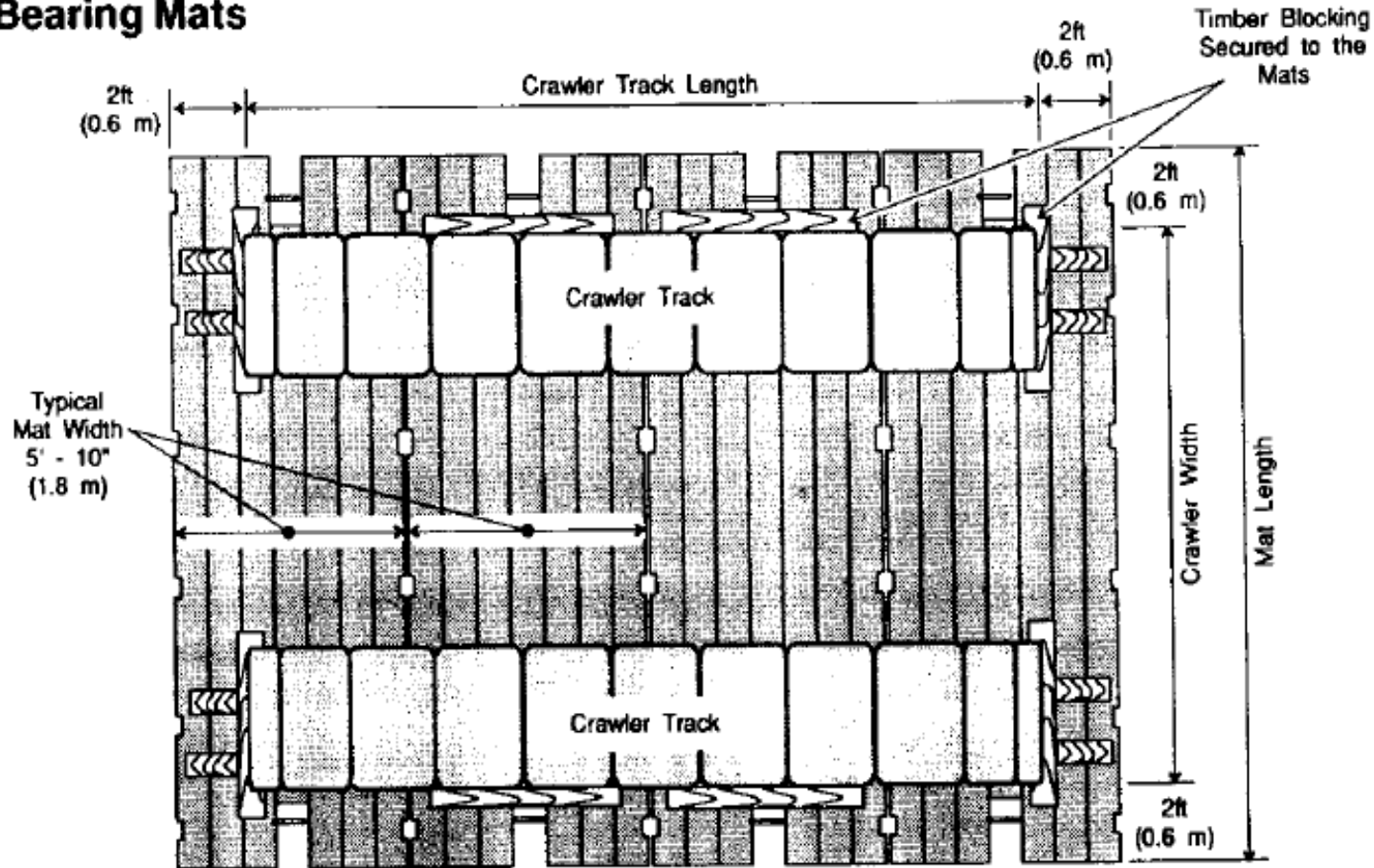


WRONG

CRANE SET UP

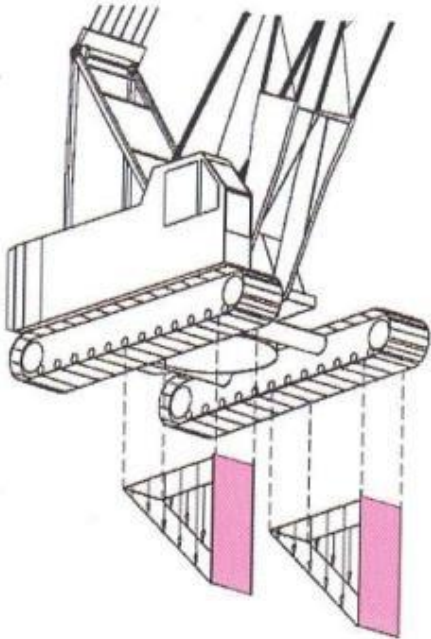
SITTING & STABILITY

Bearing Mats

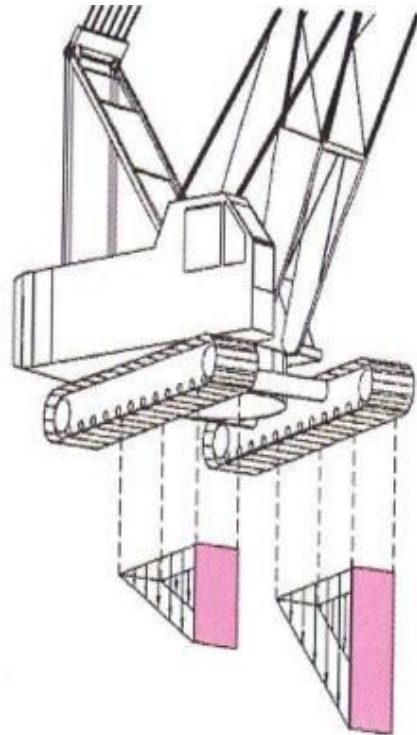


CRANE SET UP

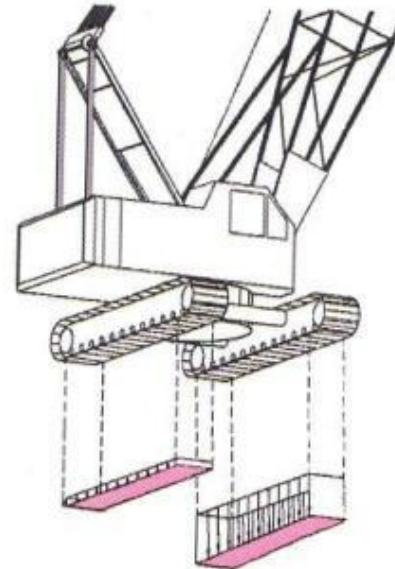
CRAWLER CRANE LOADING CASES



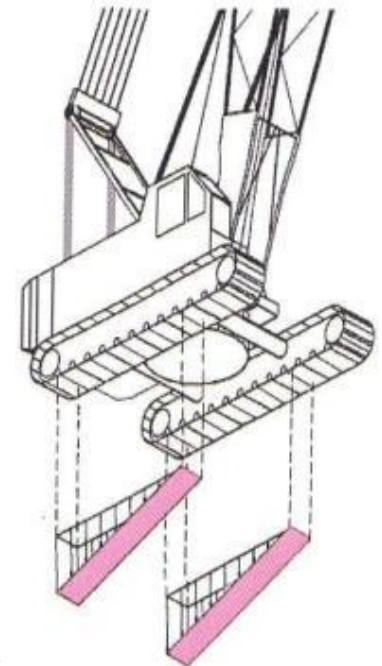
EQUAL LOAD ON EACH TRACK
(EQUAL TRIANGULAR LOAD)



MORE LOAD UNDER THE LEFT
TRACK AS CRANE SLEW LEFT



MORE LOAD UNDER LEFT
TRACK AS CRANE SLEW 90°
(RECTANGULAR LOAD)

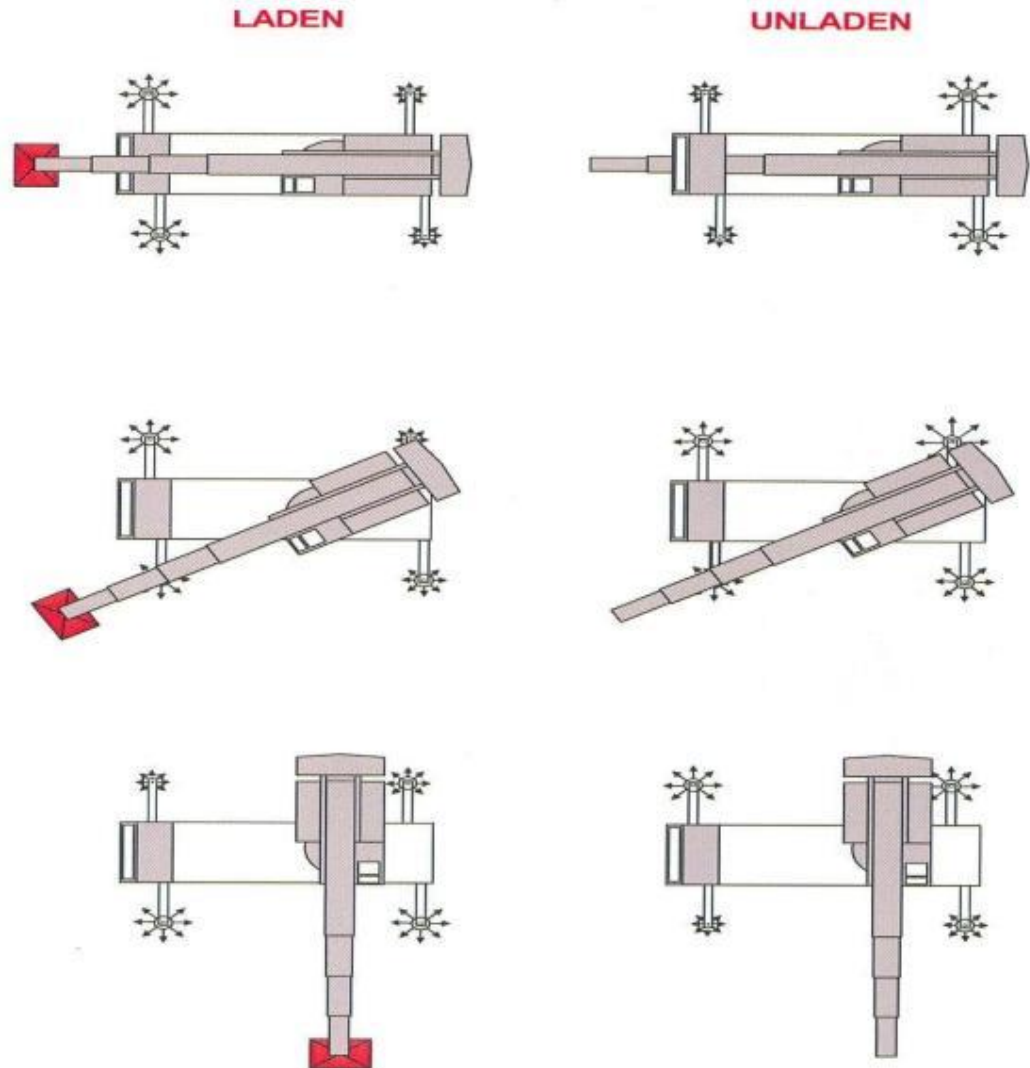


NO LOAD

CRANE SET UP

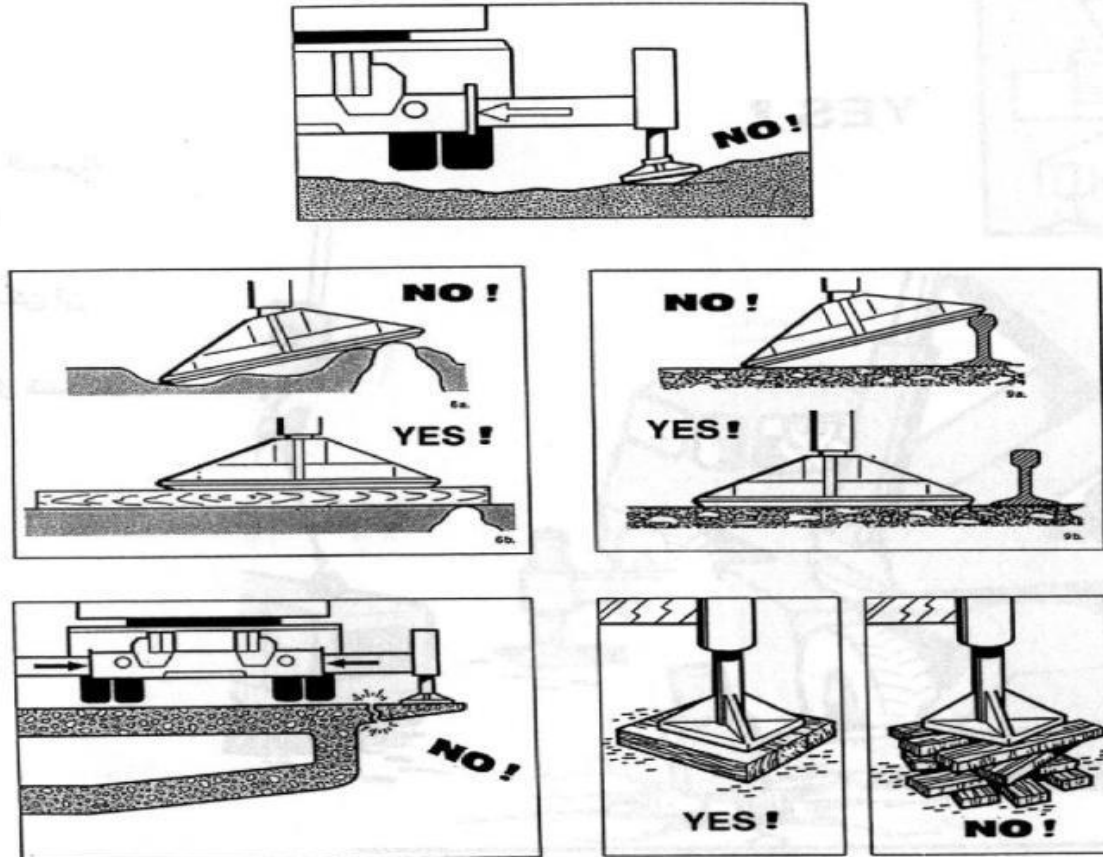
MOBILE CRANE LOADING CASES

Lifting a load over a corner produces maximum ground bearing pressure.



CRANE SET UP

FOLLOW YOUR CRANE MANUFACTURER INSTRUCTIONS

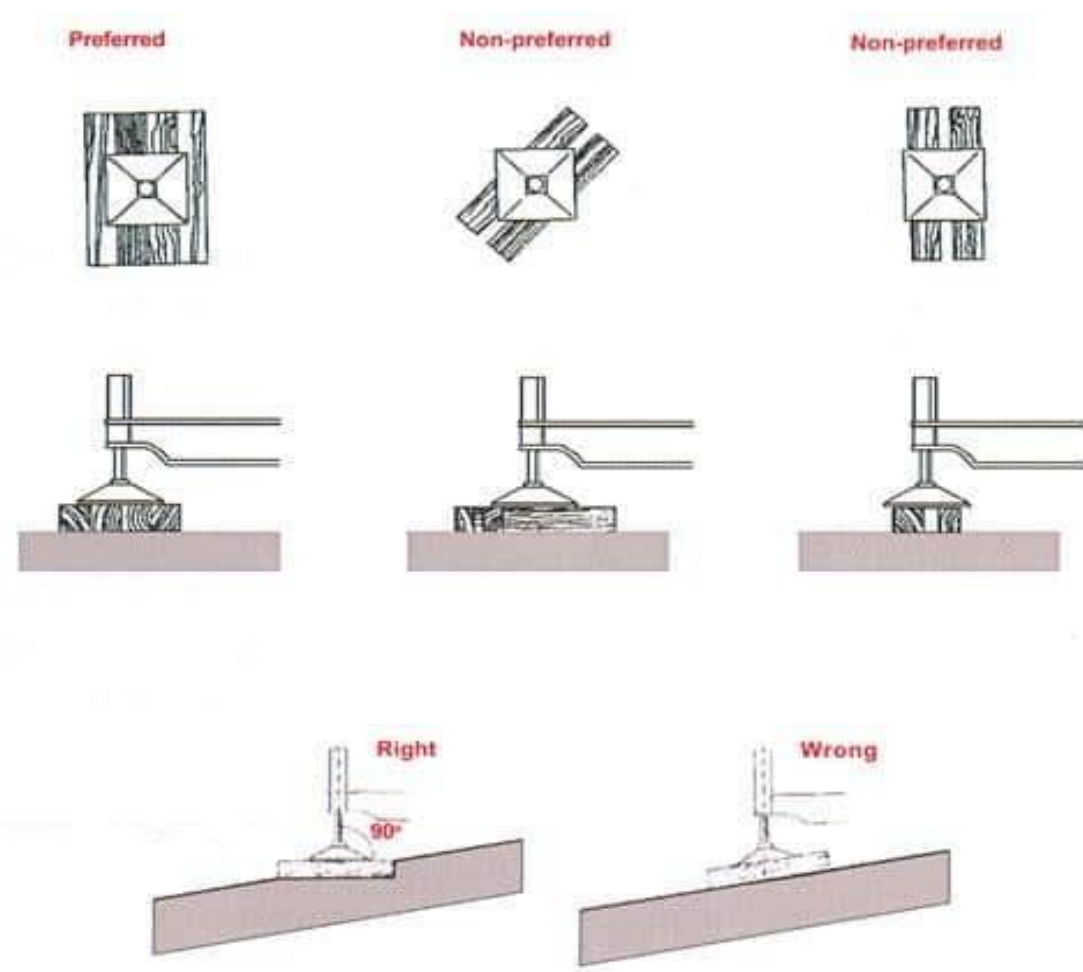


CRANE OUTRIGGERS SET UP

CRANE SET UP

FOLLOW YOUR CRANE MANUFACTURER INSTRUCTIONS

- ▶ Extend and set all outriggers;
- ▶ Set the jib at minimum radius and slew through 360° holding the counterweight for a short period over each outrigger in turn;
- ▶ If outrigger sinks, lower the load and report situation to the appointed person or crane supervisor.



CRANE SET UP

GROUND CONDITION

CRANE STANDING OR SUPPORT CONDITION

The APLO Should ensure that the load imposed by the crane can be sustained by the ground or any means of support, by obtaining the competent person assessment;

- ▶ Get the total load of crane including (counterweights, lifting attachments, dynamic forces caused by movements & wind loading;
- ▶ Typical conditions for which you should be alert are:

Uncompacted fill

Basements

Underground services Heavy

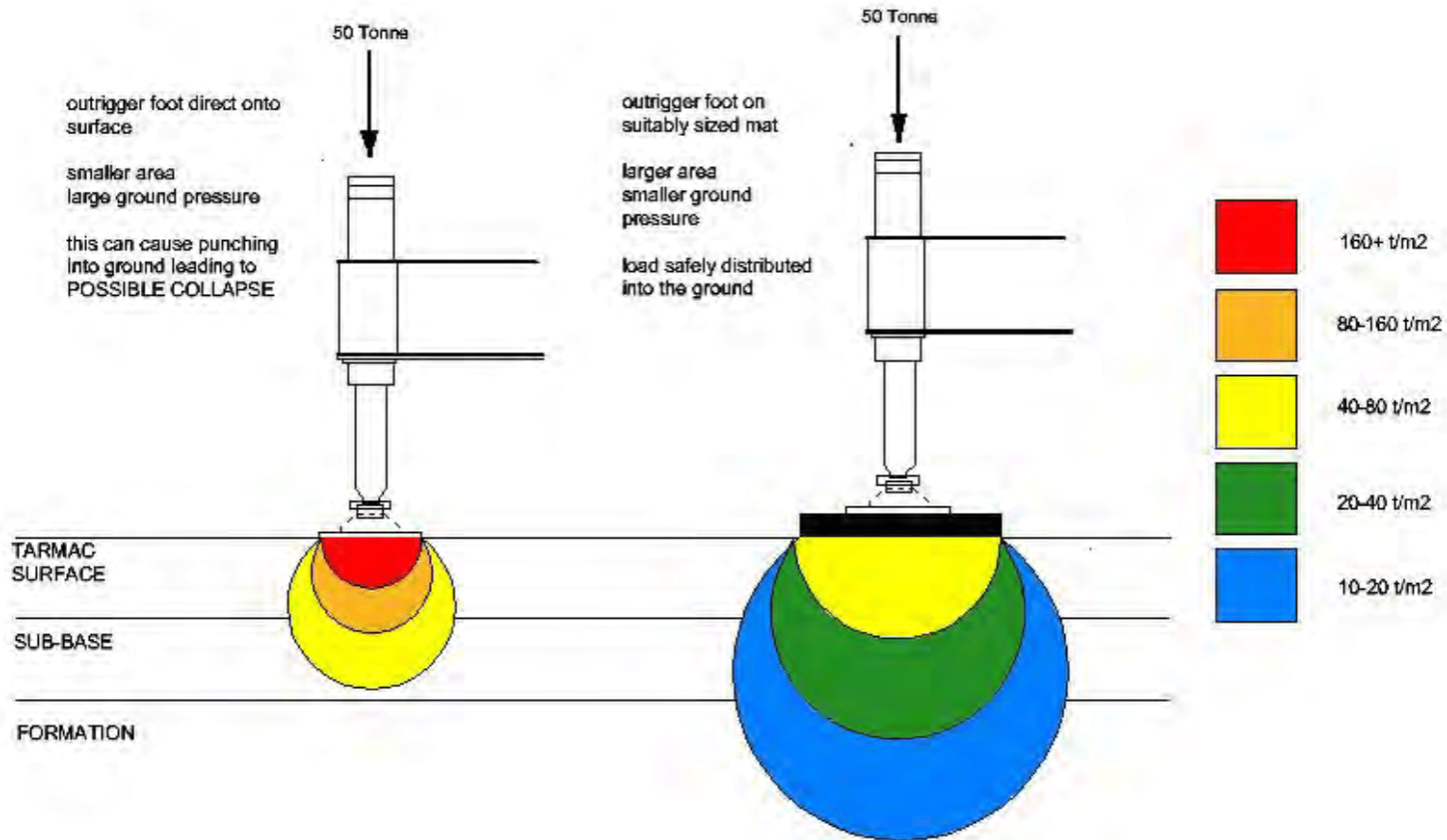
or prolonged rain



CRANE SET UP

GROUND CONDITION

Danger from insufficient bearing area



Ultimate Ground Bearing Pressure / Capacity

The **ultimate ground bearing pressure** (sometimes called ultimate bearing capacity) is the **maximum pressure that the soil can theoretically withstand before failure**.

- It is the **soil's failure point**, where settlement or shear failure occurs.
- Denoted as q_u in engineering.

Key Points:

- Calculated based on soil type, depth, foundation size, and load.
- Not used directly for crane operations; a **factor of safety** is applied.
- Exceeding this may cause **sinking, tilting, or catastrophic failure**.

Ground Bearing Capacity (Safe or Allowable)

The **ground bearing capacity** is the **actual capacity of soil to safely support the crane or foundation, considering safety factors**.

- It is the **load that can be applied safely without risk of failure**.
- Denoted as q_a or q_{allow} .

Key Points:

- Derived from **ultimate capacity ÷ factor of safety (FOS)**.
- Used in **crane lift planning** and **foundation design**.
- Can be influenced by ground prep (mats, timber, compacted soil).

Permissible Ground Bearing Pressure / Capacity

The **permissible ground bearing pressure** is the **maximum pressure allowed by regulation, manufacturer, or engineer** for safe crane operation.

- Often set **below the calculated ground bearing capacity** as an additional safety measure.
- Denoted sometimes as q_p .

Key Points:

- Ensures safe operation **considering dynamic loads**, crane movement, and uneven loading.
- For mobile crane: includes **outrigger load distribution**.
- May differ for **long-term vs short-term loads**.

Soil stability is the ability of soil to support loads without excessive settlement, tilting, or failure.

In crane operations, unstable soil can lead to tipping, sinking, or collapse, even if the crane is within its rated load.

Soil stability = capacity of the ground to safely support the crane and load under operational conditions without failure.

Relationship

Ultimate Ground Bearing Pressure (q_u)

- Maximum pressure soil can physically withstand before failure.
- This is the theoretical limit, determined by soil type, foundation size, depth, etc.
- Not used directly for crane setup — too risky.

Ground Bearing Capacity / Safe Bearing (q_a)

- Calculated from ultimate pressure using a Factor of Safety (FOS):

$$q_a = q_p / FOS$$

- Represents the safe load the ground can carry without structural failure.
- This is used for planning crane lifts, foundations, and outrigger mats.

Permissible Ground Bearing Pressure (q_p)

Set below the safe bearing capacity to account for:

- Uneven outrigger loading
- Dynamic effects (lifting, slewing, wind)
- Temporary soil weaknesses

Ensures additional safety margin on site.

$$q_p \leq q_a$$

CRANE SET UP

GROUND CONDITION

How should a Ground Assessment be carried out?

The ability of ground to sustain applied loadings is typically expressed in two ways:

- ▶ **Ultimate bearing capacity** is the loading at which the ground will fail. This is the un-factored capacity of the ground calculated from the results of ground testing. This is always a much higher value than the permissible bearing capacity and **must not** be used without applying a factor of safety.
- ▶ **Permissible (Allowable) bearing capacity** includes a factor of safety and may be supplied by the ground engineer where this has been specifically requested. If you require the soil investigation specialist to provide interpreted test results eg presented as permissible bearing capacities then this must be specified from the start as it is likely to increase the cost of the service.

CRANE SET UP

GROUND CONDITION

For Onshore Mobile Cranes, below points to be considered in addition to the above:

- a) Calculations to select the Appropriate Mat Size to be provided and to specify the Mat's Material (Wooden, Steel or Concrete).
- b) Site Ultimate Ground Bearing Pressure report to be provided for review. Get the Allowable Ground Bearing Capacity from a certified geotechnical engineer for that specific site coordinate and calculate the bearing pressure based on that report.
- c) "Calculated Ground Bearing Pressure < Allowable Ground Bearing Capacity
- d) All Four Outriggers/Crawler Tracks Pressure on Ground (under Worst Case Scenario) to be calculated using Crane Manufactures Software or Manually using the method specified in UK NCC (National Construction College), i.e., $\frac{((Crane\ Weight + Additional\ Counterweight) \times 0.75) + Load\ Weight}{Outrigger\ Area}$.

CRANE SET UP

GROUND CONDITION

For Onshore Mobile Cranes, below points to be considered in addition to the above:

- d) Ultimate Ground Bearing Pressure should be more than Outrigger/Crawler Tracks Pressure on Ground after adding a Minimum Safety Factor of 1.5 in case using Crane's Manufacture's Software
(The factor of 1.5 is the absolute minimum, shall be used only under the guidance of an experienced geotechnical engineer) and a Minimum Safety Factor of 2 in case of Manual Calculation.
- e) Ground Foundation type to be mentioned.

CRANE SET UP

GROUND CONDITION

Sound & adequate packing should be used to spread the load under outriggers and it should be placed to give proper, firm support on all types of surface, including concrete and tarmac;

- ▶ The amount & type of packing should be specified in the lift plan or method statement... (timber / plywood, steel & concrete mats);
- ▶ You should know the ground bearing pressure and the loading under each outrigger, as the crane is slewed;
- ▶ “Rule of thumb” calculation can be done if there are no obvious signs of ground problems:

CRANE SET UP

GROUND CONDITION

Calculations – Minimum Pad Area

ASSUME MAXIMUM ALLOWABLE GROUND BEARING PRESSURE = 15 t per m²

TOTAL WEIGHT OF CRANE (Crane + Counterweight) = 60 t

TOTAL WEIGHT OF LOAD AND ACCESSORIES(MGW) = 15 t

Load on Outrigger = 75% of Crane's Weight + Weight to be lifted (Including Hook block weight & Lifting Accessories weight)

Minimum Pad Area =
$$\frac{\text{Load on Outrigger}}{\text{Allowable Ground Bearing Pressure}}$$

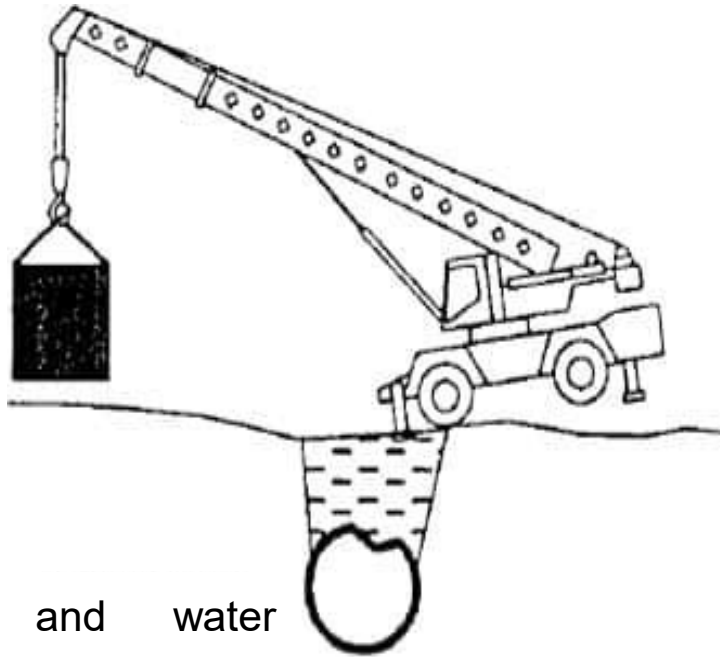
Load on Outrigger = $(60 \times 0.75) + 15 = 60 \text{ t}$

Min Mat Area = $60 \text{ t} / 15 \text{ t per m}^2 = 4.0 \text{ m}^2$

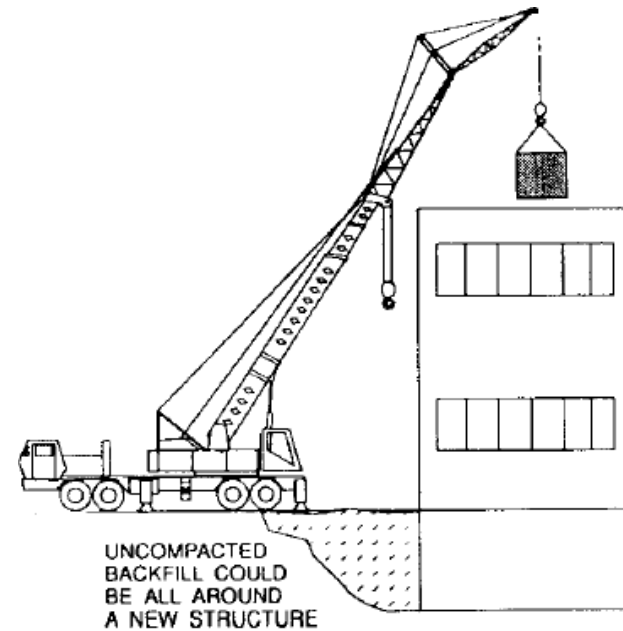
EACH OUTRIGGER REQUIRES 4.0 m² MAT AREA

CRANE SET UP

GROUND CONDITION



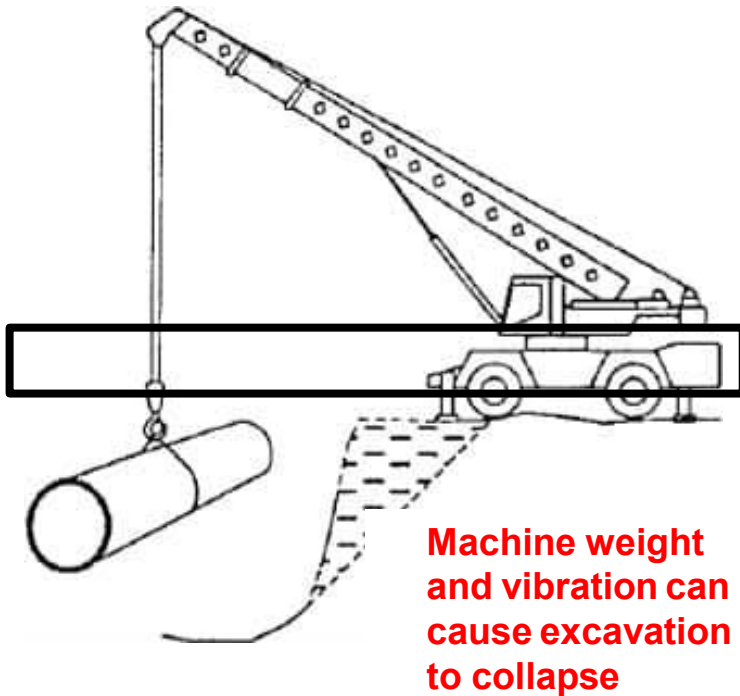
Sewers and water mains can collapse from machine weight and vibration



Use extreme caution when hoisting beside buildings (particularly newly constructed) with un compacted backfill, along trenches which could collapse, or in areas where water mains, sewer pipes, or steam lines may possibly undermine the soil.

CRANE SET UP

GROUND CONDITION ... TRENCHES

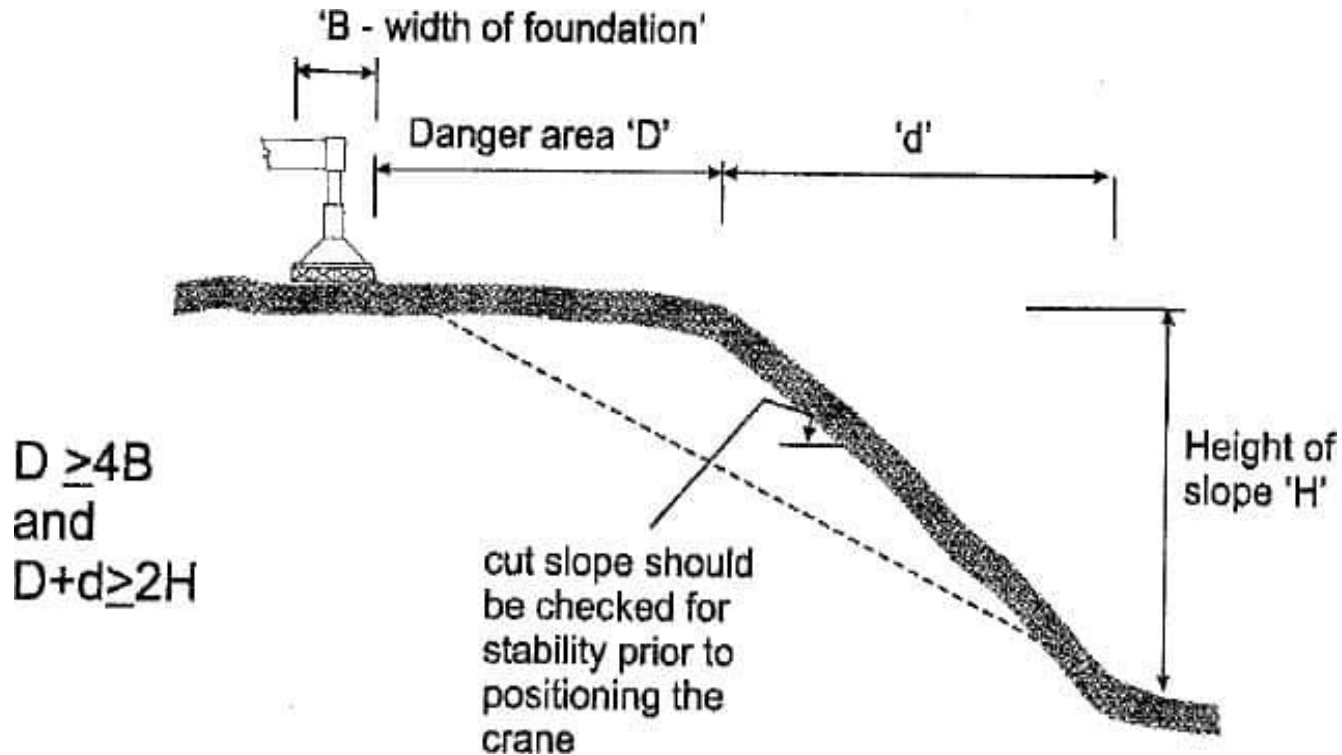


- ▶ Even if mats are properly dimensioned;
- ▶ Check the excavation face condition;
- ▶ Do not position the crane outriggers wheels or tracks any closer to the edge than a distance equal to trench depth unless trench walls are properly supported;
- ▶ Check the excavation face condition as frequently as possible;
- ▶ Ensure that the crane is levelled

STAY AWAY FROM TRENCHES

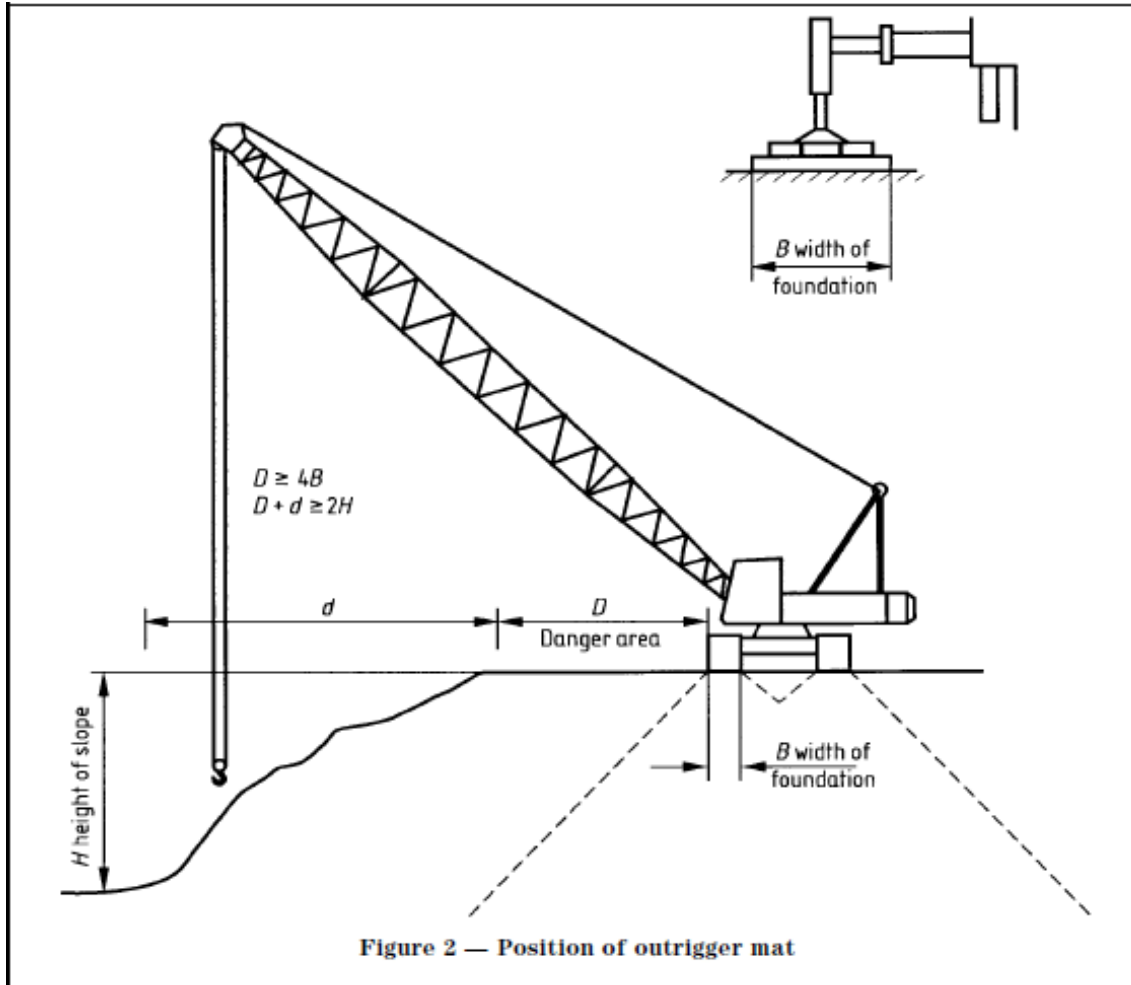
CRANE SET UP

GROUND CONDITION ... TRENCHES



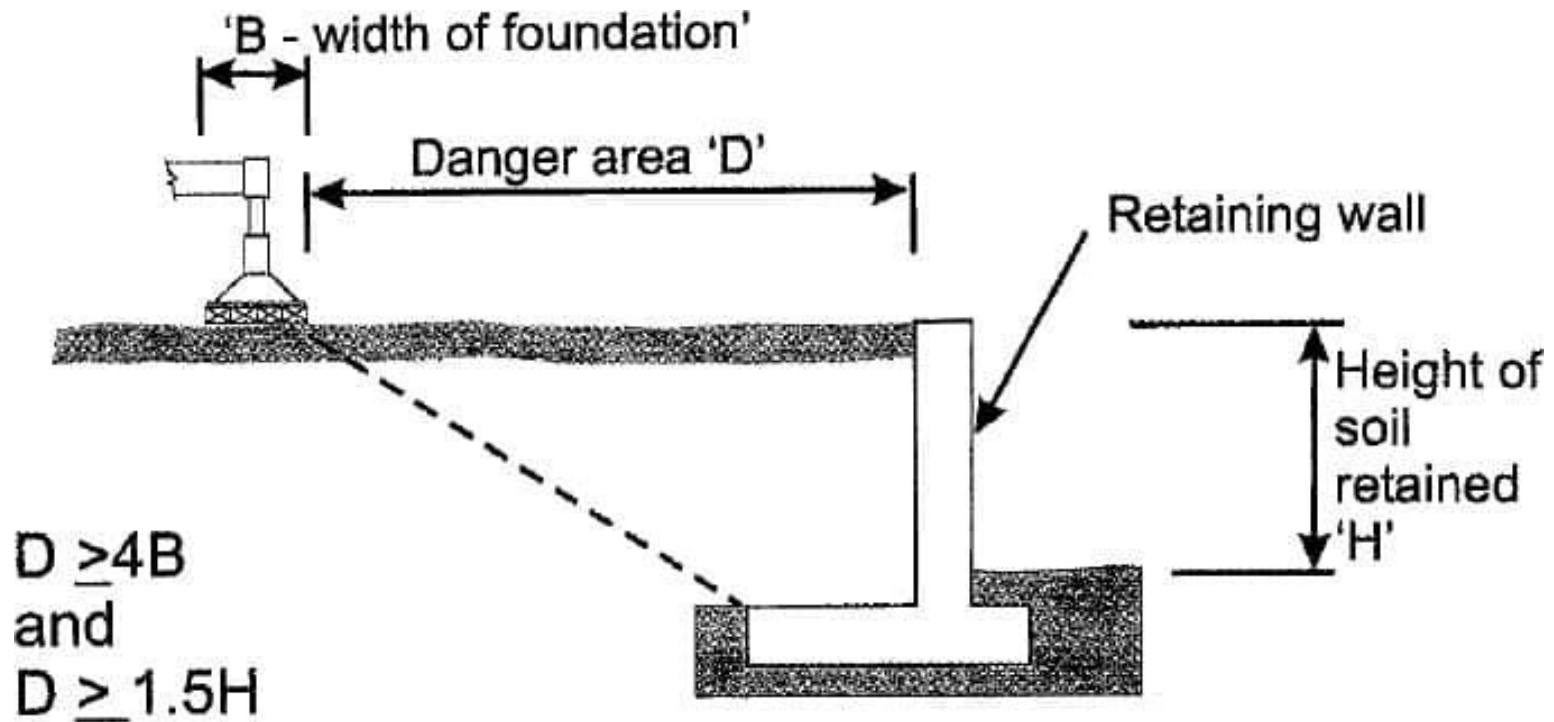
CRANE SET UP

GROUND CONDITION ... TRENCHES



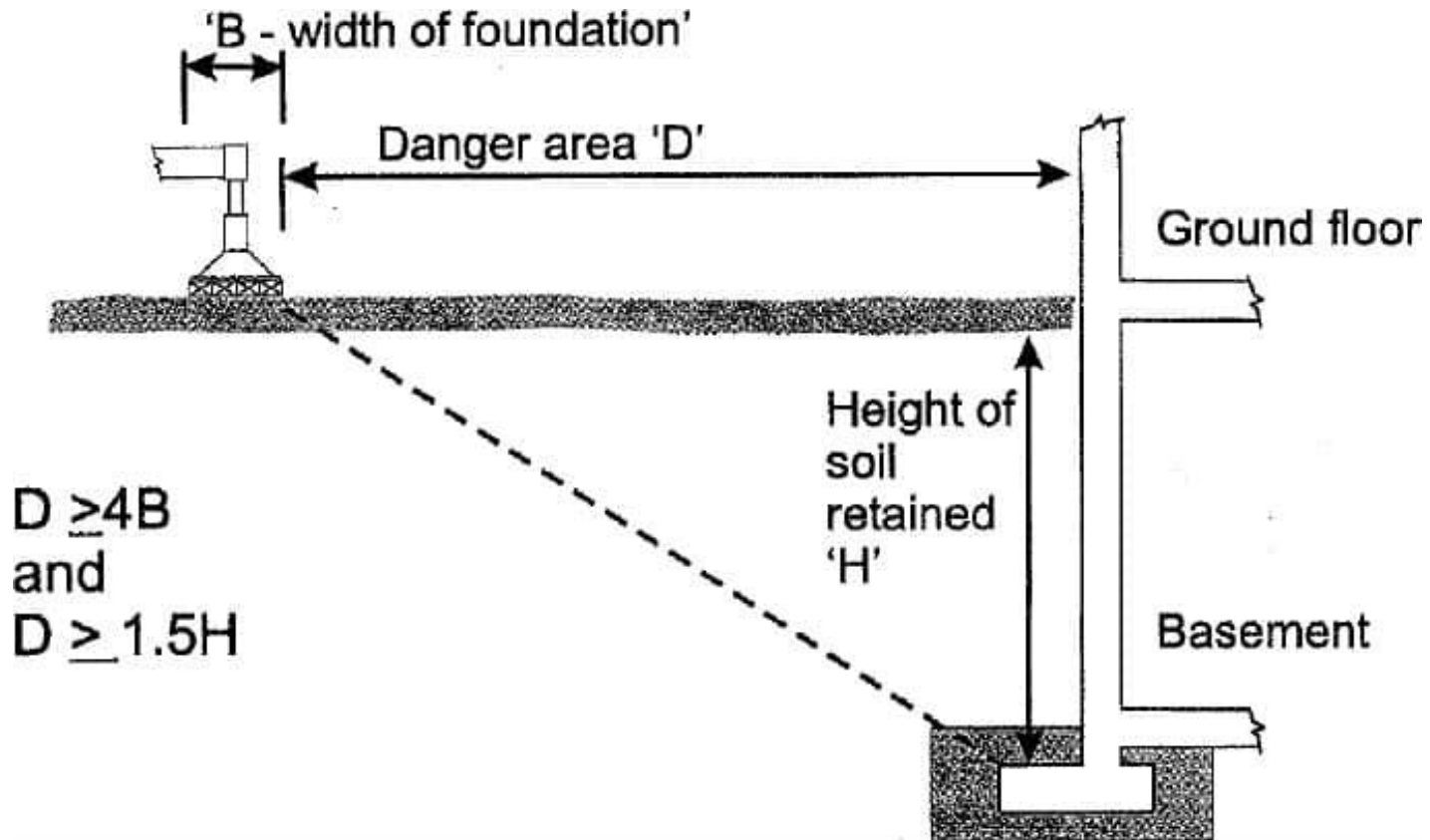
CRANE SET UP

GROUND CONDITION ... TRENCHES



CRANE SET UP

GROUND CONDITION ... TRENCHES



CRANE SET UP

LEVELLING

- ▶ Ensure the crane is levelled both lengthways and across the chassis before any lift is attempted;
- ▶ Check the levelling during lifting operation;
- ▶ Manufacturers rate their crawler cranes for level operation;
- ▶ Three Degrees Off Level Will Reduce Any Crane Capacity By Approximately 50%;
- ▶ One Degree Off Level Will Reduce Any Crane Capacity By Approximately 30%.



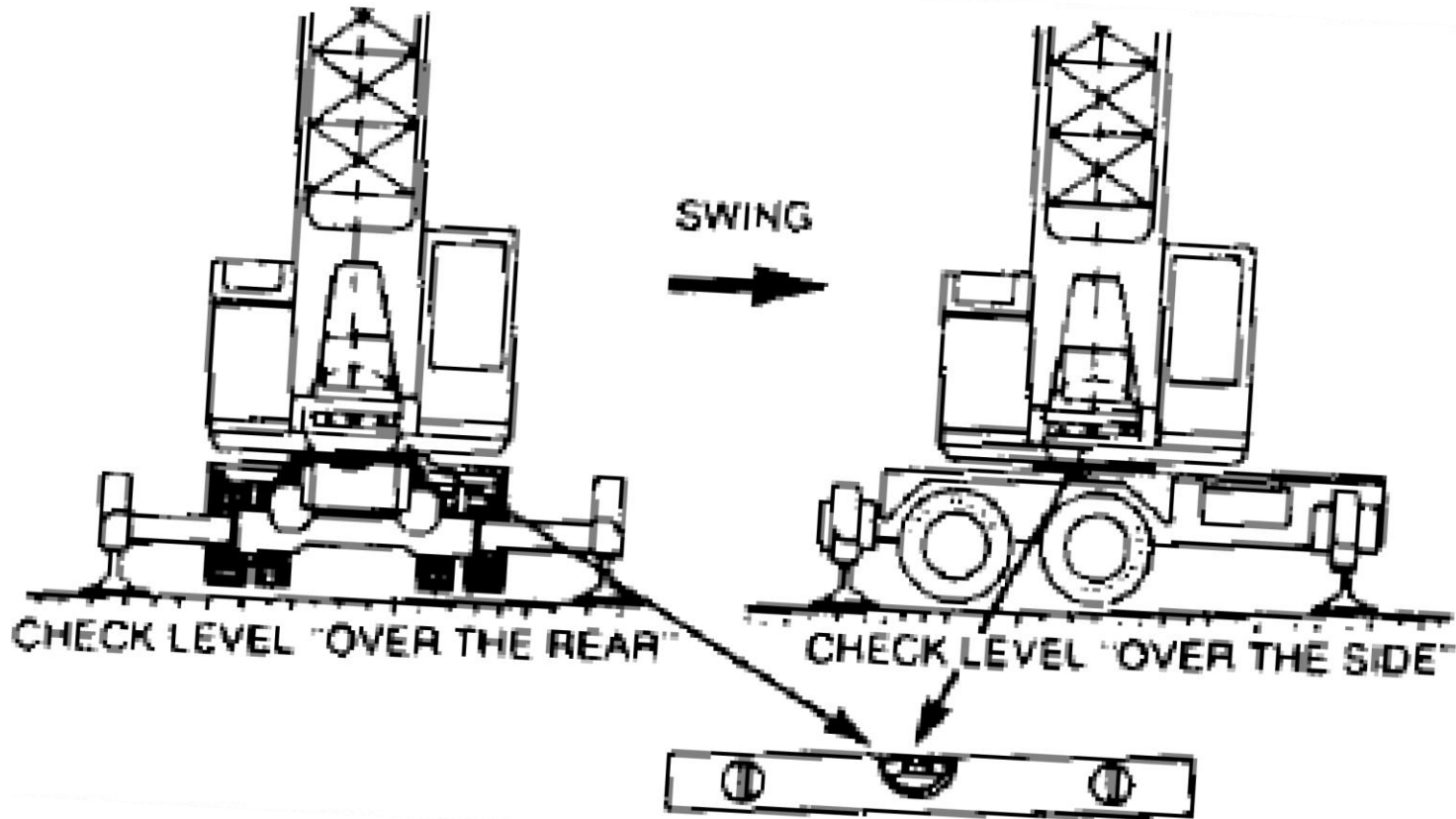
CRANE SET UP

CARPENTER LEVEL



CRANE SET UP

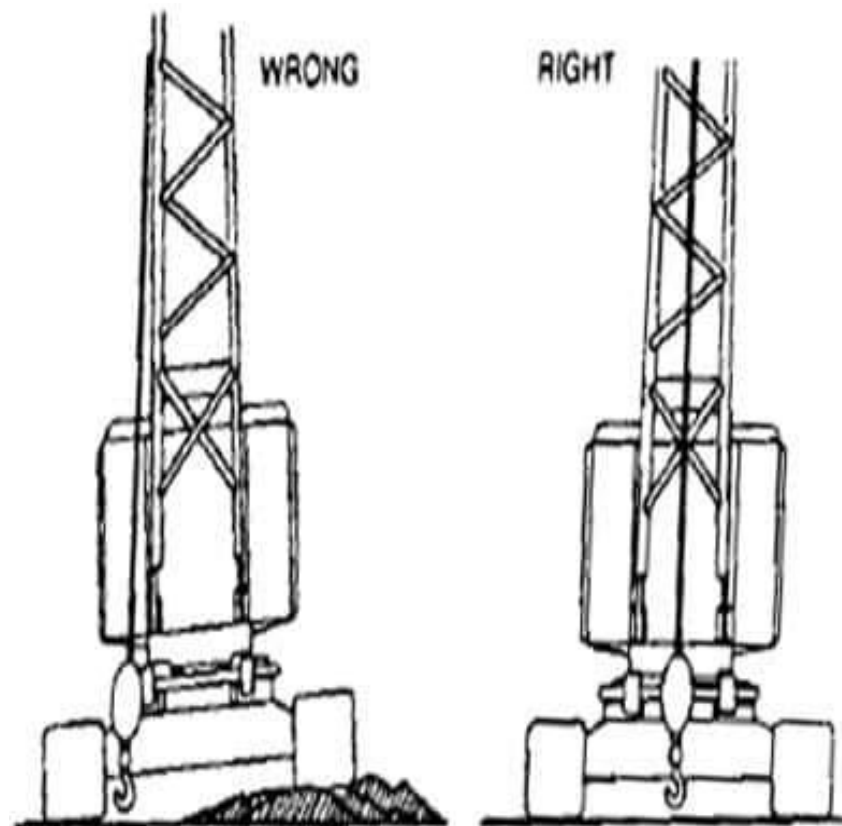
CARPENTER LEVEL



CRANE SET UP

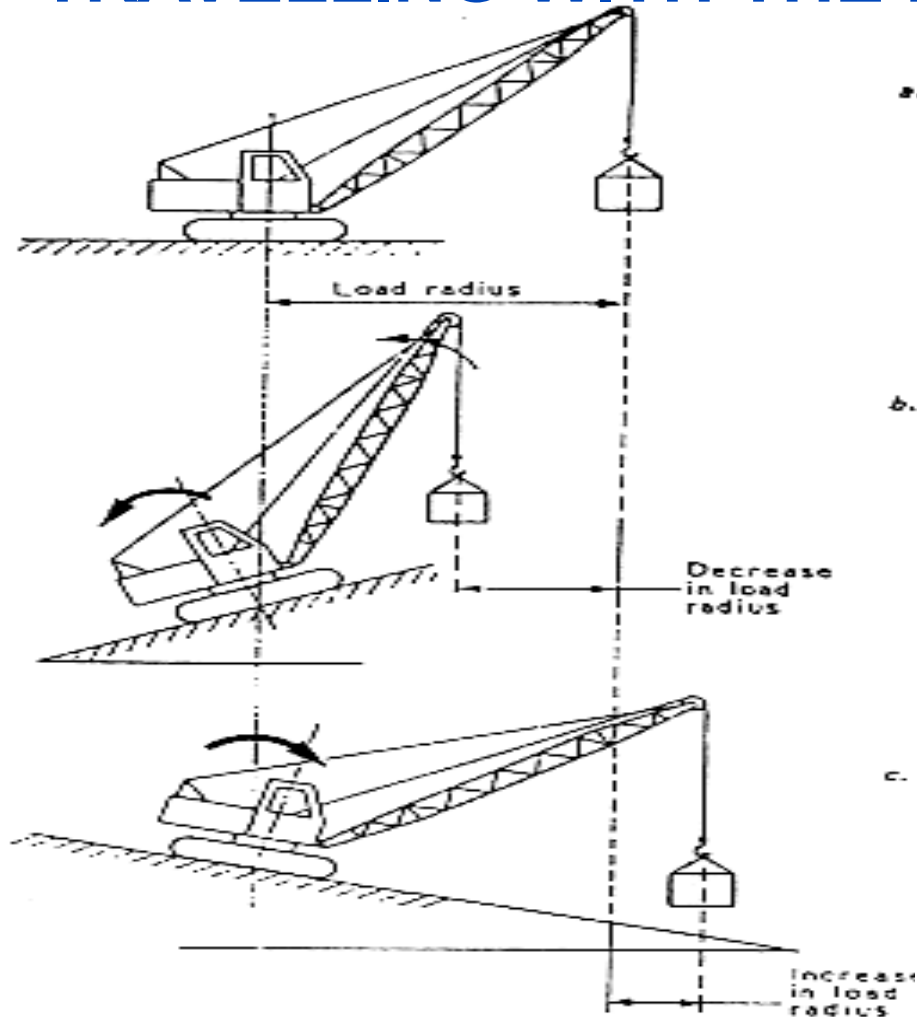
LEVELLING

Boom Length & Lift Radius	Chart Capacity Lost When Crane Out of Level By		
	1°	2°	3°
Short Boom, Minimum Radius	10%	20%	30%
Short Boom, Maximum Radius	8%	15%	20%
Long Boom, Minimum Radius	30%	41%	50%
Long Boom, Maximum Radius	5%	19%	15%



LEVELLING WITH THE WHIP LINE

TRAVELLING WITH THE LOAD



AVOID WORKING ON SLOPING GROUND

a. **A) Level ground**

Correct load radius

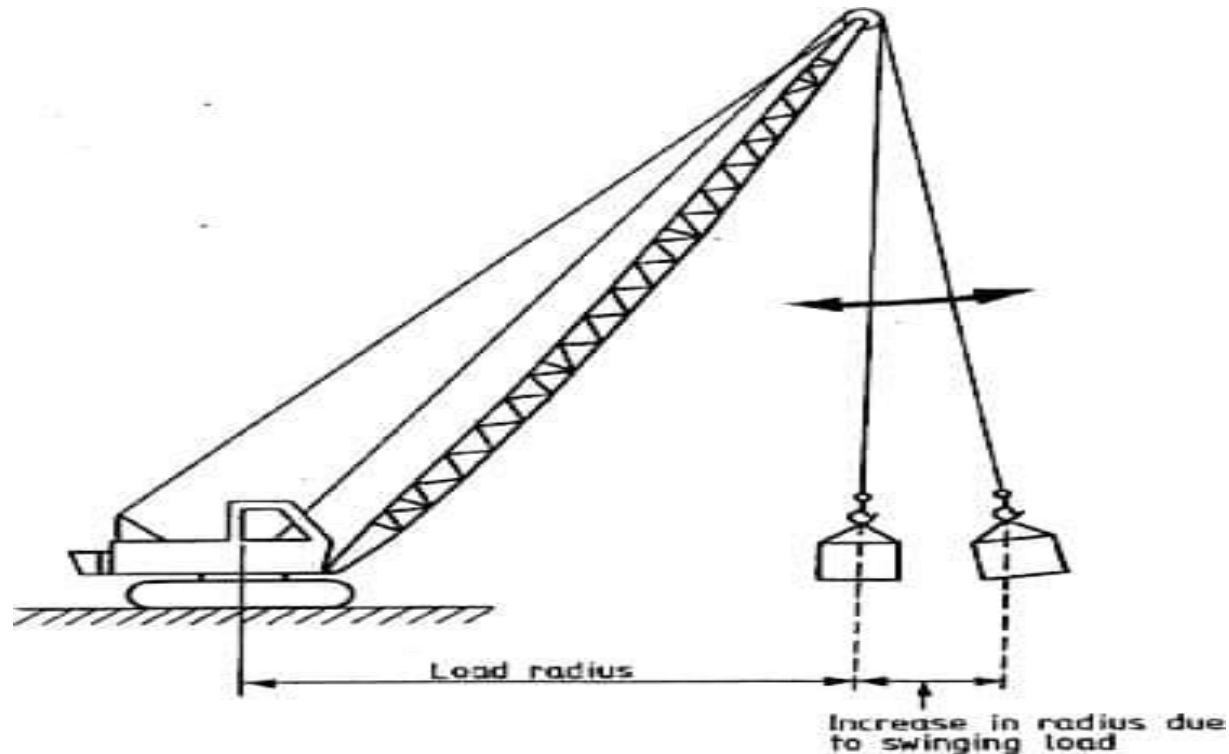
b. **B) Uphill position**

The load moves in towards the machine. The decrease in load radius may cause the machine (or jib) to tip over backwards. Greatest danger of instability occurs when load set down

c. **C) Downhill position**

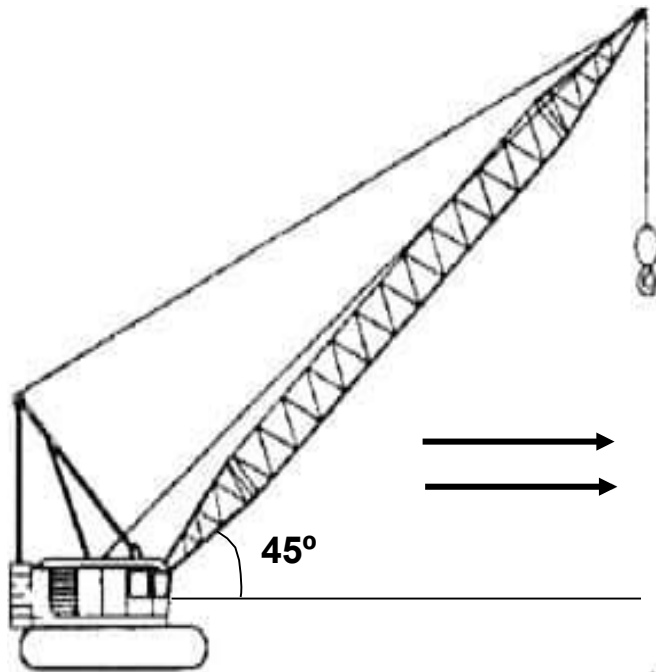
The load moves out of radius away from the machine. This may overload the crane and cause the machine to tip over forwards

TRAVELLING WITH THE LOAD

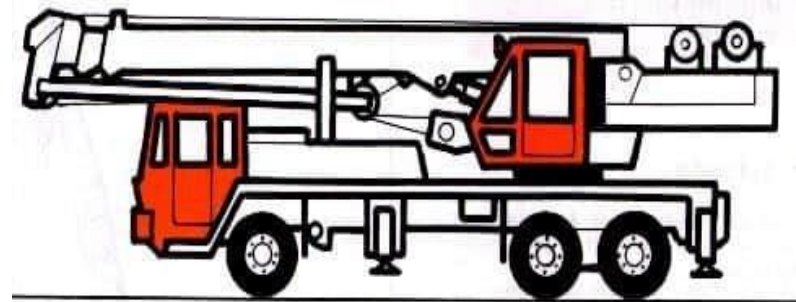


Note: loads should always be lifted gently and crane motions should be operated smoothly to avoid loads swinging (a swinging load will increase the overturning moment of the cranes). Steady lines should be used where necessary and where the load presents a wind catching area. Travel should always take place with the load near to ground level so load swinging can be controlled.

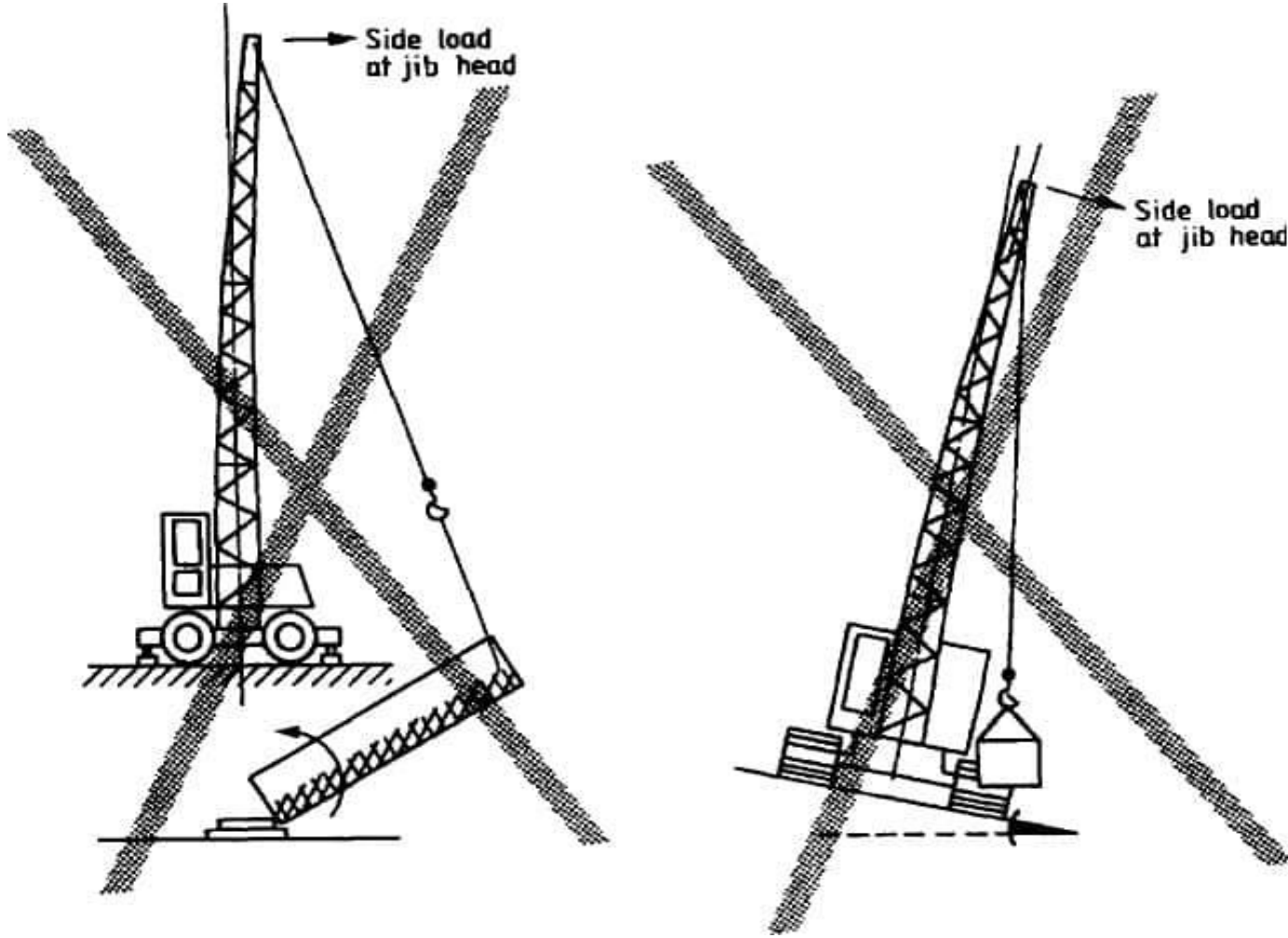
TRAVELLING WITH THE LOAD



- ▶ When travelling on site without load:
- ▶ Position the crawler crane boom @ 45°;
- ▶ Stow the telescopic crane jib in the support bracket;
- ▶ Engage the slew lock pin (if fitted) when travelling loaded or unloaded.



SWINGING



CONTROL OF PENDULUM SWINGING OF LOAD

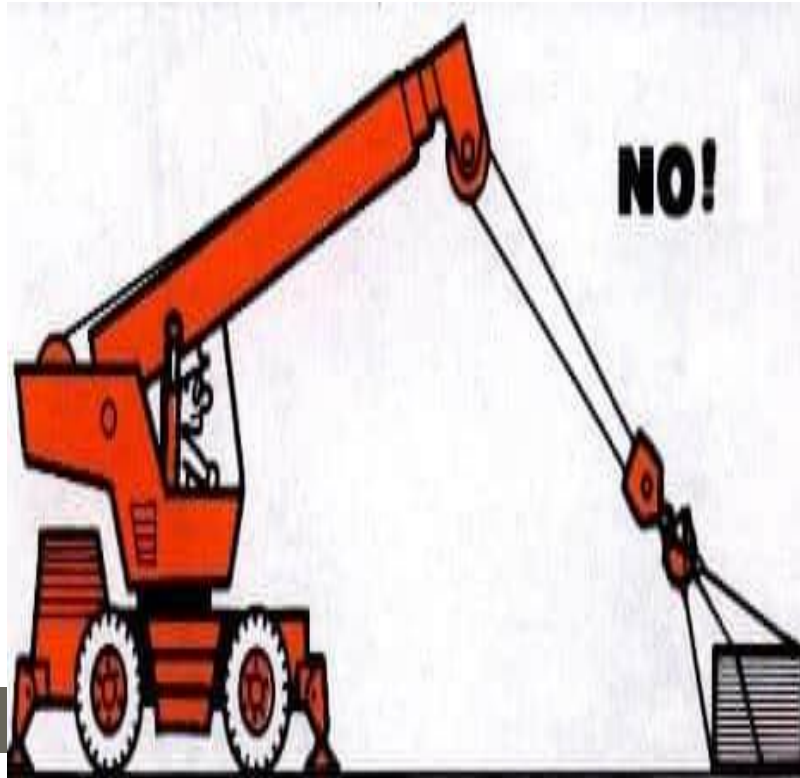
VIDEO ILLUSTRATION



BAD LIFTING PRACTICES

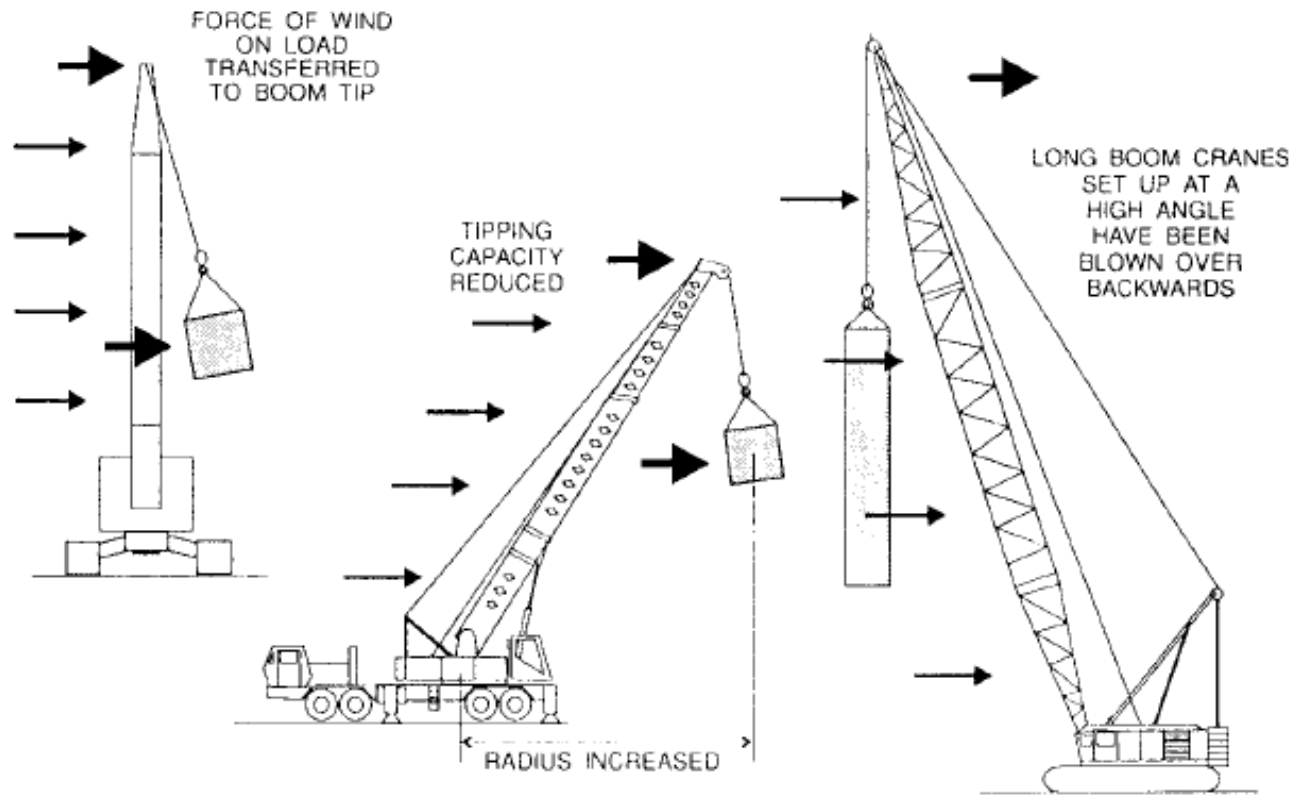
BAD LIFTING PRACTICES

DO NOT DRAG THE LOAD



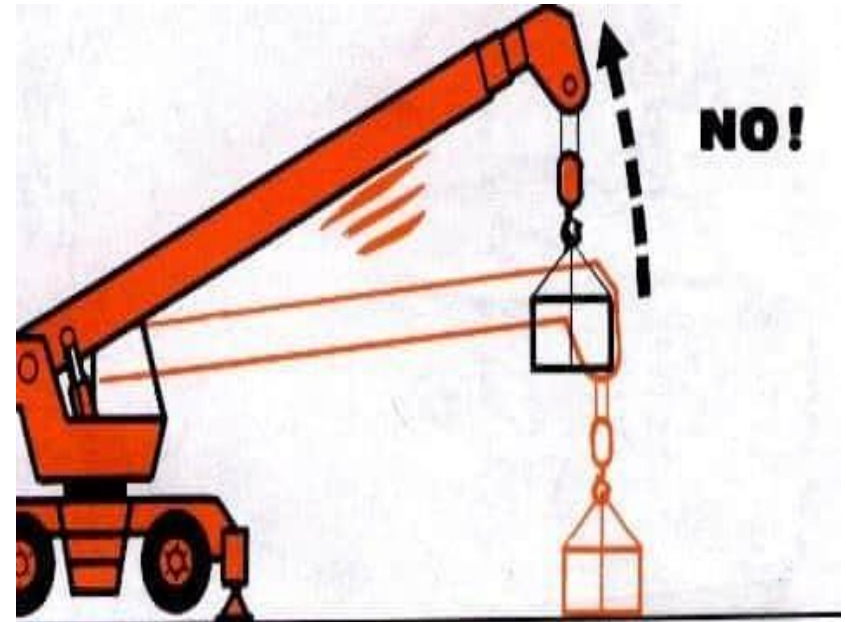
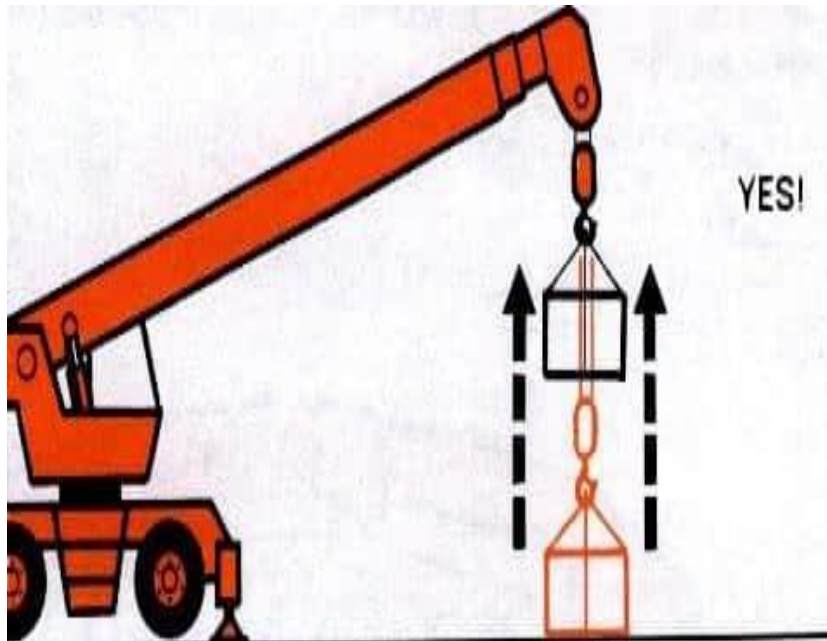
BAD LIFTING PRACTICES

Wind Force & Capacity Loss



BAD LIFTING PRACTICES

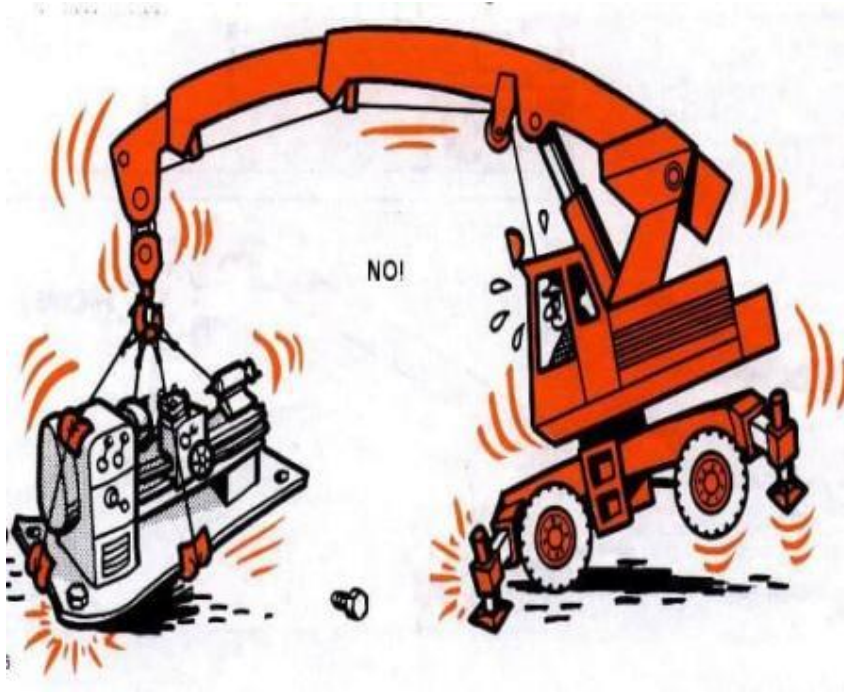
DO NOT BOOM UP WITH LOAD INITIALLY



- ▶ Never extend/retract boom with suspended load.

BAD LIFTING PRACTICES

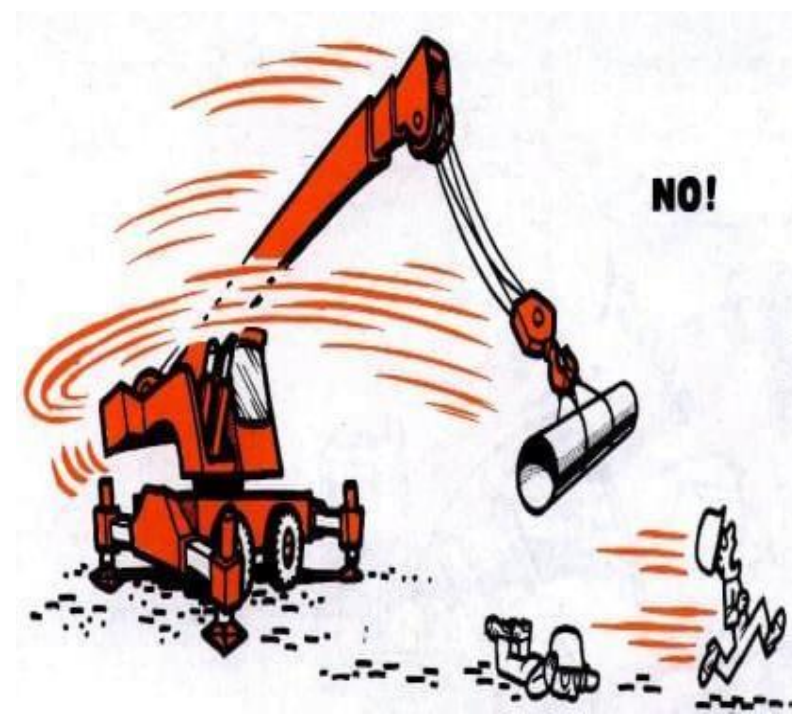
MEASURE YOUR RADIUS



BAD LIFTING PRACTICES



LEVEL YOUR CRANE



DO NOT SWING YOUR LOAD QUICKLY !

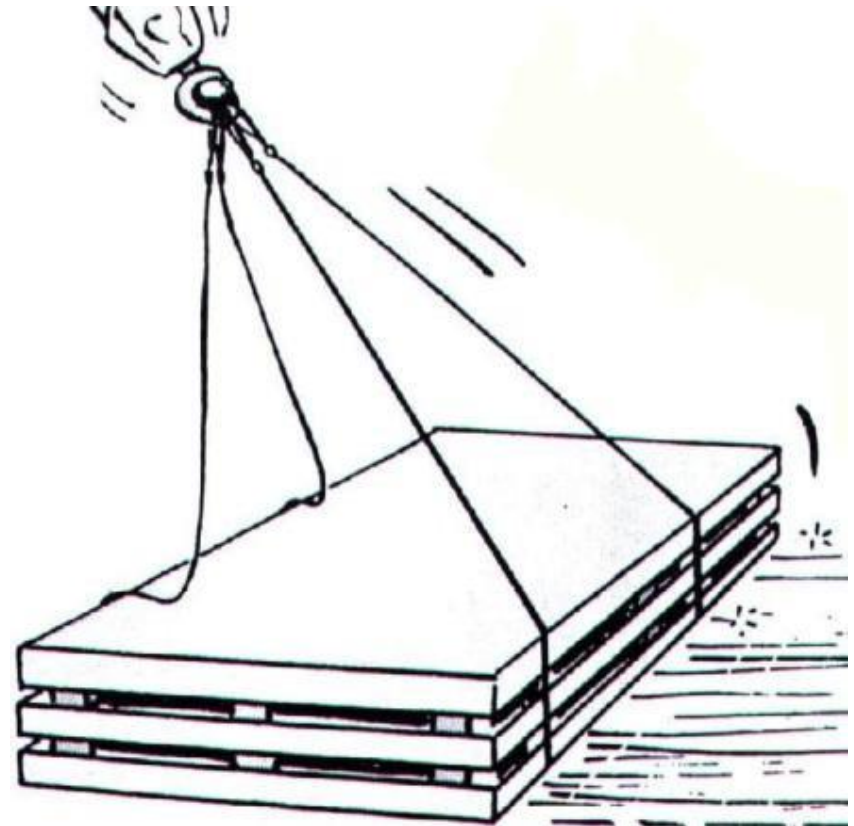
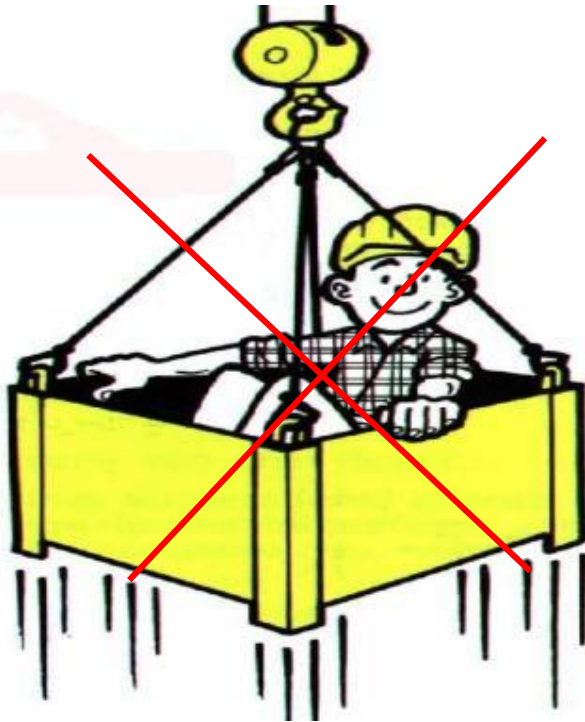
BAD LIFTING PRACTICES

LOWER YOUR BOOM SLOWLY & LOOK AT THE LOAD ALL THE TIME



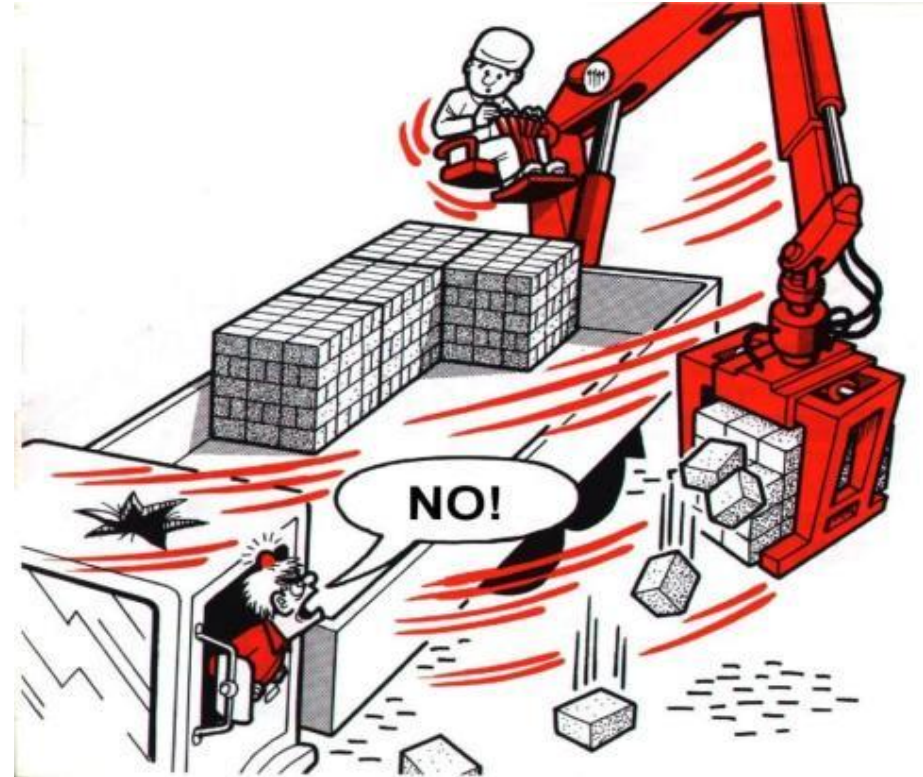
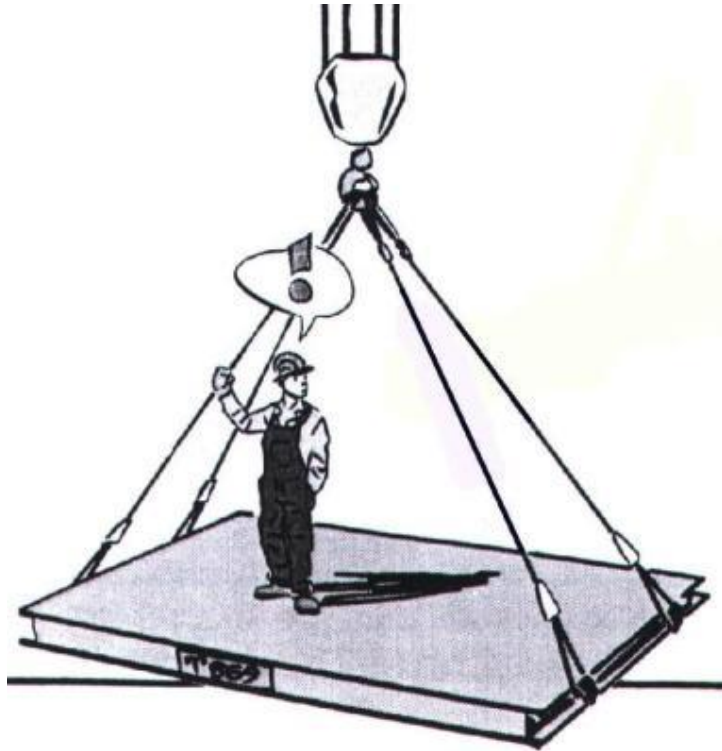
BAD LIFTING PRACTICES

DO NOT LIFT PERSONNEL IN HALF HEIGHT CONTAINERS



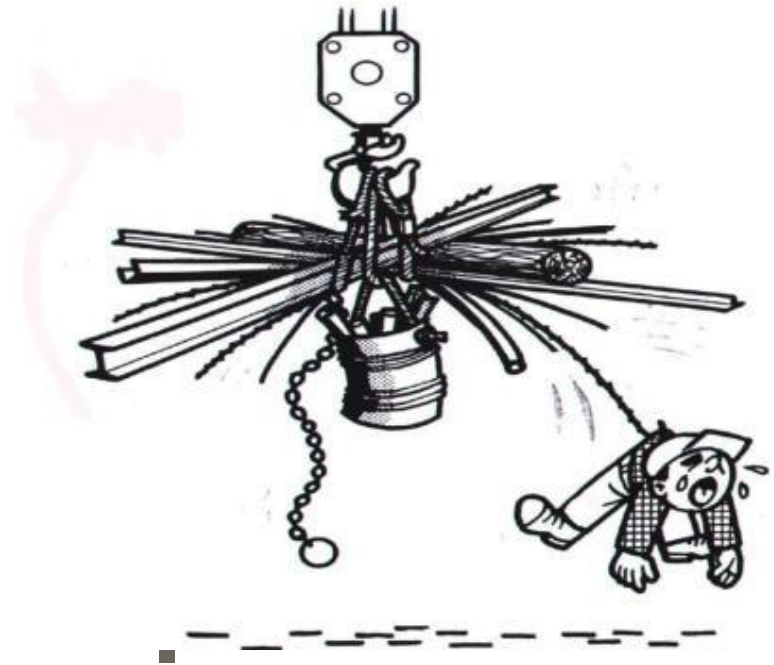
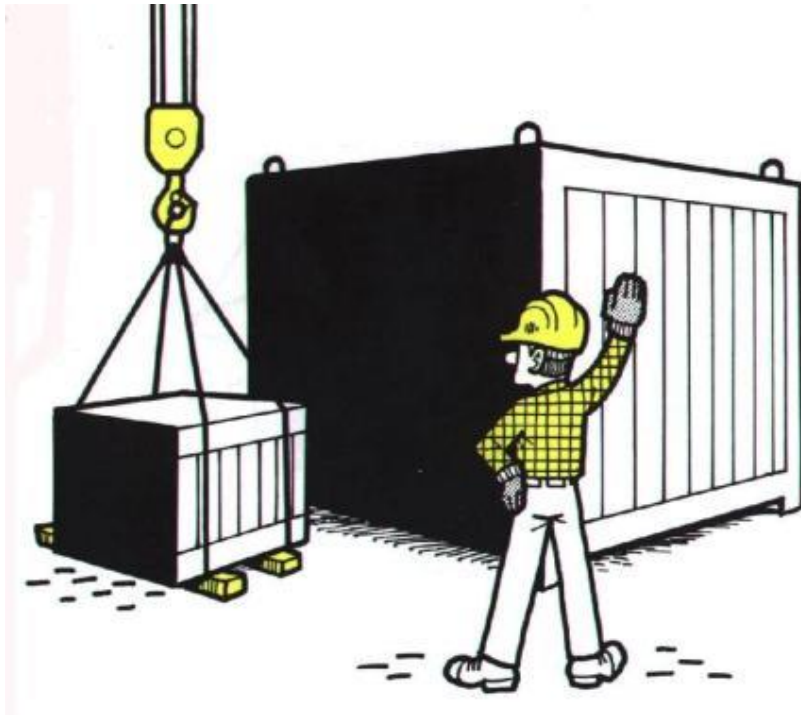
BAD LIFTING PRACTICES

DO NOT LET PERSONNEL STANDING ON LOAD WHILE LIFTING



BAD LIFTING PRACTICES

SECURE YOUR LOAD BEFORE LIFTING



VIDEO ILLUSTRATION



LOAD RATING CHARTS



LOAD RATING CHARTS

A Load Chart is a manufacturer-approved table that specifies the maximum safe lifting capacity of a crane for different configurations such as:

- Boom length
- Load radius
- Boom angle
- Outrigger position
- Counterweight

It is based on a percentage of the crane's tipping load (typically 85% on outriggers, 75% on rubber).

Load Chart = The official table that tells how much weight the crane can safely lift under specific conditions.

Load Chart : A Load Chart is a diagram or table showing the Safe Working Load and the Rated Capacity relative to the radius, environmental conditions, out of plane influences and type of operation. The load chart shall state the in-service operational limits of the Crane, e.g. wind, heel, trim, ice, etc. and the chart is permanently fix located within the Crane's Operator Cabin.

LOAD RATING CHARTS

UNITS

- ▶ The tonne (unit symbol t) or metric ton is a unit of mass equal to 1,000 kg (2,204.62262 lb) approximately the mass of one cubic metre of water at four degrees Celsius.
- ▶ The short ton is a unit of weight equal to 2,000 pounds (907.18474 kg)
- ▶ Long ton is equal to 2,240 pounds (1,016.0469088 kg)
- ▶ 1 yard = 3 ft = 36 inches = 0.91 meter
- ▶ 1 meter = 1.09 yds = 3.28 ft = 39.37 in.
- ▶ 1 pound = 0.45 kg
- ▶ 1 kg = 1000 grams = 2.2 lbs

LOAD RATING CHARTS

HITACHI CRAWLER CRANE – 250 t

RADIUS	BOOM LENGTHS											
	15.25	18.30	21.35	24.40	27.45	30.50	33.50	36.55	39.60	42.65	45.7	48.75
4.60	250.00											
5.00	29.70	219.4/5.2	197.5/5.7									
6.00	188.50	188.30	188.20	180.0/6.2	166.4/6.8							
7.00	162.70	162.50	162.40	162.10	161.80	145/7.3	138.4/7.8					
8.00	143.00	142.80	142.70	142.40	142.10	142.40	137.60	125/8.3	114.4/8.9			
9.00	127.40	127.20	127.10	126.80	126.50	126.80	126.50	123.10	114.10	104.6/9.4	95.0/9.9	
10.00	110.50	110.40	110.40	110.40	110.30	110.60	110.40	110.40	111.30	103.10	95.00	86.6/10.5
12.00	84.20	84.10	84.00	84.00	83.80	84.10	83.90	83.90	83.80	83.50	84.00	84.00
14.00	67.70	67.50	67.40	67.30	67.10	67.40	67.10	67.20	67.00	66.70	66.60	66.60
16.00	62.0/14.8	56.20	56.00	55.90	55.60	55.90	55.60	55.70	55.50	55.20	55.00	55.00
18.00		49.8/17.5	47.70	47.50	47.30	47.60	47.30	47.30	47.10	46.70	46.60	46.60
20.00			41.40	41.20	41.00	41.20	40.90	40.90	40.70	40.30	40.20	40.10
22.00			41.1/50.1	36.30	36.00	36.20	35.90	35.80	35.60	35.30	35.10	35.10
24.00				34.8/22.7	32.00	32.20	31.80	31.80	31.60	31.20	31.10	31.00
26.00					29.6/25.4	28.90	28.50	28.40	28.20	27.90	27.70	27.60
28.00						26.10	25.70	25.70	25.40	25.10	24.90	24.80
30.00							23.40	23.30	23.10	22.70	22.50	22.40
32.00							22.7/30.7	21.30	21.00	20.60	20.50	20.40
34.00								20.10	19.30	18.90	18.70	18.60
36.00									17.8/35.9	17.30	17.10	17.00
38.00										16.00	15.80	15.60
40.00										15.6/38.6	14.60	14.40
42.00											13.9/41.2	13.30
44.00												12.4/43.9

LOAD RATING CHARTS

HITACHI CRAWLER CRANE

RADIUS	BOOM LENGTHS												
	51.80	54.85	57.9	60.95	64.00	67.05	70.10	73.15	73.15	76.20	79.25	82.30	85.35
9.00													
10.00	79.2/11.0	72.9/11.5											
12.00	77.70	72.20	67.10	61.3/12.6	56.4/13.1	52.0/13.6							
14.00	66.30	66.30	64.80	59.90	55.60	51.70	47.4/14.2	43.0/14.7	37.5/14.5	34.5/15.0	32.7/15.5		
16.00	54.70	54.50	54.50	54.50	53.90	50.10	46.10	41.80	35.90	33.50	32.10	31.5/16.1	25.0/16.5
18.00	46.20	46.10	46.00	45.70	45.70	45.50	42.80	38.50	34.30	31.70	30.40	28.60	25.00
20.00	39.80	39.60	39.60	39.30	39.20	39.00	39.50	35.40	32.90	29.60	28.30	27.00	25.00
22.00	34.70	34.60	34.50	34.20	34.10	33.90	33.60	32.80	30.50	27.80	26.40	25.80	25.00
24.00	30.60	30.50	30.40	30.10	30.00	29.80	29.50	29.50	29.20	26.70	25.30	24.50	23.00
26.00	27.30	27.10	27.00	26.70	26.60	26.40	26.10	26.10	27.00	25.20	24.30	23.50	22.00
28.00	24.40	24.30	24.20	23.80	23.80	23.60	23.30	23.20	24.20	23.90	23.10	22.40	21.00
30.00	22.00	21.90	21.80	21.40	21.40	21.20	20.80	20.80	21.70	21.70	21.60	21.30	19.90
32.00	20.00	19.80	19.70	19.40	19.30	19.10	18.80	18.70	19.70	19.60	19.50	19.60	18.80
34.00	18.20	18.00	17.90	17.60	17.50	17.30	16.90	16.90	17.80	17.80	17.70	17.70	17.60
36.00	16.60	16.40	16.30	16.00	15.90	15.70	15.30	15.30	16.30	16.20	16.10	16.10	16.20
38.00	15.20	15.00	14.90	14.60	14.50	14.30	13.90	13.90	14.80	14.80	14.70	14.70	14.80
40.00	14.00	13.80	13.70	13.30	13.30	13.00	12.70	12.60	13.60	13.50	13.50	13.50	13.50
42.00	12.90	12.70	12.60	12.20	12.10	11.90	11.60	11.50	12.50	12.40	12.40	12.40	12.40
44.00	11.90	11.70	11.60	11.20	11.10	10.90	10.60	10.50	11.50	11.40	11.30	11.30	11.40
46.00	11.10	10.90	10.70	10.30	10.20	10.00	9.70	9.60	10.60	10.50	10.40	10.40	10.50
48.00	10.9/46.5	10.10	9.90	9.50	9.40	9.20	8.80	8.80	9.70	9.70	9.60	9.60	9.60
50.00		9.6/49.1	9.20	8.80	8.70	8.40	8.10	8.00	9.00	8.90	8.80	8.80	8.90
52.00			8.6/51.8	8.10	8.00	7.70	7.40	7.30	8.30	8.20	8.1	8.10	8.20
54.00				7.50	7.40	7.10	6.70	6.70	7.60	7.60	7.50	7.50	7.50
56.00				7.4/54.4	6.80	6.50	6.20	6.00	7.00	7.00	6.90	6.90	6.90
58.00					6.5/57.1	6.00	5.50	5.40	6.50	6.40	6.40	6.40	6.40
60.00						6.5/59.7	4.90	4.80	6.00	5.90	5.90	5.90	5.90
62.00							4.40	4.20	5.50	5.50	5.40	5.40	5.40
64.00							4.3/62.3	3.70	5.10	5.00	4.90	4.90	4.90
66.00								3.5/65.0	4.9/64.9	4.50	4.40	4.40	4.40
68.00										4.2/67.5	4.00	3.90	4.40
70.00											3.50	3.50	3.90
72.00											3.5/70.2	3.10	3.50
74.00												3.0/72.8	3.10
76.00													2.70
78.00													2.6/74.8

LOAD RATING CHARTS


TADANO ATF 60-3 CRANE

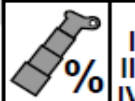




13.2t

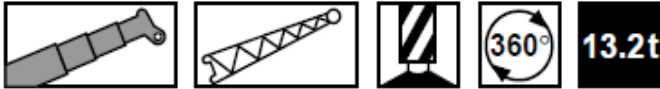
DIN / ISO

 m	10.4 m	14.1 m	17.8 m	21.6 m	25.3 m	29.0 m	32.7 m	36.5 m	40.2 m
2.5	60.0*								
2.5	55.0								
3.0	49.6	30.0							
3.5	45.2	30.0	30.0						
4.0	41.6	30.0	29.0	20.0					
4.5	38.4	30.0	27.6	20.0					
5.0	35.5	30.0	26.2	20.0	17.0				
6.0	30.5	29.2	22.6	18.7	17.0	13.0	13.0		
7.0	26.3	25.5	20.0	17.5	15.8	13.0	13.0		
8.0	17.8	21.0	20.0	16.2	14.5	12.4	13.0	9.0	7.0
9.0		17.1	17.5	14.4	13.3	11.9	12.0	8.8	7.0
10.0		14.3	14.7	12.9	13.0	11.3	11.0	8.5	7.0
11.0		12.1	13.0	11.9	12.6	10.7	10.1	8.3	7.0
12.0			12.0	11.5	11.6	9.7	9.2	8.1	7.0
14.0			9.4	9.5	9.0	8.1	7.8	7.6	6.5
16.0				7.6	7.7	7.0	6.7	6.5	6.1
18.0				6.2	6.4	6.2	5.4	5.8	5.3
20.0					5.4	5.4	4.5	5.0	4.6
22.0					4.5	4.6	4.0	4.1	3.9
24.0						3.9	3.6	3.4	3.2
26.0						3.3	3.2	2.9	2.7
28.0							2.9	2.4	2.2
30.0							2.5	2.0	1.8
32.0								1.6	1.5
34.0								1.3	1.2
36.0									0.9

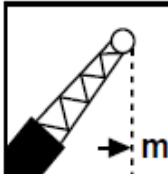
 %	I	II	III	IV
	0	50	50 / 100 / 0	100 / 0
	0	0	50 / 0 / 33	50 / 50
	0	0	0 / 0 / 33	0 / 50
	0	0	0 / 0 / 33	0 / 50

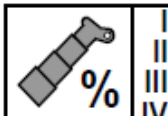
LOAD RATING CHARTS

TADANO ATF 60-3 CRANE



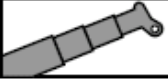




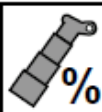
DIN / ISO

	36.5 m + 9.0 m			40.2 m + 9.0 m			40.2 m + 16.0 m		
	5°	20°	40°	5°	20°	40°	5°	20°	40°
10	4.8			3.8					
11	4.8			3.8					
12	4.8	3.8		3.8	3.4		2.2		
14	4.6	3.6	2.5	3.8	3.4	2.5	2.2		
16	4.3	3.3	2.4	3.7	3.3	2.5	2.2	1.8	
18	4.1	3.1	2.3	3.6	3.1	2.4	2.1	1.7	1.3
20	3.8	2.9	2.2	3.4	3.0	2.3	2.1	1.7	1.3
22	3.6	2.8	2.1	3.3	2.9	2.2	2.0	1.6	1.2
24	3.2	2.6	2.1	3.0	2.7	2.1	1.9	1.5	1.2
26	2.6	2.5	2.0	2.7	2.6	2.1	1.8	1.5	1.2
28	2.1	2.3	2.0	2.2	2.4	2.0	1.7	1.4	1.1
30	1.7	1.8	1.9	1.8	1.9	2.0	1.6	1.3	1.1
32	1.3	1.4	1.5	1.4	1.5	1.6	1.5	1.2	1.1
34	1.0	1.1	1.1	1.1	1.2	1.3	1.4	1.2	1.0
36	0.7	0.8	0.8	0.8	0.9	1.0	1.3	1.1	1.0
38	0.5	0.5	0.5	0.6	0.6	0.7	1.0	1.1	1.0
40							0.8	0.9	0.9
42							0.6	0.7	0.8
44								0.5	0.6

									
	I		100				100		
II		100				100			
III		75				100			
IV		75				100			

LOAD RATING CHARTS

TADANO ATF 60-3 CRANE

    DIN / ISO										
 m	10.4 m	14.1 m	17.8 m	21.6 m	25.3 m	29.0 m	32.7 m	36.5 m	40.2 m	
2.5	60.0*									
2.5	55.0									
3.0	49.3	30.0								
3.5	45.0	30.0	30.0							
4.0	41.0	30.0	29.0	20.0						
4.5	37.6	30.0	27.6	20.0						
5.0	34.2	30.0	26.2	20.0	17.0					
6.0	27.8	26.6	22.6	18.7	17.0	13.0	13.0			
7.0	20.8	19.8	20.0	17.5	15.8	13.0	13.0			
8.0	16.3	15.4	15.9	15.0	14.5	12.4	13.0	9.0	7.0	
9.0		12.4	13.0	12.6	13.0	11.9	12.0	8.8	7.0	
10.0		10.2	11.9	12.0	11.5	10.6	11.0	8.5	7.0	
11.0		8.5	10.2	10.3	10.5	9.1	9.2	8.3	7.0	
12.0			8.8	8.9	9.1	8.5	7.9	8.1	7.0	
14.0			6.8	6.8	7.1	7.1	6.7	6.6	6.4	
16.0				5.4	5.6	5.6	5.7	5.2	5.0	
18.0				4.2	4.4	4.5	4.6	4.0	3.8	
20.0					3.6	3.6	3.7	3.2	3.0	
22.0					2.9	3.0	3.0	2.5	2.3	
24.0						2.4	2.5	1.9	1.8	
26.0						2.0	2.0	1.5	1.3	
28.0							1.6	1.1	0.9	
30.0							1.3	0.8	0.6	
32.0								0.5		
34.0										
36.0										
 %	I	0	50	50 / 100 / 0	100 / 0	50 / 100 / 0	100 / 0	100 / 0	100 / 50	100
	II	0	0	50 / 0 / 33	50 / 50	50 / 100 / 66	100 / 83	100 / 100	100 / 100	100
	III	0	0	0 / 0 / 33	0 / 50	50 / 0 / 66	25 / 83	50 / 100	75 / 100	100
	IV	0	0	0 / 0 / 33	0 / 50	50 / 0 / 66	25 / 83	50 / 100	75 / 100	100

LOAD RATING CHARTS


TADANO ATF 60-3 CRANE

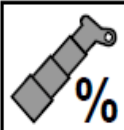




13.2t

DIN / ISO

 m	10.4 m	14.1 m	17.8 m
3.0	12.7	11.3	
3.5	11.4	10.3	10.4
4.0	10.3	9.5	9.5
4.5	9.3	8.6	8.7
5.0	8.5	7.9	8.1
6.0	7.0	6.5	6.9
7.0	5.6	5.5	6.0
8.0	4.4	4.7	5.2
9.0		4.0	4.5
10.0		3.4	3.9
11.0		2.9	3.4
12.0			3.0
14.0			2.1
16.0			
18.0			
20.0			
22.0			
24.0			
26.0			


 %	I	0	50	0
	II	0	0	33
	III	0	0	33
	IV	0	0	33

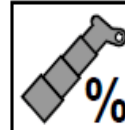




6.1t

DIN / ISO

 m	10.4 m	14.1 m	17.8 m
3.0	12.1	11.0	
3.5	10.9	10.1	10.0
4.0	9.8	9.0	9.2
4.5	8.8	8.1	8.5
5.0	7.9	7.2	7.8
6.0	5.8	5.4	6.2
7.0	4.2	4.1	4.9
8.0	2.8	3.1	4.0
9.0		2.5	3.2
10.0		1.9	2.7
11.0		1.4	2.2
12.0			1.8
14.0			1.1
16.0			
18.0			
20.0			
22.0			
24.0			
26.0			

 %	I	0	50	0
	II	0	0	33
	III	0	0	33
	IV	0	0	33

LOAD RATING CHARTS


TADANO ATF 60-3 CRANE

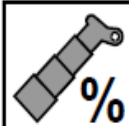




5.0t

DIN / ISO

 m	10.4 m	14.1 m	17.8 m
3.0	12.1	11.0	
3.5	11.0	10.1	10.1
4.0	9.9	9.3	9.3
4.5	8.6	8.0	8.3
5.0	7.4	6.7	7.4
6.0	5.4	5.0	5.8
7.0	3.9	3.8	4.6
8.0	2.6	2.8	3.8
9.0		2.2	3.0
10.0		1.7	2.5
11.0		1.3	2.0
12.0			1.6
14.0			1.0
16.0			
18.0			
20.0			
22.0			
24.0			
26.0			


 %	I	II	III	IV
I	0	50		0
II	0	0		33
III	0	0		33
IV	0	0		33

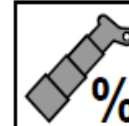




5.0t

DIN / ISO

 m	10.4 m	14.1 m	17.8 m
3.0	11.5	10.6	
3.5	10.4	9.1	9.6
4.0	8.9	7.8	8.3
4.5	7.6	6.9	7.3
5.0	6.6	6.0	6.4
6.0	4.9	4.3	5.1
7.0	3.5	2.9	3.9
8.0	2.4	2.1	3.0
9.0		1.3	2.4
10.0		0.9	1.8
11.0			1.4
12.0			1.0
14.0			0.5
16.0			
18.0			
20.0			
22.0			
24.0			
26.0			

 %	I	II	III	IV
I	0	50		0
II	0	0		33
III	0	0		33
IV	0	0		33

LOAD RATING CHARTS

STRUCTURAL & STABILITY RANGE ON LOAD CHART

Capacities appearing below the bold line are limited by the cranes' stability (overloading of the crane in any of the listed configurations would result in the crane tipping before any structural damage occurred).

Capacities above the bold line are limited by the structural strength of the crane (overloading the crane in any of these configurations would likely result in structural damage before tipping of the crane occurred).

BOLD LINE

RADIUS IN FEET	Main Boom Length in Feet (Power Pinned Fly Retracted)							Power Pin Fly & 96 ft. 125
	40	45	55	65	75	85	96	
10	120,000 (72)	90,000 (74)	87,300 (77.5)	82,250 (79.5)				
12	98,300 (68.5)	85,400 (71.5)	83,000 (75)	77,400 (78)	60,550 (80)			
15	83,100 (63.5)	79,700 (67)	74,000 (72)	70,500 (75)	55,050 (78)	48,850 (79.5)	33,500 (81.5)	
20	65,550 (54.5)	60,550 (60)	58,700 (66)	55,250 (70.5)	47,250 (74)	41,600 (76)	33,500 (78.5)	21,000 (81.5)
25	46,000 (44.5)	46,000 (51.5)	46,000 (60)	44,100 (65.5)	41,400 (69.5)	36,100 (72.5)	33,000 (75)	21,000 (79)
30	33,300 (31)	33,300 (42)	33,300 (53.5)	33,300 (60.5)	33,300 (65.5)	31,300 (69)	28,150 (72)	19,050 (76.5)
35		24,200 (30)	24,200 (46)	24,200 (55)	24,200 (61)	24,200 (65)	23,800 (68.5)	16,800 (74.5)
40	See Warning No. 16		18,050 (38)	18,050 (49)	18,050 (56.5)	18,050 (61)	18,050 (65.5)	15,000 (72)
45			13,700 (26.5)	13,700 (42.5)	13,700 (51.5)	13,700 (57)	13,700 (62)	13,500 (69.5)
50				10,500 (34.5)	10,500 (46)	10,500 (53)	10,500 (58.5)	12,250 (67)
60					6,100 (32.5)	6,100 (43)	6,100 (50.5)	8,300 (61.5)
70						3,220 (30.5)	3,220 (42)	5,340 (56)
80							1,180 (30.5)	3,250 (50)
90								1,690 (43)

**STRUCTURAL
RANGE**

STABILITY RANGE

LOAD RATING CHARTS

STRUCTURAL & STABILITY RANGE ON LOAD CHART

On this chart a thick black line is shown this defines the basis upon which the rated capacity is calculated.

Figures shown above the black line are based on the structural strength of the crane and figures below the black line are based on the tipping capabilities of the crane, in other words it's stability.

Therefore, if the crane is overloaded above the thick black line structural failure is likely to occur before the crane overturns. But if the crane is overloaded below the black line, then the crane's stability will be compromised and the crane will overturn before structural failure occurs.

In simpler terms overload above the black line break it below the black line tip it.

By deploying the front jack, the cranes rated capacities as shown are applicable through the full 360 degrees of rotation.

LOAD RATING CHARTS

STRUCTURAL & STABILITY RANGE ON LOAD CHART

Structural range is the operating condition where the crane's lifting capacity is limited by the strength of its structural components (boom, wire rope, pins, hydraulic cylinders).

Happens When:

- Short radius
- Boom at low angle
- Heavy load close to crane
- Structural stress reaches allowable limit before tipping

Risk: Structural failure (boom bending or breaking) before tipping

Stability range is the operating condition where lifting capacity is limited by crane stability (tipping) rather than structural strength.

Happens When:

- Large radius
- Boom highly extended
- Side lifting
- Load creates large overturning moment

Risk:

Crane tips before structural components fail

LOAD RATING CHARTS

Precautions During Stability Range Operation:

When a crane is working in the **stability range**, the lifting capacity is limited by **tipping risk**, not structural strength.

This usually happens at **long radius, high boom extension, or side lifting**.

Precautions:

1. Ensure Proper Outrigger Setup

- Fully extend outriggers as per load chart.
- Use proper **outrigger mats** (engineered size).
- Check crane is **100% level** (spirit level or LMI display).
- Never operate on soft or uncompacted ground.

2. Strictly Follow Load Chart

Precautions:

- Verify boom length, radius, and configuration.
- Confirm counterweight installed as per chart.
- Check LMI reading before lifting.
- Never rely only on range diagram.

LOAD RATING CHARTS

Precautions:

3. Control Radius Carefully

- Increasing radius = rapid reduction in capacity.
- Avoid sudden boom down movement.
- Keep load as close as possible.
- Avoid side loading.

4. Avoid Dynamic Forces

Do NOT:

- Sudden slewing.
- Rapid acceleration or braking.
- Travel with load (unless approved).
- Lift in high wind conditions.

Dynamic load can increase effective load by 10–30%.

LOAD RATING CHARTS

5. Monitor Ground Conditions

Check:

- Soil bearing capacity.
 - Underground services.
 - Water accumulation.
 - Slope (as per allowed by OEM's).
- Ground failure = immediate tipping.

6. Wind & Weather Control:

- Stop operation if wind exceeds manufacturer limits.
- Long boom acts like sail → increases overturning moment.

7. Watch for Early Warning Signs:

Warning signs of approaching tipping:

- One outrigger pad lifting.
- Rear tires lifting.
- LMI overload alarm.
- Crane feels unstable during slewing.

If observed:

- Immediately stop
- Lower load safely
- Reassess lift plan

LOAD RATING CHARTS

STRUCTURAL & STABILITY RANGE ON LOAD CHART

Typical Stability & Setup Scenarios

● Safe Zone:

- Crane fully leveled.
- Outriggers deployed correctly.
- Load within rated capacity.
- Boom angle optimized for minimal tipping moment.
- Load percentage < capacity on chart.

● Caution Zone:

- Load close to chart maximum.
- High working radius.
- Boom fully extended.
- Larger dynamic forces (e.g., movement, wind).
- Operator must proceed with extreme caution.

● Danger / Tipping Risk:

- Exceeding the rated load (85% stability margin).
- Operating without outriggers (“on rubber”).
- Uneven ground or slope.
- Side lift beyond manufacturer’s recommended quadrant.

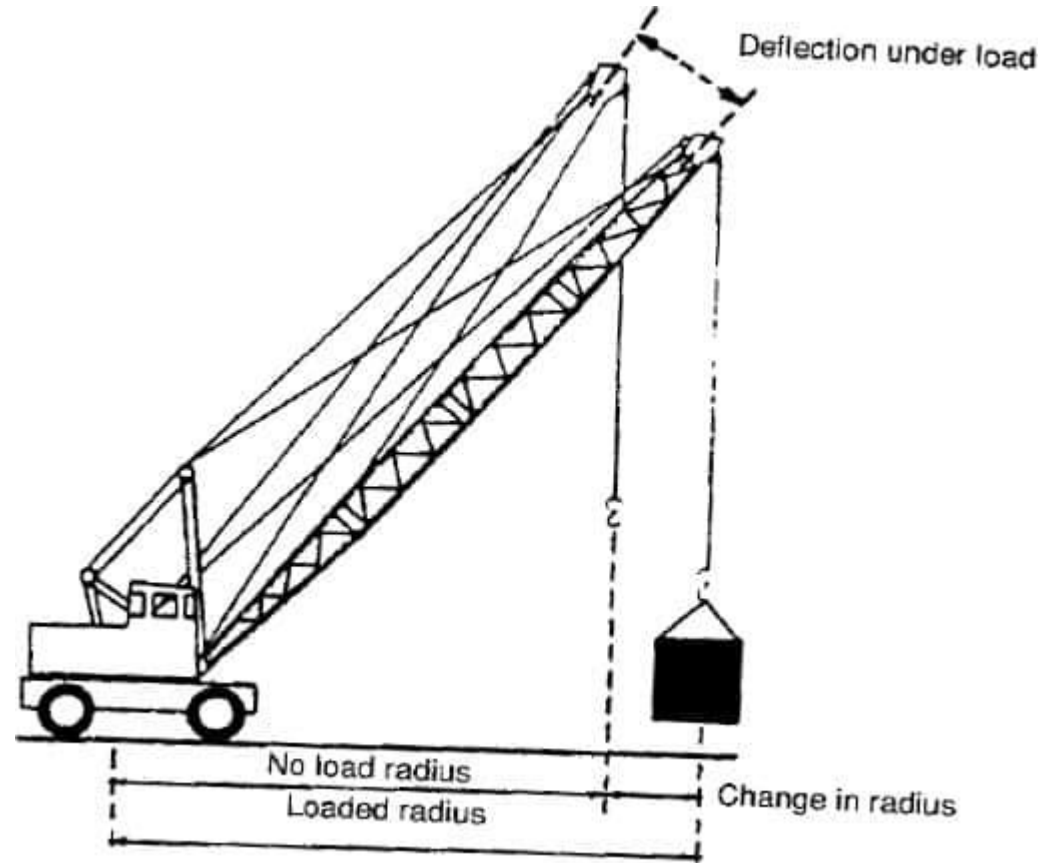
LOAD RATING CHARTS

BOOM DEFLECTION

Before the operator pick up a load

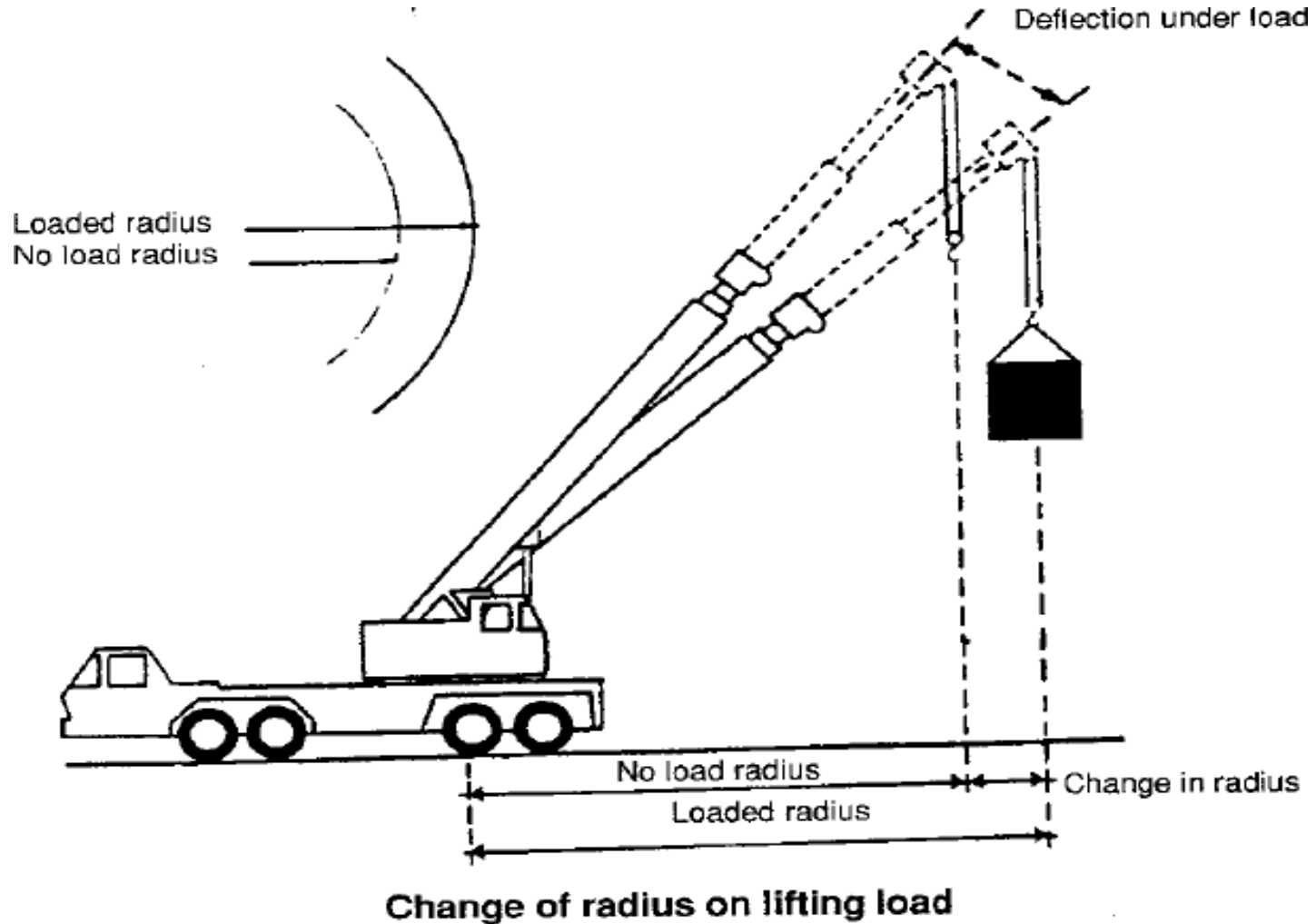
He must allow for rope stretch and deflection of the jib or boom when a load is lifted;

Remember “an increase in radius means a decrease in capacity”



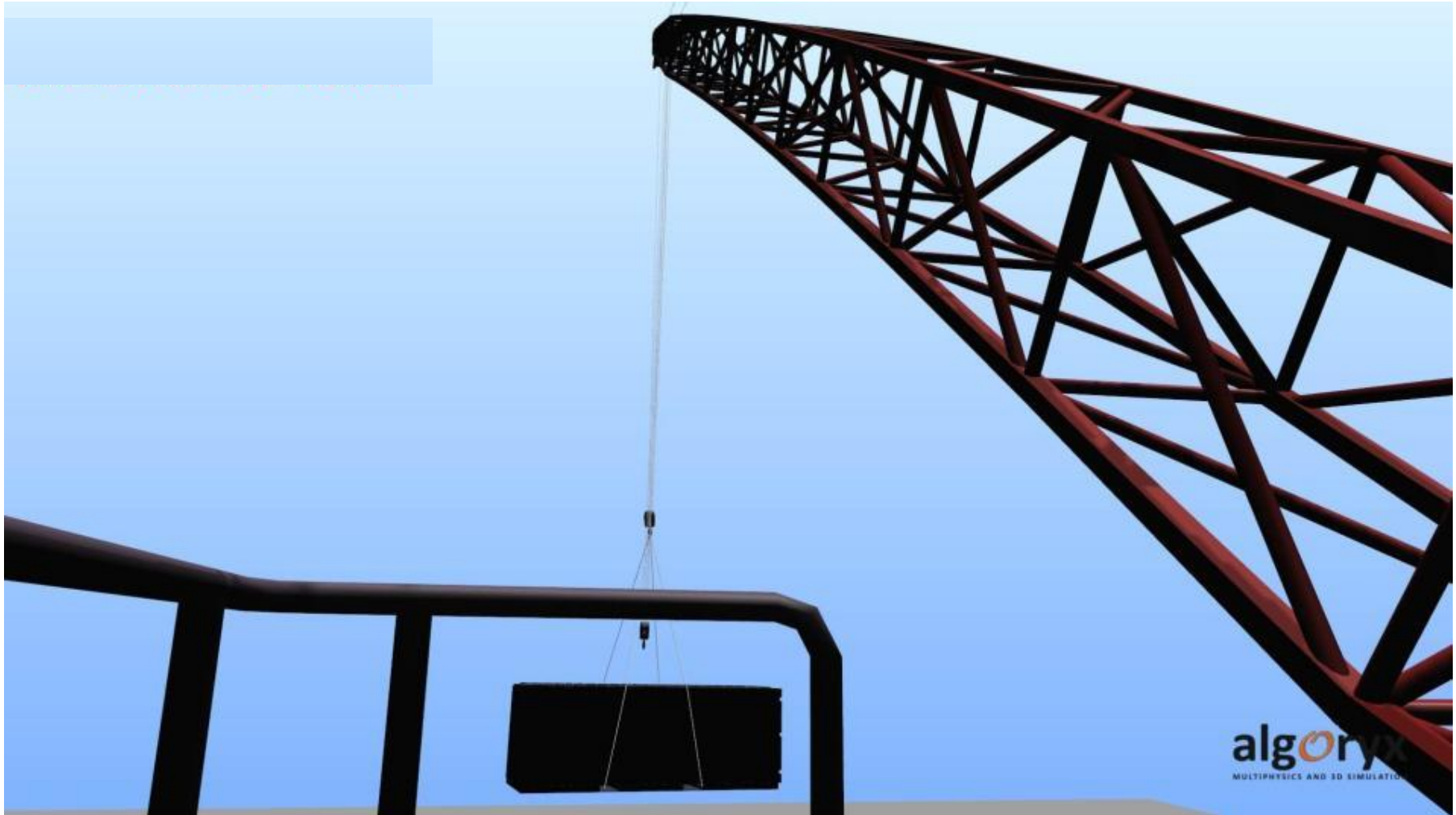
LOAD RATING CHARTS

BOOM DEFLECTION



LOAD RATING CHARTS

BOOM DEFLECTION



LOAD RATING CHARTS

BOOM DEFLECTION

Telescoping Boom Flexing

When fully extended and under load modern booms can flex quite extensively, this is normal and allowable. However, if there is a downward bend whilst not under load it may indicate that the bottom and top wear pads may need adjustment or replacement. To verify the allowable deflection, you can measure the maximum radius and check against the rated capacity chart.



LOAD RATING CHARTS

BOOM DEFLECTION

Looking at a boom like the picture below this would indicate that the side wear pads on the outer section of the boom require adjustment or replacement.

A simple method of checking to see if boom wear pads require replacing or adjustment is to fully extend the boom and get the operator to swing a short distance then stop suddenly, any movement in the boom can then be observed.

If the whole boom moves, this is expected and acceptable, if individual sections of the boom move sideways, adjustment or replacement of the wear pads in these sections are indicated.



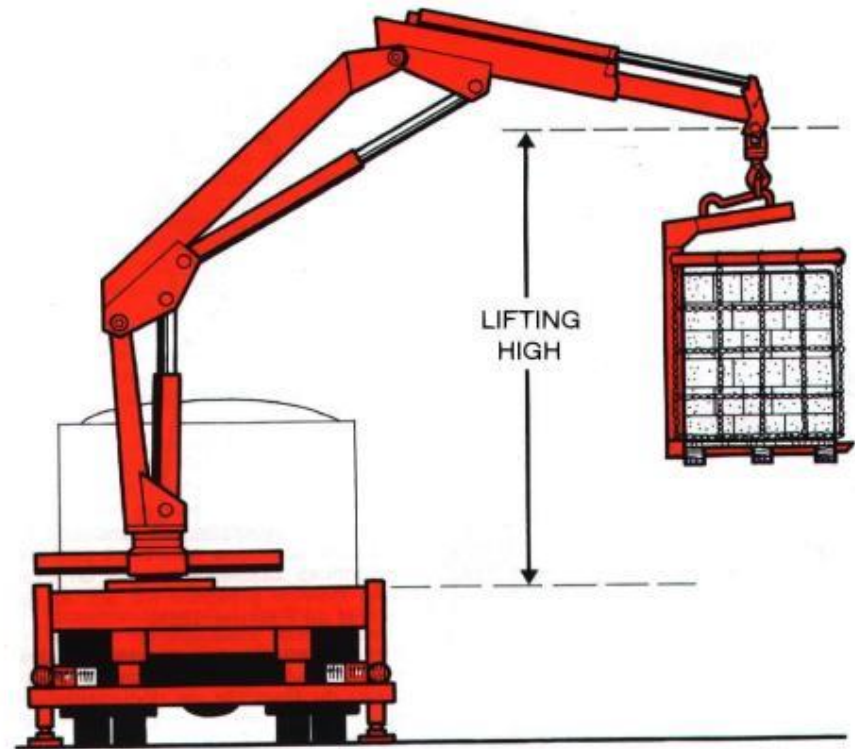
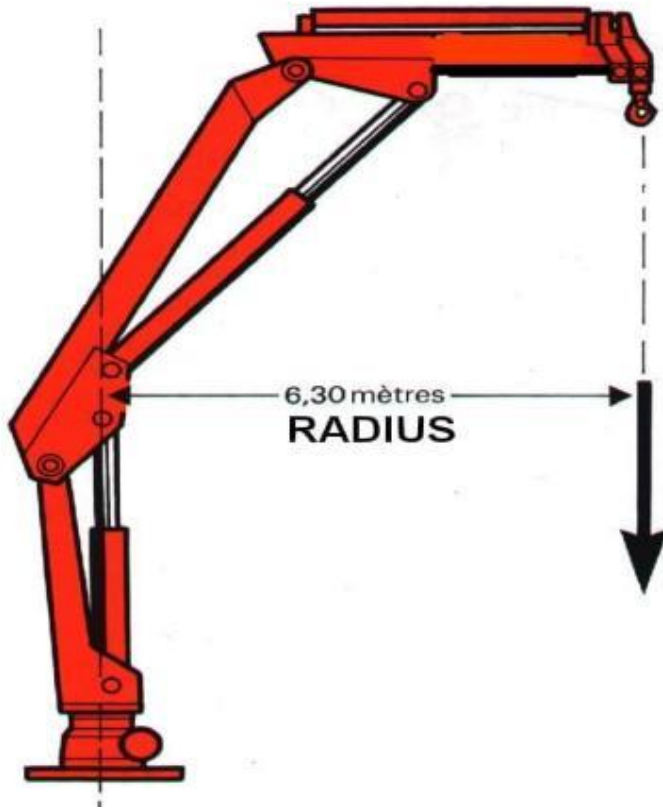
LOAD RATING CHARTS

BOOM DEFLECTION



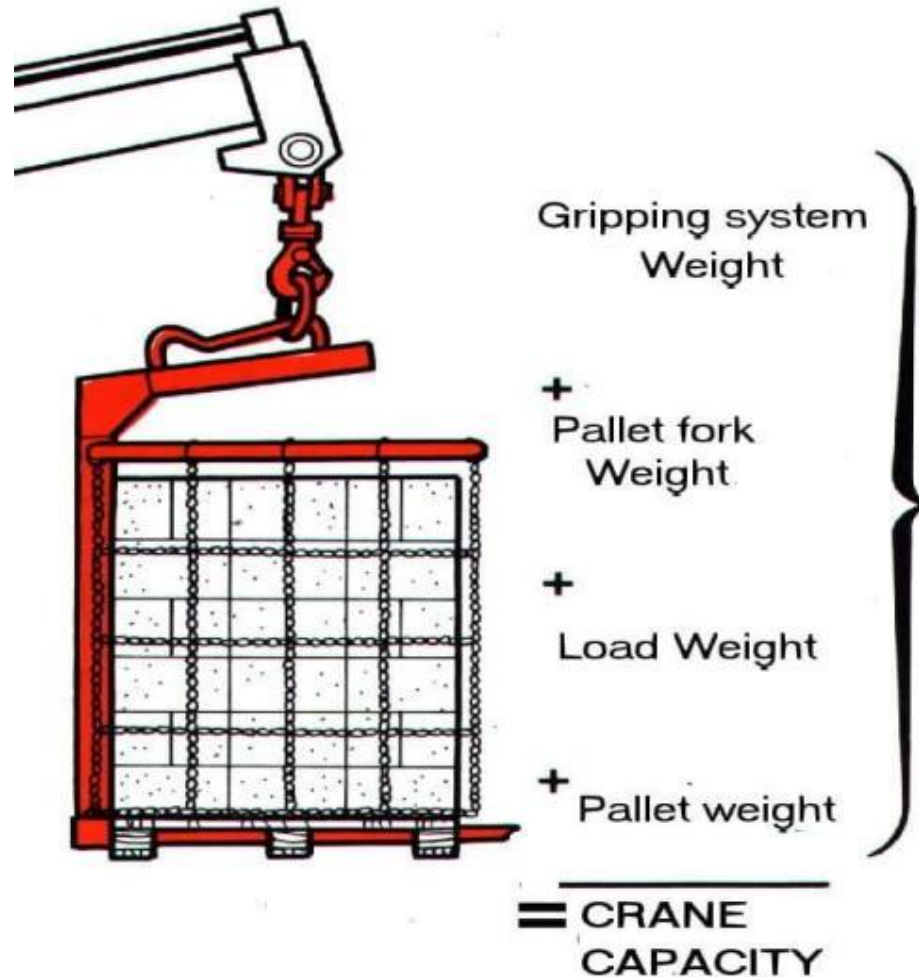
LOAD RATING CHARTS

LORRY LOADING CRANE



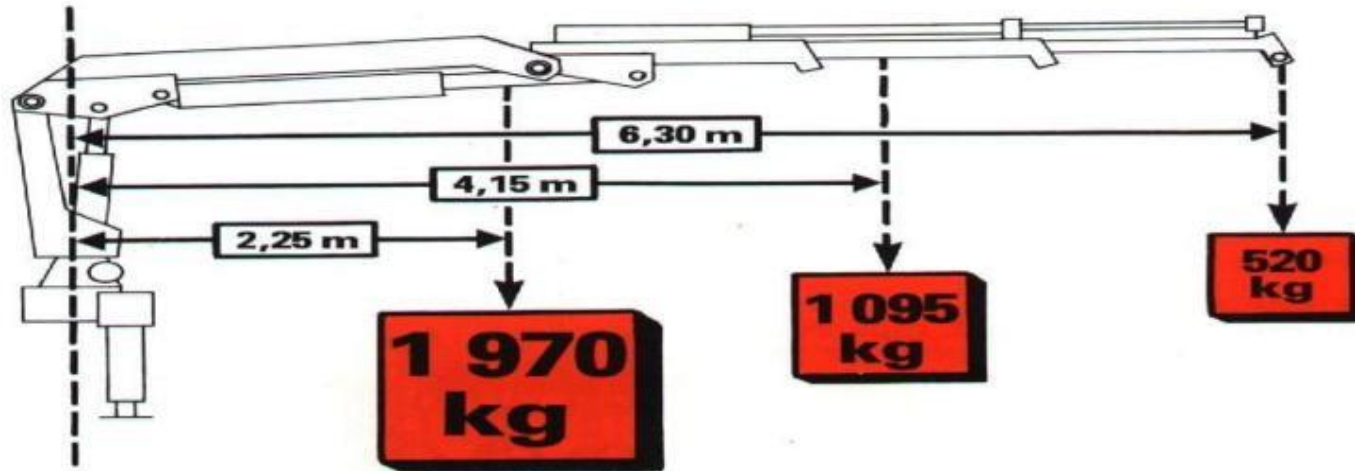
LOAD RATING CHARTS

LORRY LOADING CRANE



LOAD RATING CHARTS

LORRY LOADING CRANE



HIAB 166 B-3 HIDUO

m	3.1	4.5	6.3	8.2	10.3	12.5
ADC kg	5200	3600	2500	1860	1480	1140
kg	4900	3400	2300	1760	1380	

377 2284

LIFTING AREA DIAGRAM

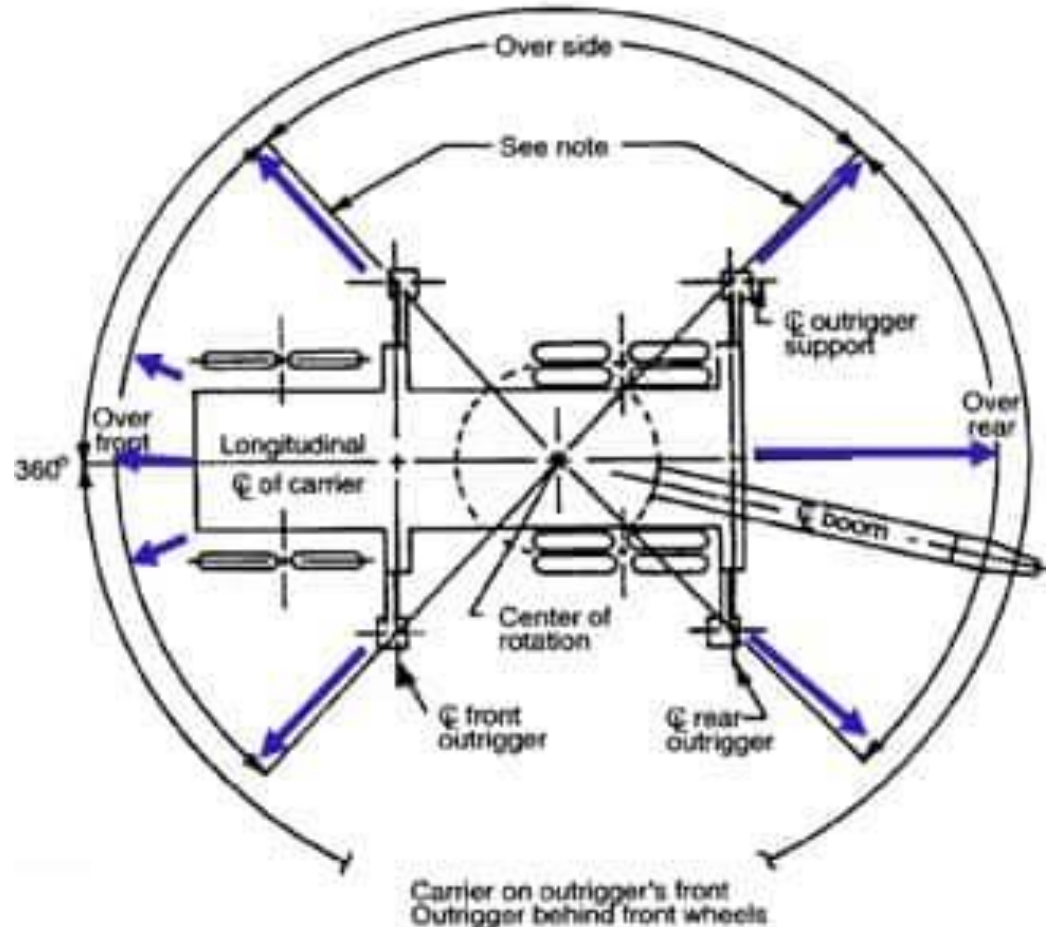
LIFTING AREA DIAGRAM

SAMPLE OF WORKING SECTORS

→ OUTREACH

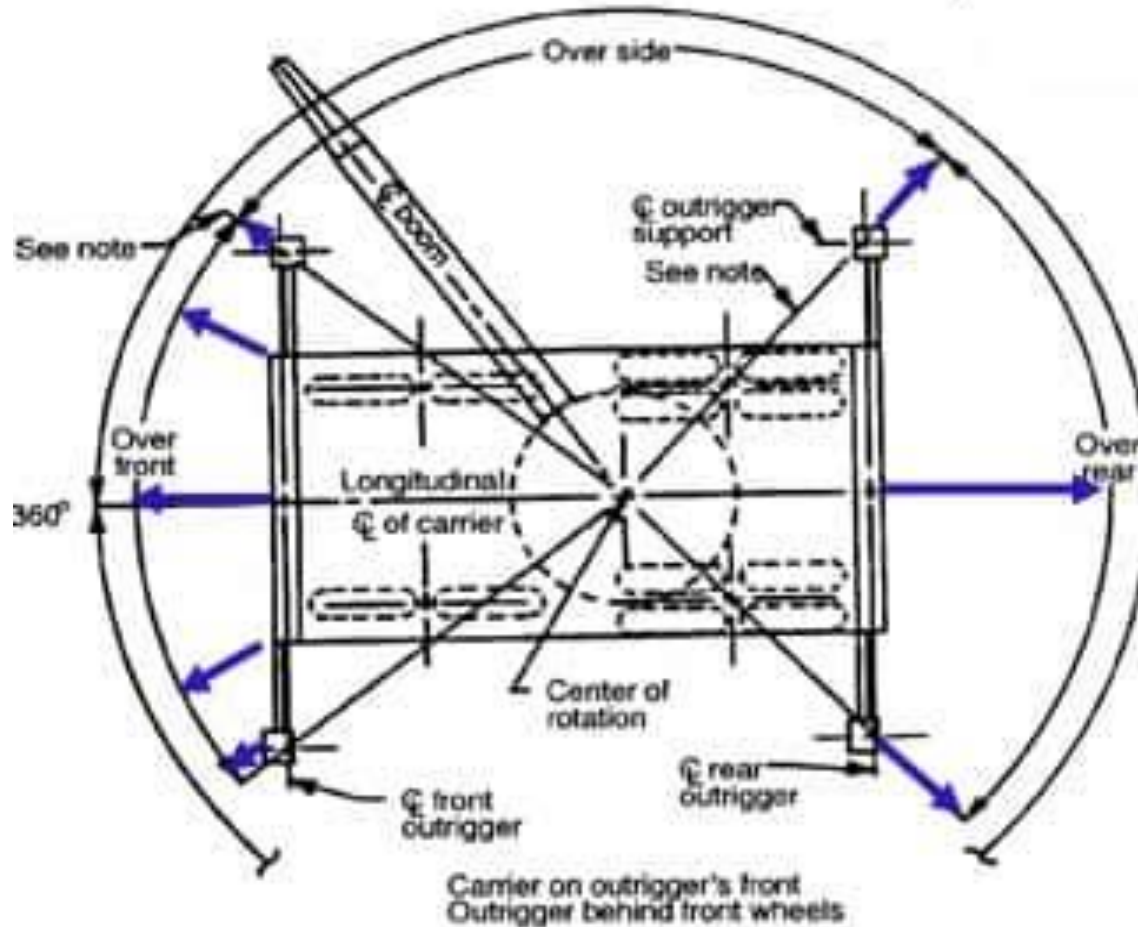
Outreach: distance from the edge of the crane structure to the load

These lines determine the limiting position of any load for operations within working areas indicated



LIFTING AREA DIAGRAM

SAMPLE OF WORKING SECTORS

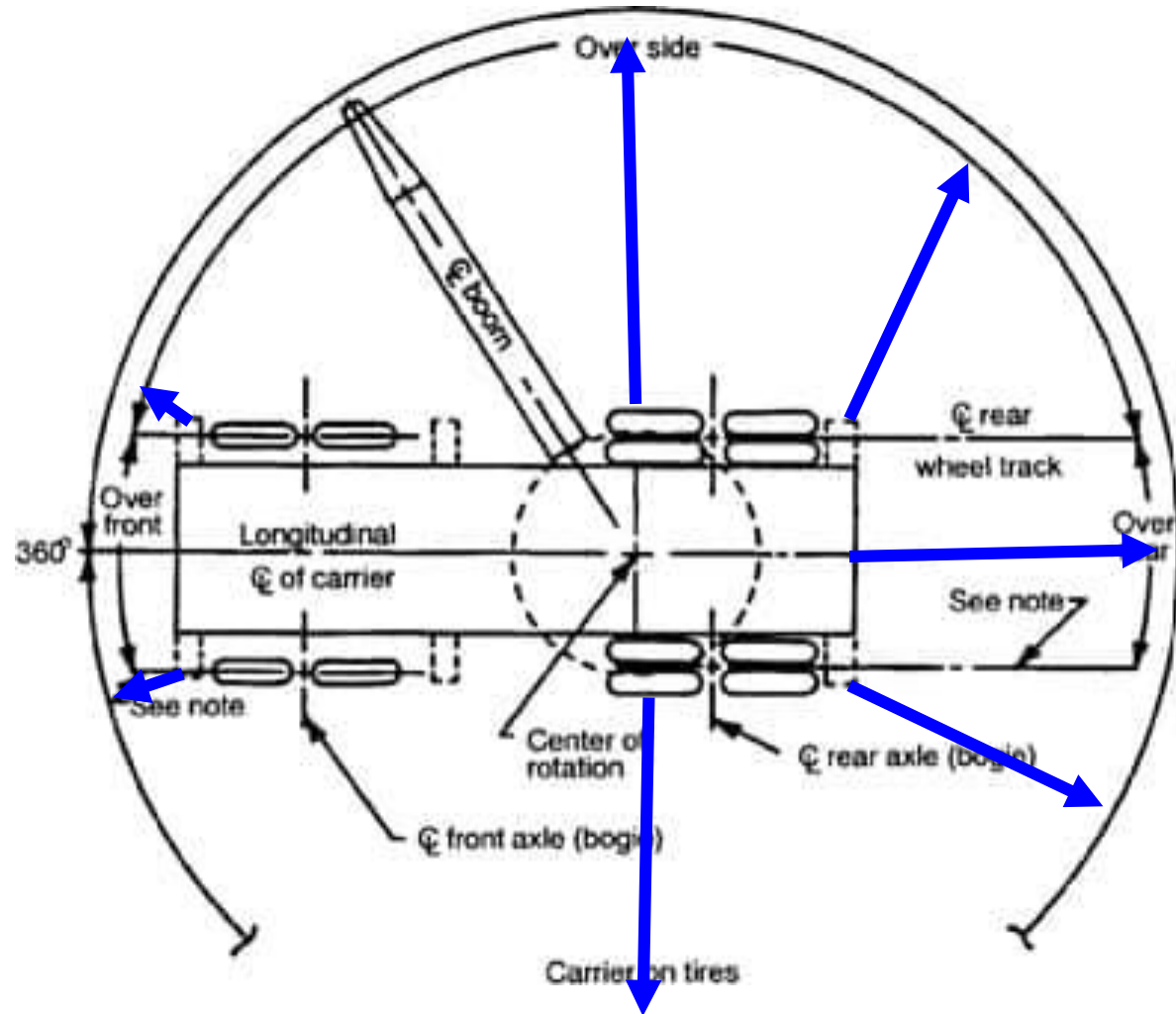


Note: These lines determine the limiting position of any load for operation within working areas indicated.

LIFTING AREA DIAGRAM

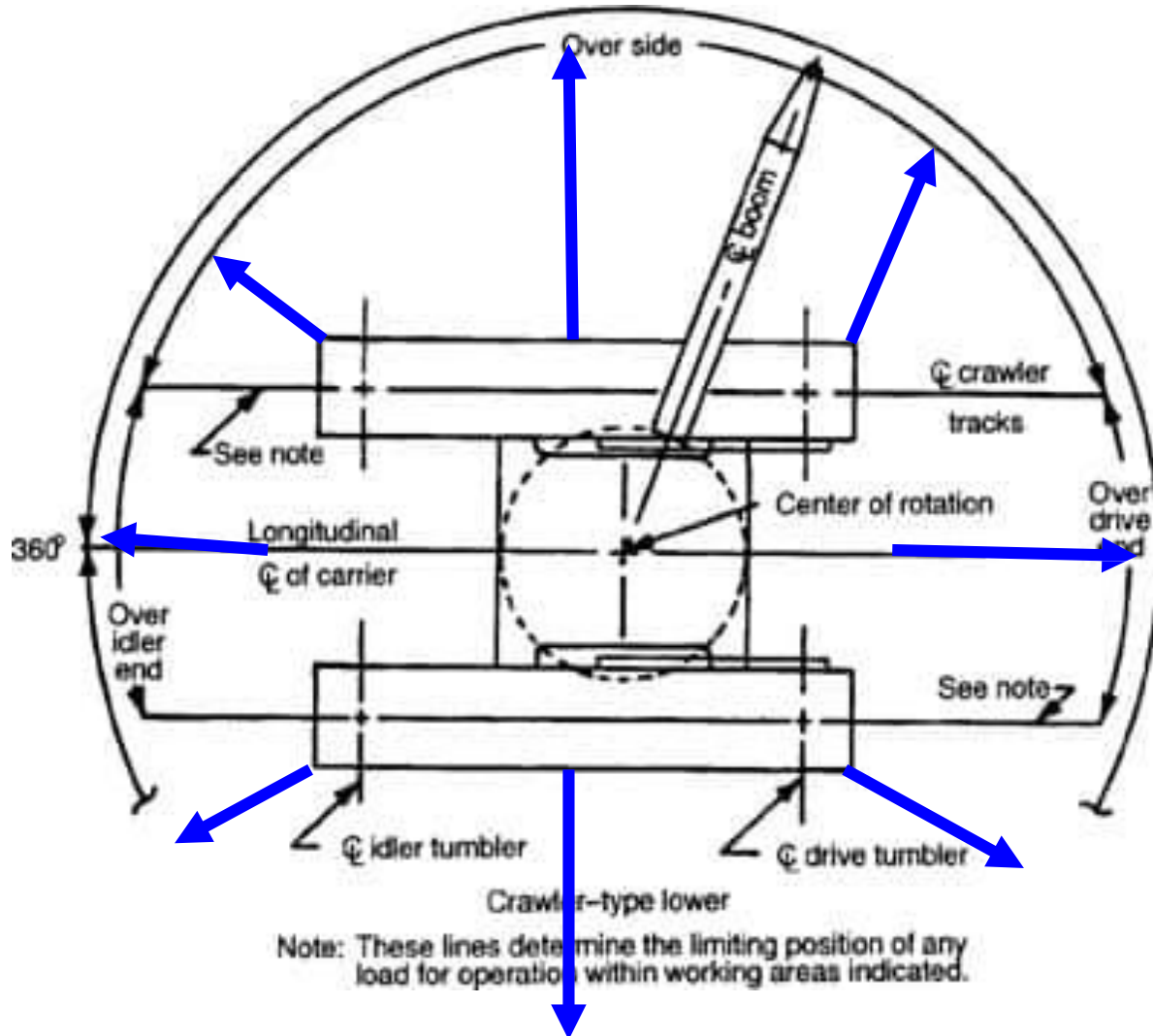
SAMPLE OF WORKING SECTORS

CARRIER ON TYRES



LIFTING AREA DIAGRAM

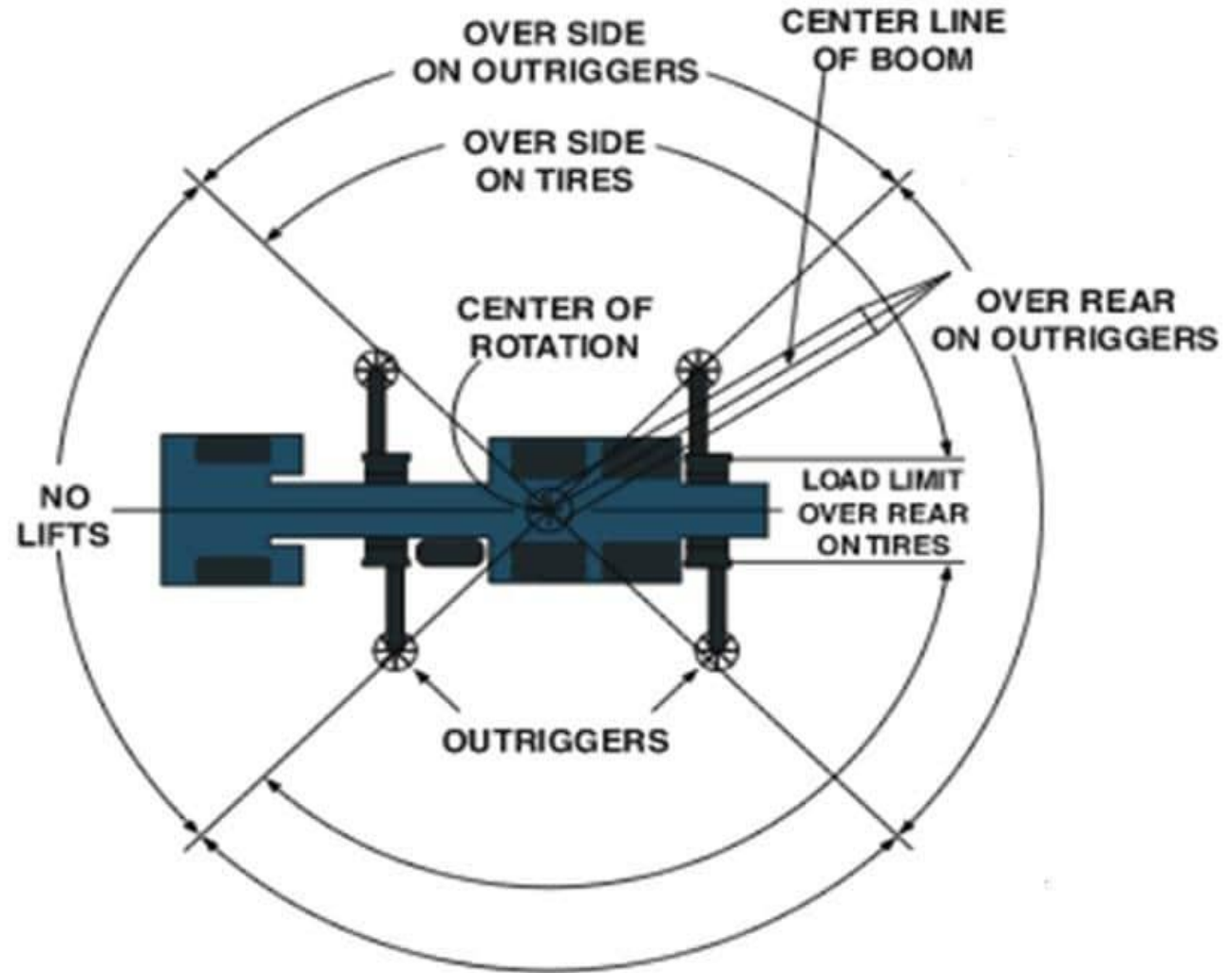
SAMPLE OF WORKING SECTORS



LIFTING AREA DIAGRAM

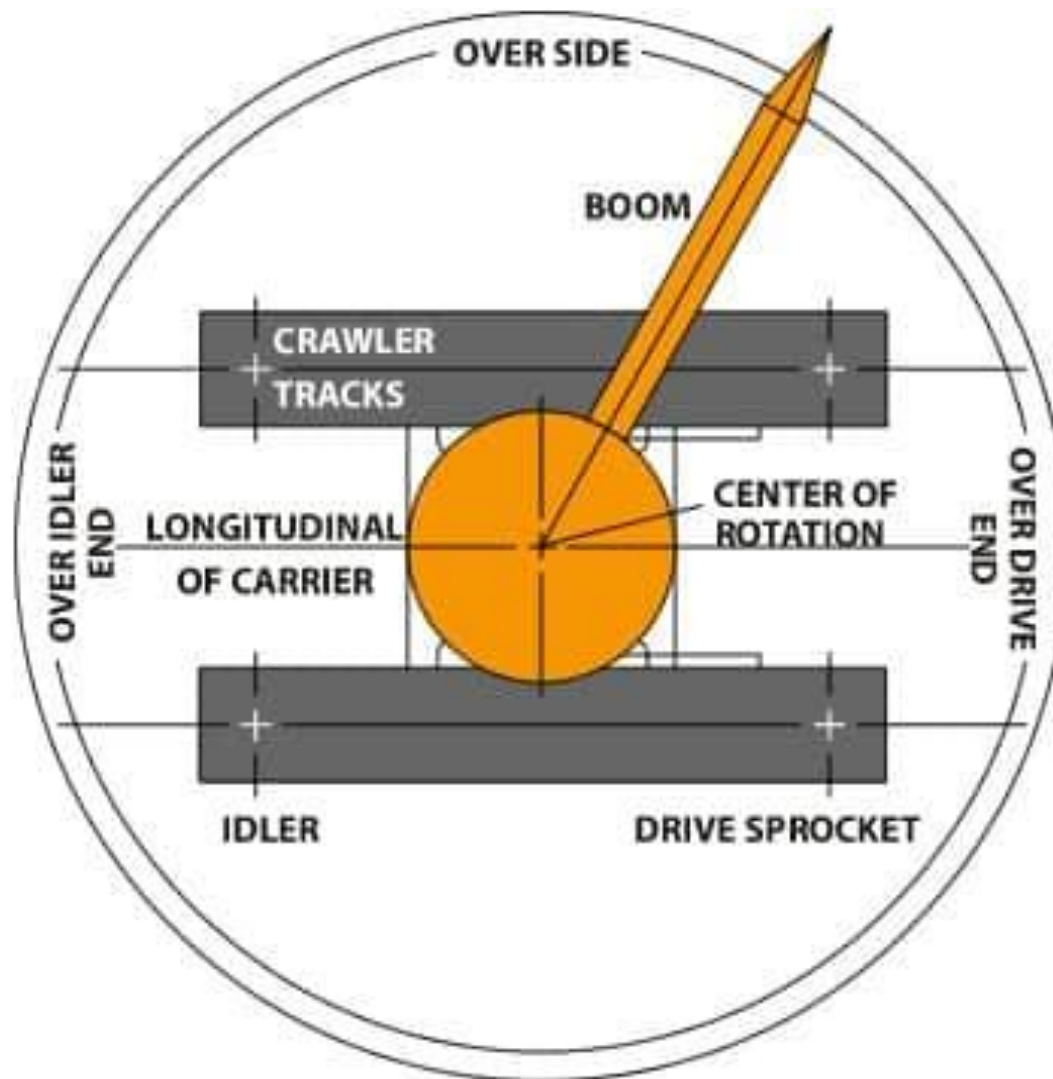
SAMPLE OF WORKING SECTORS

NO LIFTS OVER
THE FRONT



LIFTING AREA DIAGRAM

SAMPLE OF WORKING SECTORS



RANGE DIAGRAM



RANGE DIAGRAM

Range diagram provide details of crane's out reach in vertical & horizontal directions.

Each crane is equipped with this diagram.

This is essential for an Lifting Supervisor to select the correct type of crane suitable to perform his lifting job assignment during his Lift Plan.

A Range Diagram is a graphical side-view drawing that shows the working envelope of the crane, including:

- Maximum hook height
- Maximum and minimum radius
- Boom angle positions
- Boom length reach

In Short

Range Diagram = The drawing that shows how far and how high the crane can reach. It does not show lifting capacity.

Simple Difference in between load chart and range diagram:

Load Chart → “How much can I lift?”

Range Diagram → “Can I reach the load?”

RANGE DIAGRAM

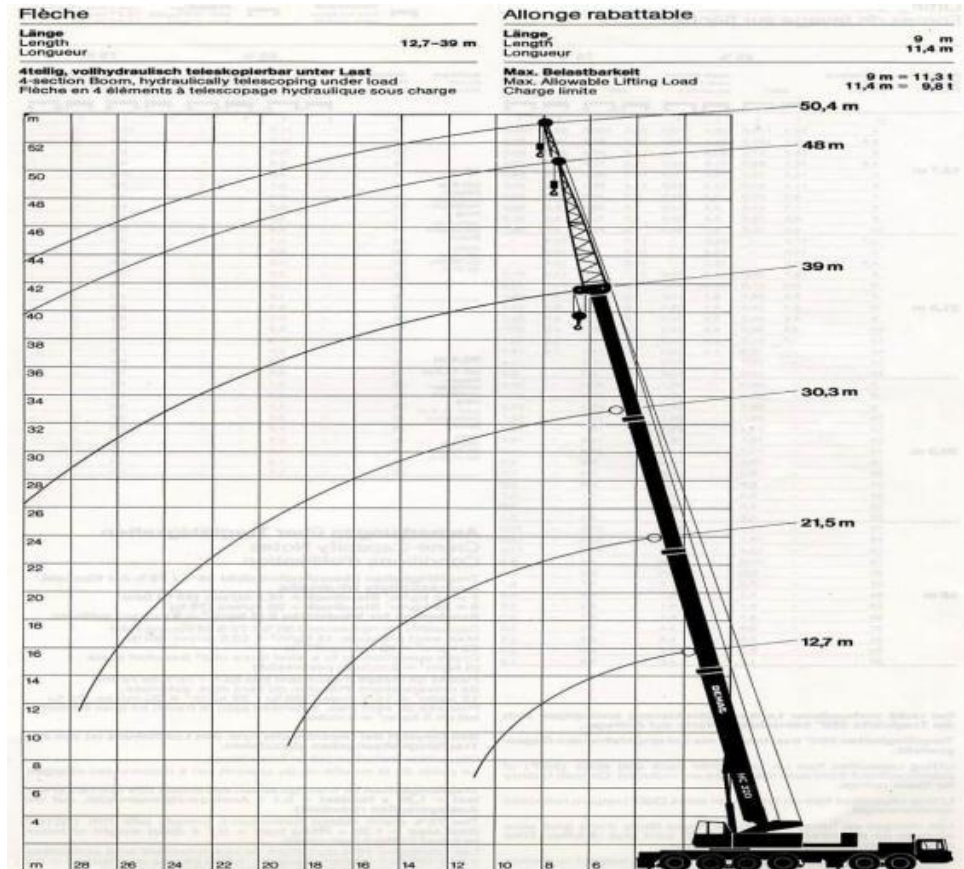
SAMPLE OF THE RANGE DIAGRAM

The range diagram

This diagram is useful as it is showing all possible combinations of boom angle, boom length and radius.

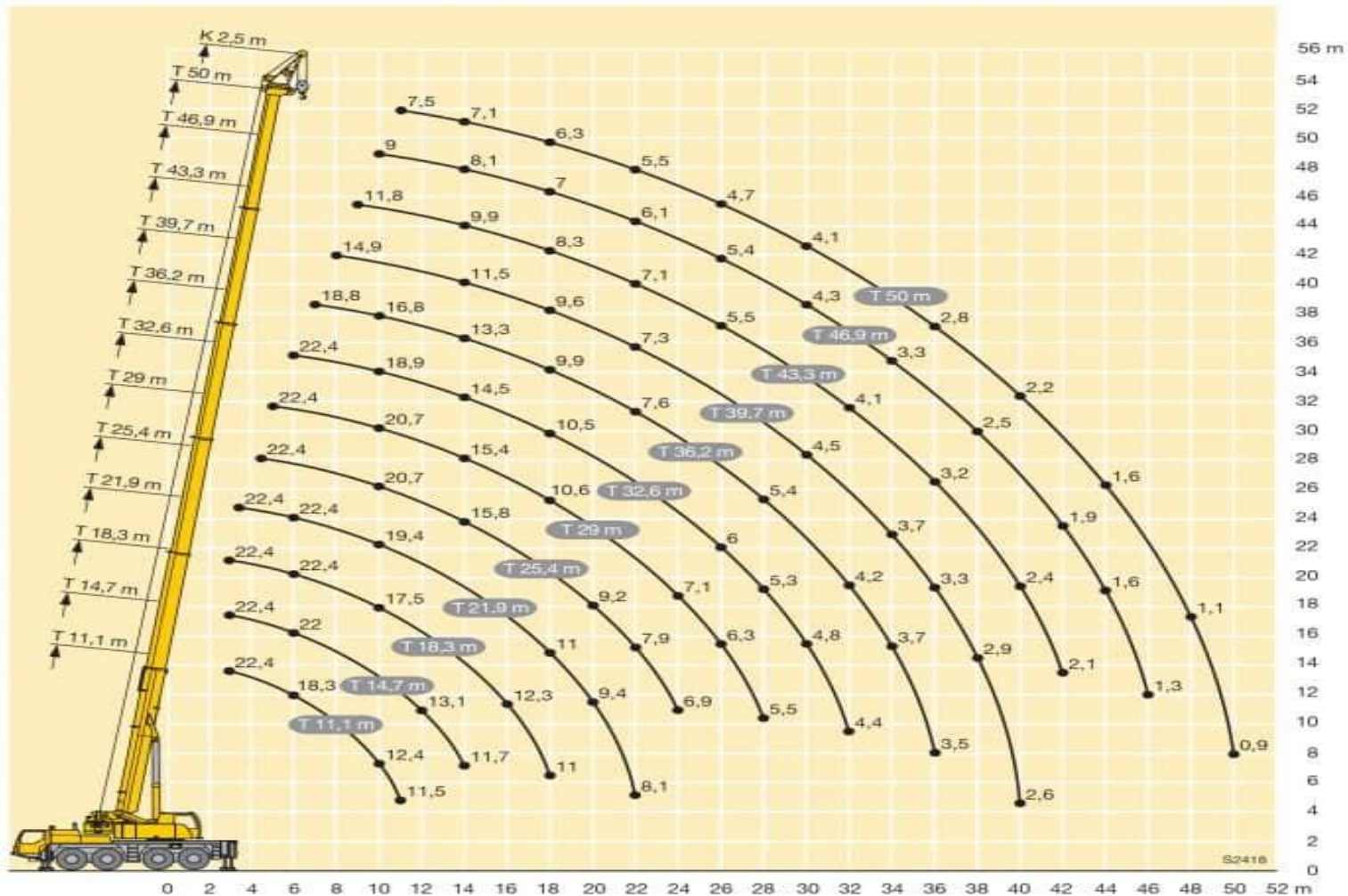
If the operator knows the height and radius that the load is to be lifted, he can use this chart to determine boom length and boom angle necessary to handle the lift. He then checks the capacity chart to determine if the crane can handle the load weight.

Conversely, if boom length and boom angle are known, the radius can be determined using this chart.



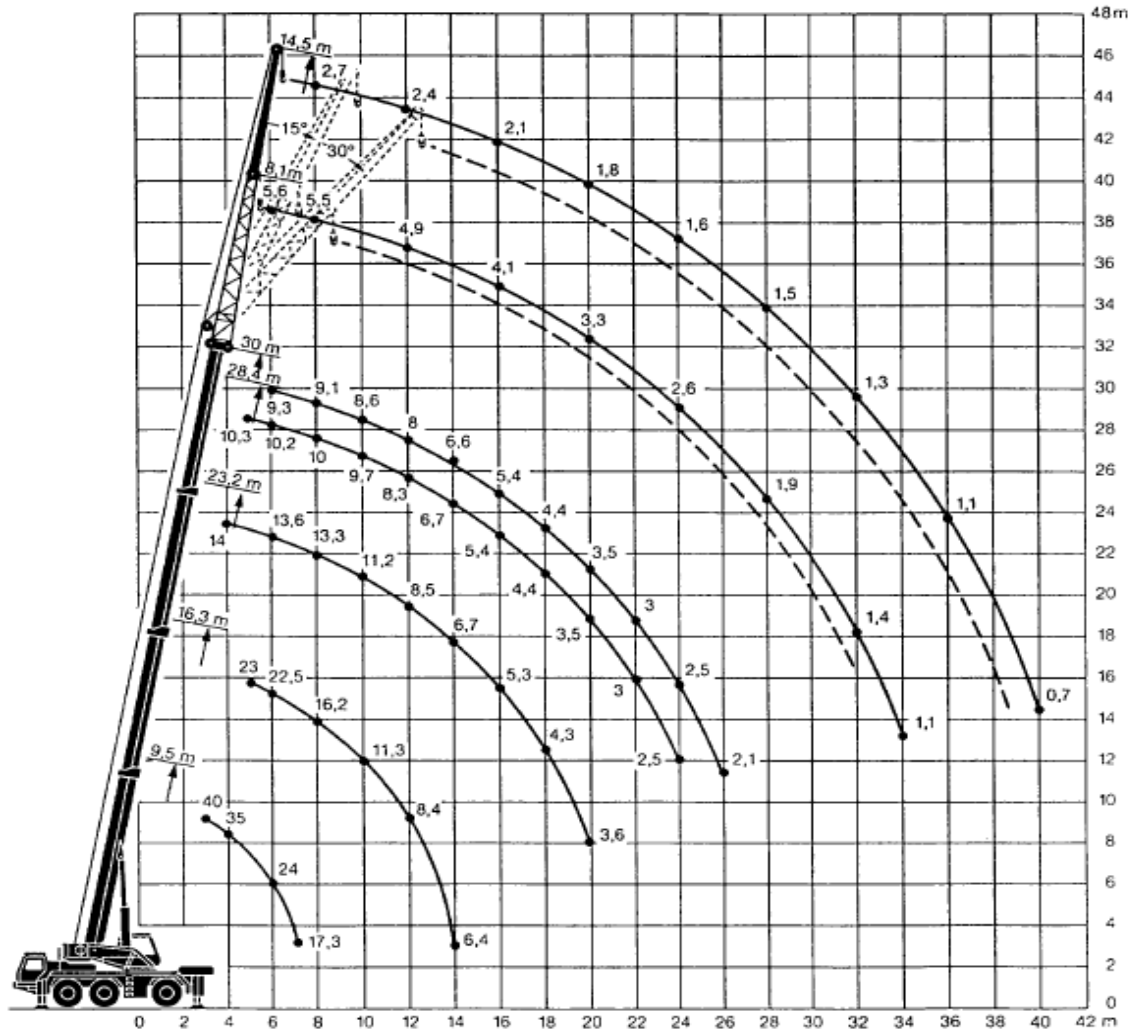
RANGE DIAGRAM

LIEBHERR CRANE RANGE DIAGRAM



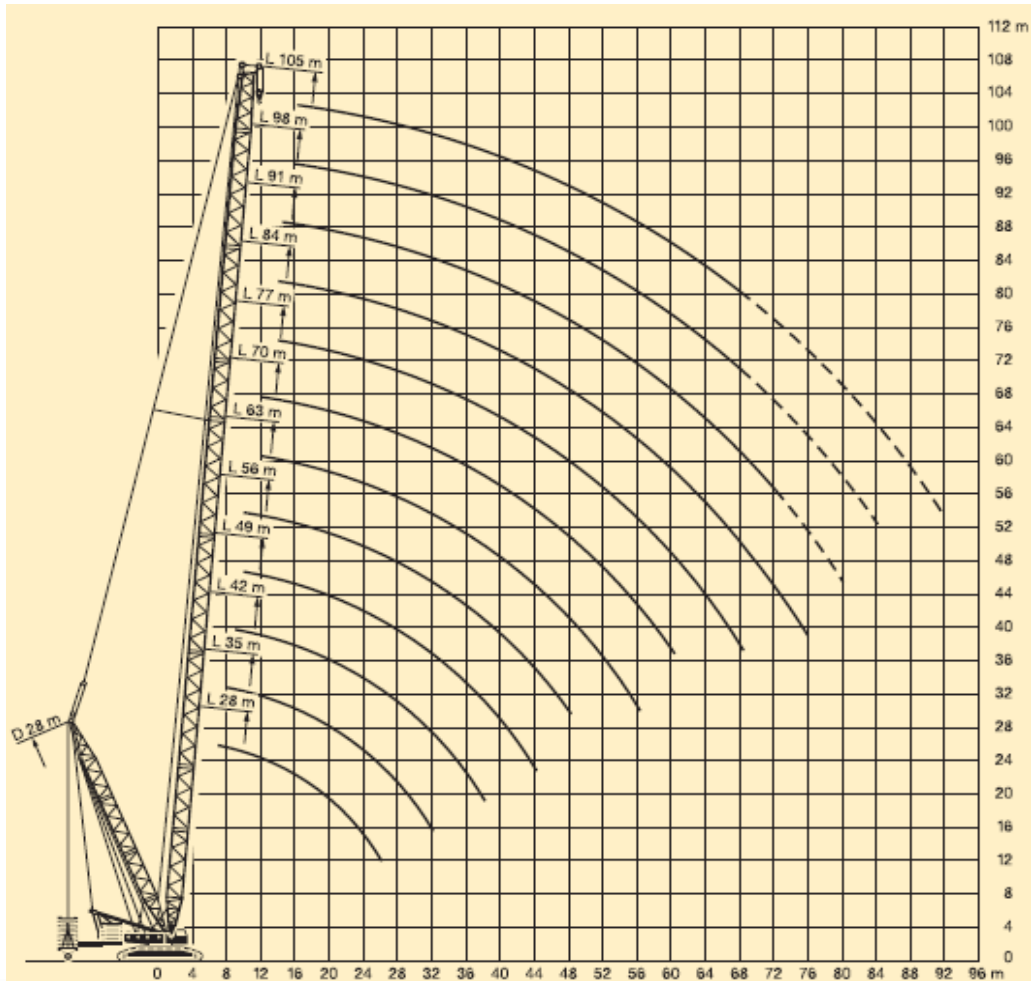
RANGE DIAGRAM

TADANO CRANE RANGE DIAGRAM



RANGE DIAGRAM

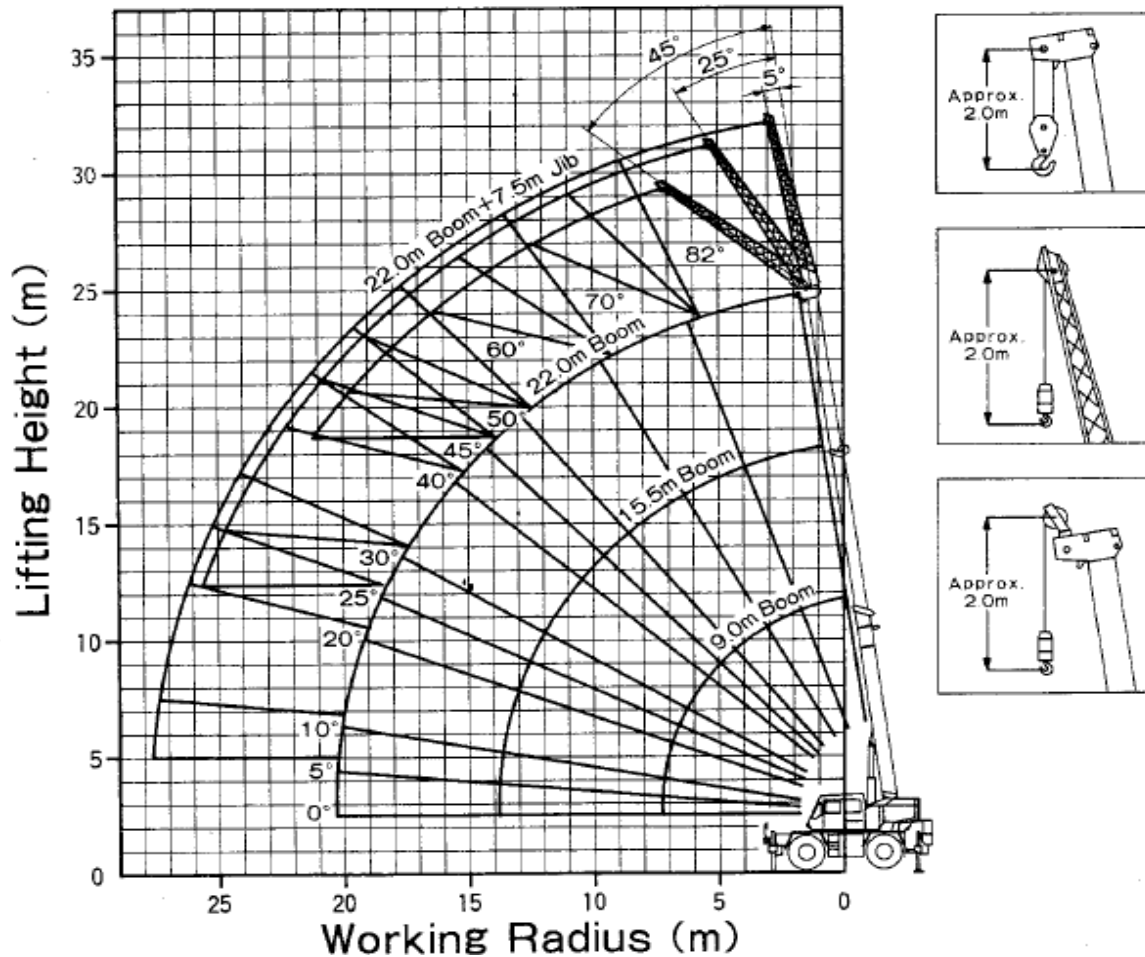
TADANO CRANE RANGE DIAGRAM



RANGE DIAGRAM

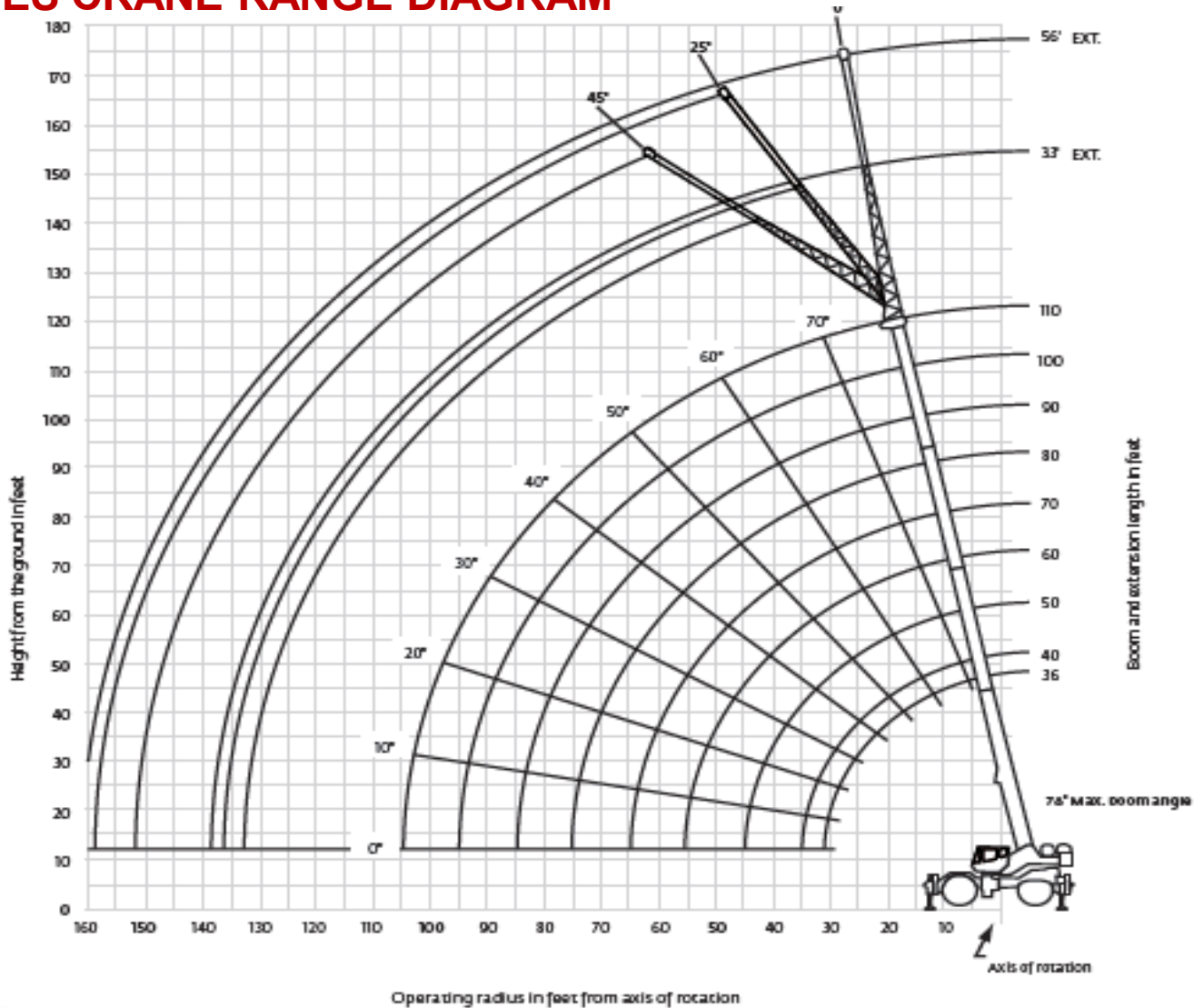
TADANO CRANE RANGE DIAGRAM

TR-200EX WORKING RADIUS & LIFTING HEIGHT



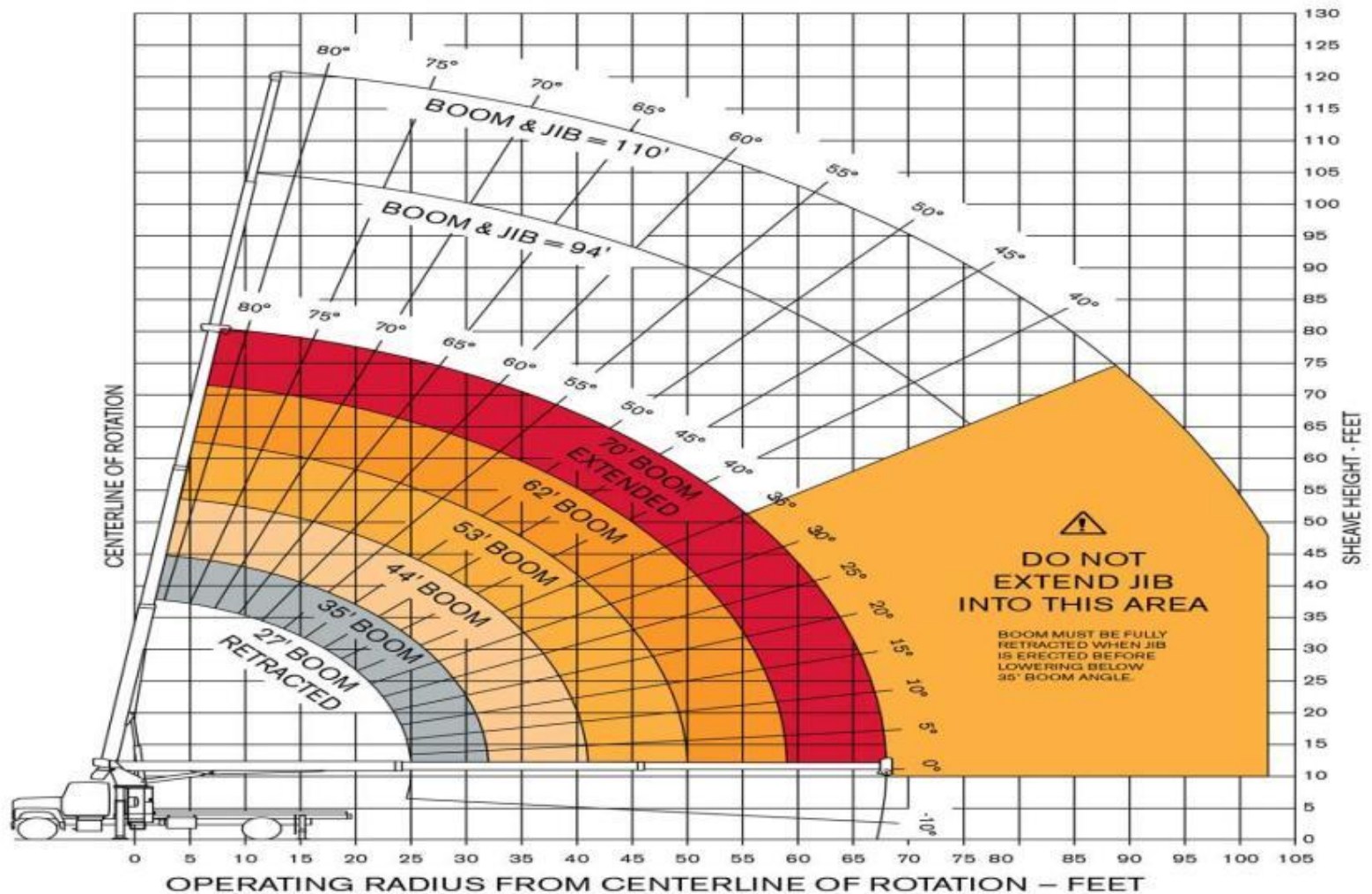
RANGE DIAGRAM

GROVES CRANE RANGE DIAGRAM



RANGE DIAGRAM

TEREX BOOM TRUCK RANGE DIAGRAM



Exercise: Load Rating Chart

OPERATING RADIUS IN METRES	12.19 m		15.24 m		18.29 m		21.34 m		24.38 m		27.43 m		30.48 m		33.53 m		36.58 m		
	∠	KGS	∠	KGS	∠	KGS	∠	KGS	∠	KGS	∠	KGS	∠	KGS	∠	KGS	∠	KGS	
4	78	80 000																	
4.5	76	68 900	79	68 800															
5	73	57 200	77	57 000	79	56 900													
5.5	71	48 800	75	48 600	77	48 500	79	48 500											
6	68	42 500	73	42 300	76	42 200	78	42 200	79	42 100									
7	63	33 700	69	33 600	72	33 400	75	33 400	77	33 300	78	33 200							
8	57	27 800	65	27 700	69	27 500	72	27 500	75	27 400	76	27 400	78	27 100	79	27 100			
9	52	23 600	60	23 500	66	23 300	68	23 300	72	23 200	74	23 200	76	22 900	77	22 900	78	22 800	
10	45	20 500	56	20 400	62	20 200	66	20 200	70	20 100	72	20 000	74	19 800	75	19 700	77	19 600	
12			46	16 000	55	15 800	60	15 800	64	15 700	67	15 200	70	15 400	72	15 300	73	15 200	
14			34	13 100	47	12 900	54	12 900	59	12 800	63	12 700	66	12 500	68	12 400	70	12 200	
16					37	10 800	42	10 800	53	10 700	58	10 600	62	10 400	64	10 300	67	10 200	
18					25	9 200	39	9 200	47	9 100	53	9 000	57	8 800	60	8 700	63	8 600	
20							29	8 000	40	7 900	47	7 800	53	7 600	56	7 500	60	7 400	
22									32	6 900	41	6 800	48	6 600	52	6 600	56	6 500	
24											35	6 000	42	5 800	48	5 800	52	5 700	
26														36	5 200	43	5 100	48	5 000
28														29	4 600	38	4 600	43	4 400
30															31	4 100	39	4 000	
32																	33	3 600	
34																			
36																			
38																			
40																			

Crawler Crane Lattice Boom

- SWL = 80 t.
- Boom Lengths between 12.19 m to 54.86 m.
- Radii Lengths between 4 m to 40 m.
- 360° Rotation.
- Boom Angles 45° to 79°

Q: How much you can lift if Boom 27.43 m and Radius 10 m ?

A: 20 t

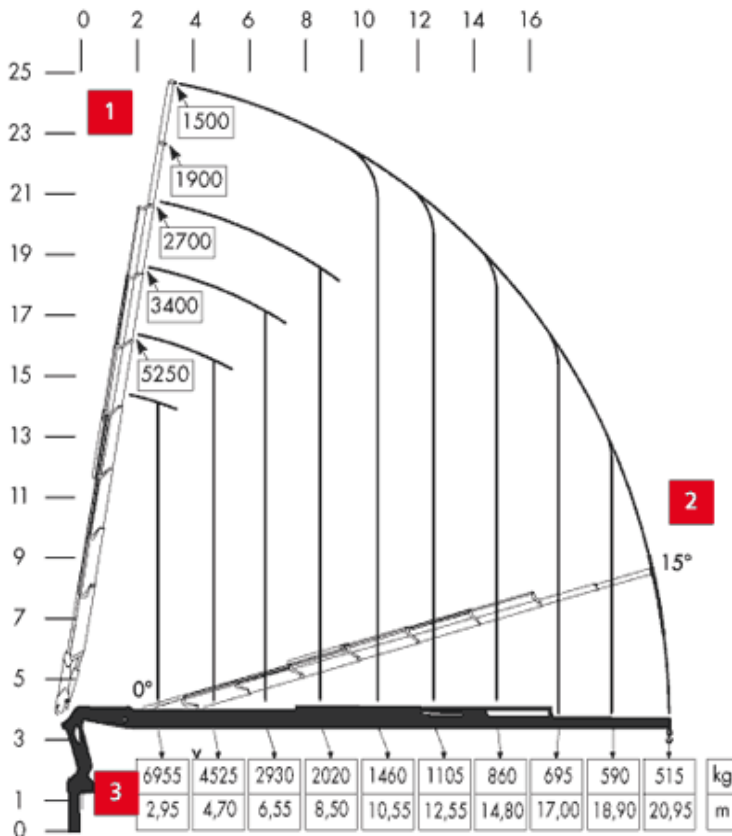
Q: How much you can lift if Boom 54.86 m Radius 10 m ?

A: Zero t

Exercise: Load Rating Chart

Jib Lorry (Boom Truck) Crane

- SWL = 6.9 t.
- Boom Length up to 25 m.
- Radii Lengths between 2.95 m to 20.95 m.



Q: How much you can lift if Boom 21 m and Radius 8.5 m ?

A: 2020 kg

Q: How much you can lift if Boom 15 m & Radius 21 m ?

A: Zero t

RCI, ASLI, LMI

- **LMI (Load Moment Indicator)** is an electronic safety system that continuously calculates the crane's load moment and warns the operator before overload or tipping occurs.

What It Monitors:

- Actual lifted load
- Boom length
- Boom angle
- Working radius
- Rated capacity
- Percentage of tipping

How It Works:

Sensors → send data to computer → compares with load chart → gives:

- Warning (90–95%)
- Cut-off (100–110% depending on OEM)

Function:

Prevents overload and tipping

- **SLI (Safe Load Indicator)** is a safety device that alerts the operator when the load approaches or exceeds safe working limits.

Difference from LMI:

SLI mainly gives warning & indication

LMI calculates load moment + automatic cut-off

In many cranes, SLI and LMI terms are used interchangeably.

- **ASLI (Automatic Safe Load Indicator)** is an advanced SLI system that automatically restricts crane functions when unsafe limits are reached.

Features:

- Automatic motion cut-off
- Real-time load calculation
- Configuration detection
- Fault diagnosis

Common in modern all-terrain cranes.

- **RCI (Rated Capacity Indicator)** is a system that shows the rated lifting capacity and compares it with the actual lifted load.

What It Displays:

- Rated load
- Actual load
- Load percentage
- Boom data

RCI is often another name used for LMI in certain regions

System	Full Form	Main Function	Auto Cut-Off
LMI	Load Moment Indicator	Calculates load moment	Yes
SLI	Safe Load Indicator	Warning system	Sometimes
ASLI	Automatic Safe Load Indicator	Auto restriction + monitoring	Yes
RCI	Rated Capacity Indicator	Shows rated vs actual load	Depends

LMI → Brain of crane safety system

SLI → Warning system

ASLI → Advanced automatic safety system

RCI → Capacity display system

RCI, ASLI, LMI

RCI : Rated Capacity Indicator

SLI : Safe Load Indicator

ASLI : Automatic Safe Load Indicator

LMI : Load Moment Indicator

All Above mentioned are the same device inside the operator cabin to give him accurate reading for the following (as a minimum):

1. Load radius,
2. Boom angle,
3. Boom length,
4. SWL of the crane for every position it reaches,
5. Actual load the crane is lifting,
6. Crane mode (General, Personnel etc.).

RCI, ASLI, LMI

All these indicators/limiters aid the equipment operator by sensing (directly or indirectly) the overturning moment on the equipment, i.e. load multiplied by radius. They compare the lifting condition to the equipment's rated capacity, and when the rated capacity is reached, warn the operator that an increase in the load or radius will result in the rated capacity being exceeded. This, of course could result in serious consequences.

Rated Capacity Limiters is a device which is installed on mobile cranes to alert the operator if the lift is exceeding the safe operating range of the machinery. In some cases, the device will physically lock the machinery in circumstances it determines to be unsafe.

Rated Capacity Limiter systems are usually composed of a microprocessor connected to various sensors on the crane itself. The RCL measures the angle and extension of the boom along with the load weight and compares this with the manufacturer's specifications to determine if the lift is safe.

The RCL has the capability of detecting the angle, weight of load lifted, and ground radius of any lifting device. It controls the lifting equipment to the level that it tries to keep the machinery functioning as per the manufacturer's suggested safety charts.

RCI, ASLI, LMI

The crane is fitted with multiple sensors, for each of the measured parameters, which are then further displayed in the operator's cabin for his benefit.

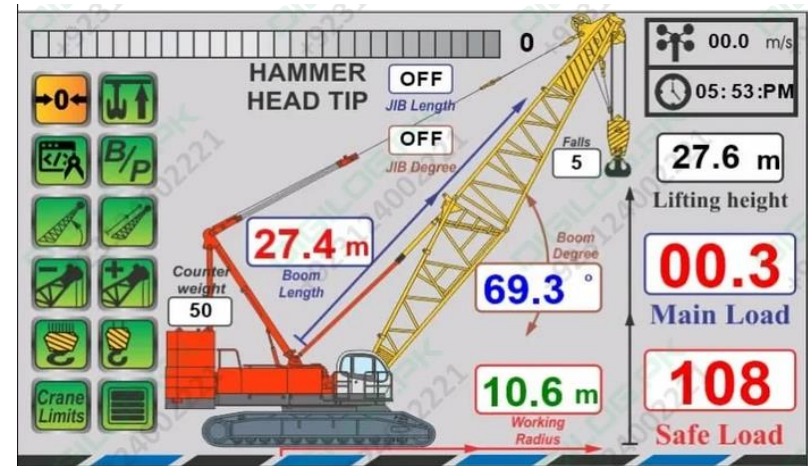
Only a Rated Capacity Limiter will actually shut off elements of the crane's systems to prevent an increase in the severity of the loading on the equipment, e.g. hoisting, telescoping out, or luffing out.

Typically, those functions which decrease the severity of the loading on the equipment remain operational, e.g. lowering, telescoping in, or luffing in.

In some crane models the device informs the operator of the configuration of the boom, confirms that all the locking devices are in place and aids the operator in installing the counterweights.

RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY



RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY

Boom angle and length

Load Reading



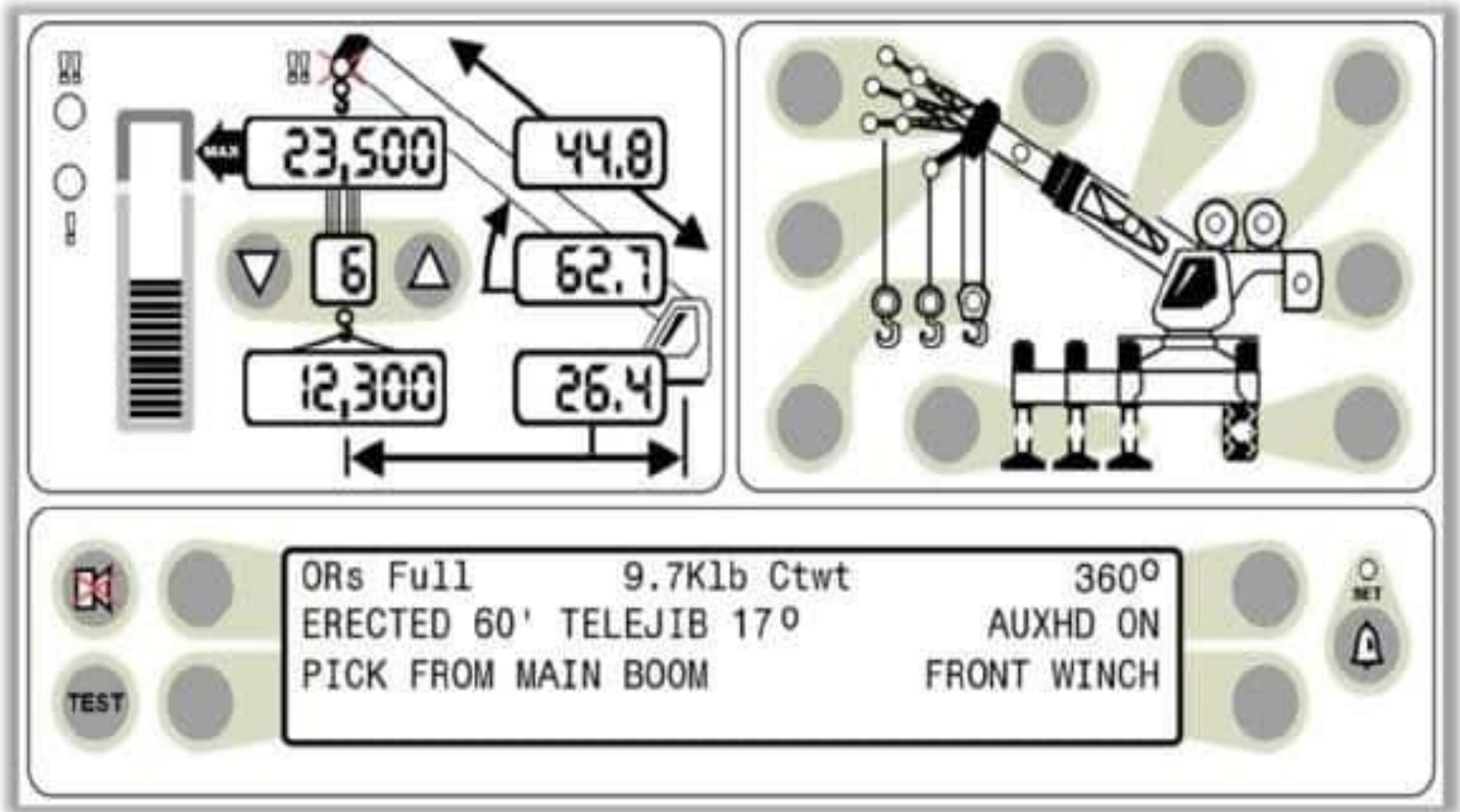
Capacity

Crane image matching actual crane type

% of safe working load bar

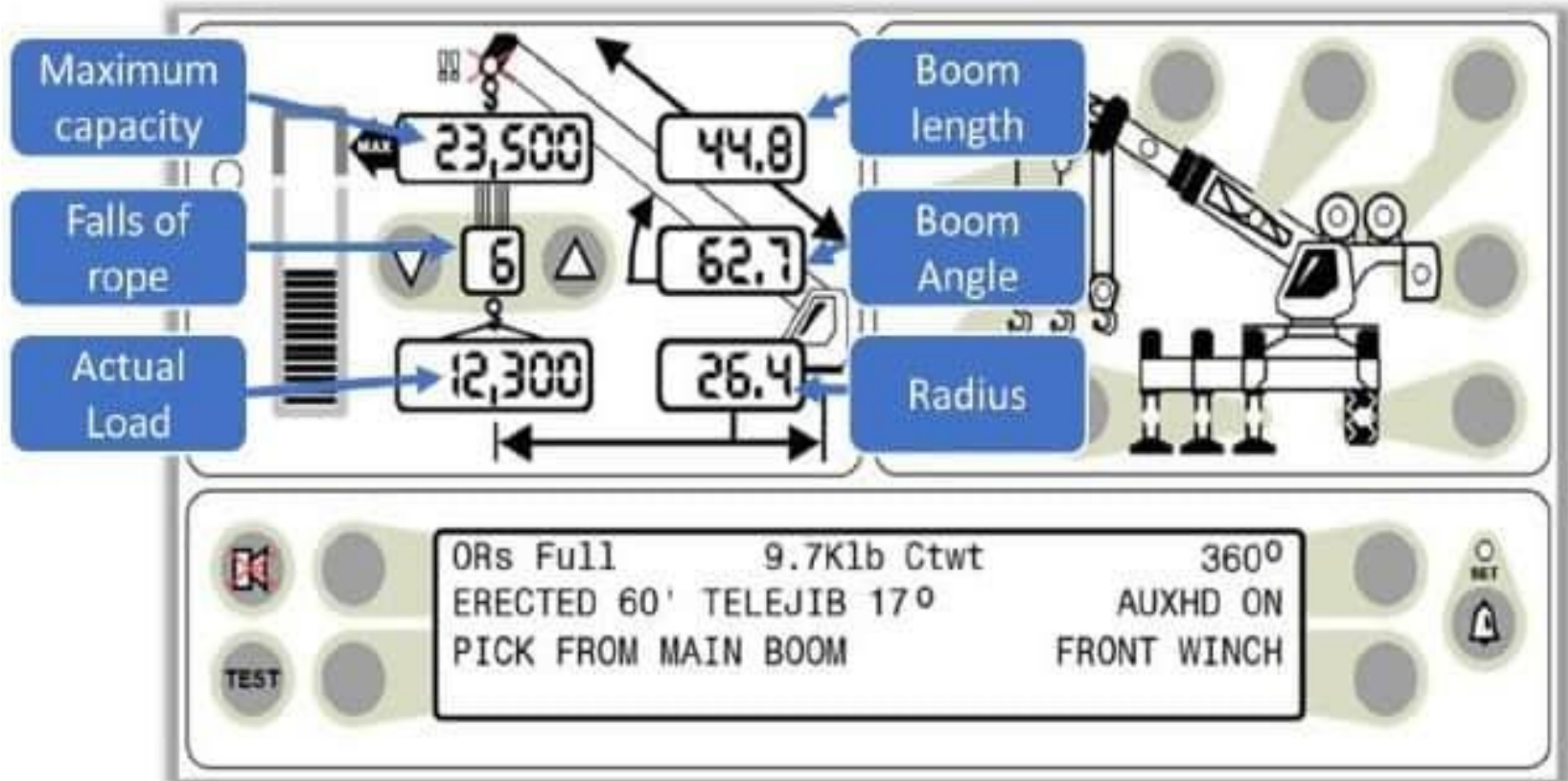
RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY



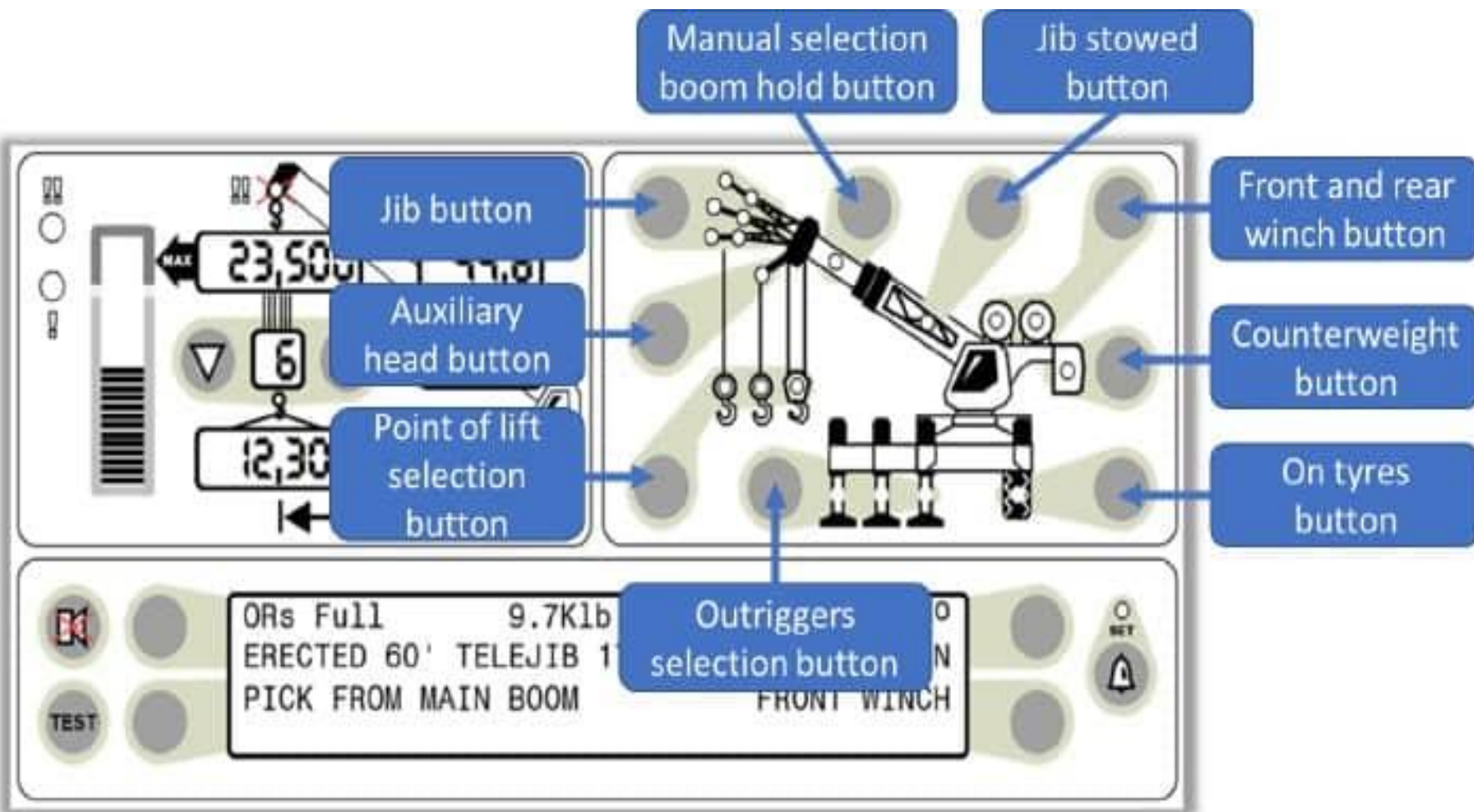
RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY



RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY



RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY

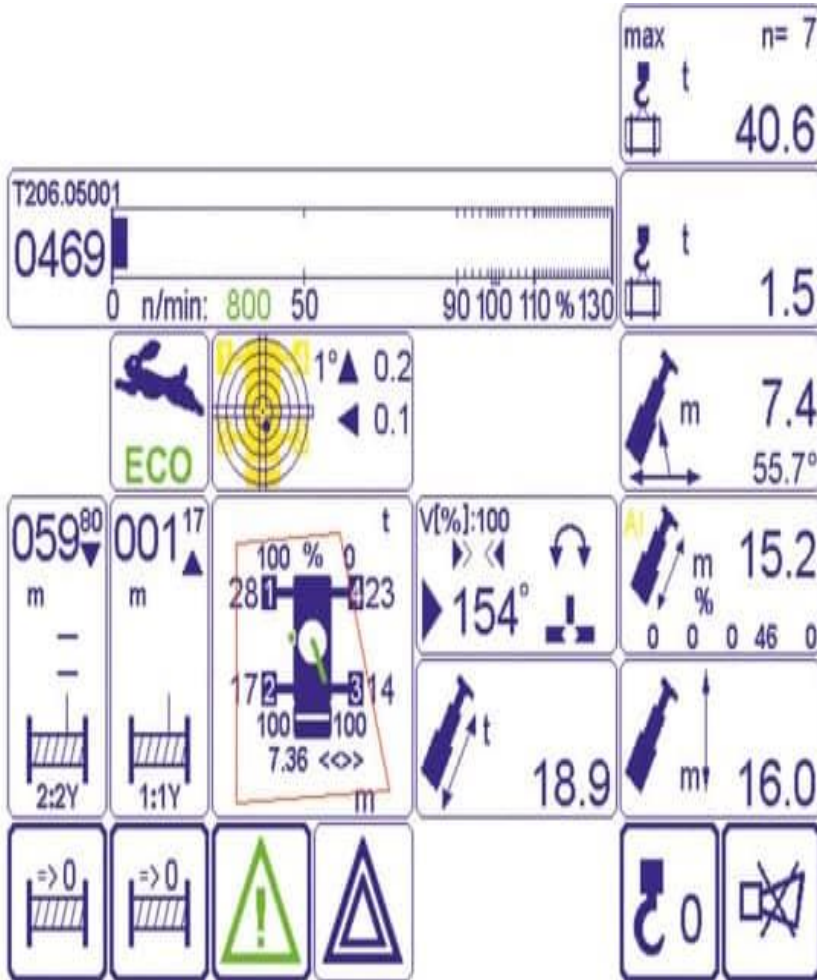
The image shows a handheld device screen displaying a grid of data for a crane configuration. The screen is annotated with blue callout boxes pointing to specific fields:

- Configuration code:** Points to the top header area containing alphanumeric codes.
- Radius:** Points to a field on the left side of the grid.
- SWL:** Points to a field in the middle-left section of the grid.
- % of each boom section to be used:** Points to a field in the middle-left section of the grid.
- Type of boom & boom extension:** Points to a field in the bottom-left section of the grid.
- Amount of counterweight:** Points to a field in the bottom row of the grid.
- Length of outriggers:** Points to a field in the bottom row of the grid.
- Working area:** Points to a field in the bottom row of the grid.
- Boom length:** Points to a field on the right side of the grid.
- Number of falls:** Points to a field in the bottom-right section of the grid.


The screen also features a numeric keypad on the right and function keys (SHIFT, F1-F8, ENTER) at the bottom.

RCI, ASLI, LMI

EXAMPLE OF RCI DISPLAY



	[m]	[t]	CODE: 0001	T206.60001	1(4)		
	11.5	15.2	15.2	15.2	15.2	19.0	19.0
3.0	82.6						
3.5	82.6	71.5	60.8	51.3	51.3	67.6	59.0
4.0	79.9	72.4	61.5	51.9	50.6	68.2	59.5
4.5	73.1	69.7	62.4	52.6	47.9	66.6	60.1
5.0	66.9	64.1	62.7	53.5	45.4	61.0	60.5
6.0	58.3	56.3	56.7	53.4	41.3	53.8	54.5
7.0	50.5	50.3	50.8	49.1	37.8	48.1	48.9
8.0	43.5	43.4	43.8	44.2	34.9	43.2	43.9
9.0	37.9	37.8	38.3	38.7	32.5	37.6	38.3
* n *	* 10 *	* 9 *	* 8 *	* 7 *	* 7 *	* 9 *	* 8 *
4(95)				▼			>>
1	0+	0+	0+	0+	0+	46+	0+
2	0+	46+	0+	0+	0+	46+	46+
3	0+	0+	46+	0+	0+	0+	46+
4	0+	0+	0+	46+	0+	0+	0+
% 5	0+	0+	0+	0+	46+	0+	0+


 T--
 35.0
t
 7.36 x
17.00
m
 360°
 n
7x
 OK

RCI, ASLI, LMI

TYPE OF WARNINGS DISPLAYED BY RCI

Warning of approach to SWL: The RCI/ASLI/AML shall give a clear and continuous warning of approach to SWL. The warning shall commence at not less than 90 % of the SWL and at not more than 97.5 % of the SWL. The approach to SWL warning shall continue to function until the percentage of the load to the SWL falls to some value which is less than the value at which the warning was initiated.

Warning of overload: The RCI/ASLI/AML shall give a clear and continuous warning of overload. The warning shall commence at not less than 102.5 % of the SWL and at not more than 110 % of the SWL. The overload warning shall continue to function until the percentage of the load to the SWL falls to some value which is less than the value at which the warning was initiated.

Warnings Indicator: The warnings for both approach to SWL and overload shall be continuous and shall be audible and visual. The audible warnings for approach to SWL and overload shall be clearly distinguishable from each other and also from other relevant sounds such as telephones. The visual warnings shall be clearly distinguishable under all conditions.

SAFETY & CONTROL DEVICES

Safety devices are protective systems installed on a crane to prevent accidents, overload, tipping, or unsafe operation.

They monitor conditions and either:

- Give warning alarms, or
- Automatically stop dangerous movements.

Purpose:

To protect:

- Operator
- Load
- Crane structure
- Surrounding personnel & property

Examples of Safety Devices

- LMI / SLI / RCI – Prevent overload
- Anti-Two Block (ATB) – Prevent hook collision
- Boom angle limit switch
- Over hoist limit switch
- Emergency stop button
- Outrigger interlock system
- Slew limit switch
- Wind speed indicator

Control devices are mechanisms used by the operator to operate and move the crane functions.

They do not prevent danger by themselves — they control movement.

Purpose:

- To control:
- Hoisting
- Slewing
- Luffing
- Telescoping
- Traveling

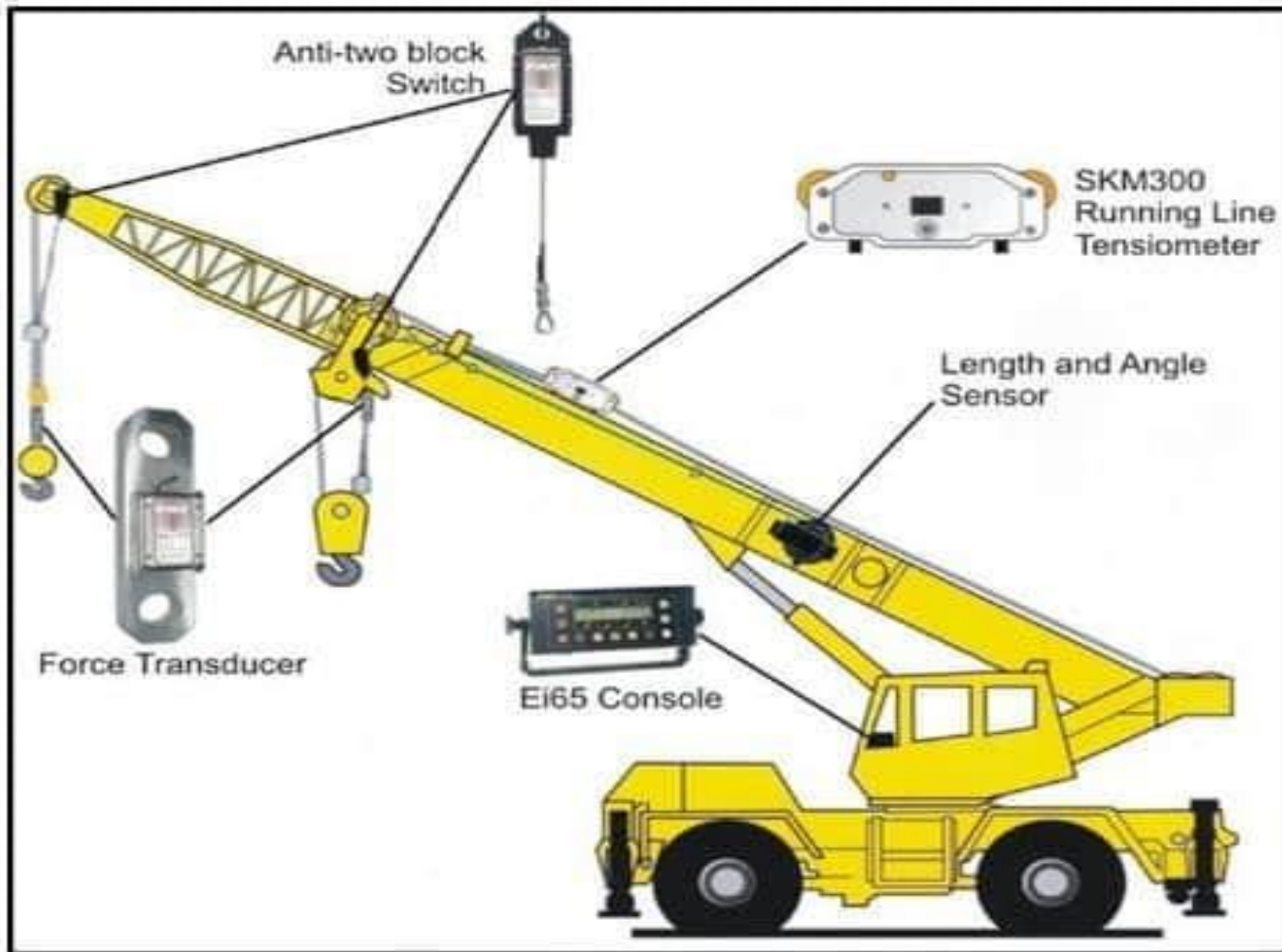
Examples of Control Devices:

- Joysticks
- Hydraulic levers
- Foot pedals
- Control desk switches
- Remote-control handset
- Touchscreen function selector

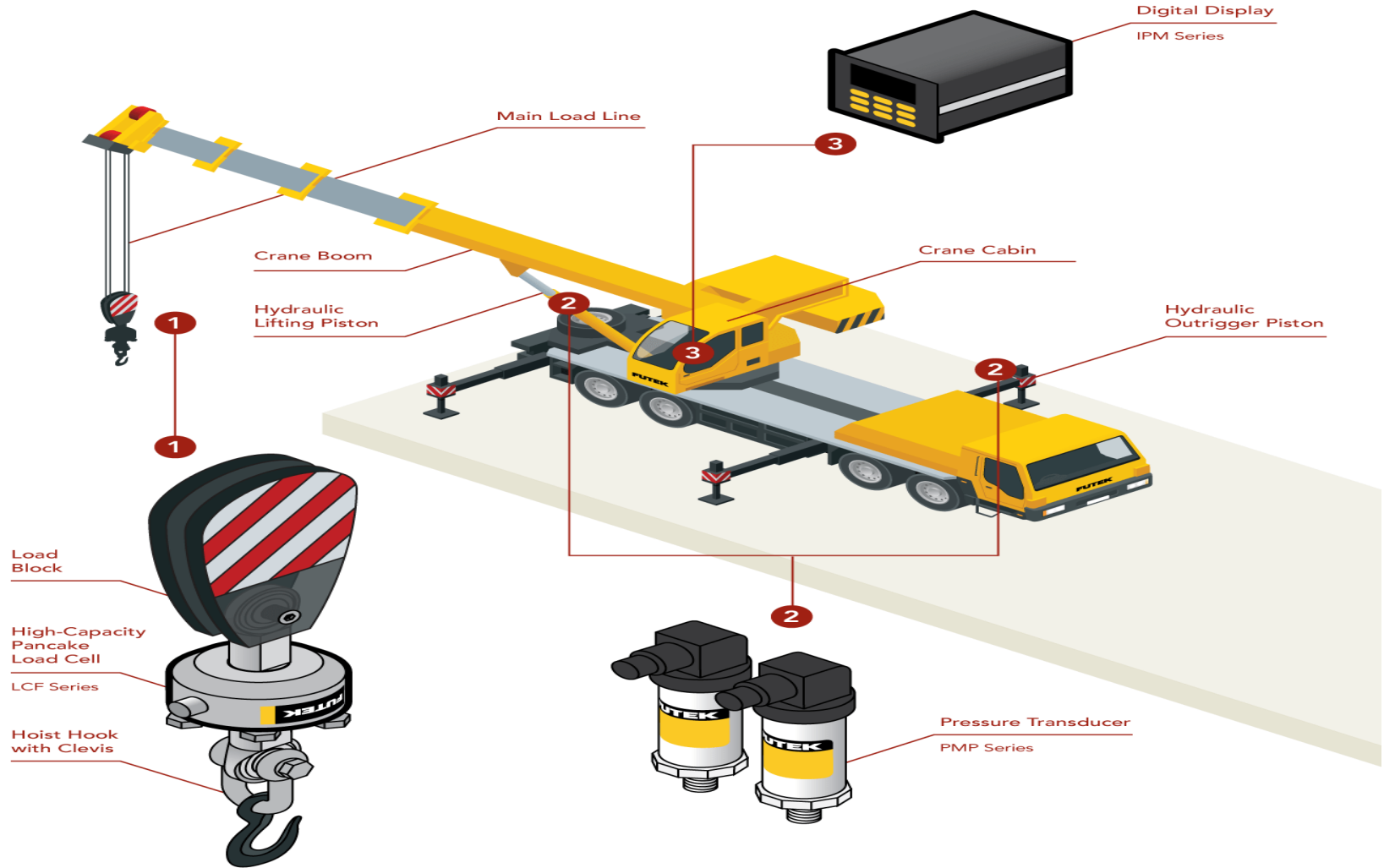
Safety devices protect the crane.

Control devices move the crane.

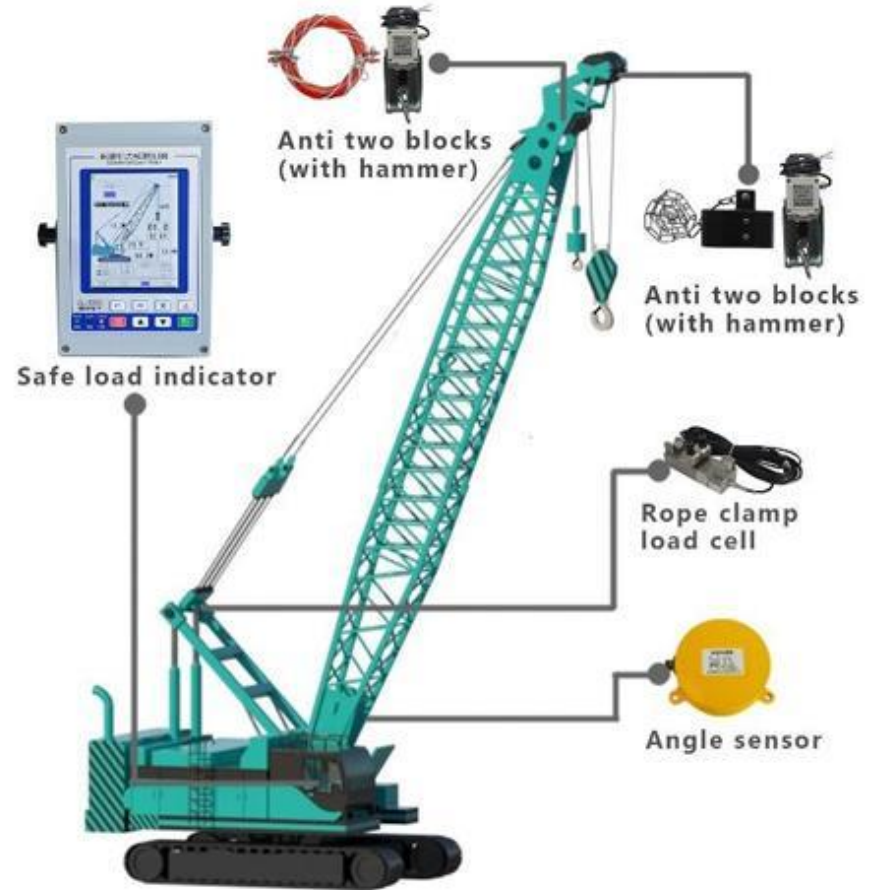
SAFETY & CONTROL DEVICES



SAFETY & CONTROL DEVICES



SAFETY & CONTROL DEVICES



SAFETY & CONTROL DEVICES

CABIN CONTROLS



SAFETY & CONTROL DEVICES

CABIN CONTROLS



SAFETY & CONTROL DEVICES

BOOM ANGLE INDICATOR (MECHANICAL)



SAFETY & CONTROL DEVICES

BOOM ANGLE SENSOR



This sensor is measuring the angle and giving the reading to the crane system, then the crane system calculates the radius depending on the given angle **Radius = Boom length cos (boom angle)**. So any false reading from this sensor means directly **WRONG BOOM RADIUS**

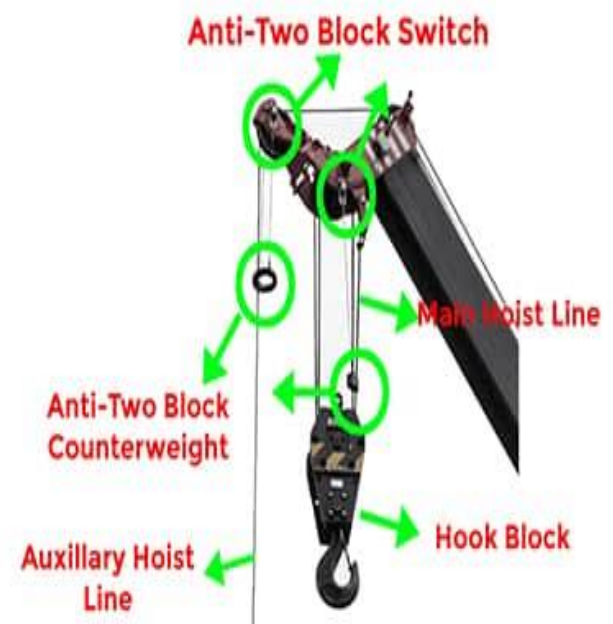
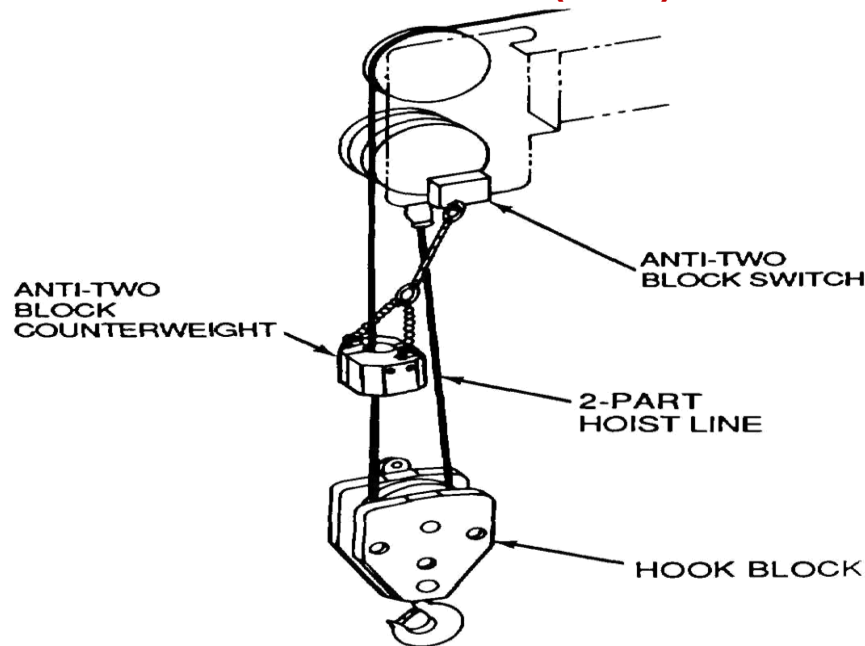
SAFETY & CONTROL DEVICES

CRANE HOOK BLOCKS SAFETY LATCHES



WORKING WITH CRANE

ANTI TWO BLOCK LIMIT SWITCH (A2B)



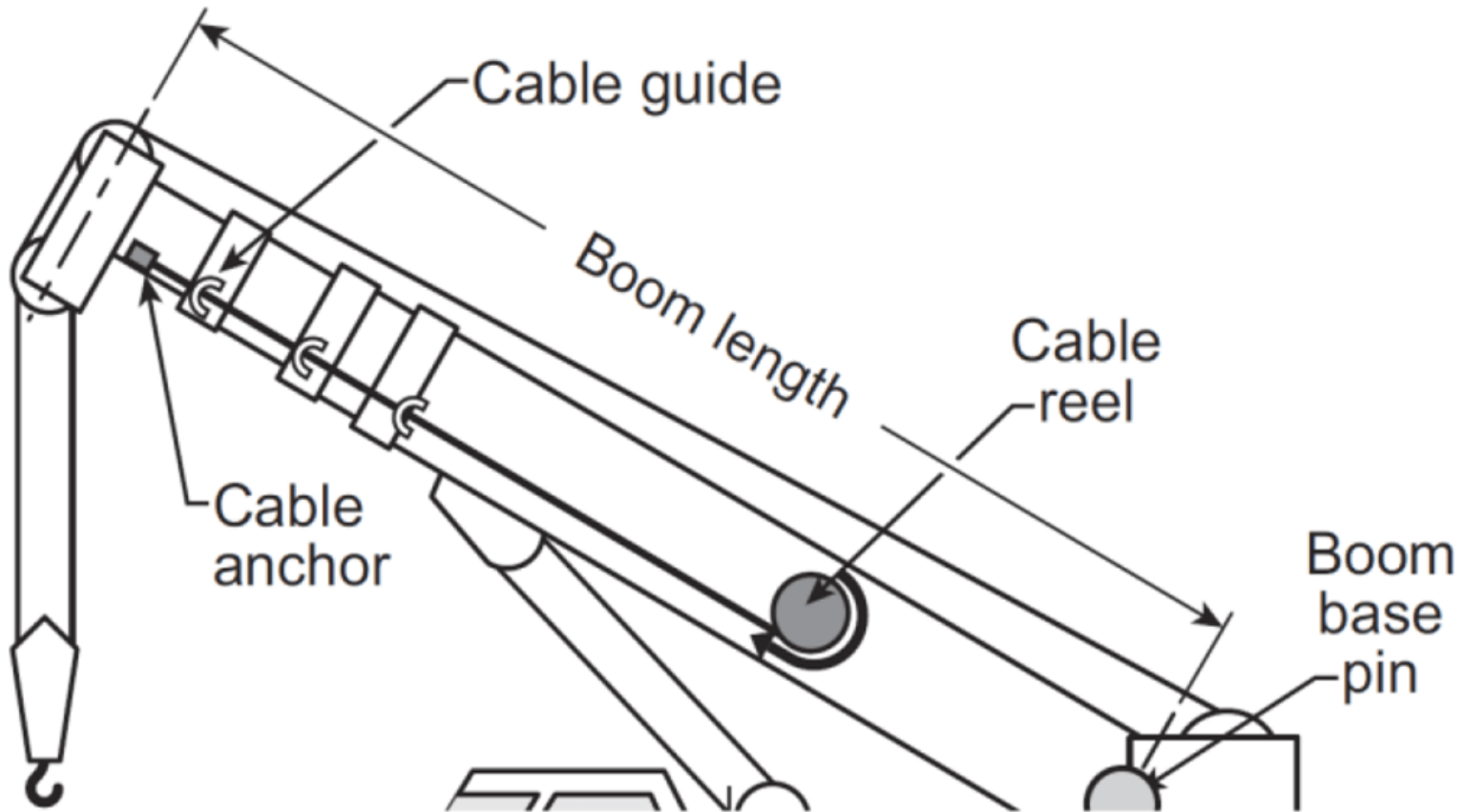
Anti-Two Block System

Part of the Rated Capacity Limiter system is the anti-two block assembly or cut out, this normally consists of a weight wrapped round the dead-line of the crane hoist wire and suspended from a micro switch by a chain or small wire.

If a hook block travels past the limit set by the chain or wire, the weight is lifted and the micro switch is activated, sending a signal to the operator cab which will cut out any further hoisting movement, but may allow lowering.

SAFETY & CONTROL DEVICES

BOOM LENGTH SENSOR (TELESCOPIC BOOMS)



SAFETY & CONTROL DEVICES

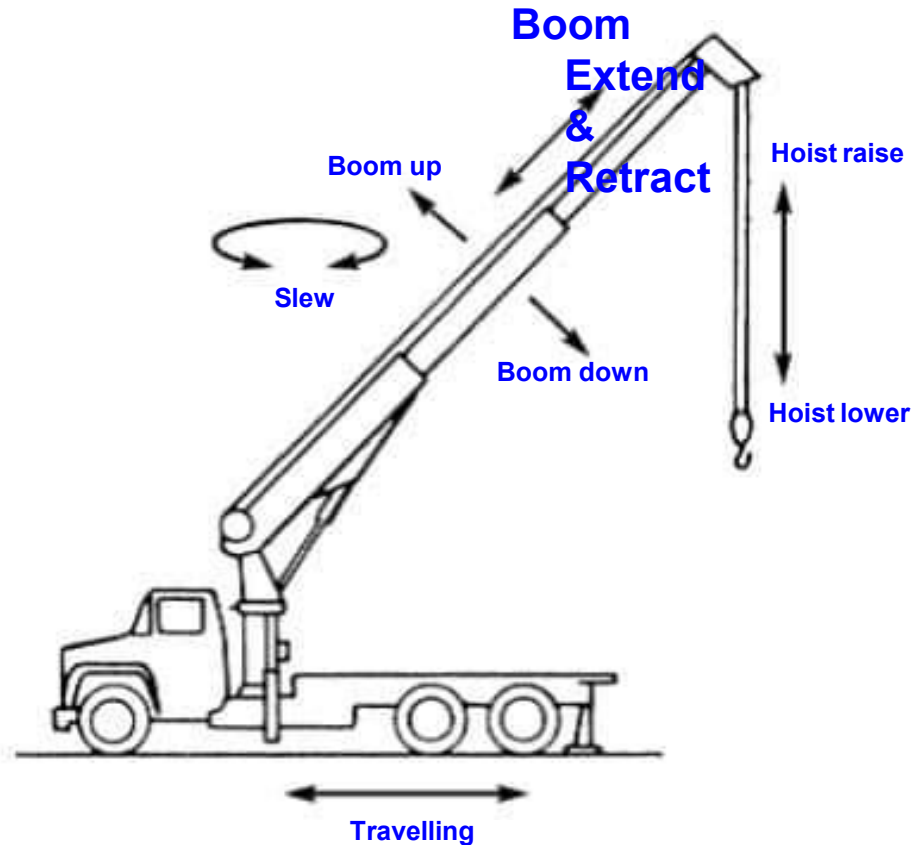
BOOM LENGTH SENSOR (TELESCOPIC BOOMS)

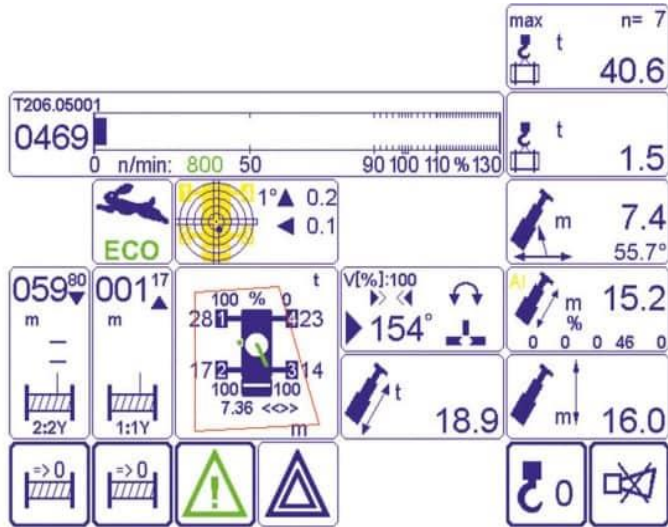


SAFETY & CONTROL DEVICES

CRANE MAIN MOTIONS AND THEIR LIMITS

- ▶ Boom Up,
- ▶ Boom Down,
- ▶ Hoist Raise,
- ▶ Hoist Lower,
- ▶ Slew Left,
- ▶ Slew Right,





	[m]	[t]	CODE: 0001	T206.60001	1(4)	
	11.5	15.2	15.2	15.2	19.0	
3.0	82.6					
3.5	82.6	71.5	60.8	51.3	51.3	
4.0	79.9	72.4	61.5	51.9	50.6	
4.5	73.1	69.7	62.4	52.6	47.9	
5.0	66.9	64.1	62.7	53.5	45.4	
6.0	58.3	56.3	56.7	53.4	41.3	
7.0	50.5	50.3	50.8	49.1	37.8	
8.0	43.5	43.4	43.8	44.2	34.9	
9.0	37.9	37.8	38.3	38.7	32.5	
* n *	* 10 *	* 9 *	* 8 *	* 7 *	* 6 *	* 5 *
4(96)						>>
1	0+	0+	0+	0+	0+	46+
2	0+	46+	0+	0+	0+	46+
3	0+	0+	46+	0+	0+	46+
4	0+	0+	0+	46+	0+	0+
% 5	0+	0+	0+	0+	46+	0+

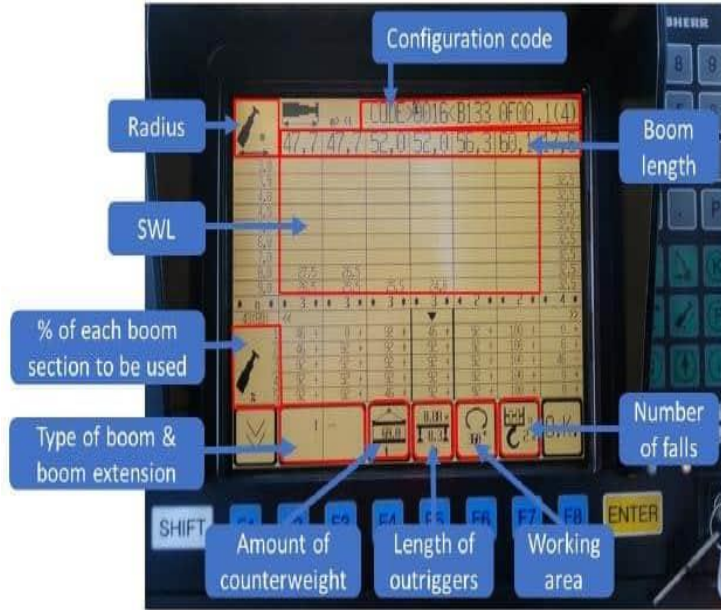
35.0 t

7.36 x 17.00 m

360°

7x

OK



WIND SPEED

WIND SPEED

- ▶ Operator should follow manufacturer recommendations/Company procedures for his crane limitations against wind speed.
- ▶ Wind speed normally measured by anemometer fitted to the tip of crane boom.
- ▶ For some cranes we must shut down lifting operations due to high wind speed and for some other cranes we de-rate the crane capacity depending on manufacturer data sheets



WIND SPEED

THE WEATHER CRITERIA FOR ONSHORE CRANE OPERATIONS

The weather criteria for all Onshore Cranes operations shall be as follows:

Maximum wind speed shall not be more than:

For Materials Lifting: **20 knots (10 m/sec.)** – steady wind measured at 10 meters above the sea level

For Personnel Lifting: **15 knots (7 m/sec.)**, measured with a calibrated hand-held anemometer at a similar level to that to which the carrier will be lifted

or as per the Crane Manufacturer's Wind Speed Limit whichever is the lesser



VIDEO ILLUSTRATION



TANDEM LIFTING

TANDEM LIFTING

WHAT IS TANDEM LIFTING

A tandem lifting is a lifting operation which involves the simultaneous use of two or more lifting appliances, e.g. cranes, hoists, chain blocks etc.

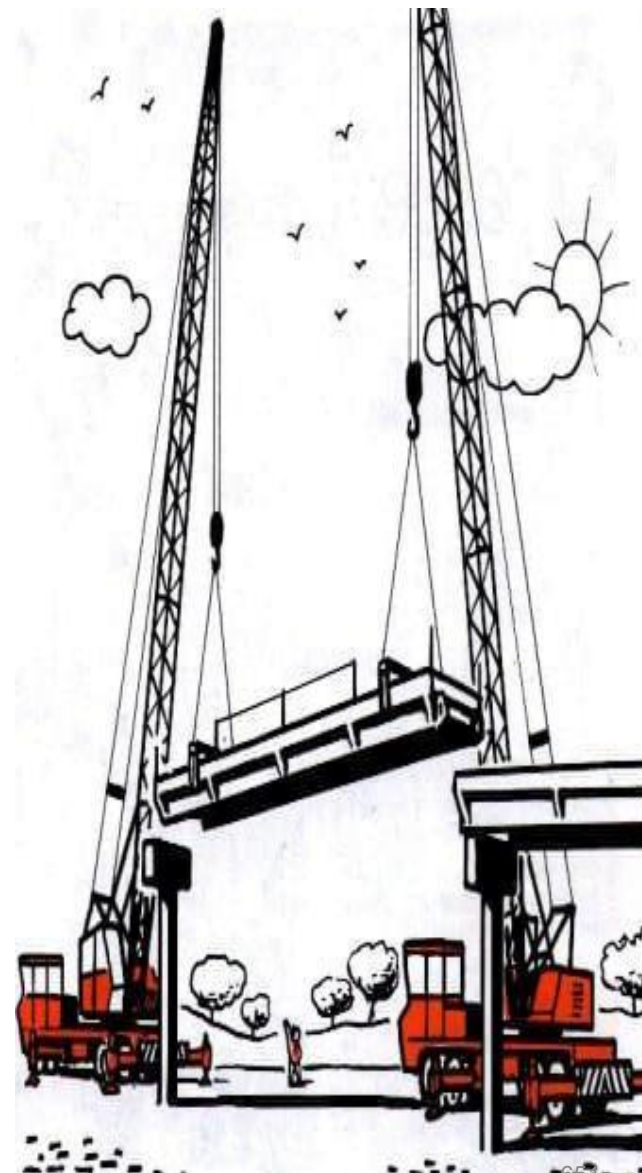


TANDEM LIFTING

TANDEM LIFTING REQUIREMENT

- ▶ Proper planning (by appointed person).
- ▶ Accurate and detailed lift plan & risk assessment of the load on each crane
- ▶ Similar crane capacities is preferable.
- ▶ Use one BANKSMAN to signal both crane drivers.
- ▶ Use suitable lifting gear.
- ▶ Additional factor of safety to be considered
- ▶ Each crane utilization ratio should be 70% (or less) of its estimated share of the load.

Do not use tower cranes for tandem lifting at all !!!

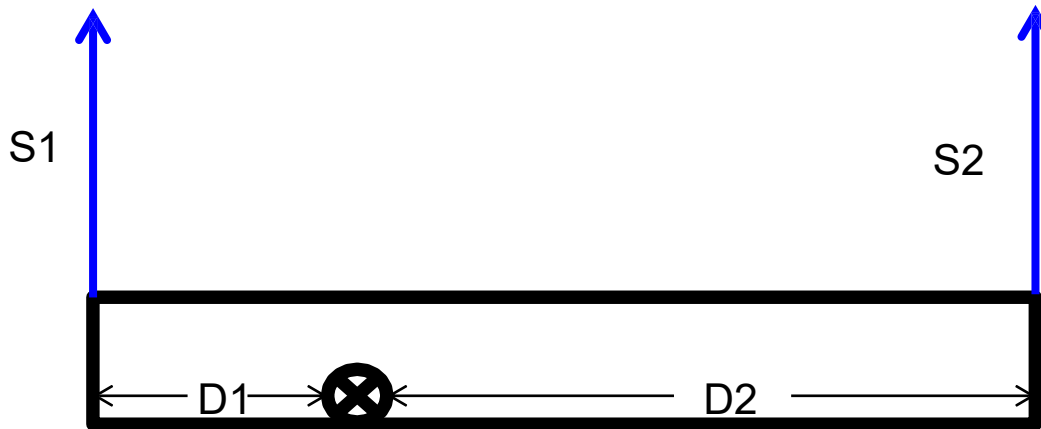


TANDEM LIFTING

LOAD ON EACH CRANE (2 CRANES)

$$\text{Load on Sling S1} = \left[\frac{W \times D2}{(D1 + D2)} \right]$$

$$\text{Load on Sling S2} = \left[\frac{W \times D1}{(D1 + D2)} \right]$$

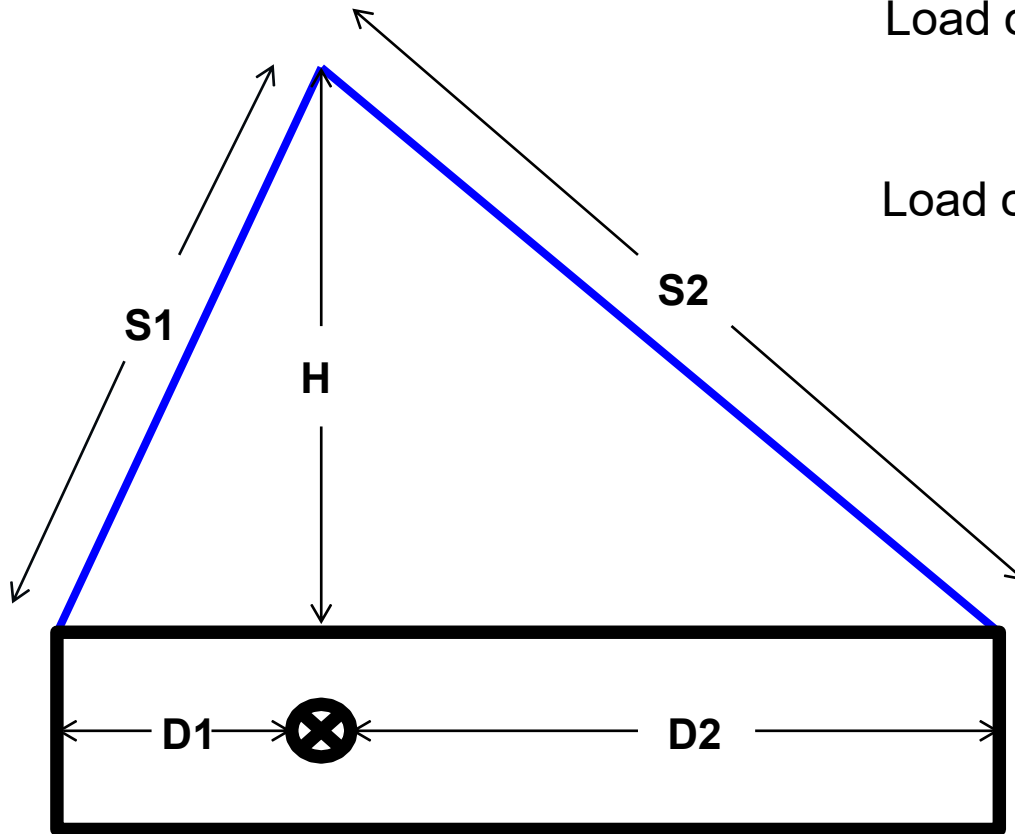


Total Weight of Equipment = W

SLING LENGTH AND SLING TENSION CALCULATIONS

SLING LENGTH AND SLING TENSION

LOAD ON SLINGS (UNEQUAL SLINGS)



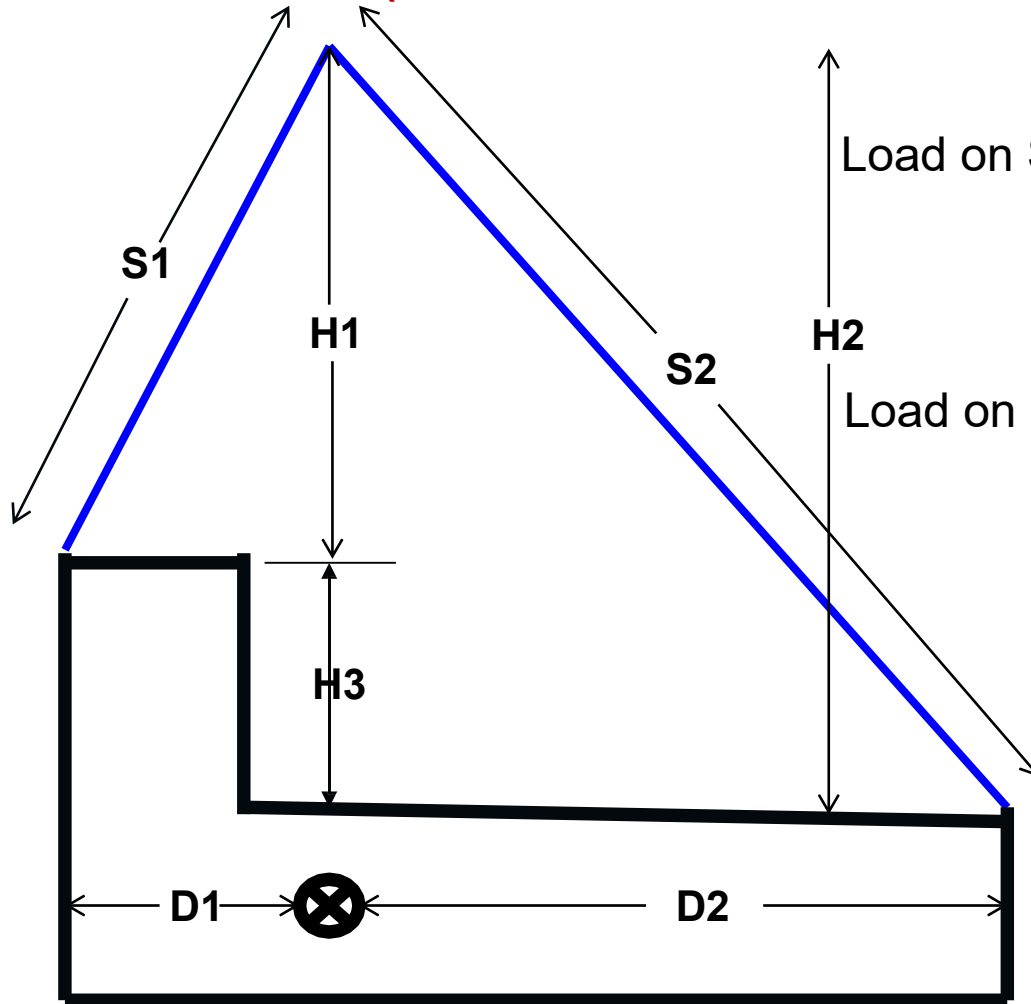
$$\text{Load on Sling } S1 = \frac{(W \times D2 \times S1)}{H \times (D1 + D2)}$$

$$\text{Load on Sling } S2 = \frac{(W \times D1 \times S2)}{H \times (D1 + D2)}$$

Total Weight of Equipment = W

SLING LENGTH AND SLING TENSION

LOAD ON SLINGS (UNEQUAL SLINGS & LOAD HEIGHT)



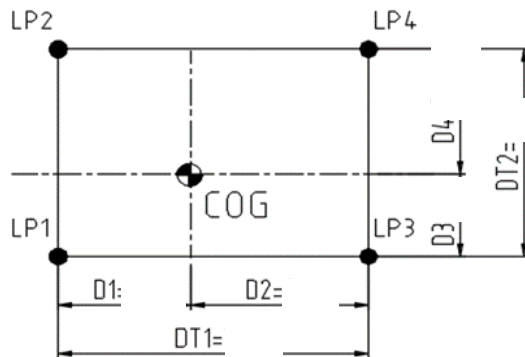
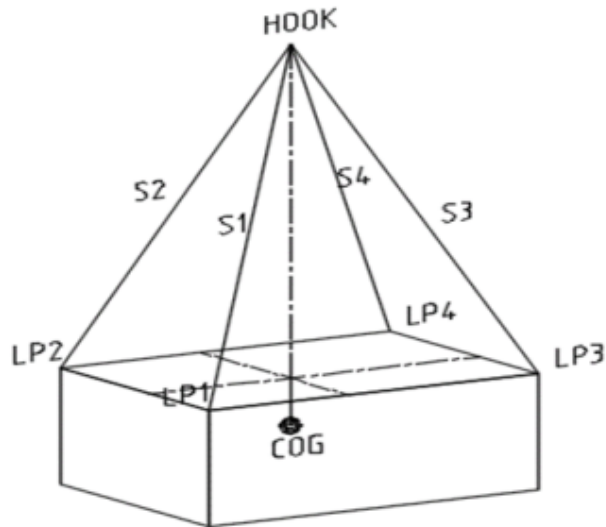
$$\text{Load on Sling S1} = \frac{(W \times D2 \times S1)}{(D2 \times H1) + (D1 \times H2)}$$

$$\text{Load on Sling S2} = \frac{(W \times D1 \times S2)}{(D2 \times H1) + (D1 \times H2)}$$

Total Weight of Equipment = W

SLING LENGTH AND SLING TENSION

LOAD ON SLINGS (UNEQUAL SLINGS & LOAD HEIGHT)



W = Cargo Weight

$D1$ = Lifting Point 1 Distance to COG

$D2$ = Lifting Point 2 Distance to COG

$D3$ = Lifting Point 1&3 Distance to COG

$D4$ = Lifting Point 2&4 Distance to COG

$DT1$ = Total distance for $D1$ & $D2$

$DT2$ = Total distance for $D3$ & $D4$

SLING LENGTH AND SLING TENSION

LOAD ON SLINGS (UNEQUAL SLINGS & LOAD HEIGHT)

Load at Lifting Point 1

$$L1 = W * (D2/DT1) * (D4/DT2)$$

Load at Lifting Point 2

$$L2 = W * (D2/DT1) * (D3/DT2)$$

Load at Lifting Point 3

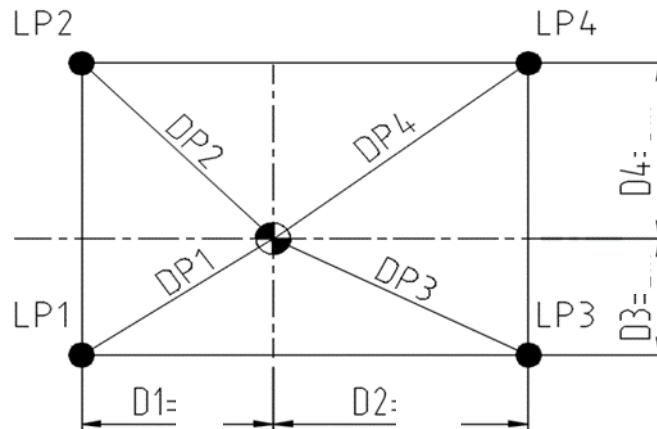
$$L3 = W * (D1/DT1) * (D4/DT2)$$

Load at Lifting Point 4

$$L4 = W * (D1/DT1) * (D3/DT2)$$

SLING LENGTH AND SLING TENSION

LOAD ON SLINGS (UNEQUAL SLINGS & LOAD HEIGHT)



DISTANCE FROM EACH LP To CoG

Distance from LP1 - CoG

$$DP1^2 = (D1^2 + D3^2) \underline{\hspace{2cm}}$$

Distance from LP2 - CoG

$$DP2^2 = (D1^2 + D4^2) \underline{\hspace{2cm}}$$

Distance from LP3 - CoG

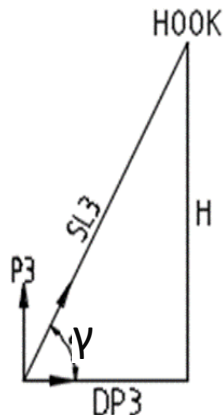
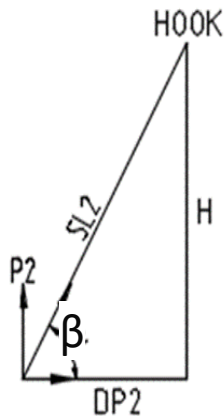
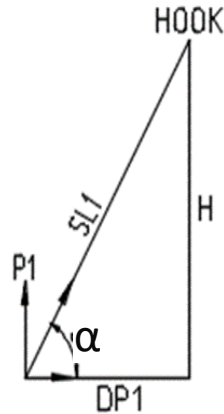
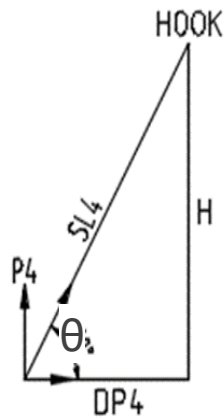
$$DP3^2 = (D2^2 + D3^2) \underline{\hspace{2cm}}$$

Distance from LP4 - CoG

$$DP4^2 = (D2^2 + D4^2) \underline{\hspace{2cm}}$$

SLING LENGTH AND SLING TENSION

LOAD ON SLINGS (UNEQUAL SLINGS & LOAD HEIGHT)



SLING 4 (Lifting Point 4 - Hook)

Sling Angle to Horizontal,

$$H = DP4 * \tan\theta$$

$$\text{Sling Length } SL4 = H / \sin\theta$$

SLING 3 (Lifting Point 3 - Hook)

Sling Angle to Horizontal,

$$H = DP3 * \tan\alpha$$

$$\text{Sling Length } SL3 = H / \sin\alpha$$

SLING 2 (Lifting Point 2 - Hook)

Sling Angle to Horizontal,

$$H = DP2 * \tan\beta$$

$$\text{Sling Length } SL2 = H / \sin\beta$$

SLING 1 (Lifting Point 1 - Hook)

Sling Angle to Horizontal,

$$H = DP1 * \tan\alpha$$

$$\text{Sling Length } SL1 = H / \sin\alpha$$

So If Height from hook to COG or angles between slings changes we have to use above points to get the final relations and value too.

VIDEO ILLUSTRATION

Safe Crane Operation and How to Check the Cranes



CASE STUDY

ASSIGNMENT



NCMT

3

LIFTING PLAN PREPRATION

LIFTING MANAGEMENT SYSTEM

LIFTING MANAGEMENT SYSTEM

LEADERSHIP, COMMITMENT AND ACCOUNTABILITY

Site Manager and Supervisors shall visibly demonstrate their commitment to managing lifting operations by:

- a) Personally conducting site visits and intervening if not fully satisfied with the conduct of lifting operations.
- b) Allocating the necessary resources to lifting and hoisting
- c) Communicating clearly that lifting and hoisting safety standards are an important company requirement.
- d) Providing appropriate training and assessment for all personnel involved in lifting and hoisting operations.
- e) Encouraging employee and third parties suggestions for measures to improve safety performance, and commend safe practice.
- f) Setting plans and targets and measuring safety performance of all personnel involved in lifting operations against established standards.
- g) Defining accountability, responsibility, and authority for lifting operations to nominated individual managers and down through the lift team.

LIFTING MANAGEMENT SYSTEM

POLICY AND STRATEGIC OBJECTIVES

Local lifting and hoisting procedures compatible with the corporate HSE policy shall be defined. These shall be in appropriate local languages and in an easy-to-use format.

The lifting and hoisting objectives shall aim to:

- a) Reduce the number of incidents, especially serious incidents, every year to a minimum, with a target of zero.
- b) Establish lifting and hoisting personnel selection, testing and training programs.
- c) Establish and support safe lifting and hoisting working procedures and practices.
- d) Ensure that the company will employ only lifting and hoisting assets, facilities and equipment that conform to acceptable procedures and standards and are maintained in a safe, secure and operational condition.

LIFTING MANAGEMENT SYSTEM

ORGANIZATION, RESOURCES AND DOCUMENTATION

A management structure for lifting and hoisting shall be in place. This management structure:

- a) Shall clearly identify those people who have an active responsibility for lifting and hoisting management and state what those responsibilities are.
- b) Shall ensure that sub-contractors have management systems that control lifting and hoisting to an agreed standard consistent with this RP. Joint reviews at regular intervals shall occur to ensure that objectives are achieved.
- c) Shall maintain procedures to ensure that its employees, its contractors, partners and others are aware of the requirements for managing lifting and hoisting.
- d) Shall ensure that communication is designed to bridge difficulties related to language and cultural understanding.

Management shall ensure that adequate resources are made available to ensure safe lifting and hoisting.

Records shall be kept to demonstrate auditable and effective control of lifting and hoisting operations and equipment.

LIFTING MANAGEMENT SYSTEM

EVALUATION AND RISK MANAGEMENT OF LIFTING AND HOISTING

Procedures shall be systematically implemented to identify, record and mitigate potential hazards and their consequences throughout the total life cycle where lifting and hoisting is involved. These shall demonstrate that:

- a) All foreseeable hazards associated with lifting and hoisting have been identified.
- b) The likelihood and consequences of an incident have been assessed.
- c) Controls to mitigate significant risks are in place
- d) Emergency response measures to mitigate incidents are in place
- e) There is a defined hierarchy of control.

LIFTING MANAGEMENT SYSTEM

PLANNING

All aspects of lifting and hoisting operations, equipment selection and use shall be planned to comply with the requirements of this RP. The plans shall especially address the introduction of any new or unusual techniques, types of lift or of environment. As part of emergency response arrangements, procedures shall be in place to identify, reduce the risk and consequence of, respond to and manage all foreseeable lifting and hoisting emergencies.

Deviations from this RP shall follow a formal deviation or management of change process.

LIFTING MANAGEMENT SYSTEM

IMPLEMENTATION AND MONITORING

There shall be written procedures for all lifting and hoisting activities. An active and reactive monitoring system shall be in place to ensure that the management system is effective, and that procedures are followed.

Active monitoring provides information on the extent to which lifting and hoisting safety requirements are being complied with, and objectives and performance criteria are being met, e.g., monitoring of safety critical maintenance and reporting backlogs or of compliance to procedures.

Reactive monitoring provides information from incidents that have occurred (including near misses, asset/environmental damage, investigations and safety statistics) and provides insight into the means to prevent similar incidents in the future.

LIFTING MANAGEMENT SYSTEM

AUDIT AND REVIEW

A program of planned and systematic audits of lifting and hoisting operations together with management reviews of performance and competence shall be established and maintained based on the degree of risk and the results of previous audit findings. Audit protocols shall be established that ensure that adequate resources, personnel requirements and methodologies are in place for the audit, together with procedures for reporting audit findings and tracking the implementation status of audit recommendations.

MANAGEMENT REVIEW

Senior management shall carry out a documented review of the lifting and hoisting safety aspects of their management system at appropriate intervals to ensure its continuing suitability and effectiveness for the ongoing operations.

LIFT PLANNING

LIFT PLANNING

LIFTING OPERATIONS PROCESS (ADNOC GROUP)

The Competent Person responsible for preparing a Lift Plan shall follow the following steps starting from:

- ▶ Preparing
- ▶ Categorization
- ▶ Assessment
- ▶ Planning
- ▶ Authorization
- ▶ Execution and
- ▶ Measure & Lesson Learnt

LIFT PLANNING

LIFT PREPARATION

- ▶ In the preparation stage of lift planning, it will be necessary to verify from that site database if the particular operation has been carried out before, and the availability of a Lift Plan including a Risk Assessment that may already exist.
- ▶ If a particular Risk Assessment and Lift Plan do exist then they shall be assessed to confirm that they are still applicable.
- ▶ If the lifting operations have not been carried out before then the operation should be categorized and risk assessment and lift plan preparation shall follow.

LIFTING PLAN CLASSIFICATION

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING AND HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

As a pre-requisite and in order to identify minimum controls, Lifting and hoisting operations shall, at all times, be categorized. The following lift categories are recognized as per ADNOC Lifting and Hoisting Operations standard (HSE-PSW- CP19) :

- ▶ Simple Lift,
- ▶ Complicated Lift and
- ▶ Non-Routine Complex.

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

1. Simple Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
<ol style="list-style-type: none"> 1. Load Net Weight less than or equal to 80% SWL; within the normal operating parameters of the lifting equipment. 2. Permanent/Temporarily installed lifting equipment. 3. Certified lifting point or points. 4. Ample headroom to complete lifting operations. 5. Not lifting over live plant or occupied areas or people. 6. Not lifting over or in close proximity (less than 3 m) to active or energized hydrocarbon process or pressurized utilities process equipment. 7. Load has known and uniformly distributed Weight, Uniform Shape, and Identified Centre of Gravity. 8. Centre of gravity below the lifting points. 9. Lifts with or without pre-slung arrangement and/ or not using any special lifting accessories/ attachments or slinging methods (Standard rigging arrangement), 10. Suitable lay down area available. 11. Single Lifting Appliance. 12. Not lifting personnel. 13. Using proprietary lifting accessories or attachments for vehicle loading and unloading (See Example 6 below). 14. Skidding Operation using Skates & Ground Trolleys. 	<ol style="list-style-type: none"> 1. Risk Assessment (generic) in line with the requirements of ADNOC HSE Corporate Practice for JSA. 2. Lifting Plan (generic reviewed annually) 3. Work Permit as required by ADNOC HSE Corporate Practice for permit to work. 4. Toolbox Talk. 5. Ten questions for a safe lift through IOGP Mechanical Lifting Start-Work Check (SWC). 	<ol style="list-style-type: none"> 1. Lifting Equipment Operator and Rigger/ Banksman as required. 2. Lifting Supervisor

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

1. Simple Lifting Operations

Examples:

- Forklift offloading palletized loads in warehouse/ maintenance yard within the facility storage area.
- Removing pump motor using chain block and permanent lifting beam and lifting point during maintenance.
- CCU with pre-slung and declared weight & shape with cargo not more than 110% height of CCU and doesn't interfere with pre-slinging arrangement.
- Manual chain block lifting portable "A" frames in maintenance yard.
- Offloading pre slung and stacked tubulars off vehicle and into storage.
- Using mobile elevated work platforms at < 80% of capacity.
- Using excavators as cranes for lifting during construction tasks.
- Using barrel clamps on a forklift truck
- Using a container lifting frame on a dock side crane.
- Use of hyd. Lift Gates fitted at back of a Truck

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

2. Complicated Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
<ol style="list-style-type: none"> 1. Load Net Weight more than 80% SWL but less than 90% SWL; without any Factor of Safety with exception of Overload Testing of Fixed and Mobile Lifting Appliances”. 2. Temporary installed lifting equipment. 3. Non-certified lifting point or points Where load testing is not applicable but validated through engineering calculation 4. Limited headroom to complete lifting operations. 5. Lifting in close proximity (less than 3 m) to active or energized hydrocarbon process or pressurized utilities process equipment. 6. Load is unknown or not uniformly distributed weight, or not uniform shape, or difficult to identify center of gravity or not Robust Packaging. 7. Centre of gravity above the lifting points. 8. Use of special lifting accessories, attachments or slinging methods (Non-standard rigging arrangements). 9. Unsuitable or unavailable lay down area. 10. Use of two or more Lifting Appliances including tailing pipes using winch and crane (Tandem Lift). 11. Lifting of personnel, including rig floor Man-Riding winch operations. 	<ol style="list-style-type: none"> 1. Risk Assessment (generic) in line with the requirements of ADNOC HSE Corporate Practice for JSA. 2. Lifting Plan (generic reviewed annually) 3. Work Permit as required by ADNOC HSE Corporate Practice for permit to work. 4. Toolbox Talk. 5. Ten questions for a safe lift through IOGP Mechanical Lifting Start-Work Check (SWC). 	<ol style="list-style-type: none"> 1. Lifting Equipment Operator and Rigger/ Banksman as required. 2. Rigging Foreman 3. Appointed Person, 4. Single Point Authority 5. TPA competent person.

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

2. Complicated Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
12. Load lowered into or lifted from a confined space. 13. When the wind load is calculated with applicable Crane wind speed limit as per OEM. 14. Overload testing 15. Cross-hauled the load or restrained using two or more non powered (Manual) lifting appliance.		
Examples: 1. Direct Lifting operation near pipe corridor but not over it; however, crane's failure could lead to part of the Crane or load coming close to a pipe. 2. Transferring loads from ship to ship or ship to shore/ platform in adverse weather (high winds or wave height above 4 m). 3. Jacket Piles installation and possible upending of pile on-board the Barge prior to install it vertically. 4. Lifting Tubulars (All types)		

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

3. Non-routine Complex Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
<ol style="list-style-type: none"> 1. Load Net Weight is $\geq 90\%$ of SWL (without any factor of safety); however Dynamic Lift Load which is compared to Load Chart shall not exceed 100% SWL considering all applicable Factors of Safety. 2. Temporary installed lifting equipment. 3. Limited headroom to complete lifting operations. 4. Lifting over active or energized hydrocarbon or pressurized utilities process equipment. 5. Load is unknown or not uniformly distributed weight, or not uniform shape, or difficult to identify centre of gravity or not Robust Packaging. 6. Centre of gravity above the lifting points. 7. Large loads (large Surface Area/ Volume) requiring special lifting and slinging requirements. 8. Unsuitable or unavailable lay down area. 9. Tandem lift with two cranes or more. 10. Dangerous goods cargo lifting, such as explosives, propane tanks etc. 11. Load is special and/or expensive the loss of which would have a serious impact on production operations, e.g. power plant turbine. 12. Snatching a load from untied vessel for None DP/II (Dynamic Positioning) vessels. 	<ol style="list-style-type: none"> 1. Formal work pack (Lifting Plan Dossier Appendix 6) with method statement. 2. Risk Assessment (Activity specific scenario based) in line with the requirements of ADNOC WMS 3. Lifting Plan specific to the task prepared by AP, reviewed by qualified TPA (If required) and reviewed/ approved by SPA/ TA. 4. Drawings shall mention Crane Position in Plan & Elevation and Rigging Plan before and after Lift and clearly marked (to scale if identified in risk assessment). 5. Work Permit as required by ADNOC WMS. 6. Toolbox Talk. 7. Ten questions for a safe lift through IOGP Mechanical Lifting Start Work Check (SWC). [Refer to Section 7.3.3] 	<ol style="list-style-type: none"> 1. At site-Competent Lifting Equipment Operator. 2. In addition, for cranes- Rigger level 3/ Signaler/Banksman. 3. Lifting Supervisor 4. Appointed Person. 5. Single Point Authority. 6. Asset Owner. 7. Lifting Technical Authority. 8. Third Party Lifting Specialists (If requested by the site or the project).

LIFT CATEGORIZATION

LIFT CATEGORIZATION: ADNOC LIFTING & HOISTING OPERATIONS STANDARD (HSE-PSW-CP19)

3. Non-routine Complex Lifting Operations

Categorization Criteria	Control Measures	Competent Personnel
13. Transferring the load from one lifting appliance to another. 14. Lifting with a helicopter. 15. Subsea lifting (the entire Load to be submerged in the water regardless of Crane's Hook Block).		
Examples: 1. Recovering a failed lifting operation with additional/ replacement equipment due to malfunction, inadequacy or unsuitability of existing equipment. 2. Heavy Loads or loads likely to be affected by environmental/ weather conditions such as high winds. 3. All Helicopter lifting operations (Snatch Lift).		

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(✓)		
		Simple	Complicated	Non-routine Complex
1	Load Net Weight $\geq 90\%$ of SWL (without any factor of safety); however Dynamic Lift Load which is compared to Load Chart shall not exceed 100% SWL considering all applicable Factors of Safety.			✓
2	Large loads (large Surface Area/Volume) requiring special lifting & slinging arrangements, when the wind load is calculated.			✓
3	Dangerous goods cargo lifting, such as explosives, propane tanks etc.			✓
4	Load is special and/or expensive the loss of which would have a serious impact on production operations, e.g. power plant turbine.			✓
5	Lifting overactive or energized process equipment or utilities.			✓
6	Transferring load from one lifting appliance to another			✓

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(v)		
		Simple	Complicated	Non-routine Complex
7	Tandem lift with two cranes or more.			✓
8	Snatching a load from untied vessel for none DP/II (Dynamic Positioning) vessels.			✓
9	Subsea lifting (the entire Load to be submerged in the water regardless of Crane's Hook Block).			✓
10	Lifting with a helicopter			✓
11	Load Net Weight more than 80% SWL but less than 90% SWL without any Factor of Safety (with exception of Overload Testing of Fixed and Mobile Lifting Appliances).		✓	
12	Load unknown or having not uniformly distributed weight, or not uniform shape, or difficult to identify centre of gravity or not Robust Packaging.		✓	
13	COG is above the lifting points.		✓	

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(√)		
		Simple	Complicated	Non-routine Complex
14	Non-certified Lifting points where load testing is not applicable but validated through engineering calculation		√	
15	Unsuitable or unavailable lay down area.		√	
16	Load lowered into or lifted from a confined space, or blind lift		√	
17	Large loads (large Surface Area/ Volume) requiring special lifting and slinging arrangements, when the wind load is calculated with applicable Crane wind speed limit as per OEM.		√	
18	Lifting in close proximity (less than 3m), but not over live/energized process equipment or utilities, or occupied areas or people.		√	
19	Cross-hauled the load or restrained using two or more non-powered (Manual) lifting appliance		√	
20	Using two or more Lifting Appliances, including tailing pipes using winch and one crane (Tandem Lift).		√	

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(√)		
		Simple	Complicated	Non-routine Complex
21	Personnel lifting, including rig floor Man-Riding winch operations.		√	
22	Overload testing of the crane.		√	
23	Permanent / Temporary installed lifting equipment.	√		
24	Using Proprietary lifting accessories or attachments for vehicle loading and unloading.	√		
25	Lifts without pre-slung arrangement and/ or use of specialist lifting accessories; attachments or slinging methods (Non-std. rigging arrangements).	√		
26	Limited headroom to complete lifting operations.	√		
27	Skidding Operation using Skates & Ground Trolleys.	√		

LIFT CATEGORIZATION

LIFT CATEGORIZATIONS CHECKLIST

The following checklist can be used to finalize the category of lifting operation.

S/no	Criteria	The lowest lift category for respective criterion Tick in white cells as applicable for planned lifting operation(✓)		
		Simple	Complicated	Non-routine Complex
35	Suitable lay down area available.	✓		
36	No lifting over or in close proximity (less than 3m)to live/energized process equipment or utilities, or occupied areas, or people.	✓		
37	Single Lifting Appliance.	✓		
38	No personnel lifting.	✓		

RISK ASSESSMENT

RISK ASSESSMENT

- **Hazard:** Anything with the potential to cause harm, including health hazards, occupational illness, or damage to property/environment.
- **Risk:** The likelihood (probability) that a hazard will cause harm, combined with the severity (consequence) of that harm.
- **Goal:** To manage risks to a level that is **As Low As Reasonably Practicable (ALARP)**.

Stage Risk Assessment Process

- **Hazard Identification:** Identifying hazards, including occupational health, process safety, and environment.
- **Scenario Definition:** Defining representative scenarios for study (e.g., pipeline rupture, chemical spill).
- **Analysis of Consequence:** Assessing the potential severity (people, environment, assets, reputation).
- **Frequency Calculation:** Calculating the probability of the scenario occurring.
- **Risk Estimation:** Using the **Risk Matrix** to determine the risk level (Low, Medium, High, Extreme).
- **Interpretation & Mitigation:** Drawing conclusions and taking action to control or eliminate the hazard.

RISK ASSESSMENT

Basic Risk Assessment (Site/Task Level)

- **Job Hazard Analysis (JHA/JSA):** Used for daily tasks to identify hazards for each step of a job.
- **Checklist & What-If Analysis:** Brainstorming potential deviations from normal operation (e.g., "What if a valve leaks?").
- **Basic Site Inspection:** Evaluating PPE, emergency access, and equipment condition (e.g., fire extinguishers, H2S monitors)

Advanced Risk Assessment (Process/Project Level)

- **HAZOP (Hazard and Operability Study):** Highly structured team study of process deviations (e.g., more flow, less temperature).
- **QRA (Quantitative Risk Assessment):** Uses statistical data and modeling to derive numerical values for Individual Risk (IR) and Societal Risk (SR).
- **SIL (Safety Integrity Level) Assessment:** Assessing the reliability of safety instrumented systems.
- **Bow-Tie Analysis:** Visualizing the relationship between hazards, threats, preventative barriers, and recovery measures.

RISK ASSESSMENT

Key Principles in ADNOC Assessments

- **Personnel Awareness:** Training employees to recognize and report hazards.
- **Occupational Health Focus:** Identifying health risks, not just safety hazards.
- **Continuous Monitoring:** Reviewing assessments periodically, particularly when procedures or equipment change.
- **Control Measures:** Applying the Hierarchy of Controls (Elimination, Substitution, Engineering, Administration, PPE).

RISK ASSESSMENT

The assessment of all foreseeable hazards and their associated and consequences risks shall be conducted through an approved method which directly relates to the level of complexity of the lifting operation, impact to operations and potential injury to personnel.

Generic Risk Assessment:

Routine & Non-Routine Simple lifts shall adopt a generic Risk Assessment which covers a broad range of hazards associated with lifting operations.

Specific Risk Assessment:

Non-Routine Complicated lifts shall require a Task Based Risk Assessment specific to the conditions surrounding that particular lifting operation.

RISK ASSESSMENT

HAZID / HAZOPS:

Non-Routine Complex lifts shall be subject to a Hazard Identification Risk Assessment; this will involve multiple disciplines of varying levels of authority to assess the risks involved with performing the operation and the impact to their specific field of expertise.

Tool Box Talk:

A Tool box talk shall be held to ensure that all personnel involved in the lifting operation fully understand the Lift Plan. Prior to all lifts (Routine Lifts and Non- Routine Lifts) the Appointed Person shall verify that the answers to the following 10 questions in the next slide for a safe lift are all addressed.

RISK ASSESSMENT

Ten Questions for Safe Lift:

1. Are you aware of and fully conversant with the lifting and hoisting procedures applicable to the lift?
2. Has everyone involved with this lifting operation attended the toolbox talk?
3. Has a pre-use inspection of the Lifting Equipment been carried out and are the Lifting Tackle tagged or marked with: : **a)** Safe working load. **b)** A unique identification number. **c)** A valid certification date.
4. Are all safety devices working?
5. Do you know the Person-in-Charge of the lift?
6. Is everyone competent and aware of his or her tasks?
7. Is there a current Lift Plan and JSA/JHA, which manages risks?
8. Do you know the environmental limits for the lift?
9. Is the lift area controlled and is everyone clear if the load falls or swings?
10. Are signaling methods and communication agreed and clear to you?

RISK ASSESSMENT

HOW TO ASSESS THE RISKS IN YOUR WORKPLACE:

Follow the five steps

STEP 1: Look for the hazards (HAZID)

STEP 2: Decide who might be harmed and how (Hazard Evaluation)


STEP 3: Evaluate the risks and decide whether the existing precautions are adequate or whether more should be done (Risk Assessment & controls)

STEP 4: Record your findings

STEP 5: Review your assessment and revise it if necessary

RISK ASSESSMENT

INCIDENT POTENTIAL MATRIX (IPM QUALITATIVE)

 ADNOC Corporate Risk Matrix						Term	Rare	Unlikely	Possible	Likely	Very Likely	Almost Certain	
						ERM Criteria	Hasn't happened in the industry in the last 50 years	Could be incurred in the next 20-30 years	Could be incurred within a 5-10 year time frame	Could be incurred within the 3 year Strategic Planning period	Could be incurred over the next 1-2 year budget period	Could be incurred once or more during the next year	
						HSE Frequency	$10^2 \leq < 10^3$	$10^1 \leq < 10^2$	$10^0 \leq < 10^1$	$10^{-1} \leq < 10^0$	$10^{-2} \leq < 10^{-1}$	$10^{-3} \leq < 10^{-2}$	
						HSE Likelihood	Has not occurred in world-wide industry	Has occurred in world-wide industry but not in ADNOC	Has occurred at least once in the Group Company	Has occurred at least once in Group Company but not on the site	Has occurred more than once in Group Company or once on the site	Has occurred more than once on the site	
Severity	Health & Safety	Environment	Reputation	***Financial		Legal	#	A	B	C	D	E	F
				Direct Financial Impact (DFI)	Production Loss (PL)								
Disastrous	Multiple public (more than 1) / workers (more than 10) fatalities or permanent total disabilities	Disastrous effect (severe and permanent impacts, consistently exceeding limits)	Prolonged international impact and public attention. Effect will last for years and can spread internationally and affect other industry players	>=\$1 Billion in a year	>=\$1 Billion in a year	Inability to comply with laws, regulations or contracts resulting in substantially material losses. Disastrous regulatory sanction, prosecution or prolonged multiple litigations. Potential jail terms for executives.	6	6A	6B	6C	6D	6E	6F
Catastrophic	Multiple worker fatalities (upto 10) / permanent total disabilities, or single public fatality	Catastrophic effect (serious impacts on many attributes of environment in larger area)	Serious international impact and public attention - extensive adverse coverage in the international media with potentially severe impact on licenses.	>=\$100 million - <\$1 Billion in a year	>=\$100 million - <\$1 Billion in a year	Significantly constrained ability to comply with laws, regulations or contracts resulting in material financial losses. Very serious litigation, including class actions.	5	5A	5B	5C	5D	5E	5F
Major	Single worker fatality / permanent total disability or serious injury to public	Major effect (negative impacts on surrounding environment and repeated non compliances)	Significant national impact and public concern - extensive adverse attention in the national media. Effect could last a few months and likely to spread to close industry partners	>=\$10M - <\$100M in a year	>=\$10M - <\$100M in a year	Major breach of law, contract or regulation. External investigation(s), significant regulatory sanction or major litigation	4	4A	4B	4C	4D	4E	4F
Serious	Serious injuries or health effects (permanent partial disability)	Local effect (reversible impacts but frequent non compliances)	Considerable impact - adverse attention in local media / local government / action groups	>=\$1M - <\$10M in a year	>=\$1M - <\$10M in a year	Serious breach of law, contract or regulation - moderate fines / litigation and / or requires reporting to regulator(s)	3	3A	3B	3C	3D	3E	3F
Minor	Minor injuries or health effects (reversible effects - weeks to months)	Minor effect (impacts limited organizational surroundings)	Limited impact - some local media / political attention. Effect will last a few days only	>=\$100K - <\$1M in a year	>=\$100K - <\$1M in a year	Minor breach of law, contract or regulation where mild regulatory sanction or minor litigation	2	2A	2B	2C	2D	2E	2F
Notable	Slight injuries or health effects (short term effects)	Slight effect (impacts within fence area)	Slight impact - no public concern	<\$100K in a year	<\$100K in a year	Low-level legal or business ethics issue; litigation or regulatory sanction unlikely	1	1A	1B	1C	1D	1E	1F
Minimum Required Action													
Risk Level												Management Signoff Authority	
HIGH (OR CATEGORY 1)	Report immediately upon identification. Must be reduced as soon as possible to As Low As Reasonably Practicable (ALARP) / Management satisfied the costs to reduce the risk exceed the benefits of doing so. Include in Risk Register for tracking. Consider advanced risk methodologies for further investigation. Quantification of **Financial impact, Maximum Foreseeable Loss (MFL) and Risk Control Effectiveness (RCE) shall be calculated.											Signoff by Director or GC CEO	
HIGH-MEDIUM / CATEGORY 2	Should be reduced as soon as possible to ALARP / Management satisfied the costs to reduce the risk exceed the benefits of doing so. Include in Risk Register for tracking. Consider advanced risk methodologies for further investigation. Quantification of **Financial impact, Maximum Foreseeable Loss (MFL) and Risk Control Effectiveness (RCE) shall be calculated.											Signoff by Unit Manager / SVP	
MEDIUM / CATEGORY 3	Medium priority, monitor and improve effectiveness of current controls. Include in Risk Register for tracking. Quantification of **Financial impact, Maximum Foreseeable Loss (MFL) and Risk Control Effectiveness (RCE) should be calculated.											Signoff by Dept. Manager / VP	
LOW / CATEGORY 4	Low priority, monitor and improve effectiveness of current controls.											Signoff by Line Manager	

*Financial criteria for Operating Companies shall be specified by ADNOC Corporate / for upward reporting Operating Companies shall report against the ADNOC Corporate & Operating Company Financial Consequence levels.

**Financial impact is the combination of Direct and Indirect costs.

*** For Investments, "Financial" refers to NPV impact.

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RISK ASSESSMENT

PROBABILITY:

- ▶ **RARE:** Has not occurred in worldwide industry.
- ▶ **UNLIKELY:** Has occurred in worldwide industry but not in ADNOC.
- ▶ **POSSIBLE:** Has occurred at least once in the Group company.
- ▶ **LIKELY:** Has occurred at least once in the Group company but not on the site.
- ▶ **VERY LIKELY:** Has occurred more than once in Group company or once on the site.
- ▶ **ALMOST CERTAIN:** Has occurred more than once on the site.

RISK ASSESSMENT

HEALTH & SAFETY:

- ▶ **DISASTROUS:** Multiple Public (more than 1) / workers (more than 10) fatalities or permanent total disabilities.
- ▶ **CATASTROPIC:** Multiple worker fatalities (up to 10) / permanent total disabilities or single public fatalities.
- ▶ **MAJOR:** Single worker fatality / permanent total disability or serious injury to public.
- ▶ **SERIOUS:** Serious injuries or health effects (Permanent partial disability).
- ▶ **MINOR:** Minor injuries or health effects (reversible effects – weeks to months).
- ▶ **NOTABLE:** Slight injury or health effects (Short term effects).

RISK ASSESSMENT

ENVIRONMENT:

- ▶ **DISASTROUS:** Disastrous effect (Severe and permanent impacts, consistently exceeding limits).
- ▶ **CATASTROPIC:** Catastrophic effect (serious impacts on many attributes of environment in large area).
- ▶ **MAJOR:** Major effect (negative impacts on surrounding environment and repeated non compliances).
- ▶ **SERIOUS:** Local effect (reversible impacts but frequent non compliances).
- ▶ **MINOR:** Minor effect (impacts limited organizational surroundings).
- ▶ **NOTABLE:** Slight effect (impact within fence area)

RISK ASSESSMENT

REPUTATION:

- ▶ **DISASTROUS:** Prolonged international impact and public attention. Effect can last for years and can spread internationally and affect other industry player.
- ▶ **CATASTROPIC:** Serious international impact and public attention – extensive adverse coverage in the international media with potential severe impact on licenses.
- ▶ **MAJOR:** Significant national impacts and public concern - extensive adverse attention in the national media. Effect could last a few months and likely to spread to close industry partners.
- ▶ **SERIOUS:** Considerable impact – adverse attention in local media /local government / action groups.
- ▶ **MINOR:** Limited impact - some local media / political attention. Effect will last a few days only.
- ▶ **NOTABLE:** Slight impact - no public concern.

RISK ASSESSMENT

FINANCIAL:

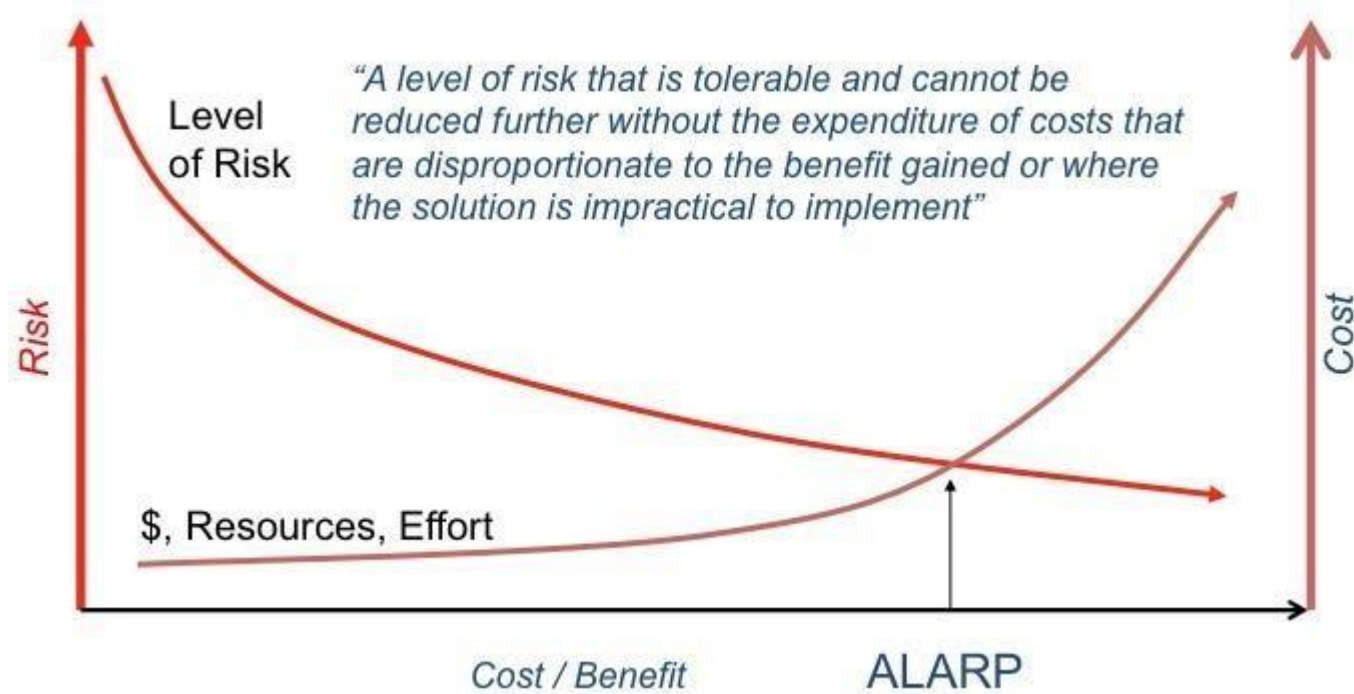
SEVERITY	FINANCIAL	
	DIRECT FINANCIAL IMPACT (DFI)	PRODUCTION LOSS (PL)
DISASTROUS:	>= \$50 Million in a year	>= \$50 Million in a year
CATASTROPIC:	>=\$15M - <\$50M in a year	>=\$15M - <\$50M in a year
MAJOR:	>=\$5M - <\$15M in a year	>=\$5M - <\$15M in a year
SERIOUS:	>=\$500K - <\$5M in a year	>=\$500K - <\$5M in a year
MINOR:	>=\$50K - <\$500K in a year	>=\$50K - <\$500K in a year
NOTABLE:	<\$50K in a year	<\$50K in a year

RISK ASSESSMENT

ALARP:

MEANS TO REDUCE a RISK TO a LEVEL, WHICH IS

“AS LOW AS REASONABLY PRACTICABLE”



RISK ASSESSMENT

RISK POTENTIAL MATRIX:

▶ High Risk

Unacceptably High

This level of risk exposes the company to intolerable losses to people, assets, Environment or reputation. The hazard should be eliminated or its risk reduced to tolerable levels immediately

ACTION MUST BE TAKEN IMMEDIATELY

▶ Medium Risk

Accepted but must be managed

The hazard must be managed to reduce the frequency and/or the severity of the hazardous events to ALARP

Risk Reduction measures must be planned and documented

▶ Low Risk

Acceptable without further action

Correction (s) may be applied as resources allow

RISK ASSESSMENT

HAZARD CONTROL HIERARCHY:

- ☑ **Eliminate the Hazard** → **First Choice**
- ☑ **Engineering controls** → **Second choice**
 - ✓ Work Station Design
 - ✓ Process Modification
 - ✓ Substitution
 - ✓ Isolation
 - ✓ Tool Selection and Design
 - ✓ Mechanical Assist
 - ✓ Ventilation
- ☑ **Administrative Controls** → **Third Choice**
 - ✓ Training Programs
 - ✓ Policy and Procedures
 - ✓ Job Rotation/Enlargement
- ☑ **Personnel Protective Equipment** → **Last choice**
 - ✓ Gloves
 - ✓ Ear Protection
 - ✓ Shields
 - ✓ Eye Protection
 - ✓ Non-Slip Shoes
 - ✓ Aprons

PLANNING THE LIFTING OPERATIONS

PLANNING THE LIFTING OPERATIONS

GENERAL REQUIREMENTS:

All lifting operations shall be properly planned, appropriately supervised and carried out to ensure safety of workers, other working around and Assets. This section outlines the process for planning the lifting and hoisting operations that is applicable to all lifting operations

1. Identify the lifting & hoisting operations:

The Asset Owner should identify or be informed of the need for a lifting and hoisting operation and designate an AP. The AP shall plan and, if appropriate, supervise the lifting and hoisting operation. Every lifting and hoisting operation shall be risk assessed and planned by the AP before the work begins. The AP shall ensure that appropriate controls are in place for those hazards identified in the written risk assessment such that the risks are managed as an integral part of the “Lifting Plan”.

PLANNING THE LIFTING OPERATIONS

GENERAL REQUIREMENTS:

2. Determine the scope of work:

The AP shall begin the planning process by determining the scope of work - defining what is to be done, who shall be involved, how the lifting and hoisting operations will be conducted. This may require an initial “Lifting Plan”, sketches, sequence of operations, notes etc. Having identified the particular operation has been carried out before on that site, and a Risk Assessment and “Lifting Plan” may already exist. If do exist, shall be assessed to confirm that they are still applicable. Changes to personnel, site layout or work environment could all result in the need for a reassessment of hazards. Assuming that significant changes have not taken place, may proceed under the requirements of the “Lifting Plan”, subject to the approvals.

PLANNING THE LIFTING OPERATIONS

GENERAL REQUIREMENTS:

3. Plan the lifting & hoisting operations:

All lifting and hoisting operations shall be planned and appropriately managed on the basis of risk, complexity of operations and work environments. “Lifting Plan” is intended to clearly identify to which it relates, step by step user’s instructions for carrying out lift, the type and number of equipment required, the activity assigned to each person, recovery and contingency plans.

PLANNING THE LIFTING OPERATIONS

- ▶ A lift plan is required for every lift. If the lift deviates from the plan, make safe and stop the job.
- ▶ Hazard identification and risk assessment are an integral part of planning a lift.
- ▶ An assessment of the lift and determination of the lift method, equipment and number of people required are critical to planning of the lift.

PLANNING THE LIFTING OPERATIONS

BRIEF INFORMATION - LIFT PLAN:

Key Requirements: Lift plan addresses three key requirements for safe lifting equipment use:

1. Employing the proper lifting equipment and the correct personnel for the task,
2. Operating it safely,
3. Ensuring the worksite is safe.

PLANNING THE LIFTING OPERATIONS

BRIEF INFORMATION - LIFT PLAN:

A lift plan also has to answer the following questions:

1. What has to be lifted?
2. Where does it have to be picked up?
3. Where does it have to be placed?
4. Where is the lifting equipment located to do the lifting?

PLANNING THE LIFTING OPERATIONS

BRIEF INFORMATION - LIFT PLAN:

The following contents shall described on the lift plan but not limited to;

- a) Unique identification number for the specific task, categorization and authorization.
- b) Description of Lift.
- c) Engineering Drawings: Shall mention Plan & Elevation show the Crane Position & Rigging Plan before & after Lift and clearly marked to scale.
- d) Detailed List of all Lifting Equipment & Accessories required the availability of Valid Certification and instructions to check it at site prior to the lift.
- e) Load information: Net weight, Gross Weight, load integrity, centre of gravity, stability, the lift suspension points, Dimensions of Load, Height of Lift and Maximum Radius.

PLANNING THE LIFTING OPERATIONS

BRIEF INFORMATION - LIFT PLAN:

- f) In Complex Lifts; the Net Weight taken by the Crane(s) shall be known accurately within +/- 2%.
- g) In Complex Lifts; a Certificate from an ADNOC Approved TPIA shall be granted for the Load being lifted and Certificate to be issued accordingly.
- h) Crane Information with Load Chart and Lifting Configurations.
- i) Assessment for Crane and Load Access & Egress Points to determine load-bearing capability of the site
- j) Hazard identification and lifting Risk Assessments. (TRA)
- k) Slinging difficulties, Top Heavy Loads, Sharp Edge Loads and other Hazards.
- l) A method statement that identifies the sequence of steps during the lift including Contingency Plan.
- m) Consideration of the placement of lifting equipment, plus potential consequences of catastrophic failure or unintended motion of the load or equipment, with particular attention to areas where people congregate.

PLANNING THE LIFTING OPERATIONS

VARIOUS FACTORS FOR LIFT:

The following Factors shall be considered in planning of **ANY LIFT**:

1. Contingency Factor (CTF)
2. Consequence Factor (CF)

In addition, the following factors shall be considered in planning of any complex lift:

1. Dynamic Amplification Factor (DAF).
2. Skew Load Factor (SKL).
3. Yaw Factor (YF).
4. CoG Shift Factor (CSF).
5. Tilt Factor (TF).

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Contingency Factor (CTF):

A Factor in which the Calculated Weight of Load shall be multiplied with in order to determine the Actual Net Weight of Load.

- ▶ The lift weight shall be calculated or as weighed and include contingency factors.
- ▶ The contingency factor on calculated weight of equipment shall be at least **10%** to allow for inaccuracies and any internal containment.
- ▶ The contingency factor on calculated weight of structural steel assemblies shall be at least **10%** to allow for tolerances, paint, welds etc.
- ▶ The contingency factor on final measured weight shall be at least **3%** to allow for inaccuracies in measurement.

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Consequence Factor (CSF):

A factor to ensure that main structural members, lift points, lifting beams and spreader bars /frames have an increased factor of safety (including lateral loads) related to the consequence of their failure. A consequence factor is also used in the design of slings and grommets used for lifting operations

- Additional factor of safety of magnitude related to the consequence of failure, over and above working stress design safety factor, applied to main members of the structure being lifted in the design for lifting operations. It usual has a value of 1.3 or 1.35 depending on the structure
- The Sling design load shall be calculated by lifting analysis and shall include all factors described in this section including a minimum consequence factor of 1.3

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Dynamic Amplification Factor (DAF).

Factor that is applied to the static loads to account for acceleration induced additional forces (Impact and Acceleration). Dynamic loading shall be applied to account for global dynamic effects resulting from vessel motions, boom, wire and rigging stiffness, boom tip location and motions, crane movements and wind loading.

DAF is also defined as the factor by which the weight is multiplied, to account for accelerations and impacts during the operation.

Static Hook Load (tonnes)	DAF Offshore	DAF Onshore	DAF Inshore
SHL ≤ 100	1.30	1.15	1.12
100 < SHL ≤ 500	1.25	1.10	1.12
500 < SHL ≤ 1000	1.20	1.10	1.10
1000 < SHL ≤ 2500	1.15	1.05	1.08
SHL > 2500	1.10	1.05	1.05

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Dynamic Amplification Factor (DAF).

DAF Clarification (As per Location)

Location	Crane	Lifting to / from	DAF
Jetty	Mobile Crane	Vessel	Onshore
Jetty	Mobile Crane	Barge	Inshore
Jetty	Vessel Crane	Vessel	Inshore
Jetty	Vessel Crane	Jetty	Inshore
Jetty	Vessel Crane	Barge	Inshore
Jetty	Barge Crane	Barge	Inshore
Jetty	Barge Crane	Vessel	Inshore
Jetty	Barge Crane	Jetty	Inshore
Onshore	Mobile Crane	Onshore without travel	Onshore
Onshore	Mobile Crane	Onshore with travel	Onshore + Inshore
Offshore	Barge Crane	Barge / Fixed Structure	Inshore
Offshore	Barge Crane	Vessel / Floating Structure	Offshore
Offshore	Vessel Crane	Vessel / Floating Structure	Offshore
Offshore	Vessel Crane	Barge / Fixed Structure	Offshore

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Skew Load Factor (SKL): *The skew load factor (SKL) is used to take care of additional loading caused by equipment/fabrication tolerances and other uncertainties with respect to asymmetry and associated force distribution in the rigging arrangement.*

The factor by which the load on any lift point or pair of lift points and rigging is multiplied to account for sling length mismatch in a statically indeterminate lift.

Design Load = SKL x DLL

DLL(Dynamic Lift Load) = SHL(Static Hook Load) x DAF

SHL = Gross Weight + Rigging weight + Special Loads (if Any), Hook Block weight needs to be added in case the same is not included in the crane capacity chart.

The following skew load factors are recommended:

- a) Statically indeterminate four point lift SKL = 1.25
- b) Statically determinate four point lift SKL = 1.10
- c) Statically determinate three point lift SKL = 1

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Yaw Factor (YF): *Yaw Factor (YF) is used to account for the tolerances in lift radii of the crane hook.*

For a 2-hook lift, with 2 slings to each hook, the load to each lift point shall be multiplied by a yaw factor (about 5%), to account for tolerances in lift radii of the 2 hooks.

CoG Shift Factor (CGSF): *The Centre of Gravity Shift Factor is used to account for additional loads due to possible shift in COG during lifting operations.*

For 2-Hooks (Hooks on the same Vessel); the individual gross weight of each hook shall be multiplied by (CoG Shift Factor – about 3%) and (Tilt Factor – about 3%) to account of increased loads due to tolerances of the elevation in the Crane's Hooks.

PLANNING THE LIFTING OPERATIONS

SAFETY FACTORS

Tilt Factor (TF): *Tilt Factor (TF) is used to account for additional load that may arise due to the tilting of the crane hook.*

For 2-Hooks (Hooks on the same Vessel); the individual gross weight of each hook shall be multiplied by (CoG Shift Factor – about 3%) and (Tilt Factor – about 3%) to account of increased loads due to tolerances of the elevation in the Crane's Hooks.

LIFT PLAN CONTENTS

LIFT PLAN CONTENTS:

Introduction:

The purpose of this lift plan is to ensure and define all action and necessary procedures.

Purpose:

The purpose of the procedure shall specifies specific requirements and methods for conducting lifting operation.

Scope:

The scope of the procedure shall covers the lifting method, lifting equipment needed, and necessary documents required for the lifting operation.

Reference documents:

(CLIENT) Operational safety standard, and lifting standard shall be mentioned.

LIFT PLAN CONTENTS:

Responsibilities and communication:

Overall responsibilities for ensuring full compliance to the above procedure, type of communication shall be described for lifting operations.

Lift category:

Lift category shall be specified are as follows:

- Simple,
- Complicated,
- Non-Routine Complex.

Procedure:

Procedure shall be specified are as follows:

General requirements,

- General requirements,
- Coordination,
- HSE requirements.

LIFT PLAN CONTENTS:

Lifting operations:

Sequence of the lifting operation shall be specified step by step, removal /Installation.

Safety requirements:

Necessary site safety requirements shall be specified are as follows:

- Brief all the personnel involved in the lifting operation,
- Proper house keeping shall be done,
- Crane movements, travel path, and obstructions shall be identified and arranging necessary barricade....etc.

Lifting Equipment requirements:

Type and capacity of the equipment intent to use for the lifting operation shall be specified , and all the necessary valid Approved independent third party inspection and test certificate shall be attached.

LIFT PLAN CONTENTS:

Area layout:

Area lay out shall be produces with lift plan where intent to commence the lifting operation.

Weather conditions:

Weather conditions shall be specified,

Lifting operation seized conditions shall be specified.

Ground conditions:

Ground load bearing pressure conditions shall be specified and the expert report shall be attached with lift plan.

Lifting Data summary:

Lifting data summary shall be specified are as follows:

1. Basic crane capacity details as per load chart,
2. Lifting gear items intent to use its description, capacity and its weight shall be specified.

LIFT PLAN CONTENTS:

Crane Data:

Full crane data shall be attached to the lift plan.

Crane data shall be complies are follows:

- ▶ Model.
- ▶ Sl. No.

Load chart, and load chart shall complies with all the necessary information such as Boom length, radius, angle, parts of line, maximum capacity, single line wire rope capacity, load handling devices (Hook Block, jib, Auxiliary weight any other attachments on the boom)information, counter weight details..etc shall be specified and the copy of the data sheet shall be attached to the lift plan.

LIFT PLAN CONTENTS:

Appendix-1: Area layout

Lifting area lay out sketch shall be attached

Appendix-2: Organization chart

Organization chart shall be attached to the lift plan for lifting operations.

Appendix-3: JHA/JSA (Risk assessment)

Job safety analysis and job hazard analysis shall be attached to the lift plan.

Appendix-4: Lifting equipment & Lifting gear certificate

All the lifting equipment and lifting gear intent used shall have valid

(CLIENT) approved independent third party certificate and copy shall be attached to the lift plan.

LIFT PLAN CONTENTS:

Appendix-5: Crane load chart

Copy of the crane load chart shall be attached to the lift plan, please ensure that the load chart from the crane cabin, and specification load chart and sales leaflet chart shall not be accepted.

Appendix-6: Competencies certificate

All the personnel involved in lifting operation shall be holding valid training certificate from (CLIENT) approved training center.

Competencies are as follows:

1. Appointed Person in charge of planning of the lifting operations,
2. Lifting Supervisor authorized to execute the lifting operation as per the lift plan
3. Crane operator authorized to operate the crane,
4. Banksman Authorized to signaling and move the load,
5. Rigging and slinging Authorized to attach and detach the sling on the load,

LIFT PLAN CONTENTS:

Appendix-7: Pre lift check list

Before performing the lift pre lift check list shall be completed, Pre lift check list shall be attached to lift plan.

AUTHORIZATION OF ALL LIFT PLANS TYPES

AUTHORIZATION OF ALL LIFT PLANS TYPES

- a) The level of technical review required depends on how the lifting operation is categorized; however, the Site Single Point Authority (SPA) may raise the concern that a higher level of technical review should be undertaken including the requirement to engage approved Third Party to review / verify the Lift Plan whether the Lift is being performed by ADNOC Group or Contractors.
- b) All type of lifting plans shall be reviewed and approved by a competent person (SPA). The rigor of review shall be determined by the category of lift, which may require a qualified specialist engineer.
- c) Lifting operation shall only be performed following the Lifting plan authorization by SPA and endorsement is granted by the Asset owner. Endorsement of some critical plans may require contributions from several engineering disciplines and organizations.
- d) The appointed person shall be nominated for the specific lift based on his competency.
- e) If the qualified AP is not available at site / project, then the job officer may request the same from qualified consultant or Third party approved by ADNOC Group. However, the Non-routine-complex Lifting plans shall be reviewed and approved by Lifting Technical Authority if the site / Project does not have SPA.

AUTHORIZATION OF ALL LIFT PLANS TYPES

ADNOC LIFT PLANS AUTHORIZATION as per ADNOC Group Standard “HSE-PSW-CP19”

	Simple Lift	Complicated Lift	Non-Routine Complex Lift
Create	Appointed Person	Appointed Person	Appointed Person
Review & Approval	Single Point Authority	Single Point Authority	SPA or Lifting Technical Authority
Endorse	Asset Owner	Asset Owner	Asset Owner

EXECUTE THE LIFT PLAN

EXECUTE THE LIFT PLAN

- ▶ Prior to starting any simple, complicated or non-routine complex Lift, a pre-job safety meeting should be conducted to assess the Lifting Plan and to familiarize personnel with the risks identified. At this time, minor variations should be documented to take account of current physical and environmental conditions.
- ▶ Effective and reliable communications should be confirmed; especially where everyone involved does not speak a common language.
- ▶ All personnel should stay out of any area where they might be injured by a falling or shifting load. Do not stand below loads. Never stand between loads and walls, bulkheads or other immovable surfaces. Always identify an available escape route.
- ▶ Whenever a lift deviates from the plan or any complication arises, the lifting operation shall be stopped and made safe immediately. All personnel should remain in positions clear of the lift until reassessment / re-planning of the lift is completed.

EXECUTE THE LIFT PLAN

- ▶ Simple lifting operations shall be undertaken by a minimum of Four competent people: Rigging Foreman, Crane Operator, Banksman/Flagman and Rigger/Slinger. Certain lifting operations may be safely undertaken by fewer than three people, if risk-assessed by the Appointed Person and approved by Site Manager; however, Appointed Person is accountable for all Lifting Operations at site.
- ▶ Complicated and Complex lifting operations shall be undertaken by a minimum of five competent people: Appointed Person, Rigging Foreman, Crane Operator, Banksman/Flagman and Rigger/Slinger

LESSON LEARNED

ANOMALY REGISTER:

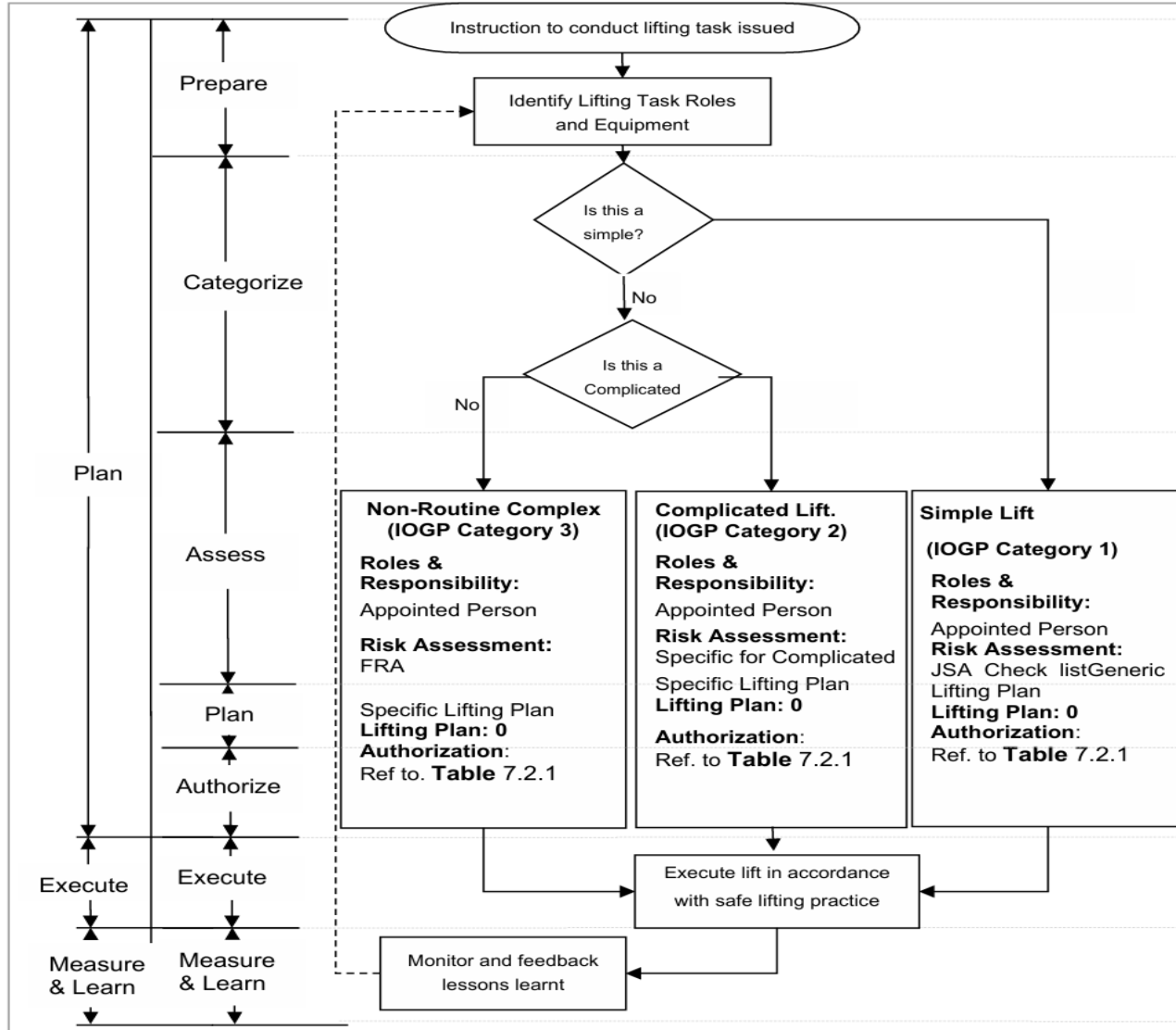
- ▶ The Divisions/Contractor shall monitor both operational and equipment integrity through an anomaly register, any unplanned event should be recorded and tracked through the remedial process within the register. Initially any unplanned event shall be highlighted through a Near Miss Report. Depending on the event, there may be a need for further examination through Incident Reporting.

LESSON LEARNED

PERIODIC REVIEW OF PROCEDURES:

- ▶ The Divisions/Contractor shall periodically review all routine lifting plans, risk assessments and maintenance procedures for all fixed lifting equipment to confirm that they are still applicable. The anomaly register shall be used as a tool to assess the adequacy.
- ▶ Any changes to routine lifting plans, risk assessments and maintenance procedures by the contractor must go through an approval process whereby the Company appointed Technical Authority must endorse any amendments prior to the formal implementation of these changes.

ADNOC LIFTING OPERATIONS PROCESS



METHOD STATEMENT

METHOD STATEMENT

Method Statement : *A formal document setting out how a lifting operation will be carried out safely in a step by step process. It describes how to do the work, who does what, what equipment and controls are used, and how hazards are managed throughout the job. It complements the Risk Assessment (the risk assessment identifies hazards & evaluates risk), while the method statement sets out how to control those risks in practice.*

- ▶ A document prepared by the Appointed Person for each lifting Operation.
- ▶ One of the major element of Safe System of Work
- ▶ Describing how a lifting Operation should be carried out, including any contingency plan if the Operation becomes interrupted because of weather change, break down, etc.
- ▶ Consist of briefing all personnel involved in the lifting Operation to ensure that the Safe System of Work described in the Method statement in effectively communicated, prior to any lift.
- ▶ The lifting supervisor ensures that the Lifting Operation is carried out in accordance with the Approved Method statement.
- ▶ A consultation from all concerned is essential prior to finalization.

METHOD STATEMENT

It includes step-by-step description of the Safe System of Work for the entire lifting Operation and should include at least the following, but NOT limited to:

- ▶ Schedule of Responsibilities
- ▶ Full details of the crane
- ▶ Details of Lifting Accessories
- ▶ Name of the appointed person & Name of the Lifting Supervisor
- ▶ A complete plan including the sequence of Operations,(from site preparation, arrival on site, any erection, positioning of crane, lifting & placing of load, dismantling of crane, moving off site)
- ▶ Ground condition, & Safe means of access and egress
- ▶ Details of the steps to be taken to eliminate danger to personnel NOT involved in the Lifting operations.

LIFTING DATA TABLES

LIFTING DATA TABLES

LIFTING DATA TABLE (ONSHORE CRANES)

LOAD DETAILS - Mobile Crane with Single Hook							
Item	Net weight	Contingency Factor (1.1 for calculated, 1.03 for weighed)	Gross Weight (Net weight X Contingency Factor)	Hook Block Weight	Rigging weight (Sling, Shackle Spreader bar)	DAF	Dynamic Lift Load (DLL) (Gross wt. + Hook Block wt. + Rigging wt.) X DAF

CRANE DETAILS – Mobile Crane/Crawler Crane with Single Hook			
Outrigger Load on Ground in MT Tracks load on Ground in MT (from manufacturer software)	Reference outrigger load or Track load in MT (Maximum Outrigger or Track load X factor of safety)	Ground bearing pressure MT/m ²	Outrigger Mat Dimension (Mobile) Tracks Pad Dimension (Crawler)
1)			
2)			
3)			
4)			
Position	Radius	Crane capacity	Crane Utilization Ratio (DLL X 100)/Crane Capacity
Pick-up			
Revolving			
Drop-off			

LIFTING DATA TABLES

LOAD DETAILS – Two Hooks of Mobile/Crawler Cranes

Item	Net Weight	Contingency Factor (1.1 for calculated, 1.03 for weighed)	Gross Weight (Net weight X Contingency Factor)	Hook Block Weight	Rigging Weight (Sling, Shackle Spreader Bar)	DAF	Additional Factors	Dynamic Lift Load (DLL) (Gross wt. + Hook Block wt. + Rigging wt.) X DAF X Tilt X Yaw X COG shift
							Tilt 1.03 Yaw 1.05 COG shift 1.05	

CRANE DETAILS - Two Hooks of Two Mobile/Crawler Cranes

Hook-1

Position	Radius	Crane capacity	Crane Utilization Ratio (DLL X 100)/Crane Capacity
Pick up			
Revolving			
Drop off			

Hook-2


Pick up			
Revolving			
Drop off			

LIFTING DATA TABLES

RIGGING DETAILS

Description	Rigging	SWL*	Leg Tension (As per Lift Analysis)	Rigging Utilization Ratio (Leg Tension X 100)/SWL	Remarks
Item-1	Shackle Sling Spreader beam Pad eye Pad ear Trunnion				* The following factors to be considered for SWL of each item Mode Factor D/d Ratio Choker Hitch Basket Hitch
Item-2	Shackle Sling Spreader beam Pad eye Pad ear Trunnion				
Items-3	Shackle Sling Spreader beam Pad eye Pad ear Trunnion				

LIFTING PLAN TEMPLATE

ABU DHABI NATIONAL OIL COMPANY						
COMPANY PROJECT No:			CONTRACTOR PROJECT No:			
LIFTING OPERATION PLAN TRANSMITTAL FORM						
LOP No.:		Date: -		Resp. By:		
From:		To:		Attn.: Company SPA		
Document class		<input type="checkbox"/> First submission	<input type="checkbox"/> Second submission	<input type="checkbox"/> Further submission		
Previous Submittal Ref:		Date:		Category:		
SI.No.	Document No.	Description	Rev.	Copies	Approval Category (For ADNOC use)	
CONTRACTOR REVIEW CHECK LIST						
<input type="checkbox"/> Reclamation <input type="checkbox"/> Conc. works <input type="checkbox"/> Rock works <input type="checkbox"/> Structural <input type="checkbox"/> General <input type="checkbox"/> Others						
THIS SUBMITTAL INTENDED FOR						
<input type="checkbox"/> APPROVAL / COMMENTS			<input type="checkbox"/> YOUR INFORMATION / RECORDS			
<input type="checkbox"/> AS PER YOUR REQUEST			<input type="checkbox"/> YOUR NECESSARY ACTION			
For Contractor:						
_____		_____		Click or tap to enter a date.		
NAME		DESIGNATION		DATE		
For ADNOC (Asset Owner):						
<input type="checkbox"/> (1) Approved		<input type="checkbox"/> (2) Approved with Comments		<input checked="" type="checkbox"/> (3) Rejected		
Comments:						
_____		_____		_____		
NAME		DESIGNATION		DATE		

LIFTING PLAN TEMPLATE

This lift plan is specific to the lifting operations described in the scope of works.

Company Name				Facility/ Project title	
Location				Contractor Project No.	
Date of lifting operation	From:	To: Click or tap to enter a date.		Specific:	
Lift Plan Reference Number				Number of Lifts to be done	Multiple
Lift Plan Category	<input type="checkbox"/> Non-Routine-Simple		<input type="checkbox"/> Complicated		<input type="checkbox"/> Non-Routine-Complex
Associated Permit Number					
Task Risk Assessment Number					
Method Statement Number					
Required Number of Personnel to attend the Lifting Operation and their designation.	<input type="checkbox"/> Appointed Person# 1	<input type="checkbox"/> Lifting Supervisor# 1	<input type="checkbox"/> Crane Operator# 1	<input type="checkbox"/> Rigger# 3	
	<input type="checkbox"/> Banksman# 1	<input type="checkbox"/> Helper# 1	<input type="checkbox"/> Safety Rep.# 1	<input type="checkbox"/> Third Party#	
Name of Lift Planning Engineer (Appointed Person) preparing this plan.					
Date	Click or tap to enter a date.		AP Signature		
Single Point Authority Name			Signature		
Purpose					
Scope of Works					
<i>It is the aim of this LOP to define and describe the equipment and safe working procedures. The scope of work is as follows:</i>					
Sequence of Operation					
<i>Note: List the Sequence of Operation in a way to do the task safely e.g. (Crane comes first or Trailer, Lift Load # 2 before Load # 1 ...etc.).</i>					
Contingency Plan					
<i>Note 1: Basically, it is Plan B should things change i.e. (Crane 1 break-down and Crane 2 with similar or higher capacity can be used if available with some changes in the Plan & using of alternate lifting accessories if the planned tackles are not available).</i>					
Drawings / Sketches					
<i>Note 1: Scaled Drawings shall be available in Non-Routine Complex / Complicated Lifts showing Plan / Elevation of Load and Crane Initial and Final Position including Stages.</i>					
<i>Note 2: Sketches shall be available in Non-Routine-Simple and-Complicated Lifts.</i>					
-Attached-					

LIFTING PLAN TEMPLATE

Details of crane provider					
Company name					
Address					
Contact name		Telephone			
Details of Crane operators:					
Load Details					
Net Weight of Load		Gross Weight of Load			
Dimension of Load		Load COG Location			
Reference shall be made to Lifting Data Tables which are required for all Lifts Categories (Refer to Appendix W Offshore Crane) and Appendix X Onshore Cranes)					
Other Details (centre of Gravity, Lifting points, Packaging, Palette, etc.)					
Details of Crane					
Manufacturer's Name		Model #		Crane Type	
Max. Crane's Capacity		ID/No. / Plate #		Required Crane Capacity	
Required Max. Radius		Required Number of Falls		Required Boom Length	
Required Hook Block		Required Counterweights		Required Anemometer	
Required Fly Jib Length & Angle		Outrigger Spread		Max. Crane's Wind Speed	
Required Ballast Weight / Full Tank (Barges)		Required Tie-back / Revolving (Barges)		Outrigger Mat Dimension	
Outrigger Mat Material		Outrigger Load on Ground (t) "Worst Case"		Ground Bearing Pressure (t/m ²) "Worst Case"	
Site Ultimate Bearing Pressure (t/m ²)		Height from Hook to Ground/Deck/Sea Level		Height from Load Bottom to Ground / Deck / Sea Level	
Required Lifting Area (Off-board / On-board / Subsea)		Crawler Crane Pad/		Required Lifting Area (Over-front/ Rear / Side)	
<p><i>Note1: Reference shall be made to Lifting Data Tables which are required for all Lifts</i></p> <p><i>Note2: Ground Condition-Temporary works design in place and checked off where appropriate. Compaction Test shall be carried out by Soil Specialist.</i></p> <p><i>Note3: where operating jib height equals or exceeds 10m above surrounding structures at any time, the Lift Planning Engineer (appointed person) must advise and consult with the manager from any airport/ airfield within 6 km of the site.</i></p> <p><i>Note4: The crane is permitted to operate at various radii as specified in the manufacturer's load chart. However, the maximum net weight to be lifted must not exceed the maximum net weight detailed in the load details table of this LOP. Additionally, all crane operations must ensure that the crane utilization remains within the specified LOP category.</i></p>					
Airport / Airfield requirements					

LIFTING PLAN TEMPLATE

Lifting accessories and configuration					
Equipment details Type and required Number (for example, spreader beam) Safe Working Load (SWL) (Note: will configuration affect SWL)	Sl. No.	Description	EWL(m)	SWL(t)	Qty
Note: Alternative/Additional lifting gears can be selected by a competent Lifting Appointed Person after assessing the lifting scenario.					
Sketch of slinging method (Scaled Rigging Plan Drawing is required in case Non-Routine-Complex and complicated Lift Plan)					
-Attached-					
Note: Reference shall be made to Lifting Data Tables which are required for all Lifts Categories					
Site conditions and hazards					
The following non-exhaustive list should be considered during the lift plan along with any other factors that could affect any aspect of the lift:					
Excavations	Culverts	Railways	Buildings, stationary objects		
Embankments	Drainage	Personnel and public	Plant & Equipment		
Overhead and underground services	Manhole/inspection chambers	Rivers	Other cranes		
Roads	Scaffolding	Environmental considerations	Airports within 10 km of site.		
Hazard		Control			
Strength and stability					
GROUND BEARING PRESSURE CALCULATION:					
Weather/environmental considerations					
Indicate in this section detail of wind speeds/Sea state/ environmental conditions that have been referenced/anticipated for the duration of the lifting operations and conditions that lifting operations must stop.					
Access					
Include travelling routes, road closures/highways notifications, and access problems.					
ACCESS/EGRESS AVAILABLE					

LIFTING PLAN TEMPLATE

Third party considerations Over-sailing works adjacent to railways, noise and restriction of view.
Emergency/breakdown procedures Maintenance service team available in case of any unforeseen defect.
Signalling Indicate whether hand signals or radios are to be used. Also indicate signalling source and radio frequency/channel. This section can also include any unique slinger/signaller identification (that is, different colour helmet/hi-vis) if required. HAND SIGNALS/RADIO SIGNALS
Site and crane layout plan Include crane position, lay-down/rigging area, position of delivery vehicles, landing points, banksman positions, ground and overhead hazards and exclusion zones. If required use elevation drawings. <p style="text-align: center;">SKETCH ATTACHED</p>
Safe system of work - methodology
Lifting Team The details of this lift plan, along with any other associated risk assessment, method statement or safe system of work, have been brought to the attention of, and explained to, the persons listed below, who have acknowledged that they understand the contents, hazards, and associated control measures. 1.Appointed person 2.Crane operator 3.Rigger/Banksman 4.Safety representative
Other relevant documentation (list and attach) Complex Lift Plan File Note shall be available following Asset Integrity Lifting Engineer (Lifting Technical Authority) or Site SPA (Single Point Authority) Approval prior to commence the actual Lifting Operation

Name	Position	Signature	Date
	Construction Manager		Click or tap to enter a date.
	Appointed Person		Click or tap to enter a date.
	Crane operator		
	Rigger-level-3		

LIFTING PLAN CASE STUDY