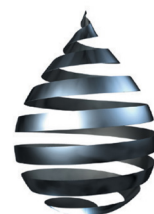


G+/DROPS

Reliable securing booklet for offshore wind



**G+ Global Offshore Wind**  
Health & Safety  
Organisation



**DROPS**

In partnership with



G+/DROPS RELIABLE SECURING BOOKLET  
FOR OFFSHORE WIND

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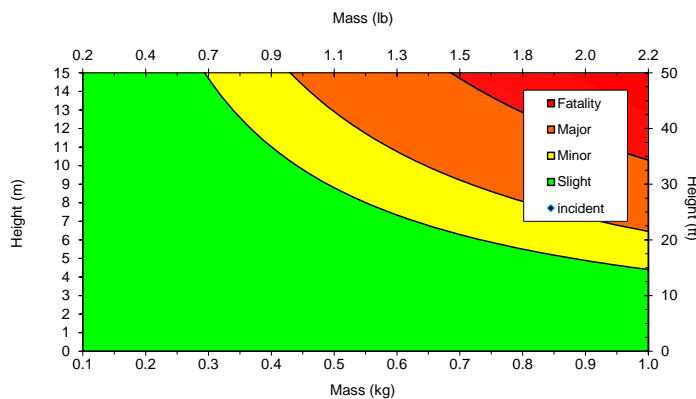
# 1 INTRODUCTION

## 1.1 BACKGROUND

A review of the G+ Global Offshore Wind Health and Safety Organisation (G+) incident data for dropped objects emphasises that there is a wide range of causes of drops – throughout the project life cycle and across the different work processes and locations.

The G+ HSE incident data show that incidents related to dropped objects vary over the years with a current peak in 2017 with 169 incidents. Of these, eight resulted in lost work day incidents, and a further 38 % were classified as being high potential (*G+ 2017 incident data report*). In 2018 there were 66 dropped object incidents, representing a reduction of over 60 % compared to 2017. This improvement can be attributed to design upgrades in turbines which decrease the opportunities for potential falling objects as well as ever improving tool attachment to belts and holsters. However, 59 % of dropped object incidents were classified as high potential meaning that dropped objects in the offshore wind industry still represent an important threat to safety (*G+ 2018 incident data report*).

Over the years the incident data show that the majority of dropped object events relate to tools or small items being dropped. However, the Dropped Objects Prevention Scheme (DROPS) (<https://dropsonline.org>) calculator demonstrates that even small objects pose a significant potential to cause harm when dropped from a certain height.



**Figure 1: DROPS calculator (sourced from <https://www.dropsonline.org/resources-and-guidance/drops-calculator>)**

In response to this, the G+ commissioned a review and analysis of the DROPS materials, tools and guidelines in order to identify whether they are transferable for use in the offshore wind industry, for all relevant stages (i.e. construction and operations).

## 1.2 DROPS RELIABLE SECURING GUIDELINE

The DROPS reliable securing guideline is an independent publication developed in close collaboration with equipment suppliers and users. Its purpose is to disseminate knowledge and best practice (*DROPS, Reliable securing, Best practice recommendations for the securing of structure and equipment at the worksite*, Revision 04, [www.dropsonline.org/resources-and-guidance/drops-reliable-securing-booklet-rev-04](http://www.dropsonline.org/resources-and-guidance/drops-reliable-securing-booklet-rev-04)).



The document states:

- *a dropped object can be defined as any item that falls from its previous position that has the potential to cause injury, death or equipment/environmental damage. A host of factors can contribute to a dropped object incident. It is important to consider these during worksite hazard identification. Energy sources such as gravity, wind, heave and mechanical motion can all contrive to initiate a sequence of events that result in something falling. Moreover, corrosion, lack of awareness and inadequate inspection or maintenance and the chances of a dropped object will highly increase.*
- *Dropped objects should not be considered an inherent hazard of a working environment. A system should be put in place to identify and prevent, and where reasonably practicable, manage the risks associated with dropped objects. These guidelines are designed to help you do just that.*

The DROPS publication aims to help eliminate the risk of dropped objects. It states that it embraces the requirement for worksite hazard management and illustrates best practice recommendations for reliable securing. Its content covers information which applies to all personnel, tools, equipment and structures associated with design, supply, transportation, installation, maintenance, operation and dismantlement activities cross industry.

## **1.2 G+ ADAPTATION FOR OFFSHORE WIND INDUSTRY**

This document is an adaptation of selected DROPS *Reliable securing* content to provide guidance and functional recommendations specifically for the offshore wind industry. This edition focuses on operations and maintenance activities in offshore wind. For future editions it is envisioned to also cover other lifecycle stages of offshore wind, as well as to address design risk assessment, adequate training and supervision to determine the risk of dropped objects and the measures suitable to prevent them.

It is acknowledged that generic DROPS best practice is applicable across all industry sectors; particularly with regard to hazard identification, risk assessment and hierarchy of control. It is recommended that these practices are considered in addition to the guidance presented in this document.

Refer to the following sections of DROPS *Reliable securing*, Revision 04:

- Section 1: Reliable securing (principles, definitions and life cycle application).
- Section 2: Securing methods (technical guidance for all fastenings in dynamic environments).
- Section 3: Understanding dropped objects (definitions, causal factors and consequences).
- Section 4: Task planning and risk assessment (reducing likelihood through effective management).
- Section 5: General tips for dropped object free worksites (observation, inspection and vigilance).

*'The content of this document, in conjunction with the guidance and resources available through the DROPS community, will help promote the opportunity to focus on underlying causes, identify and address the hazards and reduce risk through appropriate application of preventative measures.'*

*DROPS seek to consolidate reliable securing as a principal source of dropped object prevention recommendations for all industries and wishes to thank G+ and the Energy Institute (EI) for compiling this adaptation.'*

DROPS Global (admin@dropsonline.org)

Throughout this document, icons are used to signify types of content:



is used to signify good practice recommendations, and



is used to signify alerts.

## 2 WORKPLACE GOOD PRACTICE

Work operations often involve work at height. Many operations therefore contain an element of risk as:

- personnel are exposed to work or equipment above them;
- personnel on a lower level are exposed to work above, and
- personnel are working at height and could fall (more information on working at height can be found in the G+ *Good practice guideline working at height in the offshore wind industry*).

In the remaining part of this booklet, a distinction is made between the securing of personnel working at height, the securing of permanent equipment, and the securing of tools and parts that are used at height during a work operation.

Ideally, all work should be carried out on the ground or at a level where all edges and openings can be secured to prevent persons or objects falling to a lower level. Where there is a requirement to work at height, reference should be made to the employer's work at height policy and procedures.

These procedures will ensure compliance with relevant legislation on securing of personnel, erection of working platforms, over-the-side work, ladders, hoists, tools and other devices. Other key considerations such as access control, safety equipment and rescue plans will also be covered.

However, dropped objects caused by failure to secure tools and equipment continue to happen whilst they are being carried to the worksite, used or stored at height. This includes radios, detectors, pens, gauges, hard hats, water bottles and many other personal items that really should be secured properly – or not taken aloft in the first place.



**Remember, if the task cannot be undertaken at ground level and work should be done at height, refer immediately to the employer's work at height policy or ask the supervisor for assistance.**

### 3 SECURING OF PERSONNEL

Common causes of incidents are: complacency; incompetence; lack of supervision; uncertified or damaged fall arrest equipment; operator error; poor communication; snagging and collisions, and environmental factors.



- The choice of equipment to be used should be made after evaluating the workplace environment.
- Established control procedures should be followed before, during and after use.
- Anyone using personal protective equipment against falls from height should have documented training (including rescue method training).
- Nobody should work alone or unattended when using fall arrest equipment.
- Everyone involved in the work scope should have sufficient training and awareness of the equipment and safety procedures.
- A 'Buddy' check of all fall arrest, rigging and other equipment should be carried out.
- The necessary rescue equipment and trained personnel should always be available at the workplace.
- Fall arrest equipment should comply with relevant national/international standards, incorporate an anti-trauma safety device and comply with an accepted standard.
- The equipment should be checked **every time** before use and should be checked at least every six months by a competent person.
- The date for next inspection should be clearly shown on the equipment.
- The anchor point for suspension should be identified and rated to comply with relevant national/international standards, e.g. OSHA, British Standards, ISO.



**Figure 2: Equipment to secure personnel – choice should be adequate for the work place environment (sourced from DROPS)**

## 4 SECURING TOOLS <5 KG/11 LBS

Proprietary tools and tool kits, designed specifically for use at height are widely available.



- All use of tools at height should be risk assessed for suitability and for application (working environment, access, tool condition, competence of user etc).
- All tools should be suitable for use at height and secured against being dropped whilst they are being carried to the worksite, used or stored at height (use tool bag with internal loops when several and/or heavy tools are required).
- If an anchor point other than the belt or bag is required, use an appropriate part of the surrounding structure, preferably above the work level.
- Tools heavier than 2 kg/4.5 lbs should not be secured to the body; secure them to the adjacent worksite structure.
- For work on or near rotating machines or travelling equipment, all tools should always be secured to the adjacent structure.
- Attachment points/devices on tools and bags should be documentable (not all apertures on handles are actually rated tie-off points).
- All connectors/snap hooks/carabiners should be made of acid-proof steel (AISI 316); include screw lock or self-lock gates and include captive eyes.
- Lanyards on tools attached to the body should ideally be energy-absorbing (fall damper).
- The standard use of wrist lanyards is discouraged; however, it is recognised that they may be appropriate to specific tasks, e.g. within confined spaces.
- Velcro wrist lanyards are discouraged where the integrity of the fastening may be affected by the work environment.
- Tools used at height should be checked out/in a Register to ensure that nothing is left behind.



**Proprietary tools for use at height and their retention components should not be modified. Using non-proprietary or modified tools or alternative retention accessories may compromise integrity.**



**Figure 3: Lanyard attachment points (moveable, spring clip or fixed) should be selected according to size and weight of tool (sourced from DROPS)**

## 5 SECURING TOOLS >5 KG/11 LBS

Proprietary tools and hand-held machinery for heavy duty use, specifically designed and manufactured for use at height are widely available.



- All use of heavy tools and hand-held machinery where equipment may fall to an underlying level should be risk assessed.
- All heavy tools and hand-held machinery used at height should be secured against being dropped, both when in use and while being transported.
- Securing points for tools and machinery should be in place above the work site and should ideally be secured using an anchor point.
- Tools heavier than 2 kg should not be secured to the body; secure them to anchor points.
- The attachment points/devices on tools should be documented and all securing wires inspected in accordance with the manufacturer's recommendations.
- The securing wire should be as short as possible to reduce shock loading effect.
- Energy-absorbing lanyards and tethers can stretch beyond the safe calculations or drop distance, therefore fixed securing wires should be used on heavy tools at height, according to the work environment.
- Only certified lifting equipment should be used as securing devices (where appropriate).
- Tools used at height should be checked out/in to ensure that nothing is left behind.



**Proprietary tools for use at height and their retention components should not be modified. Using non-proprietary or modified tools, or alternative retention accessories may compromise integrity.**



**Figure 4: A variety of tools and hand-held machinery is available specifically for heavy duty use at height (sourced from DROPS)**

## 6 TOOL CABINETS/CHESTS FOR WORK AT HEIGHT

Tool cabinets for work at height are now readily available and employed on many facilities. The appropriate recording, securing and control of tools used at height can help to eliminate unnecessary dropped objects at the worksite.



- All tools should be appropriate for use at height and they should have documented attachment points.
- All tools should be adequately secured within the cabinets and chests, to prevent working loose during transit, or following operation of a turbine (if left *in situ* in the nacelle).
- Store tools horizontally where possible in drawers, instead of hanging vertically in cupboards.
- The location of tool cabinets and chests should be kept clear of any hatches/openings.
- In addition to the necessary tools, cabinets and chests should be equipped with adequate tool tethering provisions.
- Each cabinet should have an inventory list of certified and traceable contents and be kept locked, and one person should be designated as responsible for the cabinet.
- The responsible person should register all tools taken from and returned to the cabinet.
- The contents of the cabinet and the register of tools in use should be checked at the end of every shift.

**Table 1: Typical tools aloft register (sourced from DROPS)**

CHECK TOOLS OUT					VERIFY TOOLS RETURNED				
Date	Description of tools/equipment	Name	Authorised (Area Lead)	Time	Date	Description of tools/equipment	Name	Authorised (Area Lead)	Time



**Figure 5: Tool cabinets for work at height are now readily available and employed on many facilities**



## 7 SECURING OTHER PORTABLE EQUIPMENT

There have been several incidents reported where portable equipment such as radios, gas detectors and digital cameras have been dropped from height.



- All portable equipment used where there is a risk of the equipment falling to an underlying level should be secured against being dropped.
- Carrying pouches should always be used for radios and any other portable equipment without certified securing points.
- Locks on pouches should have a double securing mechanism to prevent unintentional opening.
- Belt clips that allow equipment to become detached when turned 180° should not be used.
- Belts with snap fasteners are not suitable for securing equipment at height.
- Battery compartments and covers on portable equipment should be secured to prevent internal components from falling.



**Remember even small items falling from significant heights can cause injury and damage.**

**Ensure all personal equipment (tally books, pens, callipers, cameras, water bottles etc.) is secure in a fastened pocket or carry pouch.**

**If the item is not required for the task, do not carry it at height – leave it at ground level.**



**Figure 6: Portable equipment used should be secured against risk of the equipment falling**

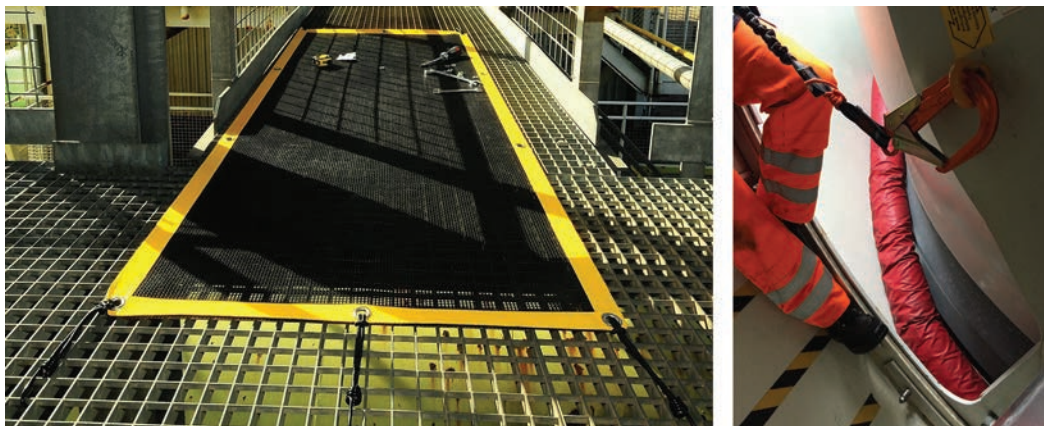
## 8 SECURING EQUIPMENT AND PARTS

Other than tools, there have been a significant number of dropped objects due to loose or discarded items left at height (e.g. nuts, bolts, screws, pins, used or replaced parts and components etc.) particularly following repair and maintenance tasks.

**Consider every item carried aloft as a potential dropped object – and ensure that all material is removed from the worksite on completion.**



- All repairs and maintenance work carried out at height should be risk assessed.
- Create an inventory of all items being taken aloft.
- Ensure all equipment, parts and materials being used at height are secured against being dropped.
- Smaller parts should be stored in suitable storage boxes, bags, etc.
- Gratings and gaps in toe boards should be covered with suitable mats or netting.
- When the work is finished, a final check and inventory count should be carried out to ensure that no tools, equipment or materials are left behind at height.



**Figure 7: Gratings and gaps should be covered with suitable mats or netting**

## 9 MOBILE ELEVATED WORK PLATFORMS

Loose tools, equipment and other items present a risk of dropped objects when working on mobile elevated work platforms (MEWPs).

Ensure that the platform does not get congested and consider installing a suitable method of enclosing the unit when working at height.



- Ensure the working platform is clear of unnecessary items and that all controls are not impeded by equipment or tools.
- All equipment should ideally be kept below the height of the toe board, and secured to the platform during rise, at operational height and during descent.
- Smaller tools and parts should be stored securely in suitable containers or tool bags.
- Equipment should not extend beyond the guard rails during rise and descent.
- Protective screens should be installed around the platform rails, suitably designed for the operation and the environment.
- Conduct an inventory count of all materials to ensure no tools, equipment or other items are left behind at height.



**Figure 8: Ensure the MEWPs do not get congested and consider installing a suitable method of enclosing the unit when working at height**

---

## 10 LIFTING EQUIPMENT AND SLING ATTACHMENT

All lifting equipment and sling attachment must comply with national legislation and harmonised standards.

The following equipment (appliances and accessories) should be considered as suspended items and should be recorded in the lifting equipment register and inspected regularly:

- beam clamps;
- chain hoists;
- crane hooks;
- rigging hooks;
- synthetic strops;
- webbing slings, and
- steel slings.

A complete register of all lifting equipment used to hoist, lift or suspend such items should be available to record data on all lifting equipment and its certification status, including identification (ID) number, working load limit (WLL) and date into service. The register should include items such as slings, shackles, pad eyes, trolley beams, hoists, lifting caps, lifting attachments or devices.

It is important to incorporate all these items within any dropped object survey and inspection management system. Inspection criteria are likely to include:

- Check arrangement of suspension equipment is in accordance with lifting and hoisting good practice.
- Check certification and test certificates.
- Check general condition of components (fatigue, corrosion, impact or other form of damage).
- Check application of equipment (correct sizing and fitting).
- Check all shackles are complete with safety securing (split pin/cotter pin).

Where employed, temporary access such as scaffolding, work platforms and staging should be designed and checked to confirm adequacy of design and construction, and fitness for planned personnel and equipment loads.

Handrails, safety gates/barriers and toe boards should be incorporated into the working platform where a risk assessment has shown that there is a danger of personnel or materials falling from that platform.

Where indicated by the risk assessment that fall protection should be used by persons working on such platforms, secure mountings for the fall protection equipment should be in place and identifiable.



**Figure 9: Home-made lifting device with a poor clamp selection (sourced from DROPS)**

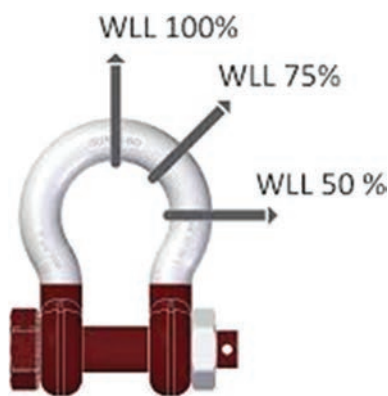


## 11 CORRECT USE OF SHACKLES

**Shackles are used in lifting and static suspended systems as removable links to connect wire rope, chain and other fittings.**

In recent years, both US and European Authorities have agreed that WLL should replace safe working load (SWL) in describing the capacity of items such as hooks, slings, shackles etc. The WLL is always specified by the manufacturer.

A general definition of WLL is: the maximum mass or force which a product is authorised to support in general service when the pull is applied in-line, unless noted otherwise, with respect to the centre line of the product.



**Figure 10: The WLL for shackles is specified by the manufacturer**



**Where side loads cannot be avoided, reduction factors should be taken into account. Always refer and adhere to manufacturer's guidance or technical data sheets.**

**Shackles come in a variety of forms and the correct type should be used for the respective work/application.**



- Shackles should be individually identifiable and have an adequate WLL and an in-date, certified and approved inspection record. Where colour coding post-inspection is used, this should be in place.
- 4-Part Shackles (Safety Bolt type) should be equipped with two barriers: nut and stainless steel split pin/cotter pin.
- Split pins/cotter pins should be of the correct size and sufficiently splayed to prevent them from being knocked out or causing injury.
- Linch pins, nappy pins or R-Clips should not be used during lifting as these may be knocked out or cause snagging.
- 2-Part Shackles (Screw Pin or Round Pin type) should never be used for permanent suspension or in any application where the pin can roll under load and unscrew.
- Shackles should only be used for their intended purpose and manner.
- The user should be familiar with the applicable limitations and guidelines for use (always refer to manufacturer's data sheet).



- Shackles are designed to support the load at the bottom of the hollow torus and evenly across the shackle bolt.
- If shackles are exposed to loads in other places, this should be taken into account during use as it will reduce capacity.
- Where point loading is unavoidable, ensure load is centred; where necessary, use packing to centralise the load on the shackle bolt.
- Never load shackle pin to shackle pin and refer to manufacturer's guidance for further details.
- Side loading of shackles is not permitted for some shackles and should always be avoided. (Side loading reduces the WLL factor (see Figure 9). Where a degree of side loading is unavoidable, manufacturers' guidance should always be adhered to.
- Where flat slings are in use, sling shackles should be considered to maintain 100 % of sling WLL and provide a more even load distribution within the sling fibres. Consideration should be given to whether the lifting accessories can be changed to eliminate the need to disconnect a shackle at height should this be required e.g. can a captive hook be used instead.



**Not all shackles may be side-loaded, e.g. sling shackles.**

**Always refer to manufacturer's technical data sheets for loading and operational limitations.**

**Split pins/cotter pins should be of the correct length.**

**Ensure pins are properly splayed (see Figure 10) to reduce the risk of snagging and injury.**



**Figure 11: Ensure pins are properly splayed to reduce the risk of snagging and injury**

## 12 SHEAVES AND SNATCH BLOCKS



- Blocks should have two integrated barriers in both the head fitting and the shaft i.e. primary fixing (forged, machined, threaded) and secondary retention (split pin, lock wire).
- Side plates should contain/enclose/capture the sheave should a centre pin failure occur, and catch the line in the event that it jumps the sheave.
- Only 4-Part shackles (bow, pin, nut and split pin) should be used for the suspension of sheave blocks.
- All blocks and suspension shackles should be marked with ID number and load rating.
- All detachable caps, guards and covers should incorporate secondary retention, or safety securing where no secondary retention is possible.
- A documented maintenance programme should be established. It is a requirement that blocks, shackles and lifting lugs should be inspected routinely by a competent person.
- Blocks should be dismantled at the request of the competent person or in accordance with the manufacturer's recommendations, and at least every five years.

**Always refer to company rigging and lifting guidance and manufacturer's recommendations for installation, operation, inspection and maintenance.**

Primary Fixing and Secondary Retention are the principal considerations in ensuring the integrity of sheave and snatch block retention at height.

In conjunction with competent use and frequent inspection, maintenance and certification, dropped objects can be prevented.

Safety securing is a mitigating measure and should be installed in specific response to an assessed risk.

Typically, the purpose of additional safety securing is to arrest the fall of the block during installations/transitions, particularly when secondary retention devices are removed.



**It is important that the selection and rating of safety securing consider the block weight, shock load (fall energy) and swing.**

Establishing safety securing measures for a potential suspension failure of a block under load is not realistically practicable, due to the significant forces involved. **It is therefore imperative that all rigging, hoisting and lifting procedures are rigorously observed.**





**Figure 12: Block with safety securing device**



**It is not practicable to install safety securing devices to arrest the fall of a block arrangement caused by operational overloading or catastrophic damage.**

- Safety securing slings should be secured to an independent anchor point from the block.
- Safety securing slings, fittings and anchor points should be certified and clearly display the WLL.
- Safety securing slings should be as short as possible to minimise shock loading and should not interfere with the performance, operation, movement or maintenance of the block.
- Only 4-Part shackles (bow, pin, nut and split pin) should be used to attach the safety securing sling.
- Safety securing slings should be subject to routine inspection and certification.

## 13 SYNTHETIC WEB SLINGS

Web or fibre slings are used in a variety of applications where their low weight, strength, soft surface, flexibility, versatility, low cost, ease of use and resistance to water and other agents have proved advantageous.

**However, these are susceptible to damage in dynamic, caustic environments and as such their use should be carefully assessed and managed.**



**Figure 13: Web or fibre slings are used where they have proved advantageous (sourced from DROPS)**



- Ensure a Lift Plan is in place before using any synthetic lifting equipment, and that all equipment to be used is certified and approved for use.
- Unprotected slings should not be used with forklifts (forks will tend to cut slings under load).
- Minimise exposure to ultraviolet radiation, chemicals and sea water as this can affect the integrity of synthetic slings.
- Do not drag slings on the floor or over abrasive surfaces and do not pull a sling from under a load when the load is resting on the sling.
- Ensure that slings are protected from contacting sharp edges on the load.
- Ensure that slings are not constricted, bunched or pinched by the load, hook or any fitting.
- Thoroughly inspect slings and attachments before and after use. Defects to look for include: knots; twists; cracks; tears; broken stitching; missing or illegible sling identification; burns; excessive wear, etc.
- Always consult with manufacturer's technical data sheet for further information.



**Safety Factor: ratio between WLL and the breaking load limit for webbing slings is 7.**

## 14 WIRE ROPE

**When selecting wire rope slings, three characteristics are considered: strength; fatigue resistance, and abrasive wear resistance.**

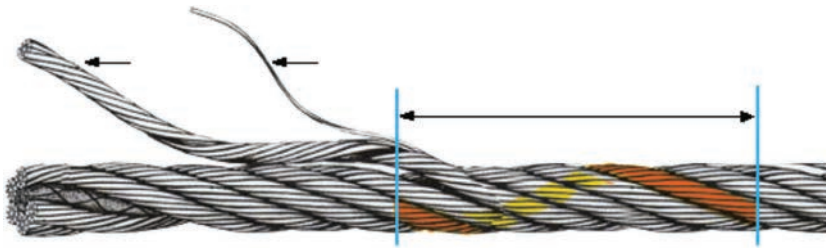
As slings are utilised through continued service, the sling's ultimate strength is reduced over time. This should be considered during sling WLL selection.

Fatigue is typically due to the development of small cracks in the individual wires of the rope. This occurs when small radius bends form during repetitive applications. Ensure bends do not exceed manufacturer's recommendations.

Smaller diameter wire is more flexible than larger dimensions but is susceptible to abrasive wear. Ensure wear and fatigue factors are considered during sling selection.



- In harsh and corrosive environments, galvanised wire rope should be considered.
- Wire rope slings (like all lifting equipment) should be visually inspected prior to each and every use, looking at the condition of the wire and its 'lay'.
- Should five wires in one strand of rope lay, or 10 wires in one lay be damaged, then the rope should be removed from service.
- Slings should be uniquely identified, with the WLL indelibly marked or stamped on the ferrule or on a permanent tag.
- Inspection of the sling end fittings for damage that could result in the sling being unsafe should also be conducted.



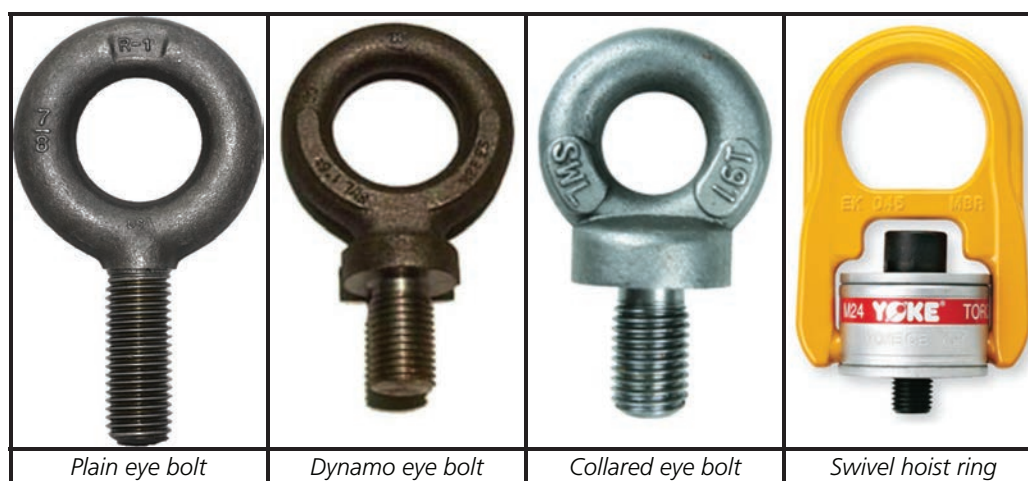
**Figure 14: Wire rope elements (sourced from DROPS)**

## 15 EYE BOLTS AND EYE NUTS

Eye bolts are one of the most commonly used items of lifting equipment, particularly during fabrication and maintenance. They have operational limitations and their misuse frequently results in serious incidents.



- Eye bolts should be of an adequate WLL, certified and approved for use (i.e. designated colour coding).
- Eye bolts should only be used for their intended purpose.
- The user should be familiar with all applicable limitations and guidelines for the application.
- Eye bolts should be properly tightened prior to use.
- Eye bolts should be removed after use and the threads in the equipment on which they have been used should be preserved and protected.



**Figure 15: Eye bolts are one of the most commonly used items of lifting equipment**



**Plain and dynamo types are for vertical lifting only.**

**Shouldered/collared machinery eye bolts can be used for non-vertical slinging within manufacturer's specified limits. Always refer to manufacturer's technical data sheets for loading and operational limitations. Refer to company rigging and lifting guidance for further details.**

## 16 HOOKS

**Hooks for lifting should always be equipped with a safety device to prevent the load becoming detached from the hook.**

The standard device is a spring safety clip that closes the throat of the hook. For many applications this is perfectly suitable. However, safety latches may be defeated when rope becomes slack and falls across the latch. To overcome this, a range of 'locking' hooks are available.



- Hooks should only be selected for use by a competent person knowledgeable in the applications and environment where they will be utilised.
- Hoisting hooks should be fitted with a latch to bridge the throat opening to prevent unplanned release of slings or attachments.
- The latch should be designed to retain such items under slack conditions.
- Check the integrity of safety latches and all secondary retention features on hook components (latches, swivels, handholds, etc.) prior to every lift.
- Hooks without latches may be used in special applications where the latch would interfere with the proper use of the hook.



*Clevis, spring clip locking*



*Clevis, self-locking (top trigger)*



*Swivel, self-locking (side trigger)*



**Figure 16: Hooks for lifting should always be equipped with a safety device to prevent the load becoming detached from the hook**

## 17 HANGING HOSES AND SERVICE LOOPS

Securing hanging hoses, in particular loading hoses, present a safety problem. Use of clips and chains has proven unsatisfactory.

**With their many parts, the clamps themselves constitute a snagging/dropped object risk.**

Incorrect positioning of clamps and chain loops that are too long have resulted in breakage/bursting and hoses falling.

Hanging hydraulic hoses are another area of concern, as are long lengths of suspended air hose.

**Note: Never mix and match different manufacturers' systems/components as this can result in serious failure.**



- The equipment manufacturer's instructions for installation and the technical description should be followed.
- Hoses and clamps for either lifting or securing should be compatible with the hose.
- Lifting eyes or clamps used to ensure safe lifting and handling are never to be used as safety clamps unless they are specifically designed for that purpose.
- Safety securing should be attached and securely fastened at the point where the hose is labelled 'Attach safety clamp here'.
- Safety chains should be as short as possible and installed as close to the vertical as possible in order to prevent fall energy and pendulum effect.
- The securing system for hoses should be documented and traceable.
- Securing devices for hoses should be designed to support the maximum loads generated by a burst hose.
- For suspended hydraulic and air hoses, whip socks of an appropriate size and rating for the working pressure are an effective fall restraint if hose/connection fails.
- For suspended unsupported electric cables, cable socks are an appropriate fall restraint.
- For restraints encompassing polymeric materials, the required resistance to wear and tear, chemicals, heat and UV radiation should be documented.
- The securing devices should be checked and labelled in accordance with the norm for lifting accessories.
- In addition to correct instructions for installation, the user manual/maintenance instructions should contain guidelines for necessary maintenance and inspection of the securing devices.
- Where Hammerlock chain connectors are used, ensure appropriate grade is selected and installed by a competent person.



**Figure 17: Hanging hoses and service loops present a safety problem (sourced from DROPS)**



## 18 PLATE PAD EYES AND LIFTING EYES

Plate pad eyes are a common anchor/attachment point for connecting loads to lifting appliances. They are common on structural steel work, on cargo transportation units and on items such as spreader beams and lifting frames.

Pad eyes are engineered devices and are designed to accommodate shackle pins appropriate to the design load of the pad eye.

Other lifting lugs such as lifting rings may also be termed pad eyes in some locations or documentation and plate pad eyes may also be described as lifting lugs.



**Welded pad Eye**

**Recessed Lifting Eye**

**Welded pad Eye**

**Figure 18: Plate pad eyes for connecting loads to lifting appliances**



- Flame plate cut or poorly drilled pad eyes without design provenance should be condemned and immediately removed from service.
- Pad eyes permanently installed at height should display the ID/Tag number and WLL adjacent to the item and be clearly visible from the normal working location of equipment utilising the pad eye as an anchor/attachment point.
- Pad eyes should be installed so that the line of pull is always in the plane of the pad eye plate.
- Pull outside the plane of the plate (side pull) is limited and only the appropriate technical data should be used to determine design limits.
- Only use the correct sized shackles for attachment to pad eyes.
- Frequent visual inspections and routine non-destructive testing (NDT) inspections should be carried out in accordance with the prevailing codes and lifting regulations.
- Ensure all lifting eye recesses are kept clear of debris to eliminate loose items and prevent corrosion and damage.



## 19 SPECIALIST LIFTING ACCESSORIES

A range of lifting accessories is employed across industry. Some of these accessories may only be suitable for low level lifting in benign environments, such as within a nacelle where space is restricted and there is limited clearance due to large plant.

**Choosing the wrong accessory for the operation is likely to result in an incident.**



**Figure 19: Specialist lifting frames (yaw gear motors and yaw callipers)**



**Figure 20: Specialist lift bags (tool pelicase and hydraulic pitch ram accumulators)**



- Only use approved, tested and certified lifting accessories.
- Only use lifting accessories for their intended use.
- Ensure all closure indicating devices are inspected and function tested daily.
- Inspect all lifting accessories prior to each use for signs of wear and defects.
- Always refer to the Lift Plan for details of compatible accessories.
- All securing clips and parts attached to the lifting accessory and the load being lifted should be adequately tightened and checked prior to any lift.
- Only persons trained in the use of specialist lifting accessories are to rig up such equipment.

## 20 CHAIN HOISTS

**Chain is a durable and flexible product and is used across a range of industrial hoisting equipment.**

It does not kink or curl and has good shock absorbing properties. It is heavier to move and install so is often used in relatively short lengths in lifting assemblies.



- Hoists should only be selected, used and maintained by a competent person knowledgeable in the applications and environment where it is used.
- Hoists should only be attached to beams/rails or anchor points that are certified for the WLL of the hoist and the weight of the hoist assembly.
- All rail/beam systems should have end stops installed at all times, of sufficient strength and size to preclude any hoist assembly running off the ends.
- Permanently installed hoists should be included in the DROPS Register detailing all components, fasteners, secondary retention features and safety securing devices (if fitted).
- Chain hoists should not be used for prolonged suspensions without approval from the appropriate authority.
- Inspection and maintenance of chain hoists should be in accordance with manufacturer's recommendations and regulatory requirements.
- Chain buckets, chain and chain block pockets should be protected from contamination by potentially harmful or corrosive materials.
- Chain bucket assemblies should be inspected frequently to ensure all fastenings are secure.
- Chains should be lubricated in accordance with manufacturer's instructions particularly when used in a corrosive environment.



*Manual chain hoist*



*Electric trolley beam chain hoist*



*BOP chain hoist*

**Figure 21: Chain is used across a range of industrial hoisting equipment**



**Steel chain should be removed from service if conditions such as the following are present:**

- **Cracks, breaks, excessive wear, nicks or gouges.**
- **Stretched, bent, twisted or deformed chain links or components.**
- **Evidence of heat damage or weld spatter.**
- **Excessive pitting or corrosion.**
- **Lack of ability of chain or components to hinge (articulate) freely.**
- **Any other conditions that cause doubt as to the continued integrity of the chain or its operation.**

**Generally, if a chain is 3 % longer than when new, it will have exceeded the Original Equipment Manufacture (OEM) recommendations for use and should be removed from service.**

## 21 GRATING, HATCHES, DOORS AND ACCESS PANELS

**Many structures and transportable equipment will incorporate gratings, hatches, doors and access panels.**

These may be subject to vibration and environmental loads that can result in integrity failures and dropped objects.

At present, there are a number of different ways of fastening grating to underlying structures or frames.

As a result of vibration and defective locking of fastenings, there are numerous incidents of loose grating or loose/missing grating, or inadvertent disengagement of hatches, doors and access panels.

### 21.1 GRATINGS



- Grating should be adequately fixed to underlying structures with fastenings that do not loosen with vibration or loads.
- Through bolts or threaded connections are recommended for fastening and should have secondary retention of the nut.
- Fastening clips should consist of as few parts as possible.
- Openings in the grating should not exceed 1 500 mm<sup>2</sup>.
- If grating is cut out and reinstalled by welding, the contact surfaces should be ground to remove galvanising and to ensure steel surfaces are clean prior to welding.
- Loads and grating support spans should be within manufacturer's recommendations for the required duty.



**Hatches and access panels present dropped object hazards due to inappropriate fixings, improper use, lack of inspection or maintenance and general lack of awareness.**



**Figure 22: There are a number of different ways of fastening grating to underlying structures or frames**

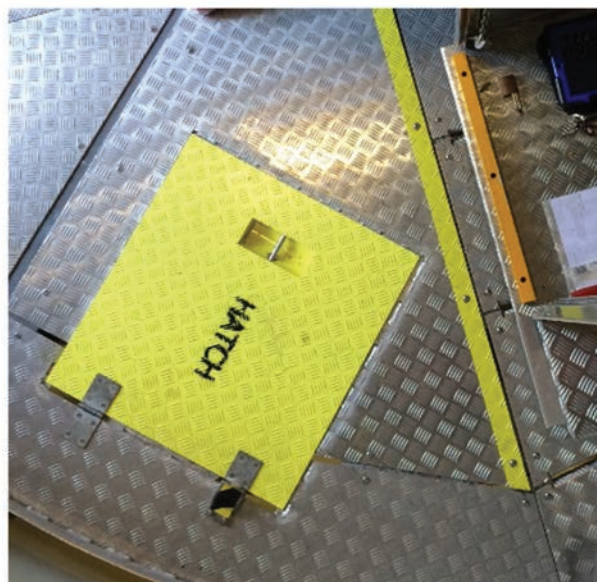
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## 21.2 HATCHES, DOORS AND ACCESS PANELS:



- Avoid gravity pin and loop hinges as these can become disengaged.
- Ensure all hatches, doors and access panels are correctly seated and secured with secondary retention.
- Sliding doors and doors on tracks/rails should be inspected for corrosion, cleanliness and the condition and security of any and all roller elements.
- Regularly inspect hinges and lugs for corrosion and wear.
- To reduce risk further, assess the requirement for safety securing wire to provide additional security.



**Figure 23:** Ensure all hatches, doors and access panels are correctly seated and secured

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## 22 PIPING AND EQUIPMENT FEEDTHROUGHS

It is not uncommon to encounter dropped objects as a result of missing covers or barriers at piping cable or equipment feedthrough point.



**Figure 24: All piping and equipment feedthroughs should have a toe board and should be covered to the greatest extent possible**



- All piping and equipment feedthroughs in decks and grating should have a toe board and should be covered to the greatest extent possible.
- Canvas or a cladding material can be used. This is especially important in areas where there is equipment requiring periodic maintenance or areas where there is an Increased risk of falling objects during rectification activities.

### 22.1 PIPE CLAMPS

Pipe clamps are prone to vibration and corrosion, resulting in components and pipework becoming loose, damaged and dislodged.

Ensure all pipe clamps are regularly inspected for fatigue, corrosion, missing components (brackets, bolts, locking wire, tab washers).

Wherever possible, ensure appropriately engineered pipe clamps are used.



**Figure 25: Appropriately engineered pipe clamps should be used**



## 23 GUARD RAILS

Major defects have been observed with guard rails that may result in dropped objects, in particular collapsible and movable modular types.

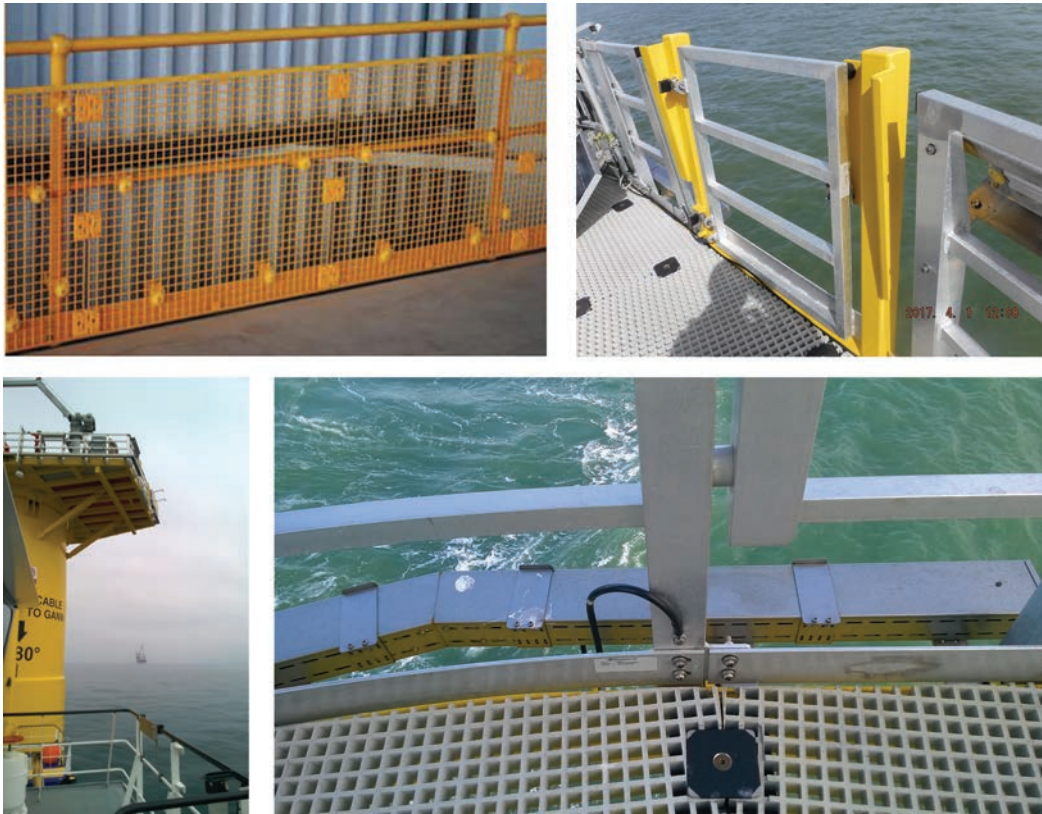


- Guard rails should be functionally designed for the area they are intended to secure, e.g. safety mesh should be installed as required (e.g. around mezzanine loading areas).
- Guard rails should not have deformations or cracks that affect their functionality or strength.
- It should always be possible to insert modular guard rails into the pockets provided and secure them using a pin or through-bolt with appropriate primary fixing and secondary retention.
- Where fitted, removable securing pins should have safety securing attached.
- The use of set screws is not recommended in permanent guard rails.
- Guard rails and attachment points for collapsible and movable guard rails should be inspected on a regular basis to maintain adequate security and functionality.
- Safety barricades and mesh systems may be applied to reduce potential for items to fall through guard rails. These should be of suitable materials, incorporate appropriate securing features and be installed and maintained in accordance with manufacturer's recommendations.
- Particular attention should be paid to fitting guardrails during the installation phase to ensure that there is no risk of dropped objects such as bolts and tools.



**The design and installation of fixed and modular guard rails and toe boards are subject to relevant national regulatory dimensions and recommended industry practices.**

**However, particular vigilance is required where the toe board is interrupted (e.g. between modules, around ladder hatches, stairways etc.)**



**Figure 26: Guard rails should be functionally designed for the area they are intended to secure (first image sourced from DROPS)**

## 24 TOE BOARD

Missing and incorrectly installed toe boards are regularly observed. Often, the gap between the bottom of the toe board and the deck exceeds requirements. Likewise, where the toe board is interrupted, the gap between toe board sections may exceed industry recommendations.



- Toe board must fulfil the requirements of EN ISO 14122 – *Safety of machinery*.
- Decks, gangways and platforms should have toe board at least 100 mm high.
- The gap between the deck or grating and toe board should not exceed 10 mm.



**When removing guard rails temporarily, the checklist should include the reinstallation of toe boards in accordance with the applicable rules and regulations.**



**Figure 27: Always refer to relevant codes, standards and recommendations in designing and installing toe boards**

## 25 SWING GATES

Many swing gates have been found to have hinges with neither the necessary quality of material nor the design strength to serve their intended function over time. Many older gates also lack integrated toe boards.



- Wherever possible, the hinges should form an integral part of the gate – i.e. they should be welded on.
- Removable gate hinge pins should be fitted with secondary retention e.g. split pin.
- Gates should open/swing inwards to the platform or deck.
- Gates should be at the same strength as surrounding guard rails.
- Gates should be secured against becoming disengaged.
- Gates should be designed to automatically return to, and remain in, the closed position.
- The use of locking fingers should be considered so that the gate can be locked in the closed position.
- Where possible, toe boards should be integrated in gates.
- Swing gates should be inspected and maintained on a regular basis to ensure adequate function.



**Figure 28: Swing gates (sourced from DROPS)**

## 26 LADDERS

Safe use of ladders in the workplace is governed by work at height codes, standards and regulations applicable in the specific region.

However, many cases have been found of damage to ladders and safety cages as a result of collisions with mobile equipment. In addition, cracks have been found in safety cages, especially in derricks, leading to dropped object incidents.



- Ladders should be inspected on a regular basis.
- Safe landing or rest platforms should be regularly inspected for loose items and all gates, hatches, removable rails and gratings checked to ensure all fastenings are secure and in place.
- Fall arrest equipment installed on ladders should be regularly inspected for damage/ loose fittings.
- Any damage and deformation should be reported and corrected as soon as possible.
- Where possible, carrying of tools when ascending and descending ladders should be avoided.
- If required to carry tools during a climb, then all tools should be tethered to the individual, using appropriate tool tethering equipment (tool lanyards, belts, etc.) to protect against tools working loose and falling.
- It is common practice to carry mobile phones and radios when ascending and descending ladders; these items should be adequately secured in pouches and the integrity of the securing method (e.g. Velcro) checked prior to each climb.
- Any platform hatches that are passed through when climbing a ladder should be closed afterwards.



**When ascending or descending ladders within a wind turbine generator (WTG), always consider the potential for snagging of personal tools and equipment when passing through platform hatches and at breaks in tower sections, as this can cause items to fall.**



**Figure 29: Many cases have been found of damage to ladders and safety cages as a result of collisions with mobile equipment. In addition, cracks have been found in safety cages, especially in derricks, leading to dropped object incidents**



## 27 SIGNAGE

**Ideally, signage should be painted directly upon structure. Where this is not possible, ensure the fastenings include the appropriate primary fixings and secondary retention.**



- Signs should be securely screwed or bolted to a mount or secured within a suitable frame.
- Where the underlying material permits, sign frames should be attached using through-bolts.
- Fasteners used for attachment to brackets and structures should be fitted with secondary retention.



**Figure 30: Ideally, signage should be painted directly upon structure**



## 28 LIGHTING UNITS



Many lighting units, such as floodlights, light fittings and navigation lights, installed at height are not adequately secured against falling or colliding with mobile equipment.

- Lighting units should be positioned to avoid collision with, or snagging of, mobile equipment/loads.
- Lighting fixtures and brackets should be fitted with secondary retention. The bolts used for mounting brackets to structures should have secondary retention and attachment brackets should have holes for fastening safety wires.
- Attachment points for safety securing devices should be integrated at both ends of the fixture.
- Light fittings positioned at height and assessed to be at risk of failure should be fitted with safety nets, particularly where multiple components are identified as potential dropped objects.
- The strength of attachment points and securing devices should be evaluated in relation to the relevant fall energies.
- For new installations, or when installing securing devices on existing equipment, an up-to-date user manual should be provided with guidelines for the correct mounting of fixings and safety securing devices and the necessary maintenance and inspection for fixings and safety securing devices.
- Hatches for exchanging light bulbs, covers and light fitting component rails should be hinged or secured with wire to the housing and be able to be properly secured in the closed position.
  - Covers should be hinged or have internal safety wires.
  - Light fitting covers should have steel hinges that can be attached on either side.
  - Hatch covers for electrical connections should not be completely removable.
  - On existing, older types of fixtures, covers should be secured using stainless tie wraps or galvanised perforated steel band.
  - Battery packs should be fitted with safety securing.
- Plastic components should be avoided, since over time they are weakened by UV radiation.
- Navigation lights with sliding grooves for bolt attachment are not recommended.
- Any temporary or task lighting when used at height should be suitably secured.



**Figure 31: Lighting unit installed at height should be adequately secured against falling or colliding with mobile equipment**

## 29 CCTV CAMERAS

CCTV cameras are subject to dynamic forces, particularly snagging. Lens covers, wipers and motors frequently fail due to collisions or loose fittings.



- CCTV camera location should be evaluated to prevent risk of contact with moving equipment/loads.
- Where there is danger of the camera being struck by mobile equipment/loads, it should either be protected by a reinforced cage or be fitted with safety wire to the structure.
- CCTV cameras (integrated solutions):
  - The attachment point for securing devices should form an integrated part of the camera casing and bracket.
- CCTV cameras (non-integrated solutions):
  - Where attachment points are not integrated into the camera parts, special clamps can be fitted around the camera casing to be used as attachment points.
  - The camera casing and motorised pan-tilt-zoom unit should be attached to the bracket and structure with adequately locked attachment bolts.
  - The camera should be fitted with two independent barriers on the camera casing, the motorised pan-tilt-zoom unit, the wiper motor and the lens cover.
- Calculations should be available for attachment points and securing devices, related to the relevant fall energies.
- For new installations or when installing securing devices on existing equipment, a user manual or maintenance instructions should be available. The instructions should also cover securing devices.



**Figure 32: CCTV cameras are subject to dynamic forces, particularly snagging**

## 30 CRANE BOOM CAMERA AND PIVOTING FLOODLAMPS

Pivoting equipment attached to crane booms is exposed to considerable shock loading, vibration and cyclic motion factors which can, if unchecked, lead to fatigue and failure of pivot fixings.



- Crane boom cameras and floodlights should have two independent barriers. Unnecessary lighting should be removed.
- Bolts used for attaching the crane boom camera/floodlight to brackets and structures should be fitted with secondary retention.
- Attachment points for the safety wire/chain should be an integrated part of the camera/floodlight casing. Alternatively, special clamps can be fitted around the camera casing.
- The safety wire should run from the camera casing through the camera bracket and then through the attachment bracket before being securely attached to the crane boom structure.
- On floodlights, the glass frame and any protective cages should be hinged or otherwise secured.
- Calculations relating to the relevant fall energies should be available for attachment points and securing devices.
- For new installations, or when installing securing devices on existing equipment, an up-to-date user manual/maintenance instructions should be provided.



**The crane boom camera- and floodlight-securing devices and attachments should be regularly inspected in order to identify any fatigue, corrosion or loose fittings.**

**The pivot bolt and all attachment brackets should also be included in the inspection routines, with particular attention afforded to the primary fixing to the main boom structure and/or the quality and design of the pivot device.**



**Figure 33: Crane boom camera and pivoting floodlamps (sourced from DROPS)**

## 31 JUNCTION/CONTROL BOXES AND CABINETS

Several risk factors have been discovered relating to the incorrect location of junction/control boxes and cabinets, to defective mounting/fastening and to inadequate securing of hatches, doors and covers.

This guidance covers permanently installed equipment as well as mobile equipment, e.g. control boxes on skidded equipment.



- Junction boxes and cabinets should be located where they do not create a snagging hazard or obstruct passage ways, evacuation routes or mobile equipment.
- The type and design of mounting/fastening should take account of calculated loads and known potential external stress factors.
- Hinged hatches/doors should be secured against unintentional disengagement and the locking device should have two barriers against opening.
- Large detachable hatches on machinery at height, and inspection hatches should be secured by a wire/chain.
- Covers should be secured by screws that are secured/locked to prevent unscrewing or by the cover being secured with an internal wire or chain.
- The securing device should be designed to support the relevant loads including wires/chains.



**Ensure all loose items are removed from junction boxes after routine maintenance.**



**Figure 34: Junction/control boxes and cabinets**



## 32 CABLE TRAYS AND LADDERS

Many instances have been discovered of loose nuts and bolts in the joints and fastenings of cable ducts (electro-steel), probably as a result of vibration and/or faulty installation.



- Only bolted connections that have been approved by the supplier of the cable support system may be used for fastening and joining.
- Pipe clips should have an adequate screw connection for functional locking.
- When attaching the cable support system to a structure, the risk of galvanic corrosion should be assessed and insulation considered where appropriate.
- Calculations should be available for the attachment point and necessary tightening force.
- The user manual/instructions should provide guidelines for:
  - correct installation, both in the joints and the attachment, and
  - necessary maintenance/retightening and inspection of both electro-steel and bolt and screw connections.



**Figure 35: Cable trays and ladders**

### 33 ANTENNAS, LIGHTS AND SENSORS

Typically, these communications and meteorological instruments are mounted at height and are exposed to continuous environmental forces. There have been several reported incidents where such items – or individual components – have become dislodged and fallen considerable distances.



- Two U-bolt fasteners or a minimum of three fasteners should always be used.
- All bolts should be through-bolts – do not use set screws.
- All fasteners and U-bolt fasteners should be secured against loosening.
- All heavy antennas should be installed with additional safety securing, such as wire or chain.
- Stay wires can be used for stability in accordance with the supplier's specifications.
- Avoid long whip antennas if possible; stretched antennas can be used as an alternative.
- Fibreglass whip antennas should be replaced every five years.
- All equipment and securing devices should have routines for preventive maintenance which include the supplier's recommendations and good practices.



**Where possible, ensure all sensors are located in areas where, in the event of a mechanical failure, they would be least likely to present a dropped object risk.**





**Figure 36: Antennas, lights and sensors are usually mounted at height and are exposed to continuous environmental forces**

## 34 CARGO CARRYING UNITS

Several serious incidents have occurred relating to the use and dispatch of cargo carrying units (CCUs) (containers, baskets, tanks etc.).



- Slings should have the necessary certification, be intact without twists or kinks, and shackles should be equipped with nuts and split pins.
- Check the condition of the CCU. Lifting lugs, doors, hinges and locks should not be excessively corroded or damaged.
- Check that drain holes on open CCUs are clear.
- Ensure doors and hatches are properly closed.
- Permitted loads in containers and baskets should be well distributed and adequately secured by use of lashing rings, lashings and nets. Lashings should not come into contact with sharp edges and edge protection should be used where required. Heavy objects should be placed at the bottom.
- Tanks should have secured and sealed tank access chambers and valves. All attached equipment (gratings, covers, plates etc.) should be adequately secured. The permitted load should not be exceeded.
- On CCUs with attached equipment such as pumps, tanks, winches etc, check to ensure no equipment protrudes from the frame.
- It should be ensured that there are no loose objects on CCUs or their cargo. Check all forklift pockets, on top and all other horizontal surfaces (e.g. floors of open units such as gas bottle racks).
- Ensure any pipe thread protectors or end caps/plugs are securely fitted.
- Cargo should be adequately secured to prevent items escaping during transportation.



**Good practice recommendations for inspection of cargo applies across all logistical activities, particularly during infield transit and back loading to shore.**

**Follow the required outbound and back loading ticket/tag procedures and attach tickets/tags to the CCU in a suitable location.**



**All forklift pockets, bumper bars, frame members, handles and roof**



**All forklift pockets, frame members, hatches, gratings/roof, caps and fittings**



**All forklift pockets and frame members**



**Remove snow, ice or other debris as it adds weight, creates dropped object hazards and obscures other loose items**

**Figure 37: Typical areas to check for potential dropped objects (sourced from DROPS)**

## 35 STORAGE OF CYLINDERS

Gas cylinders temporarily stored are often poorly secured with rope or cargo straps.



- Storing of gas cylinders should not obstruct passageways or escape routes.
- Gas cylinders should be stored and secured safely.
- Storing of gas cylinders should be risk assessed.
- Temporarily stored gas cylinders should be secured with a chain or webbing.
- Gas cylinders temporarily stored inside the CCU used to transport them should still be secured with the chains, webbing or clamps provided with the CCU.
- Permanent storage racks should be equipped with securing brackets/chains.



**Always maintain secure fastening on all bottles whilst in storage. These are top-heavy and can easily be toppled.**

**Remember adverse weather conditions can affect the integrity of bottle racks during loading and transportation. Always load partly full gas racks with bottles towards crash barriers/away from walkways.**



**Figure 38: Gas cylinders should be stored in well ventilated areas with clear signage. They should be lifted in approved and compatible bags/slides and lockable containers**

## 36 RACKS AND SHELVING

The design of racks for storage of material and equipment is often not appropriate to ensure safe storage.



- Ensure that temporary storage is permitted in a controlled manner with respect to type of goods, duration, storage area and housekeeping.
- Storage should not obstruct accessibility or evacuation of the area.
- Ensure that the stored materials do not obstruct access to emergency equipment.
- Storage racks and storage areas should be designed to ensure that equipment cannot accidentally drop to lower levels.
- The heaviest equipment should be stored lowest.
- On mobile units, temporary storage space/racks should be sea fastened and shelves should be equipped with baffle plates and shelf edges or doors. Shelving should ideally be of the closed type.



**Whilst it is imperative to consider the potential for items stored on shelving to fall, always assess the integrity, load limitations, stability and fastenings on all free standing or wall-mounted shelving to ensure appropriate securing has been applied.**

**It is advisable to regularly inspect shelving systems or heavy material storage for signs of damage, overloading or fatigue.**





**Figure 39:** The design of racks for storage should be appropriate to ensure safe storage

## **ANNEX A**

### **ABBREVIATIONS AND ACRONYMS**

CCU	cargo carrying units
DROPS	Dropped Objects Prevention Scheme
HSE	Health and Safety Executive
ID	identification
ISO	International Organisation for Standardisation
kg	kilogram
MEWP	mobile elevated work platform
mm	millimetre
OEM	Original Equipment Manufacture
OSHA	Occupational Safety and Health Administration
NDT	non-destructive testing
SWL	safe working load
UV	ultraviolet
WTG	wind turbine generator





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