

Handbook BEST PRACTICE DROPPED OBJECT MANAGEMENT

Rev. 02



www.samarbeidforsikkerhet.no

Abbreviations / terms

- **HSE** – Health, safety and environment
- **DO** – Dropped object, an uncontrolled movement of an object from one level to another
- **CCTV** – (Closed-circuit television) surveillance camera.
- **Documented training** – training whereby persons using an equipment have received documentable practical training and theoretical tuition that has provided them with knowledge of: Structure/ composition, operation, properties and areas of use, as well as maintenance and control, all in compliance with the safe-use and operating requirements in the applicable regulations and instructions for use.
- **Competent person** – A person that can document practical and theoretical knowledge in the discipline area, for example in the form of an examination certificate or a certificate of competence.
- **SfS** – Samarbeid for Sikkerhet (“Working Together for Safety”) A tripartite cooperation within the field of health, safety and the environment (HSE) in the oil and- gas industry.

Introduction

Falling objects represent a significant safety challenge in our operations.

Studies have shown that our greatest challenges are connected to work processes and inadequately secured equipment. As a corrective action Working Together for Safety (SfS) has decided to publish this handbook, which summarizes relevant requirements for securing fixed and loose equipment.

This handbook was first established by Statoil together with their contractors and users. Our aim by publishing this handbook is to communicate Best Practice to the industry. The main objective is to avoid dropped objects. To achieve this we need to know how to secure equipment. Use this handbook actively to better understand and establish necessary barriers. Also make sure that these barriers are maintained.

SfS would like to express sincere thanks to StatoilHydro for their willingness to share their Best Practice with the rest of our industry.

Erik Wiig
Leader SfS

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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 procure and to equipment already in use in/on your own and hired installations. In many cases, the functional requirements that are established for the equipment in this document will set a new standard for our activities. The definition of barriers that prevent dropped objects, deployed in the procurement, use and maintenance of equipment, has been an important goal. When procuring new equipment, we must endeavour to use integrated solutions in respect to barriers. In order to minimize the danger of collision, we must always evaluate the risk associated with the chosen location of equipment. Equipment must be designed and installed to provide the safest possible access for maintenance, ref. NORSOK, PSA, OLF and the Norwegian Labour Inspection Authority.

The functional requirements set forth in this handbook must be complied with in the whole value chain:

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

By complying with these requirements you will help SfS achieve the goal of zero dropped objects

Who is responsible?

- *Everyone in the value chain (see next page).*



Barriers

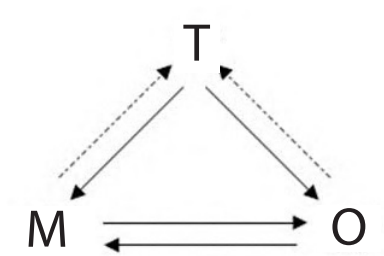
- Barriers are functions and measures designed to break a specified undesirable chains of events. In other words, their function is to prevent a danger from manifesting itself or to limit the damage by breaking an undesirable chain of events.



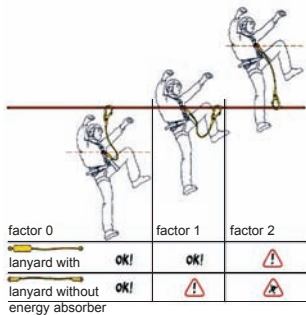
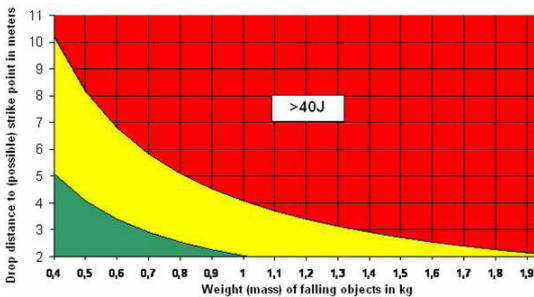
Safety barriers are technical, organizational or other planned and implemented measures intended to break an undesirable chain of events.

- **Man** (human knowledge, experience and qualities)
- **Technical** solutions alone can serve as barrier functions, but they often need to be combined with organizational and / or human solutions
- **Organizational** (procedures, specifications, checklists etc.)

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



Fall energy and fall factor



Fall factors
The “fall factor” describes the severity of a fall. It is an expression of the relationship between the length of the fall and the length of rope available to break the fall.

The fall factor is calculated using the formula on next page.

Fall energy

Fall energy, measured in Joules (J) as shown in the figure to the left, is only used in connection with the risk of personal injury (in other cases potential fall energy (E_f) is calculated using the formula $E_f = mgh$ where m is the weight of the object in kg, h is the height from which the object is dropped and g is the gravitational acceleration = 9.8m/s).

A limit of 40 J has been defined by OLF and PSA Norway, as the criterion for serious personal injury.

Fall factor

The fall factor is the total length of the fall divided by the length of the securing device that absorbs the fall energy. The force a person or object is exposed to, depends on the energy-absorbing properties of the securing device (ability to lengthen without breaking). When securing persons against falling, the fall factor must under no circumstances exceed factor 2. It should preferably be kept under factor 1.

[Reference: Petzl technical guideline.](#)

Galvanic corrosion

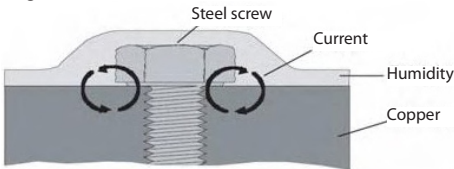
Electrochemical series

Cathode (more noble) ↑	Cathode (protected) more noble
	Graphite
	Titanium
	Silver
	Acid-proof steel A4 – passive
	Stainless steel A2 – passive
	Iconel – passive
	Nickel – passive
	Silver solder
	Monel
	Copper/nickel alloys
	Bronze
	Copper
	Brass
↓ Anode (less noble)	Iconel – active
	Nickel – active
	Tin
	Lead
	Tin solder
	Stainless steel A4 – active
	Stainless steel A2 – active
	Cast steel
	Steel and iron
	Aluminium 2024 – T4
	Cadmium
	Aluminium 1100
	Galvanised steel
	Zinc
	Magnesium alloys
	Magnesium
	Anode (corrodes) less noble

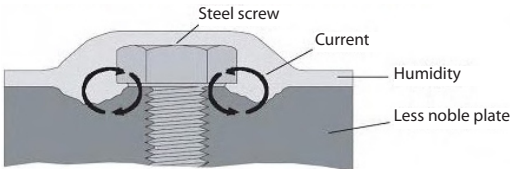
As a basic rule, only metals of the same or almost the same nobility should be combined in a corrosive environment.

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 corrode rapidly as the difference in potential is great.



If the same steel screw is fixed into a less noble plate, e.g. 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.



For these reasons, it is important that all securing devices are of the stainless steel type. This applies to cotter pins, safety pins, securing wire and locking wire for threading through nuts and bolts etc.

Bolted connections



At present, bolts are being produced to at least 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 respect to mechanical properties and corrosion resistance
- Where appropriate, use of lubricant
- Pre-tensioning and use of the correct torque equipment

Locking of bolts to secure against loss of torque and pre-tension, is defined as secondary retention.

Eighty-five per cent of all damage to bolts etc. is due to fatigue:

- dynamic load with inadequate pre-tensioning
- overstrain resulting in reduced pre-tensioning

Special bolts

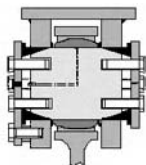
BONDURA BOLT

www.boltnorge.no

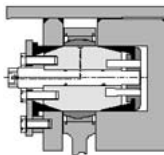
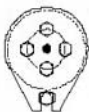
Bondura has a construction that can take up movement and ovality by using expanding tapered sleeves at both ends of the bolt. There are several variants of the bolt, both straight-through versions to other that are fitted from one side. Standard screws are tightened to press in the cones. The bolt is fixed directly to the machine or equipment with locking screws. This prevents the bolt from loosening, falling out or rotating in the bolt hole. Bondura bolts must be fitted and maintained in accordance with the manufacturer's specifications. Bondura is certified in compliance with API 8C and F.E.M. regulations.

Areas of use:

For example, as a replacement for clevis bolts in top drives and hinge bolts on dollies, pipe handling equipment and cranes.



Bondura bolt 6.6



Bondura bolt 6.1



SUPERBOLT / SUPERNUT

www.superbolt.com

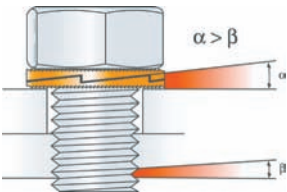
Superbolt / Supernut are constructed such that standard nuts are replaced by “stretch nuts” with integrated jackbolts and washers. Use can be very beneficial in terms of HSE because only hand tools are needed for fitting and dismantling. Rigging of heavy torque equipment and use of sledgehammers during installation and disassembly is avoided. An additional benefit is that time is saved during the operations. Bolts must be fitted and maintained in accordance with the manufacturer’s specifications. Both Superbolt and Supernut is available in a special corrosion resistant offshore version.

Areas of use:

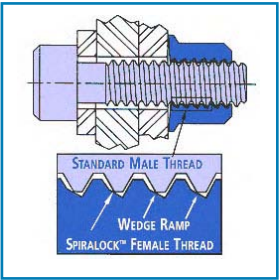
Almost unlimited; available in both inch and millimetre dimensions and diameters from M20 to M160.



Bolted connections



Nord-Lock bolt securing system



Spiralock

Dual nuts are not recommended for locking of bolted connections. The following methods are recommended for locking bolted connections.

NORD-LOCK BOLT SECURING SYSTEM

www.nordlock.com

When correctly installed, the Nord-Lock Bolt securing system provides a guaranteed secure bolted connection. Locking is achieved by means of two washers that ensure the clamping force is maintained in the bolted connection. Nord-Lock has DnV (Det Norske Veritas) type approval.

Areas of use:

Particularly suitable for connections exposed to vibrations, e.g. grating, loudspeakers, cable trays, ladders, guide rails etc. But it has an almost unlimited range of applications.

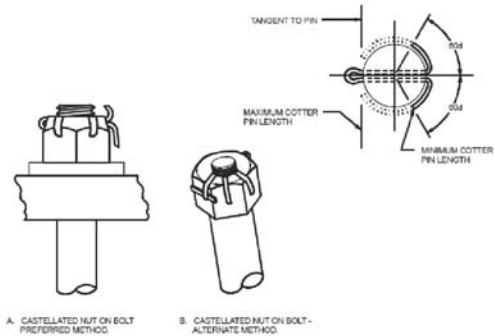
SPIRAL LOCK

www.spirallock.com

Self-lock is an all-metal lock nut/bolt and 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 helps to improve the locking of the bolt connection.

Areas of use:

Almost unlimited, frequently used for critical bolt connections.



Correct installation of cotter pins in bolts

CASTLE NUT WITH COTTER PIN

Adopted from the aviation industry, Castle nuts provide a visual and reliable method for locking bolted connections. The nut has radial slots and is locked by noncorrosive cotter pins that are inserted through a hole in the bolt.

Areas of use:

Unlimited,
but frequently used for critical bolt connections.



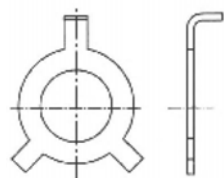
Nyloc lock nut



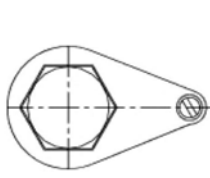
Lock nut with split top



Lock nut with deformed top



Tab washer



Tab plate

NYLOC LOCK NUT

Nyloc lock nuts are extensively used throughout the industry. Nyloc lock nuts should only be used once. Standard Din 985 Nyloc nuts have a temperature rating from -70 °C to +120 °C.

Areas of use:

This type of nut is recognized for locking in connections where a certain degree of lost pre-tension can be accepted.

ALL-METAL LOCK NUTS

All-metal lock nuts can be used on all bolt dimensions. The nut locks by the threaded section or top of the nut deforms / splits, or through 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.

Areas of use:

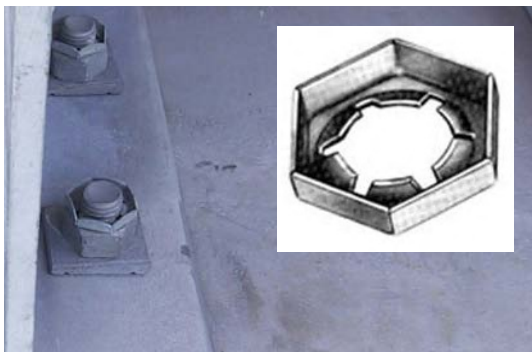
These nuts have an almost unlimited area of use.

TAB WASHER / TAB PLATE DIN 93/463

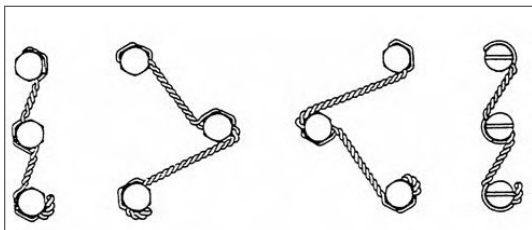
Tab washers can be used on all dimensions and in any place designed for the use of tab washers. There are several types with different areas of use for locking either nuts or bolts. It is important to use the right type for each purpose.

Areas of use:

Typically in use on machinery where it is important to prevent the bolt from rotating.



PALNUT (DIN 7967) lock nut



Lock-wiring of bolts

PALNUT

Palnut lock nut (DIN 7967) has been on the market for several decades as an alternative for 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 on top of standard nuts.

Areas of use:

On through-bolts in fixed equipment and drilling equipment. Easy to install where secondary retention are not in place.

LOCK-WIRING

Lock-wiring of bolts is a locking method adopted from the aviation industry. In brief, the method involves threading a special stainless wire through a hole in the bolt head, twisted and locked to the next bolt or structure, thus preventing the bolt to rotate and loosen. The wire can be used to lock a maximum of three bolts in a row, as shown in the illustration. (For info on the size of the hole in the bolt head, see ISO7378).

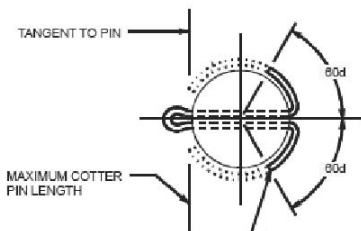
Areas of use:

Used extensively for locking external bolted connections on drilling and pipe-handling equipment. Often used where there are no through-bolts and / or there is a need for easy visual control of the locking.

Correct use of cotter pins



Cotter pin in a shacklebolt



Correct installation of cotter pins in bolts

The industry has experienced problems with the correct use of cotter pins and the choice of materials.

Best practice

- Cotter pins must be bent to prevent them from being knocked out
 - Where there is a danger of personnel exposed, the cotter pin must be bent as shown in the illustration
- When hoisting persons and loads, always use shackles with two barriers. Preferably: nut and cotter pin
- Linchpins, spring type split pins or any other type of safety pins that can be knocked out must not be used for lifting operations •
- Cotter pins should be made of stainless steel
- For static loads, shackles with two barriers are recommended
- It is a requirement that cotter pins as described above are inspected regularly and replaced when required.

References: [NORSOK R-003](#), [NORSOK R-005](#) and [DIN-EN-ISO 1234](#)

Securing pins/ safety pins



Within the industry various types of inappropriate securing pins are used. These are unsafe because they can easily be knocked out, for example; spring type split pin.

Best practice

- NB! Securing pins of the type shown in the pictures **must never be used** in lifting appliances
- Securing pins shall provide secondary retention
- Securing pins shall be of the proper size and quality
- Securing pins shall be secured by wire (where this is appropriate) to prevent drop
- It is a requirement that securing pins as described above are inspected regularly and replaced when required.

Areas of use:

Scaffolding bolts, security bolts on removable railings, claw couplings and securing brackets on gas cylinder racks etc.

References: [NORSOK R-003](#) and [NORSOK R-005](#)

Securing devices (wires, chains and couplings)

Wherever possible, equipment installed at height shall have integrated secondary retention. If not possible, or where equipment is exposed to the risk of collision, the equipment must be equipped with secondary retention securely attached to the structure.

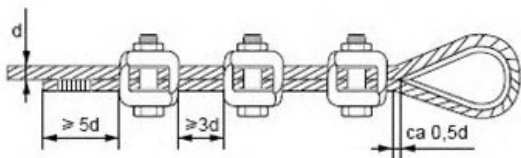


Best practice

- Securing devices must be dimensioned in accordance with the equipment supplier's calculations. The quality of materials used must be consistent throughout the entire assembly
- Only acid-proof securing wire (AISI 316, type 7x19 IWRC) shall be used. Wires must be locked with double press locks (for example Talurit 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 (AISI 316) and be equipped with locks. Snap hooks attached to shackles should have eyelets
- Chain must be made of acid-proof (AISI 316) 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 to minimize the potential fall energy
- Securing devices must be installed, maintained and inspected in accordance with the instructions provided in the user manual or maintenance instructions.

References: [SfS Recommendation 024/2008](#) and [page 10 and 11 in this handbook](#).

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.

Best practice

- 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.

Reference: [NORSOK R-003](#) and [NORSOK R-005](#)

Securing of personnel

Documented training is a mandatory requirement for all personnel using fall arrests.



Fall strap reel
with shock
absorber



SALA
trauma
strap

Best practice

- The established control procedures, both before and after use, must be followed
- Nobody shall work alone or unattended, when using fall arrest equipment
- Personal using fall protection equipment must have documented training that includes rescue methods. (Ref. page 2)
- Necessary rescue equipment must always be available at the work site
- Personal protective equipment against falls must be CE marked
- The equipment must be checked at least every 12 months by a competent person and shall be marked with the date for the next inspection
- A buddy check of rigging and equipment must be carried out
- Choice of securing equipment, shall be decided after evaluation of the work site
- The anchor point for suspension shall be able to support at least 10kN (see requirement in NS-EN795)
- The harness should preferably be equipped with a safety strap. (E.g.: SALA trauma strap, which allows you to rest on your feet after a fall, in order to ensure blood circulation to the legs).

References: The Norwegian Working Environment Act, The Norwegian Labour Inspectorate's regulation - including; nos. 500, 523, 524 and 555. Module O-2.2 Training plan for documented safety training; Fall arrest equipment and basic lifting appliances. OLF guidelines for construction of scaffolding (no. 105), OLF guidelines for fall arrest and rescue (no. 113) and Sfs Recomendation 023/2008

Derrick evacuation equipment



Best practice

- Equipment must be protected from wear and harsh environment
- Equipment should be stored in cabinet/locker to protect it from UV radiation and weather
- Evacuation blocks must be CE-marked
- The riding belt or harness must be attached to the evacuation block or to the guide line where appropriate
- Evacuation block, guide line, attachment point, couplings and shackles are defined as evacuation equipment / antifalling devices and must be checked, certified and marked accordingly
- Anchor points for suspension must be able to support at least 10kN
- The equipment must be checked at least every 12 months by a competent person and shall be marked with the next inspection date
- Safe access to and use of the equipment must be ensured.

References: NORSOK D-001, Norwegian Labour Inspectorate's regulations no. 555, NS EN 341 (Evacuation Blocks), NS EN 362 (Connectors) NS EN 795 (Anchor points) and NS EN 813 or 1497 (Riding belts)

Securing of tools at height ($<5\text{kg}$)

Weaklink



Tool belt for scaffolder



Internal securing loops



Safety wires and connectors



Securing of tools



There is a significant potential of dropped objects when using tools at height.

Best practice

- Use of tools at height must be risk-assessed
- Wires and connectors must be used between the tools, belt or bag
- Swivels with set screws should not be used
- Weak link shall be installed between the bag/ belt and safety wire
- A tool bag with internal loops should be used when various tools are deployed at height
- Wrist straps must not be used because of potential personal injury
- If an attachment point other than the belt or bag is required, use an appropriate part of the surrounding structure, preferably above the work level
- In limited areas, for example the derrick, flare boom and cranes, tools used at height must be logged out and in to ensure that nothing is left behind.

Reference: [SfS Recommendation 024/2008](#)

Securing of tools at height (5-25kg)



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

Best practice

- All use of heavy tools and hand-held machinery at height must be risk-assessed
- All heavy tools and hand-held machinery used at height must be secured against drop both when in use and while being transported
- Securing devices must be dimensioned in accordance with verifiable calculations and documented drop tests (see the section on securing devices)
- Securing points for tools and machinery must be in place above the work site and the securing device must be as taut as possible
- In limited areas, for example the derrick, flare boom and cranes, tools used at height must be logged out and in to ensure that nothing is left behind.

Reference: [SfS Recommendation 024/2008](#)

Securing of other portable equipment at height



Several of reported dropped object incidents are related to radios, pagers and gas detectors.

Best practice

- All portable equipment used at height must be secured against being dropped
- Carrying pouches must always be used for radios and any other portable equipment that don't have certified securing points
 - Locks on the pouches must have a double securing mechanism to prevent unintentional opening
- Belt clips which allow equipment to become detached when turned 180° should not be used
- Belts with snap fasteners are not recommended for securing of equipment at height.

[Reference: Sfs Recommendation 024/2008](#)



Tool cabinets for work at height



Tool cabinets/lockers for work at height have now been installed at many facilities, offshore in most cases near the drill floor. Unfortunately, a number of irregularities have been observed regarding securing, control and registration of tools. .

Best practice

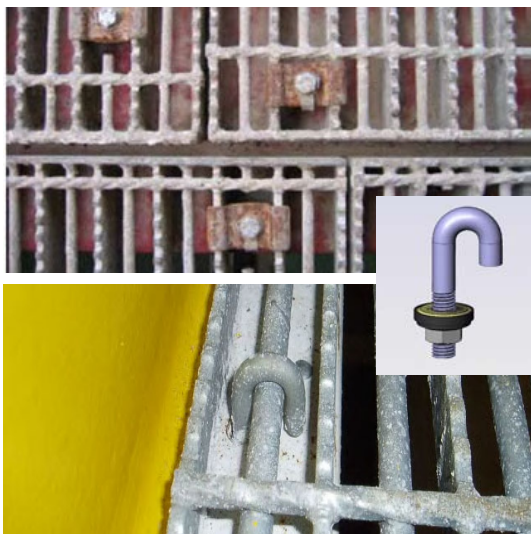
- Each cabinet/locker shall be equipped with a list of contents and be kept locked
- A designated person must be responsible for the cabinet to ensure that all tools taken from and returned to the cabinet are logged
- The contents of the tool cabinet for work at height and its accompanying log book must be checked at the end of every shift
- All tools must be adequately equipped for securing at height and must have documented attachment points
- In addition to the necessary tools, cabinets should be equipped with a sufficient number of:
 - correctly dimensioned safety wires with approved swage locks
 - connectors / snap hooks with locking
 - tool bags with internal fastening devices
 - special belts for fastening of tools and bag
 - weak links for fastening between the harness/belt and safety wire.

Reference: [SfS Recommendation 024/2008](#)

Securing of permanently attached equipment

Grating

At present there are a number of different ways of fastening grating to underlying structures or frames. As a result of vibrations and defective locking of fastening, there are incidents of loose grating and loose or missing fastening clips.



Best practice

- Grating must be adequately fixed to underlying structures to prevent loosening due to vibrations or loads
- Grating should be secured against major sideways displacement in all directions
- Through-bolts or threaded connections with locknut, are recommended for securing to structure
- Openings in the grating must not exceed 20 mm where personnel may traffic the area below, and should otherwise not exceed 35 mm.

Reference: NORSOK C-002, NORSOK S-002, EN-ISO 14122-2 and the Norwegian Labour Inspection Authority's Regulation no. 170 with guidelines.

Piping and equipment feedthroughs

Significant shortcoming in piping and equipment feed-through and missing hole covering are found throughout the industry.



Best practice

- 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. Done properly and preferably permanently, it will be an efficient measure against dropped objects.

References: Norsok D-001, NORSOK C-002 and NORSOK S-002

Railings

Major defects in railings have been observed in the industry, and particularly in collapsible, movable and aluminium railings.



Best practice

- Railing must be 1100mm high as a minimum and have integrated toe boards that are at least 100mm high
- Railing must have a functional design for the area it is intended to secure, e.g. wire mesh must be installed as required (locked areas)
- Railings shall not have deformations or cracks that affects the functionality or strength
- It must always be possible to insert movable railings into the fastenings and insert a securing through-bolt
- The safety bolt must be adequately locked using a securing pin, snap hook (with eyelet) or a cotter pin (see also the section on securing pins)
- 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-bolt and lock nut
- Use of setscrews are not recommended in permanent railings
- Railings and attachment points for collapsible and movable railings must be inspected on a regular basis to maintain adequate securing and functionality.

Reference: EN ISO 14122-3, NORSOK D-001, NORSOK C-002, NORSOK S-002 and The Norwegian Labour Inspection Authority's Regulation no. 170 with guidelines

Toe boards



Shortage of and incorrectly installed toe boards are observed throughout the industry. Commonly the gap between the toe board and deck are exceeding requirements.

Best practice

- Decks, gangways and platforms must have toe boards with a minimum height of 100mm
- On stairways, every step must have a toe board with a minimum height of 50mm
- All landings in stairways must have toe boards with a minimum height of 100mm
- The gap between the deck or grating and toe board must not exceed 10mm.

References: EN-ISO 14122-3, NORSOK D-001, NORSOK S-002, NORSOK C-002 and The Norwegian Labour Inspection Authority's Regulation no. 170 with guidelines

Swing gates



On many swing gates the hinges are fitted without the required material quality or design strength to serve the intended function. Many older gates also lack integrated toe boards.

Best practice

- Gates must be of the same strength as the surrounding railings
- Gates must be secured in order to prevent disengaging.
- Gates must open/swing inwards to the platform or deck
- Gates must be designed to automatically return to and remain in closed position.
- On floating rigs / installations it is recommended to fit a latch to secured the gate in closed position.
- Toe boards must be integrated in gates
- Wherever possible, the hinges should be an integral part of the gate
- Swing gates must be inspected and maintained on a regular basis to ensure adequate function.

References: [NORSOK D-001](#), [NORSOK C-002](#), [NORSOK S-002](#) and [EN-ISO 14122-3](#)

Ladders

Damaged ladders and safety cages have been observed in the industry. Cracks have been found in both ladders and cages, especially in derricks and are as a rule caused by collision with moving equipment / objects.



Best practice

- Ladders higher than 9m must have incorporated a rest platform every 6th m or be equipped with a fixed fall arrest device (ref. NORSOK)
- Ladders higher than 6 m should have a rest platform, in compliance with The Norwegian Labour Inspection Authority's recommendations
- Safety cages must be installed on ladders of more than 3 m and on shorter ladders where there is a risk of falling to a lower level
- The safety cage must start at a maximum of 2.2 m above the deck / floor. Minimize the distance between the upper part of the railing and the lower part of the cage, by using extra protection as appropriate where there is a risk of falling to a lower level
- The safety cage must extend to at least 1.1 m above the top level
- The diameter of the safety cage must be at least 70-80 cm
- All damage and deformation must be reported and corrected as soon as possible
- Ladders and safety cages must be inspected on a regular basis to uncover cracks or damage.

Reference: NORSOK D-001, NORSOK S-002, EN-ISO 14122-1, EN-ISO 14122-4 and The Norwegian Labour Inspection Authority's Regulation no. 170 with guidelines

Floodlights



Floodlights are rarely adequately secured against drop caused by hits from moving equipment.

Best practice

- Floodlights must be positioned to prevent being hit by equipment/loads
- If there is a potential of the floodlights being hit by mobile equipment/loads, they must either be protected with reinforced cages or be fitted with safety wires
- Floodlights must be equipped with two independent barriers. The attachment points should be integrated, for example with eye bolts threaded into the floodlight housing
- Calculations must be available for attachment points and securing devices related to the relevant fall energies
- Fastening devices for securing of equipment to bracket or structure should be fitted with secondary retention
- Hatches for replacement of light bulbs must be hinged or secured with wire to the floodlight housing/frame
- For new installations or for installing securing devices on existing equipment, a user manual/ maintenance instructions should be available. The instructions should also cover securing devices.

References: [NORSOK D-001](#), [NORSOK S-002](#) and [SfS Recommendation 024/2008](#)

Lighting fixtures



There have been several serious incidents where both the cover and the casing have dropped.

Best practice

- Lighting fixtures must be positioned to prevent being hit by mobile equipment/loads
- Lighting fixtures and brackets should be fitted with secondary retention
- Safety wires attachment points should be integrated in both ends of the fixture
- Battery packs must be fitted with secondary retention
- The earthing wire should be attached internally to function as a secondary retention
- Above walkways and other trafficked areas fixtures with power cable in from one side only, requires that the opposite end is secured with a safety wire
- The cover should have hinges that can be fitted on either side
- The component rail should be hinged and must allow for adequate securing in the closed position
- Strength of attachment points and securing devices, related to the relevant fall energies must be evaluated
- For new installations or when installing securing devices on existing fixtures, user manuals / maintenance instructions should be available.
The instructions must also cover securing devices.

References: [NORSOK D-001](#), [NORSOK S-002](#) and [SfS Recommendation 024/2008](#)

Navigation lights



Best practice

- The bolts used to attach navigation lights to brackets and structures should be equipped with secondary retention
- Attachment brackets must have holes for attachment of safety wires
- Cover for electrical connections must be hinged or secured with wire
- Strength of attachment points and securing devices, related to the relevant fall energy must be evaluated
- Navigation lights with sliding grooves for bolt attachment to the structure, are not recommended
- For new installations or when installing securing devices on existing equipment, a user manual / maintenance instructions should be available.
The instructions must also cover securing devices.

References: [NORSOK D-001](#) and [SfS Recommendation 024/2008](#)

CCTV camera



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

Best practice (integrated solution)

- CCTV camera location must be evaluated to prevent risk of being hit by 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.

References: [NORSOK D-001](#), [NORSOK S-002](#) and [SfS Recommendation 024/2008](#)



Best practice (non-integrated solution)

- CCTV camera location must be evaluated to prevent risk of being hit by 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.

References: [NORSOK D-001](#), [NORSOK S-002](#) and [SfS Recommendation 024/2008](#)

Crane boom camera



Within the industry there have been several incidents where a crane camera has been struck during lifting operations.

Best practice

- Crane boom cameras must have two independent barriers
- Bolts used for attaching the crane boom camera to brackets and structures should be fitted with secondary retention
- Attachment points for the safety wire should be integrated as part of the camera casing. Alternatively, special clamps can be fitted round the camera casing
- The safety wire must run from the camera casing through the camera bracket and then through the attachment bracket before being attached securely to the structure of the crane boom
- 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.

Reference: [SfS Recommendation 024/2008](#)

Loudspeakers



Best practice

- Loudspeakers location must be evaluated to prevent risk of being hit by moving equipment/loads
- If there is a risk of being hit by mobile equipment / loads, loudspeakers must either be protected by reinforced braces or equipped with a safety wire
- Bolts used to fasten loudspeakers to brackets and the structure should be fitted with secondary retention, as an alternative a safety wire can be attached between bracket and structure
- Strength of attachment points and securing devices, related to the relevant fall energy must be evaluated
- For new installations or when installing securing devices on existing equipment, a user manual / maintenance instructions must be available.
The instructions should also cover securing devices.

References: [NORSOK D-001](#), [NORSOK S-002](#) and [SfS Recommendation 024/2008](#)

Junction boxes and cabinets installed at height



Within the industry it is revealed incorrect positioning of junction boxes and cabinets, defective suspension / fastening and inadequate securing of hatches, doors and covers.

Best practice

- Junction boxes and cabinets must be located where they do not obstruct passageways, evacuation routes or moving equipment
- The type and design of attachment and safety devices must be in accordance with calculated loads and known potential external stress factors
- Fastening devices for securing of equipment to bracket or structure shall be fitted with secondary retention
- Where there is danger of the equipment being struck by moving equipment/loads, it must be protected by a reinforced cage or be fitted with a safety wire
- Covers must be secured by fasteners that are secured and locked to prevent loosening, and must be secured with wire or chain
- Hinged hatches/doors should be secured against unintended unhooking and locking devices should be fitted with barrier against opening
- As a minimum, the manufacturer's instructions for installation and maintenance (user manual) must be complied with.

References: [NORSOK D-001](#), [NORSOK S-002](#) and [SfS Recommendation 024/2008](#)

Cable trays and cable ladders



Best practice

- Only approved bolt connections shall be used for fastening and couplings
- Cable fixing clamps with screw connections are used for safe and functional securing of instrument cables
- When attaching the cable support system to a structure, the risk of galvanic corrosion must be assessed and insulation considered where appropriate
- The user manual/ instructions for use must also provide guidelines for correct installation, both in the joints and the attachment
- In addition, the user manual / instructions for use must provide guidelines for necessary maintenance/ retightening and inspection of both electro-steel and bolt and screw connections.

References: [NORSOK S-002](#), [SfS Recommendation 001/2001](#) and [SfS Recommendation 024/2008](#)

Wind walls



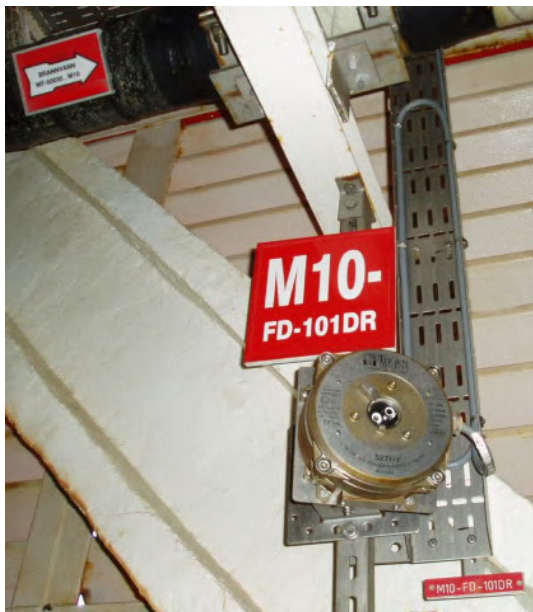
Within the industry many damaged and loose plates have been revealed in wind walls. This is due both to faulty installation and to external factors (collisions with mobile equipment and harsh environment).

Best practice

- Wind-wall panels must be fastened to a separate support / structure and never to the main structure
- Wind-wall panels must always be reinforced using 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 preferred attachment solution is through-bolts with washers and lock nuts
- The user manual / instructions must also provide guidelines for correct installation of both joints and attachment points
- Guidelines must be available on essential maintenance and inspection of wind- wall panels and their attachment points.

Reference: [NORSOK C-002](#)

Signs



Sign installation methods have in many cases been found inadequate.

Best practice

- The requirements of the Norwegian Labour Inspection Authority in respect to posting of signs must be followed
- Signs, brackets and frames for signs must always be securely attached and the frames should be of metal
- Where the underlying material permits, sign frames should be attached using through-bolts with lock nuts
- Fasteners used for attachment to brackets and structures should be fitted with secondary retention
- Identification tags that are painted or glued are recommended for identification of piping systems. On hot surfaces, identification tags should be attached with plastic-coated steel bands.

References: [NORSOK D-001](#) and the Norwegian Labour Inspection Authority's Regulation no. 526 -chapter 3 - §§ 10 and 11.

Valve handles and valve wheels
installed at height



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

Best practice

- Valve wheels and handles must be fitted with secondary retention
- Where possible, nuts and cotter pins should be used in the valve stem on stationary valve handles and wheels (Nordlock and Nyloc nuts can also be used where appropriate)
 - On large handles and wheels, bolts and lock nuts should be used instead of cotter pins
- When mobile handles or wheels are used, they should be secured
 - When not in use, handles and wheels should be stored in a suitable and safe location
- If Seeger rings are used for locking / securing, frequent inspections / maintenance should be carried out to check for corrosion and / or mechanical damage
- On wheels that are secured by a set screw only, replace the set screw with a through-bolt and lock nut
- Safety wire with a lockable snap hook may be an alternative if the securing methods mentioned above cannot be used.

References: [SfS Recommendations 001/2001](#) and
[SfS Recommendations 024/2008](#)

Locks on insulation cladding



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

Best practice

- 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.

Reference: [SfS Recommendation 024/2008](#)

Temporary / permanent storage of gas cylinders



Storage rack with bolted cylinder brackets



Temporary storage, secured with chain

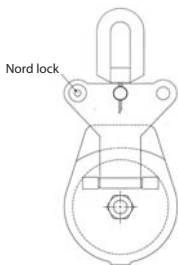
Gas cylinders temporarily stored are often poorly secured with rope or cargo straps.

Best practice

- Storing of gas cylinders must not obstruct passage
- 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.

References: [NORSOK S-001](#) and [NORSOK S-002](#)

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

Best practice

- Blocks must have two barriers both in the suspension and the shaft
- A maintenance program must be established in accordance with the user manual, including requirement for inspection every twelve months of blocks, shackles and lifting lugs by a competent person
 - 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
- Snatch blocks and suspension shackles should preferably be marked with coloured tie wraps using the designated colour code of the year.

A competence matrix must be drawn up in accordance with NORSOK for personnel who maintain and operate snatch blocks.

References: NORSOK R-003, NORSOK R-005 and Sfs Recommendation 014/2004 (Snatch blocks).

Umbilical roller sheaves (Banana sheaves)



As a result of inadequate securing of rollers in umbilical roller sheaves, there have been several serious incidents.

Best practice

- An umbilical roller sheave must have maintenance program and be subjected to testing and inspection every twelve months in accordance with the manufacturer's instructions
- Rollers must be secured with two independent barriers, for example, through-bolts with lock nuts or cotter pins
- An umbilical roller sheave must be used exclusively for the purpose for which it was delivered, i.e. it is not permitted to use it for suspending wires
- The umbilical must be installed on deck and the support rollers reinstalled and secured
- A user manual/ maintenance instructions for the equipment must be available The instructions must cover installation, inspection and maintenance. Instruction must also include securing devices
- Sheaves and suspension devices should preferably be marked with coloured tie wraps using the designated colour code of the year.

References: [NORSOK R-003](#) and [SfS Recommendation 024/2008](#)

Loop hoses

Faulty installation or inadequate maintenance of loop hoses, and especially high-pressure hoses, is a potential safety risk.



Best practice

- The equipment manufacturer's instructions for installation and technical description must be followed
- Clamps must be attached and securely fastened where the hose is marked with; "Attach safety clamp here"
- Safety chains must be as short as possible- and installed as close to the vertical as possible, to prevent fall energy and pendulum effect
- Securing devices for hoses must be designed to support the maximum loads generated by a burst hose. The design basis must be documented
- The required resistance to wear and tear, chemicals, heat and UV radiation must also be documented
- The securing system for hoses must be certified and traceable
- The securing devices must be checked and marked in accordance with the norm for lifting appliances
- In addition to correct instructions for installation, the user manual/ maintenance instructions should contain guidelines for necessary maintenance and inspection of the hose securing system.

Load Carrier Units (LCU)

Several serious incidents related to the use- and dispatch of load carriers have been revealed.



Forklift pockets and roof



Forklift pockets, frame, tank and tank top



Forklift pockets and frame

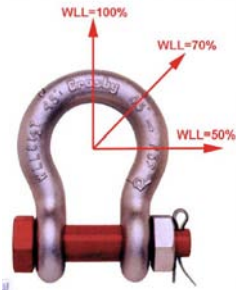
Best practice

- Chain slings must have the necessary certification, be intact and without twists. Shackles must be equipped with nuts and cotter pins
- LCU`s 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 and nets (baskets). Lashing must not come in contact with sharp edges. Padding should be used where appropriate. Heavy objects must be placed at the bottom
- On LCU`s with attached equipment such as pumps, tanks, winches etc., check and ensure that no equipment protrudes from the frame
- 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
 - It must be ensured that there are no loose objects in the forklift pockets or on top of the LCU`s or in loads
 - Check of equipment must be documented by a signature before transport to or from a location.

References: DNV 2.7.1, NS-EN 12079, NORSOK R-003, NORSOK R-005, Sfs Recommendation 024/2008 and OLF guideline no. 116

Correct use of shackles

Load direction on a shackle



Safe use of shackles.
Limitations.

Load on shackle bolt

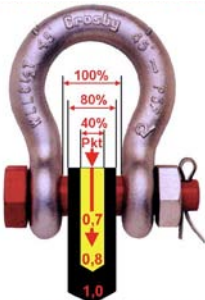


Illustration for shackles > WLL 8.5 t.
On small shackles, the load must be distributed across the whole bolt.
Example: If a load of WLL 10.5 t is distributed across only 40 per cent of the shackle bolt's length, WLL is reduced to $10.5 \times 0.8 = 8.4$ t.

$WLL \times \text{factor} = \text{Lifting capacity}$

Best practice

- Shackles must be certified, CE-marked and approved, i.e. be 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 have large openings, the reduction factor shown at the bottom of the figure may be used to prevent deformation of the shackle bolt.

References: [NORSOK R-CR-002](#), [NORSOK R-003](#), and [NORSOK R-005](#)

Correct use of eye bolts /eye nuts

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

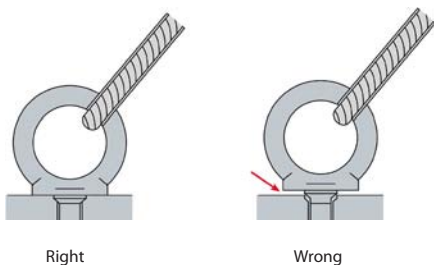
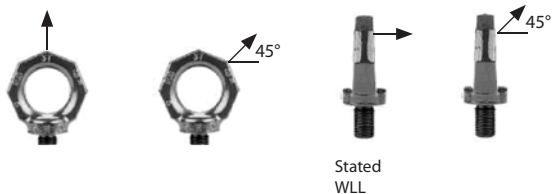


Figure showing correctly and incorrectly installed eye bolts. Note: Only grade 80 (or better) eye bolts shall be used offshore.

Best practice

- Eye bolts / eye nuts must be certified, CE-marked and approved, i.e. be 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, i.e. 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, e.g. 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 by for example; grease and a plastic plug.

References: [NORSOK R-CR-002](#), [NORSOK S-002](#), [NORSOK R-003](#) and [NORSOK R-005](#)

Racks and storage



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

Best practice

- 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 sea fastened and shelves shall be equipped with baffle plates.

References: [NORSOK S-001](#) and [NORSOK S-002](#)

Unnecessary equipment at height



Obsolete equipment is often found at height. This equipment is often excluded from established inspection and maintenance procedures, and introduces a considerable risk potential.

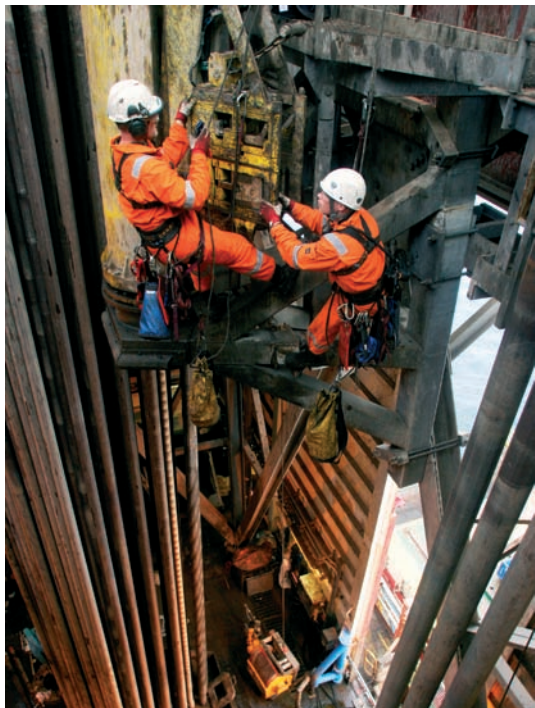
Best practice

- It is mandatory on regular basis to evaluate what equipment is required or should be removed.
- The assessment should establish whether equipment should be relocated to reduce the risk of collision with mobile equipment
- Inspection and maintenance procedures should be revised regularly, to ensure inspection and maintenance of all equipment installed at height.

Final checks must be carried out consistently to ensure that no equipment/ materials are forgotten at height.

References: [SfS Recommendation 01/2001](#) and [SfS Recommendation 024/2008](#)

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.

Best practice

- All repair and maintenance work at height must be risk assessed
- All parts, equipment and material used at height must be secured against drop
- Small parts must be stored in suitable storage containers or similar
- In limited areas, for example 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 have been left at height.

[Reference: Sfs Recommendation 024/2008](#)

Post inspection/final check of the work site



Always keep your work site tidy.

Best practice

- 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 not left behind at height
- The work site must be left in a tidy and clean state, and all tools, equipment and material must be returned to their designated storage place.

[Reference: Sfs Recommendation 024/2008](#)

Observation technique

In order to identify Potentially Dropped Objects (DO), it is important to be trained in DO observation techniques, such as DROPS or similar.

The training must include methods for reliable securing of equipment.

Best practice

Inspection:

- Ample time
- Limit size of the area
- Concentrate on a small number of categories and inspect in a structured way to maintain an overview
- Limit number of personnel in each area, to keep an overview
- Findings not in conformity with the established standard or checklist are photographed, given an accurate description and site reference
- Inspection, identification and categorization of findings are the first steps in minimizing the potential for dropped objects
- Follow-up and correction of findings are decisive factors in preventing dropped objects

Reference: SfS Recommendation 024/2008

If you have questions or comments on the contents of this handbook, please contact:
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Never let **your tools**
off the leash!

