REVISION 02
October 2009

DROPPED OBJECTS AWARENESS AND PREVENTION

Reliable Securing




DROPS

DROPPED OBJECTS

STILL HARMING
STILL KILLING

We thank StatoilHydro for their kind assistance
in the publication of this document.

Preface

In our ongoing efforts to prevent dropped objects, investigations have shown that our greatest challenges relate to behaviour, work processes and inadequate securing of equipment. As part of our continued efforts, we have updated this handbook, which collates relevant requirements for securing both fixed and freestanding equipment. Developed by StatoilHydro / SfS after much research and consultation, the handbook is an excellent guide to Best Securing Practice. **DROPS** highly recommend these guidelines as a point of reference to all on a global basis. The handbook has been compiled in close collaboration between equipment suppliers and users. The objective has been to improve safety by providing guidance and illustrations of the most important factors in the prevention of falling objects. We thank StatoilHydro for allowing us to publish the handbook to the benefit of all involved in our ongoing fight against dropped objects.

The DROPS Workgroup

October 2009

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Purpose of the handbook

This document is intended to help eliminate the risk of dropped objects. It applies both to equipment that we are going to procure and to equipment already in use on our own and hired installations. In many cases, the functional recommendations that are stipulated for the equipment in this document will set a new standard for our activities. We recognise that it may be impractical to adhere to all the recommendations, but the booklet sets a standard we must aspire to. Also, the handbook is a guide only – it does not supersede the requirements of existing legislation and / or corporate standards.

The definition of barriers that will prevent objects falling has been an important goal and these can be used in the procurement, use and maintenance of equipment for work at height. When procuring new equipment, we should endeavour to use integrated barriers. In order to minimise the danger of collision, we should always evaluate the risk associated with the chosen location of equipment. Equipment must be designed to povide the safest possible access for maintenance and inspection.

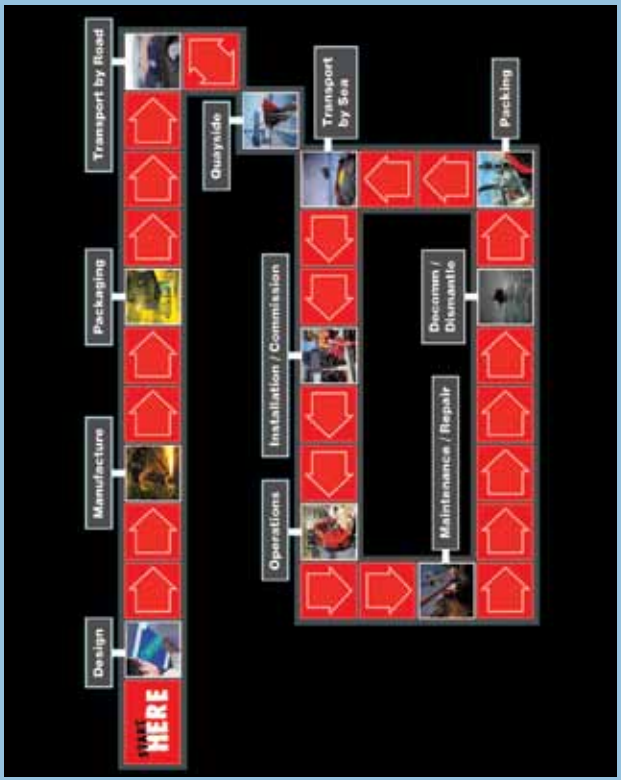
The functional recommendations set out in this handbook should be complied with through the full value chain:

- **design**
- **procurement**
- **installation**
- **operation**
- **maintenance**

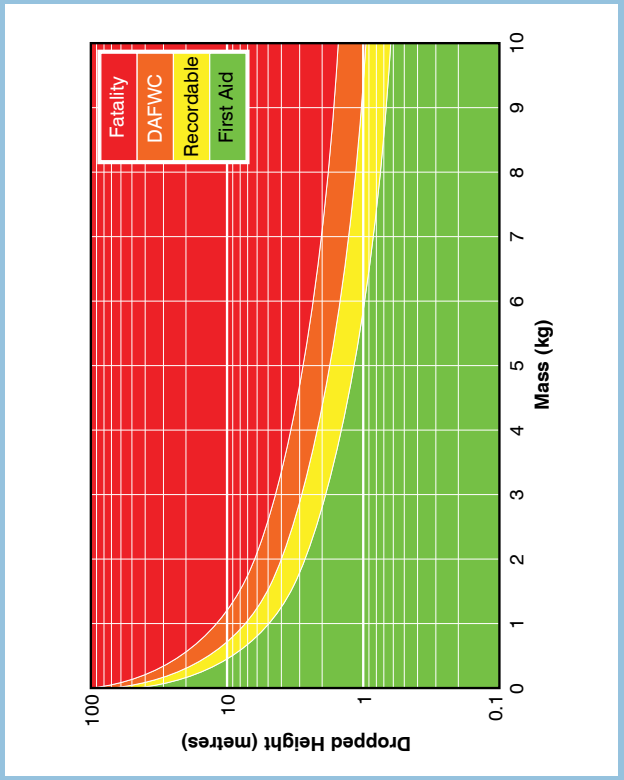
By mere compliance with these recommendations you will help achieve the goal of zero dropped objects.

Who is responsible? Everyone in the value chain.

DROPS responsibilities through the value chain



DROPS calculator

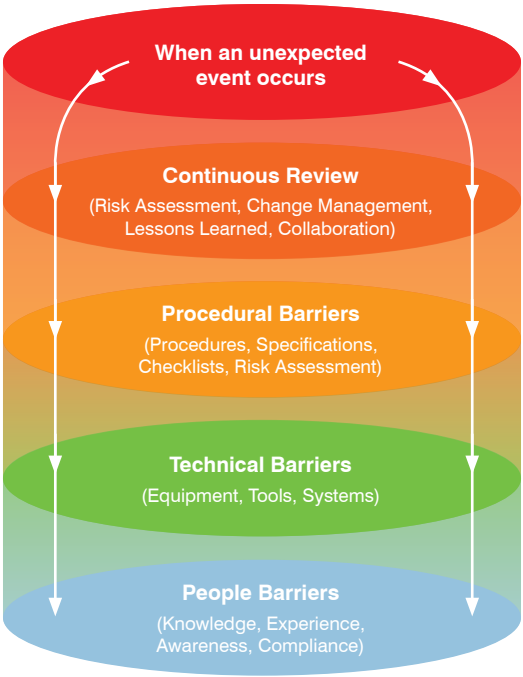


The **DROPS** Calculator (shown opposite) provides a common benchmark in the classification of the potential consequences of a dropped object.

One of a number of similar tools, the **DROPS** Calculator is endorsed by the **DROPS** Workgroup and recognised by the majority of Operators and Contractors in the global oil and gas sector. While other 'calculators' exist, they all follow the same principle – plotting the mass of a dropped object against the distance it falls to determine its possible consequences.

It is important to note that this calculator (and all others) are guides only and in reality even a very light object falling from significant height can prove fatal.

Barriers


When an unexpected event occurs
Continuous Review
(Risk Assessment, Change Management, Lessons Learned, Collaboration)
Procedural Barriers
(Procedures, Specifications, Checklists, Risk Assessment)
Technical Barriers
(Equipment, Tools, Systems)
People Barriers
(Knowledge, Experience, Awareness, Compliance)

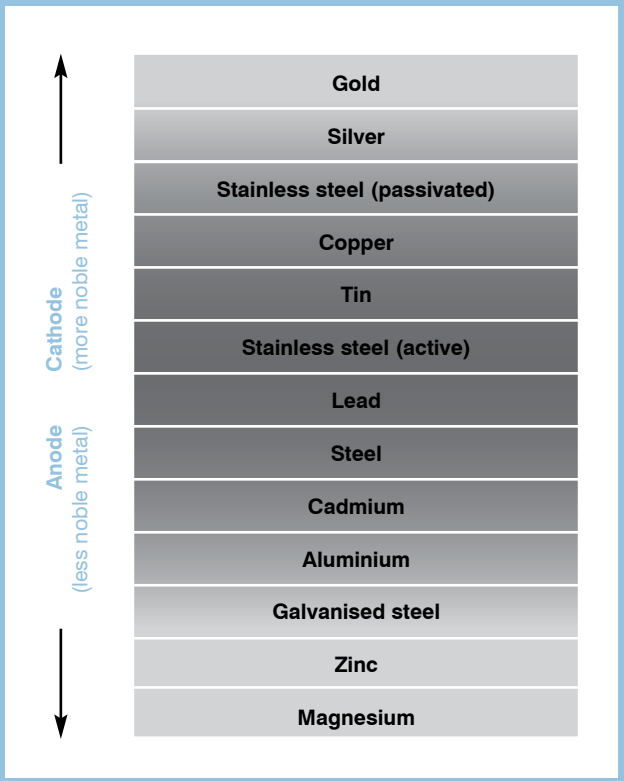
Barriers are functions and measures designed to break a specified undesirable chain of events. In other words, their function is to prevent a hazard, such as a dropped object, from manifesting itself or to mitigate the consequences by breaking an undesirable chain of events.

Safety barriers may be defined as People, Technical or Procedural measures intended to break an undesirable chain of events.

Technical solutions alone can serve as barrier functions, but they often need to be combined with organisational and / or human solutions.

People and Procedural solutions can not fill barrier functions alone; they must always be combined with at least one other solution.

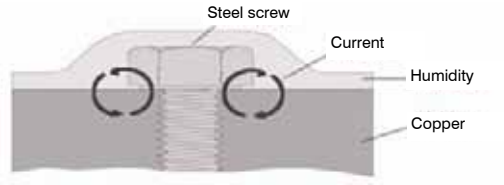
Galvanic corrosion



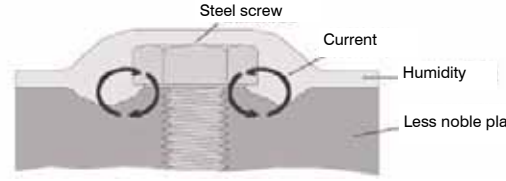
As a basic rule, only metal of the same or almost the same nobility should be combined in a corrosive environment.

Galvanic corrosion occurs when two dissimilar metals with different voltage potentials are in contact with each other in the presence of an electrolyte (damp film or seawater / fresh water). When this happens, the less noble metal becomes the anode and the more noble metal the cathode.

If a steel screw is fixed into a copper plate, the screw will be the anode since copper is the nobler metal. The screw will rust rapidly as the difference in potential is great.



If the same steel screw is fixed into a less noble plate, eg a zinc plate, the screw will be the cathode and will not rust. The zinc plate will corrode, as it is less noble than the screw.



Bolted connections

At present, bolts are being produced to 85 different industrial standards and the requirements for bolted connections vary for the different sectors depending on the given design, operational and maintenance requirements.

Achieving a stable bolted connection will therefore require a qualified evaluation of the following factors:

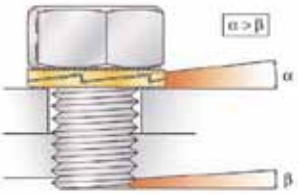
- **Load design**
- **Choice of materials with a view to mechanical properties and corrosion resistance**
- **Where appropriate, use of lubricant**
- **Pre-tensioning and use of the correct torque equipment**
- **Need for locking bolts to secure against loss of torque / pre-tension (secondary retention)**

85% of all damage to bolts etc is due to fatigue.

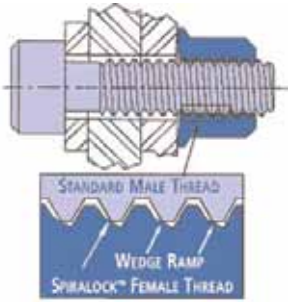
This is primarily a result of:

- **Dynamic load with inadequate pre-tensioning**
- **Overload resulting in reduced pre-tensioning**

Locking of screw / bolted connections



Nord-lock bolt



Spiralock nut

The following methods are recommended for locking bolted connections. NOTE: Dual nuts are not recommended for locking screw / bolted connections.

Nord-Lock Bolt Securing System

www.nordlock.com

When correctly mounted, the Nord-Lock Bolt securing system provides a guaranteed secure screw / bolt lock. It works by means of wedge-locking, ensuring that the squeeze force is maintained in the screw / bolted connection.

Areas of use:
Particularly suitable for connections exposed to vibrations, eg grating, loudspeakers, guide rails etc.

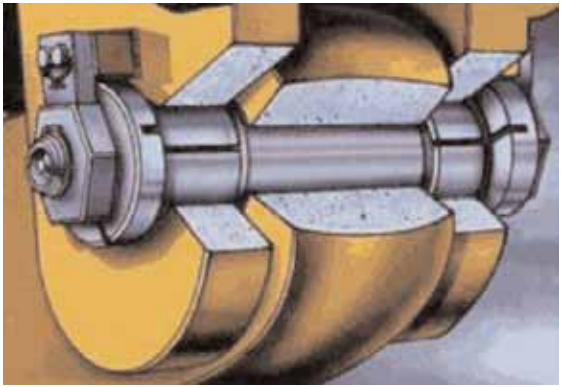
Safe-Lock (spiralock)

www.spiralock.com

Safe-lock is an all-metal lock nut. The nut has a specially designed threaded profile that locks when tightened and distributes the tension over the whole length of the thread. This provides better load distribution, which in turn helps to improve the locking of the screw connection.

Areas of use:
Used for fastening cable support systems.

Castle nut w/split pin



Bondura bolt

Castle Nut w/Split Pin

Castle nuts provide a visual and reliable method for locking bolted connections. The nut has radial slots and is locked by non-corrosive split pins that are inserted through a hole in the bolt.

Generally used for bolted connections exposed to shear forces rather than tensile stresses.

Areas of use:
Critical connections or components that are disconnected frequently.

Bondura Bolt

www.boltnorge.no

BONDURA® has a unique design which uses expanding taper sleeves at both ends of the bolt to eliminate play.

The bolt also prevents play from re-occurring. Standard screws are used to push in the bolt tapers, and the bolt is fixed directly to the machine component using locking screws. This prevents the bolt from coming loose, falling out or turning in the hole. The bolt can be retightened as the equipment is exposed to wear.

Areas of use:
Clevis bolts, Dolly, top drive, pipe rack cranes and other pipe-handling equipment.

Palnut lock nuts

Safety-wiring

Palnut

Palnut lock nuts have been on the market for several decades as an alternative to locking of bolted connections. Palnut locks by 'cutting' itself into the threads on the bolt when it is tightened. In the offshore context they are normally used for locking over standard nuts.

Areas of use:
Used on through-bolts on fixed immobile equipment and on mobile pipe-handling and drill-handling equipment.

Safety-wiring

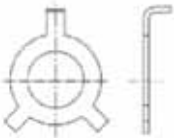
Safety-wiring of bolts is a locking method adopted from the aviation industry. In brief, the method involves threading a wire through a hole in the bolt to lock it against being rotated loose. The wire is twisted before being threaded and is locked to the next bolt. The wire can be used to lock a maximum of three bolts, as shown in the illustration.

Areas of use:
Used extensively for locking external bolted connections on drill and pipe-handling equipment used in particular where there are no through-bolts and / or there is a need for simple visual control of the locking.

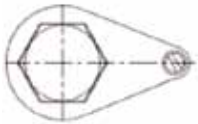
Nylock lock nut

All-metal lock nut

All-metal lock nut



Tab washer



Tab plate

Nylock Lock Nut

Nylock lock nuts are used extensively in the industry. This type of nut is approved for dimensions up to and including 10mm. Standard Din 985 nylock nuts have a temperature rating from -70°C to +120°C.

All metal lock nuts

All-metal lock nuts are recommended for use on all bolt dimensions. This type of nut locks through the threaded section or top of the nut being deformed, the top of the nut being split or the nut having a toothed ring under the collar. This provides greater friction between the bolt / underlay and nut, providing a secure connection. There are many varieties and suppliers on the market. These nuts have an almost unlimited area of use.

Tab washer / tab plate

Tab washers can be used on all dimensions and in any place designed for the use of tab washers. There are several types with different areas of use for locking either nuts or bolts. It is important to use the right type for each purpose.

Tab plates can be used on all dimensions. They are used typically on machinery where it is important to prevent the bolt from rotating.

Correct use of lock pins

Pins used in shackles are often of a non-approved type, which can have serious consequences if they are knocked out of place.

Functional recommendations

- **When hoisting persons and loads, you must always use shackles with double locking, eg nut + split pin or screwed connection with split pin.**
- **Split pins such as tractor pins or hairpins must not be used.**
- **For static loads, you must always use shackles with double locking as described above.**
- **Split pins should preferably be made of non-corrosive material.**
- **Approved securing pins as described above must be inspected regularly and replaced when they no longer function as intended.**

Correct use of eye bolts / eye nuts

Before use of grade 80 eye bolts, see designated lifting table.

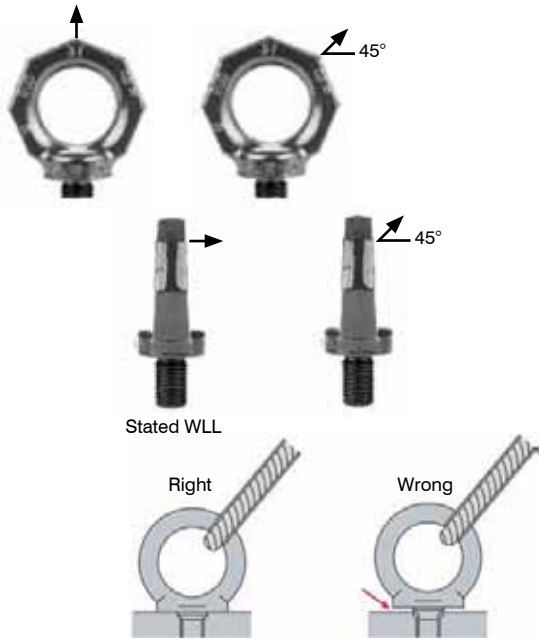


Figure showing correctly and incorrectly installed eye bolts.
note: only grade 80 (or better) eye bolts shall be used offshore.

Functional recommendations

- **Eye bolts / eye nuts must be certified and approved, i.e. marked with the designated colour code of the year (preferably by using coloured tie wraps).**
- **Eye bolts / nuts must only be used for their intended purpose and manner.**
- **The user must be familiar with the applicable limitations and guidelines for use.**
- **Eye bolts / nuts for use offshore shall be at least grade 80.**
- **Eye bolts / nuts for use onshore should be at least grade 80.**
- **Grade 80 eye bolts / nuts are labelled with the permitted load in the least advantageous direction, ie 90 degrees on the fastening bolt.**
- **Eye bolts / nuts must be adequately tightened prior to use.**
- **Manufacturer installed eye bolts / nuts are normally appropriate for use during installation / removal of the units they are installed on, eg gear boxes, pumps, motors and valves.**
- **Eye bolts / nuts must be removed after use, and the threads in the equipment on which they have been used must be preserved, eg by grease and a plastic plug.**

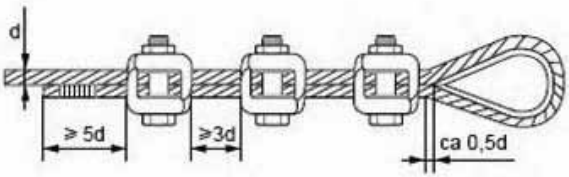
Securing devices (wires, chains and connectors)

Wherever possible, equipment installed at height shall have integrated secondary retention. Where this is not possible, or where such equipment is exposed to a risk of collision, the equipment must have secondary retention in the form of wires or chains and connectors that are securely attached to the structure.

Functional recommendations

- **Securing devices must be designed and dimensioned in accordance with the equipment supplier's calculations.**
- **Wires must be locked in accordance with the manufacturer's instructions.**
- **Only acid-proof securing wire shall be used. Wires must be locked with double press locks. The locks must be made of copper and the minimum distance between the locks must be approximately equal to the length of a fully crimped lock**
- **All connectors / snap hooks must be made of acid proof steel and be equipped with locks.**
- **Snap hooks attached to shackles should have eyelets**
- **Chain must be made of acid-proof or galvanized steel**
- **Shackles for use with securing devices should have rotating bolt with nut and cotter pin, marked with "CE", "WLL" and traceability, at least in the form of batch marking**
- **The chain or securing wire must be as short as possible and fastened as tightly as possible over the object to be secured. This will minimise the length of fall and thereby also the fall energy.**
- **Securing devices must be installed, maintained and inspected in accordance with the information provided in the user manual or instructions.**

Correct installation of wire clamps



Correct installation of iron grip wire clamps

Wire rope ø	Minimum number of wire clamps
mm	per piece
3-9	3
10-16	4
17-20	5
21-26	6
27-37	7

Corrosion and incorrect installation of wire clamps are challenges in the industry.

Functional recommendations

- **Wire clamps must be of the correct number and sized to the dimension of the wire.**
- **It is a requirement that wire clamps are assembled, inspected and maintained in accordance with the manufacturer's user manual / maintenance instructions.**

Note: Wire clamps of the U-bolt type must not be used in connection with lifting operations.

Securing of personnel

Training is mandatory for all personnel using fall arrest equipment.

Functional recommendations

- **Anyone using personal protective equipment against falls from heights must have documented training.**
  - ***The training must also cover rescue methods.***
- **Nobody shall work alone or unattended when using fall arrest equipment.**
- **The necessary rescue equipment must always be available at the work place.**
- **Established control procedures must be followed before, during and after use.**
- **The equipment must have CE approval and comply with an accepted standard.**
- **The equipment must be checked at least every 6 months by a competent person (LOLER).**
- **The control or validity date must be shown on the equipment.**
- **The choice of equipment must be made after evaluating the geometry of the work place.**

Derrick evacuation equipment

Examples only

Far too many defects have come to light in evacuation equipment. In many cases there is deficient certification, control and labelling of harnesses and blocks (brakes

Functional recommendations

- **Riding belts and blocks must be certified, controlled / inspected and labelled in line with other anti-fall equipment.**
- **The guide line, its attachment points and connectors are also defined as antifall equipment and must be certified, controlled / inspected and labelled accordingly.**
- **Riding belts must be connected to guide lines and blocks and stored so as to protect them from wear and tear / damage from external factors.**
- **It must be possible to use the equipment for the safe performance entry and evacuation operations.**
- **The equipment must be checked every 6 months by a competent person and shall be marked with the next inspection date.**

Securing of tools in use

Example only

There is a significant risk of dropped objects when using tools at height and a large number of such incidents are reported.

Functional recommendations

- **All tools used at height must be secured against falling.**
- **Wires and connectors must be used between the tools and belt or bag.**
- **There must be a weak link between the snap hook on the belt or bag and the wire.**
- **Swivels with set screws shall not be used.**
- **Wrist straps must not be used because of potential personal injury.**
- **If there is a need for more tools, a tool bag with internal loops must be used.**
- **In restricted areas, eg derrick, flare boom, cranes etc tools used at height must be logged in and out to make sure that no tools have been left behind.**

Internal securing loops

Safety wires and connectors

Securing tools

Securing tools in use (Tools 5-25kg)

Methods for securing heavy tools and hand-held machines for use at height have not been adequately defined. In view of the potential for serious damage if such tools or machines fall, it is important to have clear guidelines.

Functional recommendations

- **All use of heavy tools and hand-held machinery at height must be risk assessed.**
- **All heavy tools and hand-held machines used at height must be secured against falling when in use and while being transported.**
- **Securing devices must be dimensioned in accordance with verifiable calculations and documented free-fall tests.**
- **Securing points for tools and machines must be in place above the work site and the securing device must be as taut as possible.**
- **The fall length must not exceed the length of the securing device.**
- **In restricted areas, eg derrick, flareboom and cranes, tools used at height must be logged in and out.**

Securing of other portable equipment

Numerous reported incidents relate to fallen radios, pagers, gas detectors and other portable equipment.

Functional recommendations

- **All portable equipment used at height must be secured against falling.**
- **Carrying pouches must always be used for radios and any other portable equipment with no dedicated attachment point.**
  - ***The locks on the pouches must have a double securing mechanism to guard against unintentional opening*.**
- **Belt clips which allow the radio to become detached when turned 180° must not be used.**
- **Belts with snap fasteners are not recommended.**

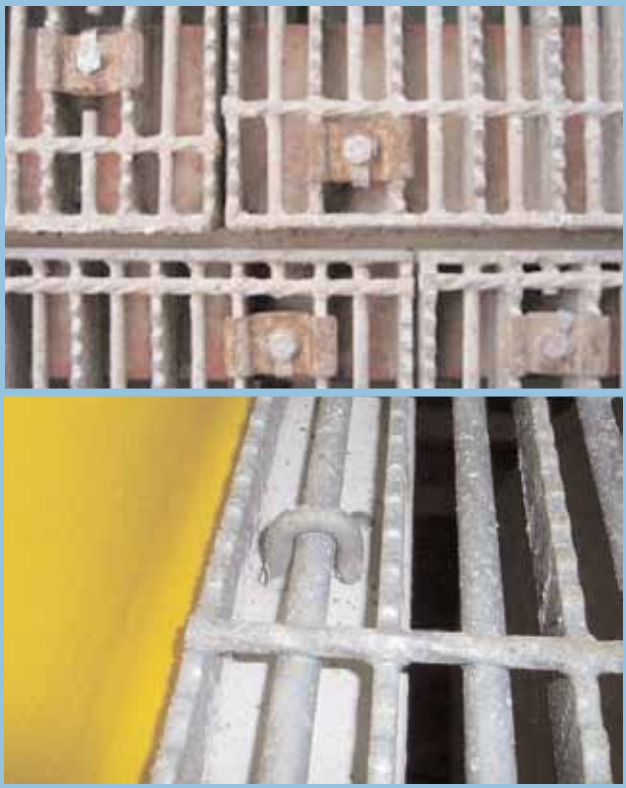
Tool cabinets for work at height

Tool cabinets for work at height are now readily available and employed on many facilities. Unfortunately a number of irregularities have been observed regarding securing, control and registration of tools.

Functional recommendations

- **All tools stored in high cabinets must be adequately secured for use at height and they must have documented attachment points.**
- **In addition to the necessary tools, cabinets must be equipped with:**
  - ***a sufficient number of correctly dimensioned safety wires with approved swage locks***
  - ***a sufficient number of connectors / snap hooks with locking***
  - ***special belts for fastening tools and bag***
  - ***weak links for the fastening between the belt and safety wire***
  - ***a sufficient number of tool bags with internal fastening devices.***
- **Each cabinet must have a list of contents and be kept locked, and one person must be designated as responsible for the cabinet.**
- **The responsible person must register all tools taken from and returned to the cabinet. The contents of the cabinet and the log shall be checked at the end of every shift.**

Grating



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 or loose grating or loose / missing fastening clips.

Functional recommendations

- **Grating must 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.**
- **Fastening clips must consist of as few parts as possible.**
- **Openings in the grating must not exceed 20mm.**
- **If grating is cut out and reinstalled by welding, the contact surfaces must be cleaned and / or polished to remove galvanisation and to ensure clean steel surfaces and adequate adhesion.**
- **If large areas are cut away, a special frame must be installed and the necessary underlay calculated.**

Piping and equipment feedthroughs

Throughout the industry, we have identified significant shortcomings in piping equipment feed-throughs, often where hole covers are missing.

Functional recommendations

- **All piping and equipment feedthroughs in decks and grating must have a toe board and must 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.**

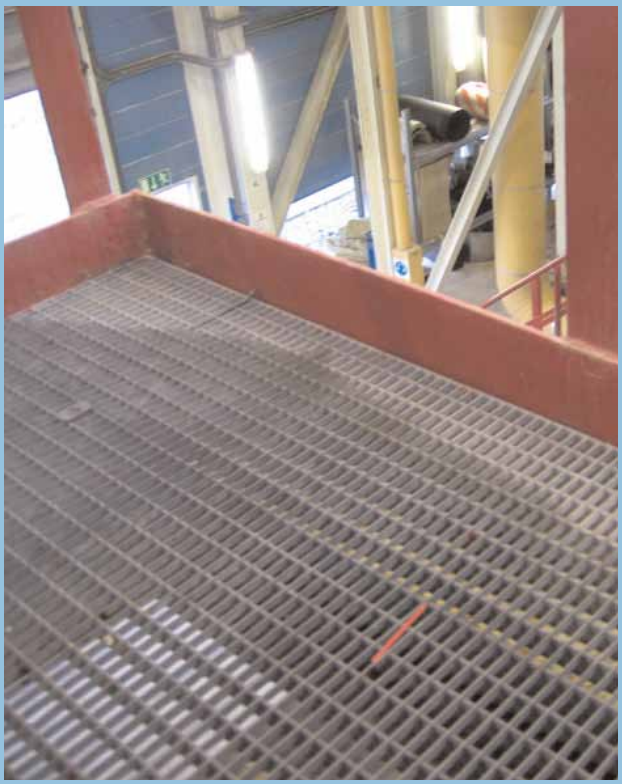
Railings

Major defects have been observed with railings, in particular collapsible and movable railings.

Functional recommendations

- **Railings must be 1100mm high as a minimum and have integrated toe boards that are 100mm high.**
- **Railings must have no deformations or cracks.**
- **It must always be possible to insert movable railings into the fastening and insert a securing through-bolt.**
- **The safety bolt must be adequately locked using a securing pin or snap hook(with grommet).**
- **Both the safety bolt and locking must be secured in the immediate vicinity of the attachment.**
- **All connections between elements in the railing must be secured with through-bolts and lock nuts.**
- **Use of setscrews is not acceptable in permanent joints between railings.**
- **Railings and attachment points for collapsible and movable railings must be inspected on a regular basis to maintain adequate securing and functionality.**

Toe boards



Missing and incorrectly installed toe boards are regularly observed. Often, the gap between the toe board and the deck exceeds requirements.

Functional recommendations

- **Decks, gangways and platforms must have toe boards at least 100mm high.**
- **On stairways, every step must have a toeboard at least 50mm high.**
- **All landings in stairways must have toe boards at least 100mm high.**
- **The gap between the deck or grating and toe board must not exceed 10mm.**
- **When removing railings temporarily, the checklist must include reinstallation of toe boards in accordance with the applicable rules and regulations.**

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.

Functional recommendations

- **Wherever possible, the hinges must form an integral part of the gate – ie they should be welded on.**
- **Gates must open / swing inwards to the platform or deck.**
- **Gates must be at the same strength as surrounding railings.**
- **Gates must be secured against becoming disengaged.**
- **Gates must be designed to automatically return to and remain in the closed position.**
- **On floating rigs, the use of locking fingers should be considered so that the gate can be locked in the closed position.**
- **Toe boards must be integrated in gates.**
- **Swing gates must be inspected and maintained on a regular basis to ensure adequate function.**

Ladders

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.

Functional recommendations

- **Ladders of more than 9m must incorporate a landing platform every 6m or be equipped with a fixed anti-fall device.**
- **Safety cages must be installed on ladders of more than 3m.**
- **The safety cage must start at a maximum of 2.2m above the deck / floor.**
- **Try to minimise the distance between the upper part of the railing and the lower part of the cage.**
- **The safety cage must continue to a minimum of 1.1m above the top level.**
- **The diameter of the safety cage must be at least 70-80cm.**
- **Ladders and safety cages must be inspected on a regular basis.**
- **Any damage and deformation must be reported and corrected as soon as possible.**

Floodlights

Many floodlights installed at height are not adequately secured against falling or colliding with mobile equipment.

Functional recommendations

- **Floodlights must be positioned to avoid collision with loads or equipment.**
- **Floodlights must be equipped with two independent barriers. The attachment points must be integrated, eg eye bolts threaded into the floodlight housing.**
- **Brackets must be fitted with secondary retention.**
- **Hatches for exchanging light bulbs must be hinged or secured with wire to the floodlight housing.**
- **Calculations must be available for attachment points and securing devices, relating to the relevant fall energies.**
- **User manuals / instructions must provide guidelines for the correct mounting of securing devices.**
- **User manuals / instructions must also provide guidelines for necessary maintenance and inspection of securing devices.**

Light fittings

Several types of light fittings found on our facilities are inadequately secured against falling. There have been several serious incidents in which both the cover and the casing of the fixture have worked loose and fallen.

Functional recommendations

- **The attachment brackets at both ends of the fixture must have secondary retention.**
- **If the electricity is fed in at both ends, the earth wire must be fastened so it can act as a second barrier. If the electricity enters at one end only, the opposite end must have secondary retention.**
- **The cover must have fixed hinges and it must be possible to move these to the opposite side.**
- **The component rail must be hinged and must allow for adequate securing in the closed position.**
- **Emergency lights must be equipped with battery units with their own safety wires or secondary securing.**
- **Calculations must be made for attachment points and securing devices, relating to the relevant fall energies.**
- **User manuals / instructions must provide guidelines for the correct mounting of securing devices.**
- **User manuals / instructions must also provide guidelines for necessary maintenance and inspection of securing devices.**

Navigation lights

Several types of navigation light used on our facilities are inadequately secured against falling.

Functional recommendations

- **The bolts used for mounting brackets to structures must have secondary retention**
- **Attachment brackets must have holes for fastening safety wires.**
- **Covers must be hinged or have internal safety wires.**
- **Hatch covers for electrical connections must not be completely removable.**
- **Calculations must be made for attachment points and securing devices, relating to the relevant fall energies.**
- **Navigation lights with sliding grooves for bolt attachment are not recommended.**
- **User manuals / instructions must provide guidelines for the correct mounting of securing devices.**
- **User manuals / instructions must also provide guidelines for necessary maintenance and inspection of securing devices.**

CCTV cameras (integrated solution)

Within the industry, it is identified that CCTV cameras have been inadequately secured.

Functional recommendations

- **CCTV camera location must be evaluated to prevent risk of contact with moving equipment / loads.**
- **In areas where there is crane activity, cameras should be shielded by protective cages.**
- **The camera casing must be fastened to the bracket and structure with adequate locking of attachment bolts.**
- **The attachment point for securing devices should form an integrated part of the camera casing and bracket.**
- **Strength of attachment points and securing devices, related to the relevant fall energies must be evaluated.**
- **For new installation or when installing securing devices on existing equipment, a user manual / maintenance instructions should be available. The instructions should also cover securing devices.**

CCTV cameras (non-integrated solution)

Functional recommendations

- **CCTV camera location must 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 must either be protected by a reinforced cage or be fitted with safety wire to structure.**
- **The camera should be fitted with two independent barriers on the camera casing, the motorized pan-tilt zoom unit, the wiper motor and the lens cover.**
- **The camera casing and motorized pan-tilt-zoom unit should be attached to the bracket and structure with adequately locked attachment bolts.**
- **The attachment point for the securing devices should be integrated into the camera parts. Alternatively special clamps can be used as attachment points.**
- **Calculations must 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 / maintenance instructions should be available. The instructions should also cover securing devices.**

Crane boom camera

There have been several cases where a crane camera has been hit by the crane during lifting operations. Since bolts through the attachment bracket would be unable to withstand the forces generated by a collision of this kind, it is vital to equip crane cameras with two anti-fall barriers.

Functional recommendations

- **Crane cameras must have two independent barriers. Where possible, the attachment point for the safety wire should be an integrated part of the camera casing: welded attachment point or eyebolts fastened to end pieces. Alternatively, special clasps can be fitted round the camera casing.**
- **The safety wire must run from the camera casing through the bracket that is holding the camera and then through the attachment bracket before being attached securely to the structure of the crane boom.**
- **Calculations must have been made and be available for attachment points and securing devices, relating to the relevant fall energies.**
- **User manuals / instructions must provide guidelines for thecorrect mounting of securing devices.**
- **User manuals / instructions must also provide guidelines for necessary maintenance and inspection of securing devices.**

Loudspeakers

There have been several cases where we have discovered loose screw connections between loudspeakers and attachment braces / brackets.

Functional recommendations

- **Loudspeakers must be fastened to the brackets in a manner that permits adequate locking of attachment bolts.**
- **Loudspeakers must be placed where they are not at risk of being hit by mobile equipment.**
- **If there is a risk of being hit by mobile equipment, loudspeakers must either be protected by reinforced braces or equipped with a safety wire.**
- **Calculations must have been made and be available for attachment points and securing devices, relating to the relevant fall energies.**
- **User manuals / instructions must provide guidelines for the correct mounting of securing devices.**
- **User manuals / instructions must also provide guidelines for necessary maintenance and inspection of securing devices.**

Junction boxes and cabinets

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

Functional recommendations

- **Junction boxes and cabinets must be located where they do not obstruct passage ways, evacuation routes or mobile equipment.**
- **The type and design of suspension / fastening must take account of calculated loads and known potential external stress factors.**
- **Hinged hatches / doors must be secured against unintentional disengagement and the locking device must have two barriers against opening.**
- **Large detachable hatches on machinery at height, and inspection hatches must be secured by a wire / chain.**
- **Covers must 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 must be designed to support the relevant loads.**

Cable ducts

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.

Functional recommendations

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

Wind walls

Many cases of damage and loose panels have been found in wind walls. This is presumably due both to faulty installation and to external factors (collisions with mobile equipment and exposure to wind and weather).

Functional recommendations

- **The type and method of attachment should be chosen in accordance with the manufacturer's instructions. The preferred solution is through-bolts with lock nuts.**
- **Wind-wall panels must be fastened to a separate support / structure and never to the main structure.**
- **Wind wall panels must always be reinforced by horizontal steel beams in accordance with the design loads.**
- **Areas that are exposed to collision risk must have stronger corner mountings secured by through-bolts and lock nuts.**
- **The manufacturer must provide guidelines for installation, necessary maintenance and inspection of wind-wall panels and attachment.**

Signs

Methods for attaching and hanging up signs have in many cases proved unsatisfactory.

Functional recommendations

Ideally, signage should be painted directly upon structure. Where this is not possible:

- **Signs must be securely attached so as to ensure that they do not accidentally come loose and fall down.**
- **Brackets and frames for signs must always be securely attached.**
- **Where the underlying material permits, sign frames should be attached using through-bolts.**
- **Identification labels that are painted or stuck on are recommended for identification of pipe systems. If the temperature precludes this, identification labels should be attached with steel tape.**

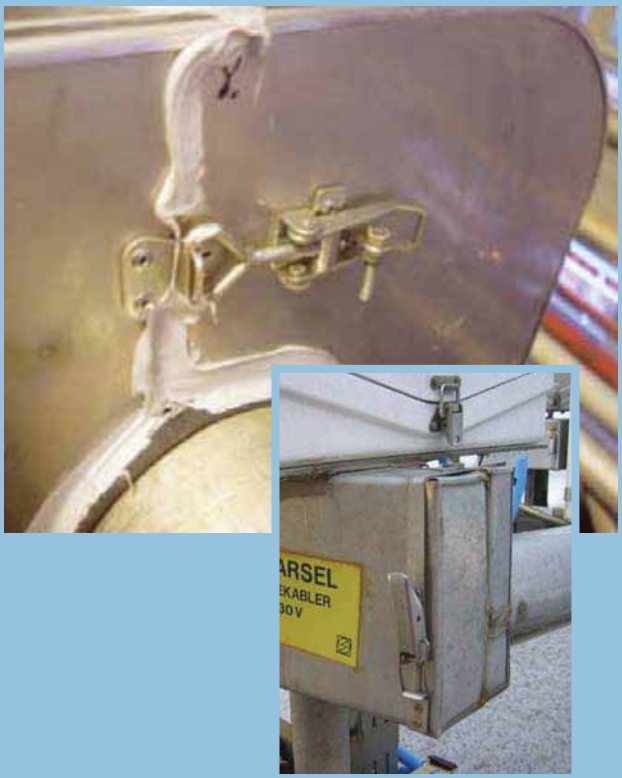
Valve wheels and handles

Many cases have been discovered where valve wheels and valve handles for manual stop valves are not adequately secured.

Functional recommendations

- **Valve wheels and handles must have two independent barriers.**
- **Where possible, nuts and split pins should be used in the valve stem on stationary valve handles and wheels.**
  - ***On large handles and wheels bolts and lock nuts should be used instead of split pins.***
- **When mobile handles and wheels are used, they should be secured by a bolt, or locked by a split pin, through the valve stem.**
- **During storage, handles and wheels must be adequately secured against falling.**
- **If Seeger rings are used for locking / securing, frequent inspections must be made to check for corrosion and / or mechanical damage.**

Locks on insulation cladding



There have been many instances within the industry where pieces of insulation cladding have dropped from height due to vibration, corrosion or strong winds.

Functional recommendations

- **Insulation cladding must be securely fastened to prevent locks from loosening unintentionally.**
- **The locks should be secured with secondary retention, either by using a bolt and lock nut or by inserting a stainless cotter pin through the securing holes in the locks or similar.**
- **Maintenance routines must include inspection of the cladding to ensure that it is in good condition.**

Temporary / permanent storage of gas cylinders

Storage rack with bolted cylinder brackets

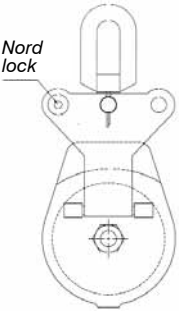
Temporary storage, secured with chain

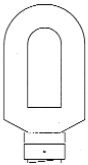
Gas cylinders temporarily stored are often poorly secured with rope or cargo straps.

Functional recommendations

- **Storing of gas cylinders must not obstruct passageways or escape routes.**
- **Gas cylinders must be stored and secured safely.**
- **Storing of gas cylinders must be risk assessed.**
- **Temporarily stored gas cylinders must be secured with a chain.**
- **Permanent storage racks must be equipped with securing brackets / chains.**

Snatch blocks





A set-screw is installed through the nut and into the stem.

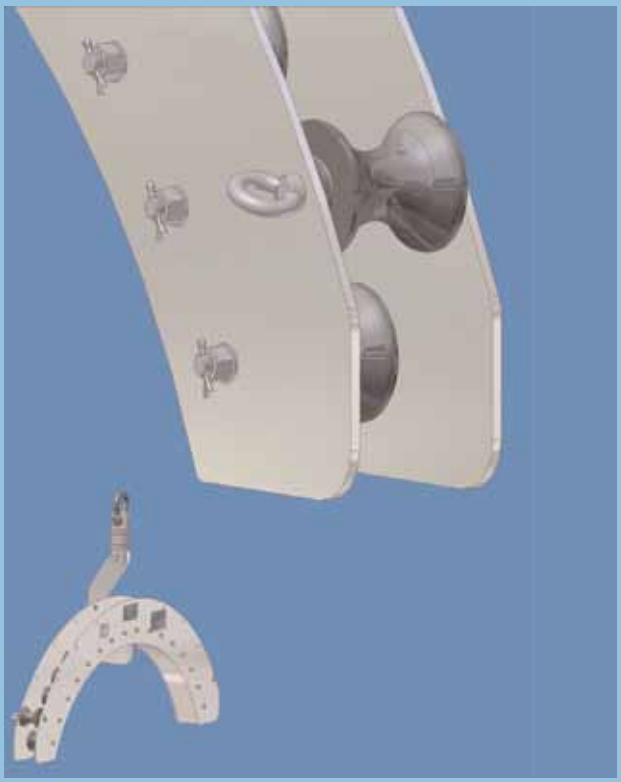
A set-screw is installed through the nut and into the bearing bolt.

Previously snatch blocks had a “securing wire” as a secondary barrier. This is not a satisfactory way of securing blocks as the wire used for this purpose will be unable to prevent the equipment from falling if the shaft or the suspension were to come loose.

Functional recommendations

- **Blocks must have two barriers in the suspension and two barriers in the shaft.**
- **A maintenance programme must be established in accordance with the instructions where there is a requirement a competent person of blocks, shackles and lifting lugs.**
- **Blocks must be dismantled at the request of the competent person or in accordance with the manufacturer’s recommendations or, in any case, at least every fifth year.**
- **A competence matrix must be drawn up for personnel who are to maintain and operate snatch blocks.**

Umbilical roller sheaves



As a result of inadequate securing of rollers in umbilical roller sheaves, there have been several serious incidents where rollers have worked loose and fallen onto the deck.

Functional recommendations

- **Rollers must be secured with two independent barriers The preferred solution is to use through bolts with lock nuts and split pins.**
- **The umbilical must be installed on deck and the support rollers reinstalled.**
- **An umbilical roller sheave must be used exclusively for the purpose for which it was delivered, ie it is not permitted to use it for suspending wires.**
- **An umbilical roller sheave must have its own maintenance programme and be subjected to annual testing and inspection in accordance with the manufacturer's instructions.**
- **User manuals / instructions must provide guidelines for the correct mounting of securing devices.**
- **User manuals / instructions must also provide guidelines for necessary maintenance and inspection of securing devices.**

Hanging hoses

Examples only

Securing hanging hoses, in particular jet water hoses, presents a safety problem. Use of clips and chains has proven unsatisfactory. With their many parts, the clips themselves constitute a dropped object risk. Incorrect positioning of clips and chain loops that are too long have resulted in breakage / bursting and hoses falling.

Functional recommendations

- **The securing system for hoses must be designed to support the maximum loads generated by a burst hosepipe. The calculation basis must be documented.**
- **Safety chains must be as short as possible and installed as close to vertical as practicable.**
- **The required resistance to chemicals, heat and UV radiation must also be documented.**
- **The securing system for hoses must be certified and traceable.**
- **The user manual / instructions must also provide detailed guidelines for correct installation of the hose securing system.**
- **It must be possible for the facility's own personnel to carry out the installation.**
- **The personnel must have documented training.**
- **The user manual / instructions must also provide guidelines for necessarymaintenance and inspection of the hose securing system.**

Load carriers

Typical landing sites for potential dropped objects

Forklift pockets and roof

Forklift pockets, frame, tank and tank top

Forklift pockets, frame and tank top

Several serious incidents have been discovered relating to the use and dispatch of carriers (containers, baskets, tanks etc).

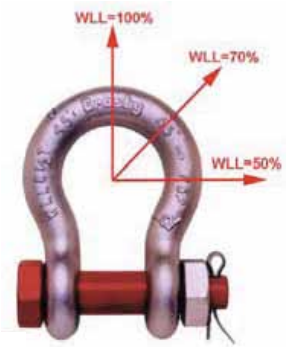
Functional recommendations

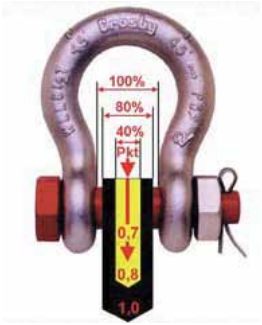
- **Chain slings must have the necessary certification, be intact, without twists and shackles and equipped with nuts and split pins.**
- **Carriers must have the necessary identification and certified lifting lugs. Lifting lugs, doors, hinges and locks must not be deformed or damaged.**
- **Permitted loads in containers and baskets must be well distributed and adequately secured by stamping, use of lashing rings, lashing and nets (baskets). Lashing rings must not come into contact with sharp edges and padding should be used where appropriate. Heavy objects must be placed at the bottom.**
- **Tanks must have secured and sealed manholes / valves. All attached equipment (grids, covers, plates etc) must be adequately secured. The permitted load must not be exceeded.**
- **On carriers with attached equipment such as pumps, tanks, winches etc check to ensure no equipment protrudes from the frame.**
- **It must be ensured that there are no loose objects in the forklift pockets or on top of the carriers or loads.**
- **Documentation must be checked out (signed) before transport to and from locations.**

Correct use of shackles

Safe use of shackles. Limitations.

Load direction on a shackle





Load on shackle bolt:
WLL x factor = Lifting capacity

Illustration for shackles > WLL 8.5 t. on small shackles, the load must be distributed across the whole bolt. example: if a load of WLL 10.5 t is distributed across only 40 per cent of the shackle bolt's length, WLL is reduced to 10.5 x 0.8 = 8.4 t.

Functional recommendations

- **Shackles must be certified and approved, ie marked with the designated colour code of the year (preferably by using coloured tie wraps).**
- **Shackles must be equipped with two barriers: nut and cotter pin.**
- **Shackles must only be used for their intended purpose and manner.**
- **The user must be familiar with the applicable limitations and guidelines for use.**
- **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 must be taken into account during use as it will reduce capacity.**
- **Point loads on the shackle bolt should be kept to a minimum as it will reduce capacity.**
- **On shackles with a capacity of more than 8.5 t, or with large openings, the reduction factor shown at the bottom of the figure may be used to prevent deformation of the shackle bolt.**

Racks and storage

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

Functional recommendations

- **Ensure that temporary storage in modules is permitted in a controlled manner with respect to type of goods, duration, storage area and house keeping.**
- **Storage must not obstruct accessibility or evacuation of the module.**
- **Ensure that the stored materials do not obstruct access to emergency equipment.**
- **Storage racks and storage areas must 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 must be seafastened and shelves shall be equipped with baffle plates.**

Unnecessary equipment at height

Inspections have revealed the frequent presence at height of equipment that is not in use. In view of the fact that equipment that is not in use is often excluded from established inspection and maintenance procedures, this involves a considerable risk potential.

Functional recommendations

- **Regular analyses must be made of what equipment is needed.**
- **Equipment that is not in use must be removed.**
- **Analyses must also be carried out to establish whether equipment should be moved to reduce the risk of collision with mobile equipment.**
- **Inspection and maintenance procedures must be revised regularly. This should ensure inspections and maintenance of remaining equipment.**
- **A final check must be made to ensure that no equipment / materials are forgotten aloft.**

Securing of parts, equipment and material during work at height

The potential for dropped objects during repair and installation work at height is severe and is reflected in a significant proportion of reported incidents.

Functional recommendations

- **All repair and maintenance work at height must be risk assessed.**
- **All parts, equipment and material used at height must be secured against falling.**
- **Small parts must be stored in suitable storage containers or similar.**
- **In restricted areas eg the derrick, flare boom and cranes, tools used at height must be logged out and in to ensure that nothing is left behind.**
- **When the work is complete, a final check must be carried out, to ensure that no material or equipment has been left at height.**

Final check of the worksite

Always keep your work site tidy.

Functional recommendations

- **Tools, equipment and material must be secured in a safe location at the end of each shift.**
- **When the work is finished, a final check and inventory count must be carried out to ensure that no tools, equipment or material is left behind at height.**
- **The worksite must be left in a tidy and clean state, and all tools, equipment and material must be returned to their designated storage place.**

Observation techniques

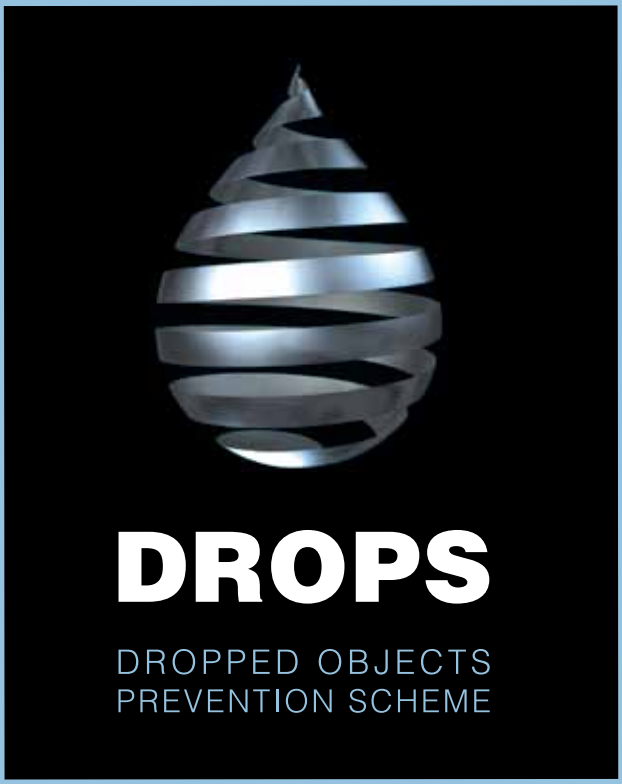
In order to identify Potential Dropped Objects, it is important to be trained in observation techniques.

The training must include methods for reliable securing of equipment.

When undertaking a DROPS inspection or sweep:

- **Allow ample time.**
- **Limit the size of the area.**
- **Concentrate on a small number of categories and inspect in a structured way to maintain an overview.**
- **Limit the number of personnel in each area, to keep an overview.**
- **Findings not conforming to an established standard or checklist should be photographed, given an accurate description and site reference.**
- **Inspection, identification and categorisation of findings are the first steps in minimising the potential for dropped objects.**
- **Follow-up and correction of findings are decisive factors in preventing dropped objects.**

Dropped Object Prevention pre-job considerations



Before you start any task, consider the potential for dropped objects:

- **Even if your task is not at height, consider the environment where you will perform the task and any other activities that may be going on around you.**
- **Before work commences, visually inspect the work area for loose items and debris. Check the equipment and structures in the work area to ensure that any fasteners, bolting, covers etc are properly secured.**
- **Check that secondary retention is in place for all items secured above the work area, eg lighting, PA equipment etc.**

When working at height:

- **Use only tools and equipment approved for work at height, including the appropriate lanyards and toolbags, and always log tools in and out on the tool register.**
- **Set up barriers beneath the work area and ensure the extent of the barriered zone is appropriate to the work height.**
- **Check that grating is secure and use mats where there is the potential for small items to fall through grating. Where a scaffolding platform is employed, ensure toeboards are installed.**
- **Remain vigilant of other activities going on around you and below you**.

When the task involves loading or lifting:

- **Ensure the lifting equipment, carrier or packaging is appropriate for the task and in good order.**
- **Ensure containerised loads are properly stacked, stored and secured.**
- **Check tubulars for items left inside and employ cap ends where practicable.**
- **Check tops of containers and fork lift pockets for loose items and debris.**
- **When work is complete, clear all scrap, debris and loose items from the worksite and return all tools, before removing barriers.**

Notes

Notes

Notes

We thank StatoilHydro for their kind assistance
in the publication of this document.

DROPPED OBJECTS DO HARM AND DO KILL

For further information or details of any DROPS product, including DROPS Membership, DROPS Training and DROPS Workpacks, visit our website or contact the DROPS Administration Team:

DROPS Campaign Team
Silverdot Limited
Banchory Business Centre
Burn O'Bennie Road
Banchory
Aberdeenshire UK
AB31 5ZU

e admin@dropsonline.org
t +44 (0)1330 826510
f +44 (0)1330 820670
w www.dropsonline.org

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