

Risk Focus: Moorings

With its team of risk assessors, the UK Club is in a unique position to gather data and target areas of risk onboard ship



Good condition of equipment - but worrying practices and procedures

In this article on mooring - the first of a series on current risk topics- we follow up on the Club's recent analysis of its mooring incidents. A twelve month exercise by the Club's in-house inspectors has produced important supplementary findings.

Summary of findings

- Equipment used during mooring was generally found to be in good condition.

BUT

- A significant number of vessels did not have adequate procedures or arrangements in place.
- Crew used during mooring were often not adequately trained or correctly supervised.
- Mooring ropes are frequently stored on drum ends.
- Layers of paint are often applied to drum ends instead of them being painted with a synthetic coating or resin.
- A large number of vessels do not have non-slip mooring decks.

Introduction

Following the *LP News* article 'Understanding Mooring Incidents' (see Appendix A), the UK Club embarked on a focused inspection. Whilst onboard, the Club's inspectors spent a considerable amount of time looking at each vessel's mooring arrangement, equipment and procedures to directly investigate current mooring issues. This was a large undertaking, and during the past twelve months 373 ships have been inspected. All of this data was recorded and has been analysed.

The aim of this exercise was not only to gauge the standard of mooring arrangements and procedures onboard but also to highlight areas where improvements could be made, as well as areas that were doing well.

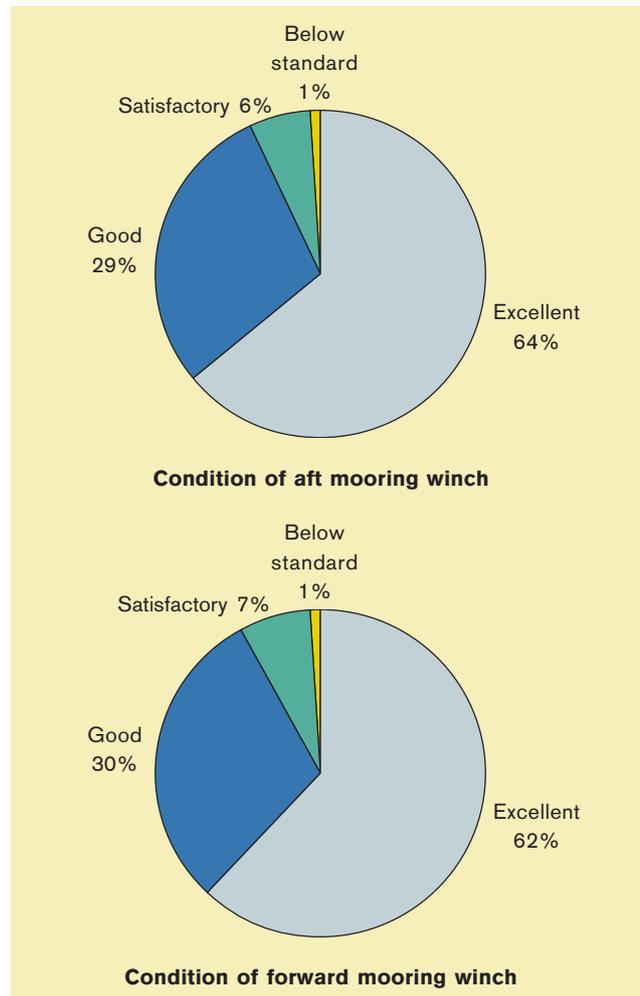
Winches, ropes and equipment

One of the major findings of the exercise was that most of the equipment used in mooring operations was found to be in good condition. Some of the inspectors noted that, despite the overall good condition of the mooring winches, it was sometimes difficult to grease the equipment correctly. It is important that all greasing points are free, working correctly and have not been



Ineffective grease point

painted over. To ensure that each point of the equipment is greased it may be beneficial to highlight or number each point and record the information in a plan.



The graphs, on the previous page show the standards of winches inspected to be very high.

Despite the good overall winch condition, inspectors commented that on a number of vessels the split drums were not set-up correctly. The first picture below shows the correct way to set up a split drum, having only around 4 or 5 turns on the smaller drum and the remainder of the rope on the larger drum.



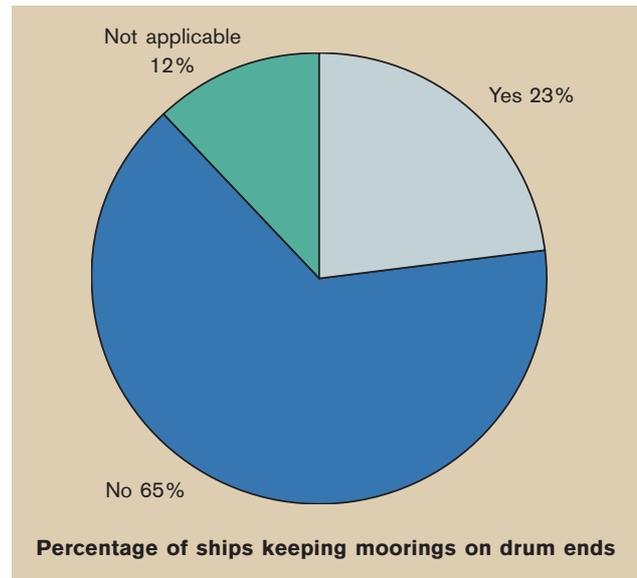
Correctly set up split drum



Incorrectly set up split drum with buried mooring line

Of all the vessels inspected 51% carried out break tests annually (26% did not, and for 23% it was not applicable). It was felt that although this is mainly a tanker requirement, it should be done on more ships, where possible, to improve the overall safety of the ship during high-risk mooring operations.

Inspectors noted that a large number of vessels kept moorings on the drum ends instead of making them fast; this was supported by the statistics which are shown above. It is not good practice to store mooring ropes on drum ends and this should be avoided. Ropes made fast on drum ends are more likely to jump and cause expensive damage to the drum end bearings or cause delays/problems should more ropes need to be deployed.



A further statistic showed that 94% of vessels had painted the drum ends. One hazard of over-painting is that the build up of paint on drum ends can cause rope damage. It is suggested that, if possible, drum ends should be smooth and coated with a thin layer of boiled linseed oil or other approved synthetic liquid for protection.



Build up of paint on the drum end

During the course of the exercise it was apparent that the majority of ropes used, were in good condition, the collection of graphs below show the overall standard of ropes, wires and links to be good.

Reassuringly, over 250 of the vessels inspected did not use spliced ropes. Where ropes are in poor or damaged condition, they should be replaced with spares.

It is important that all ropes, wires and Tonsberg links used for mooring have a certificate. It is considered good practice for these certificates to be clearly labelled and kept in an easily accessible file ready for inspection by Port Authorities. Spare mooring ropes,



Ropes badly stored on wet deck

wires and links should not be over stowed with paint, chemicals, or any other shipboard or general cleaning items. Spare mooring equipment should be stowed clear of the deck, preferably on a pallet and in a dry ventilated position. If mooring ropes and wires are stowed on deck during sea passages they should not be exposed to sunlight, sea spray or funnel soot. It is suggested that canvas or heavy duty polyethylene covers will prolong the life of the ropes/wires.

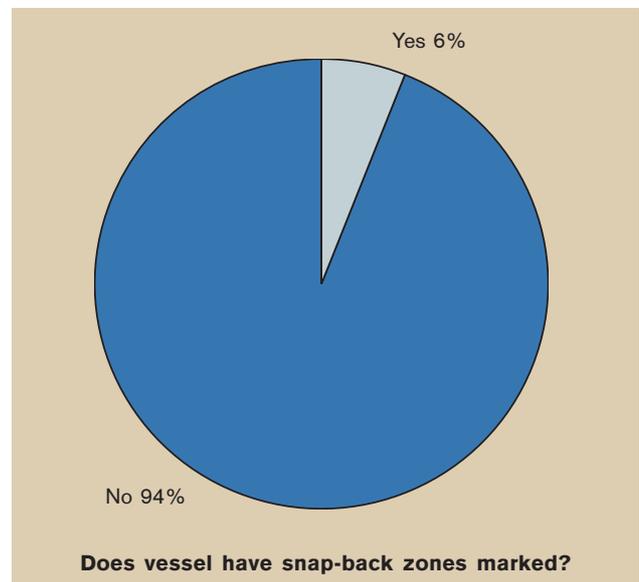
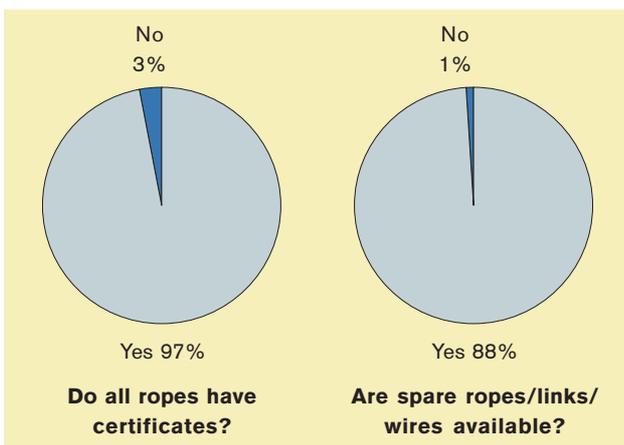
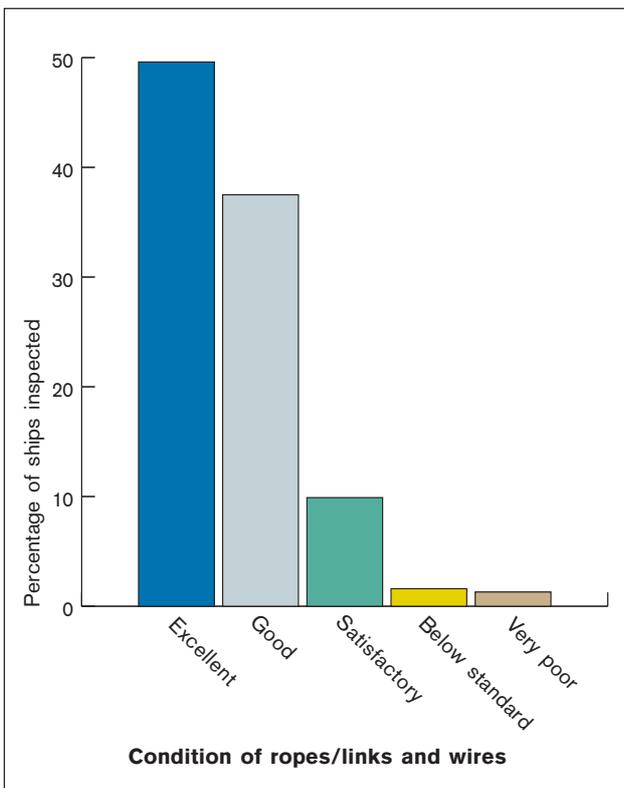
Decks, bitts and ship

In recent years it has become more and more apparent how beneficial it can be to have a fully non-slip mooring deck with clearly marked snap-back zones, this was highlighted in 'Understanding Mooring Incidents'. The following list shows the proportion of vessels with varying degrees of non-slip deck.

- Non-slip overall, 32%
- None, 32%
- Just in way of bitts, 25%
- Around the drum-ends, 11%

Despite 32% of ships having fully non-slip decks an equal amount had none at all. It is a fact that mixing sand, or an approved non-slip aggregate, into the paint prior to application can be a very effective measure in helping to reduce mooring accidents. The graph below shows that very few vessels had painted snap-back zones on deck.

A significant amount of accidents could be reduced by marking these zones on deck, many accidents occur because someone is standing in the wrong place at the wrong time.



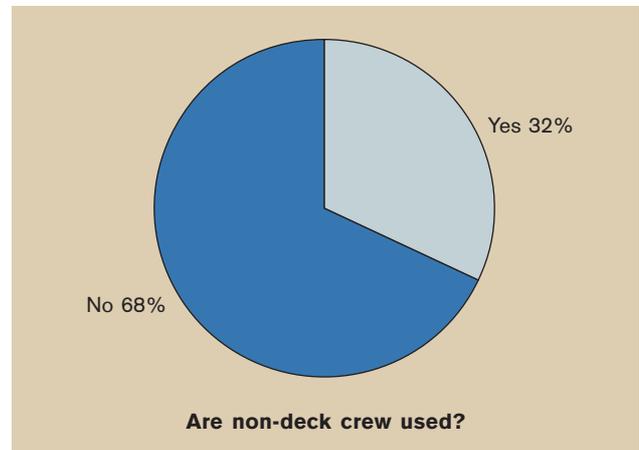


Clearly marked snap-back zone

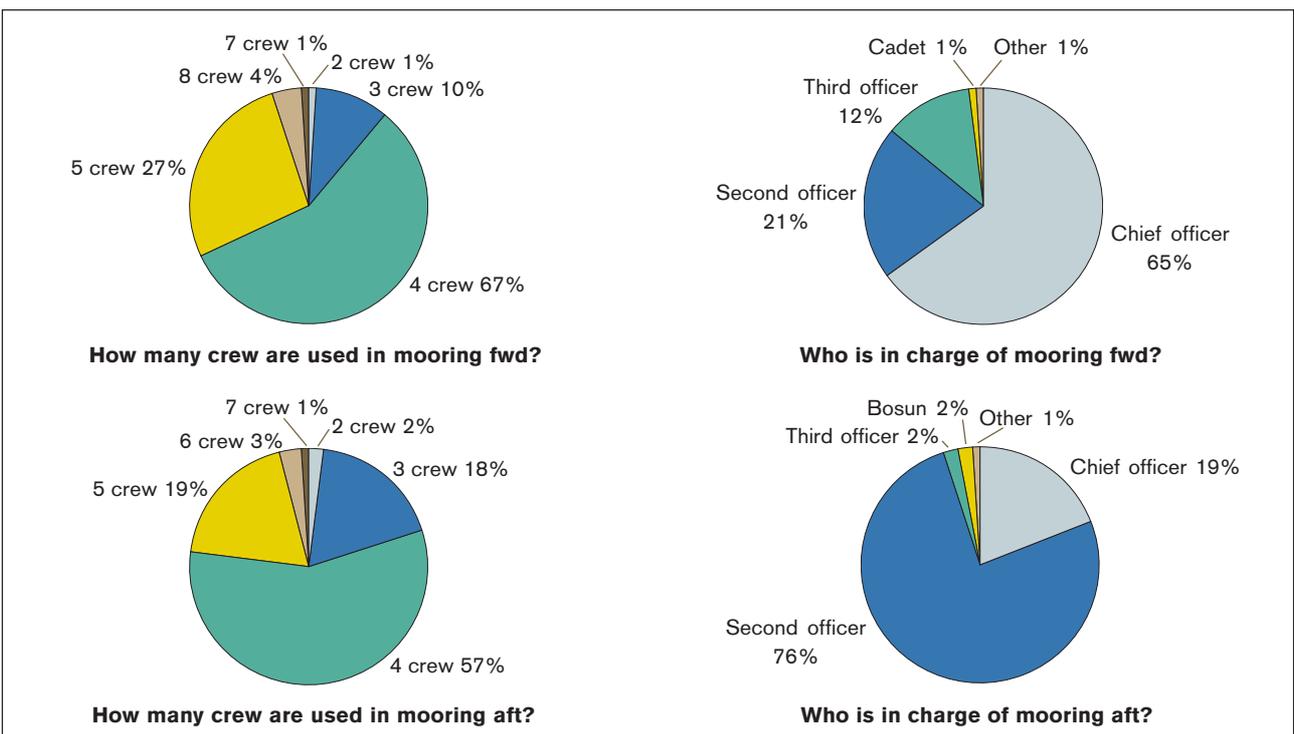
The bits, rollers and fairleads were generally found to be in good order. 99% of bits inspected were in good condition with 96% of fairleads and rollers found to be free moving and regularly greased. A well maintained mooring area is essential if a vessel is to operate safely, it is important to ensure that all rollers and fairleads are free moving, decks and bits are well maintained and that the area is kept free from clutter.

Practices and procedures

A number of key points that arose from the exercise related to the practices and procedures onboard, one of the most notable being that the mooring arrangement on 14% of the vessels inspected was "not satisfactory". This statistic coupled to the fact that 7% of ISM mooring procedures were not found to be acceptable, shows that a significant portion of those



The set of graphs below demonstrates the numbers of people used in mooring operations forward and aft as well as who is in charge of the operation.



inspected have some way to go if they are to ensure that mooring procedures are of an appropriate standard.

The Club has seen a growing number of incidents occur when non-deck crew are used during mooring operations. All crew should be trained and be familiar with bights, snap-back zones and the hazards associated with mooring operations.

It is important to have sufficient personnel to be able to moor the vessel safely and effectively. The most common number for both forward and aft was 4 people with numbers ranging from as low as 2 (2% aft, 1% forward) and as high as 7 (1% forward and aft).

Other key factors raised in this section were that 15% of ships used mixed moorings and that 9% of vessels did not use the correct stoppers, both of these points contribute to mooring accidents and should be rectified onboard, it is vital that the correct stoppers are used with the appropriate mooring ropes/wires. Stoppers should not be left around the mooring ropes once they have been made fast to the bitts.

Incidents

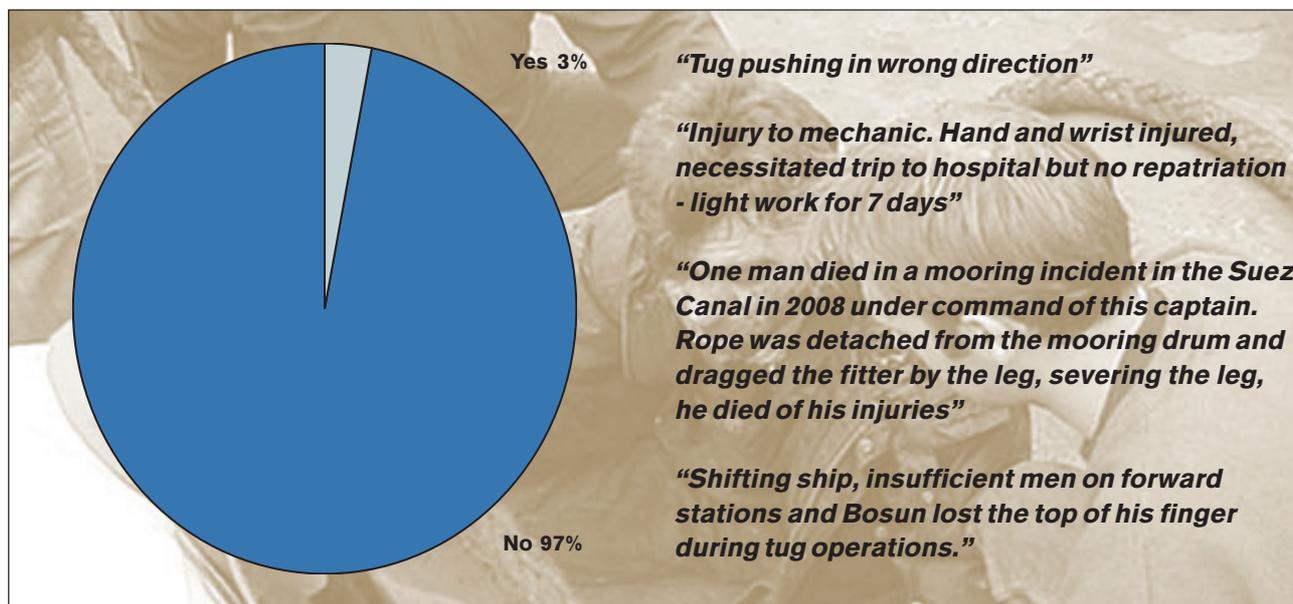
Within the last 24 months only 4% of ships had reported a near miss relating to mooring operations, the comments below detail some of the information given to ship inspectors regarding near-miss.

“Several reported and dealt with at safety meetings”

“Yes - rope snapped back (spring line)”



The chart below shows the amount of ships that had a mooring incident onboard during the last 24 months and the associated comments



“Spring line snapped back, no injuries”

“Men standing in rope bight”

“Crew standing in bight of rope, guidance given”

“Two lines parted in Amsterdam”

“Yes - cadet was nearly injured - chief mate told him to stand clear of tug line. Line parted but no injuries”

Summary

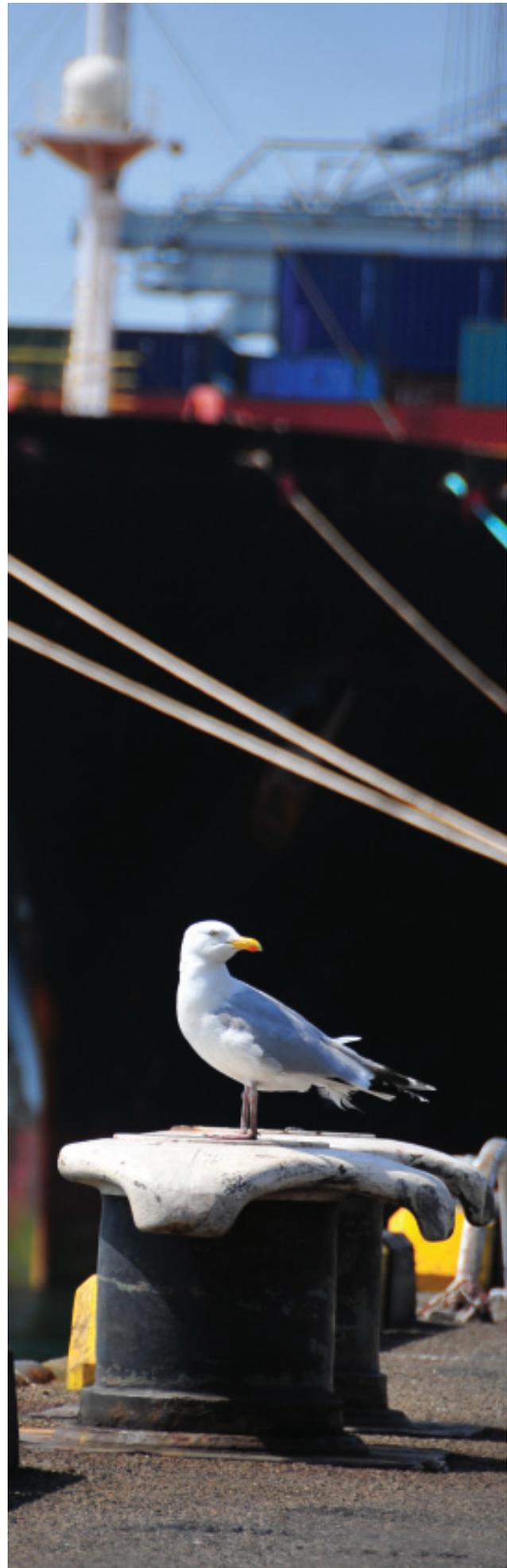
From the above report it can be seen that whilst many areas of the mooring operation are to be commended, many are still inadequate in one way or another. The key points raised are predominantly related to procedures and practices, the use of insufficiently trained crew is still a significant issue.

The basic mooring arrangement and ISM mooring procedure were not acceptable on a significant number of inspected vessels. It is vital that time is taken to ensure that procedures are not only acceptable but that they are followed by the crew. A number of familiar factors reoccur in mooring incidents, they are listed below.

- Seafarers stand in bights or snap-back zones, when ropes part those involved are often injured.
- Crew with insufficient training are used during mooring operations, it is often these people who are seriously injured if something goes wrong.
- The person supervising mooring is also involved with operation and is unable to carry out his role effectively.

The survey indicated that the standard of general equipment was relatively high, although it was disappointing to note that 3% of vessels did not have certificates for mooring ropes, wires or Tonsberg links. This may cause problems during any litigation.

To reduce the risk of an accident the vessel and equipment must be maintained to a high standard, all personnel should be adequately trained with the correct PPE, the correct procedures should be in place, work permits issued and all mooring operations should be supervised by a competent person. Training in mooring operations should be incorporated into the vessels regular training schedule and include all personnel who are to be involved.



Appendix A

Opposite is a copy of the *LP News* article *Understanding mooring incidents* which was published early last year and which provides a background for the current *Risk Focus* article on Moorings

Understanding mooring incidents

Major accidents involving mooring equipment in the last 20 years have injured many seafarers and have cost the UK Club over US\$34 million



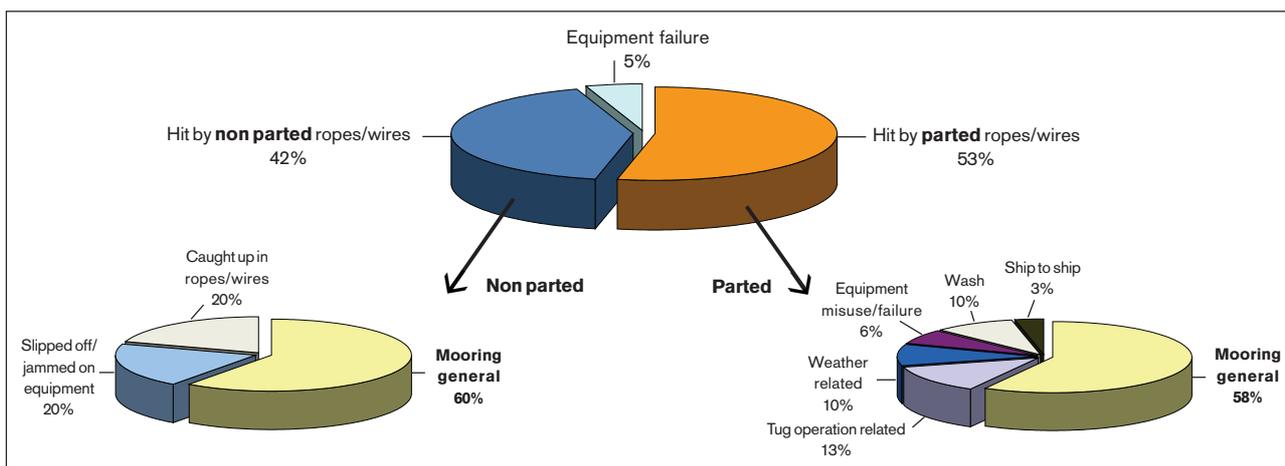
Many of these accidents have occurred during the handling of ropes/wires, where ropes/wires have parted (53%) or where ropes/wires have jumped/slipped off drum ends/bitts (42%) with 5% caused by actual equipment failure (see pie chart below centre).

Parted ropes/wires normally occur during general mooring, tug and ship to ship operations with equipment failure, misuse, wash damage and weather also playing

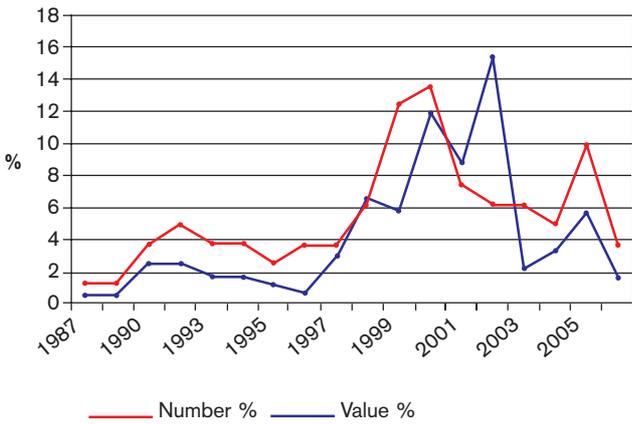
a role. Injuries from non parted ropes/wires normally occur due to crew being caught up in ropes/wires and ropes wires slipping off and becoming jammed on drum ends during normal mooring operations (see pie charts).

Whilst mooring injuries are the seventh most frequent cause of personal injuries in the Club they are the third most expensive per claim indicating how horrific some of these injuries can become.

Types of incidents resulting in personal injury



The worrying statistic is the apparent increase in number and value of these claims over the past 9 years (see graph below).



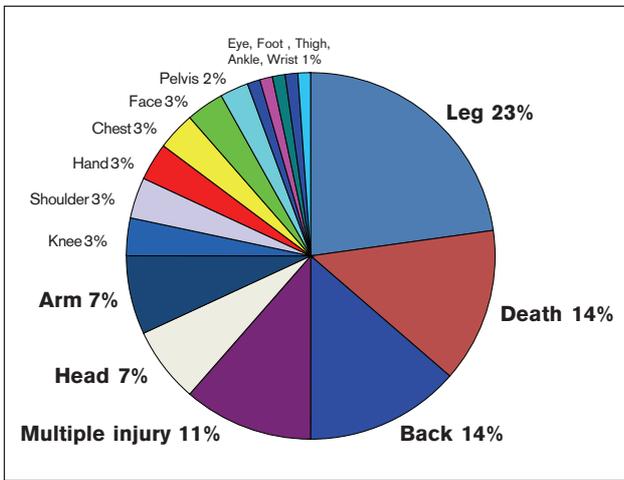
Risk assessment of mooring stations

A risk assessment should be made of all mooring areas on board; looking at the space with a view of purposely searching for hazards that may cause injury. Mooring areas naturally contain many trip hazards, and highlighting these is a good starting point.

Hazard highlighting

Physical hazards to be highlighted should not be limited to bulkhead frames, mooring bits, pedestal fairleads and cleats. It should also include structures such as platforms at the windlass and hawse pipe covers.

Injuries from mooring incidents



Two seafarers killed when struck by a parting mooring line

Crewmember in coma – struck on the head by a parting mooring line

3/O sustained 90% partial amputation of leg and fractured elbow

A/B suffered a fractured hip when struck by a parting mooring line

Both legs broken when struck by a parting mooring line

Mooring line slipped from windlass drum and struck crewmember's head

C/O killed when tow-line to barge parted and snapped back

Deck cadet suffered serious arm injuries during mooring operations

Poor and potentially unsafe mooring area example



Unfortunately this photo illustrates a sight sometimes experienced by the UK Club ship inspectors. Not only are the windlasses rusty and poorly maintained, but the mooring area as a whole suggests poor safety and maintenance standards on board:

- The mooring area is dirty and all surfaces are in need of maintenance.
- All surfaces are painted the same colour, hiding trip hazards such as save-alls, windlass platforms, forecandle access hatch and bits.
- There are no hazard highlightings or warning markings.

Highlighting hazards is particularly important for the safety of crew that are new to the vessel, cadets and other trainees, and visitors. It is also important for the benefit of experienced crew who easily become complacent, tired, or too busy in their work to not notice a hazardous situation developing.

The following images illustrate how effective hazard highlighting can be, when compared with a mooring station that is simply well painted.



Well painted but poorly highlighted mooring station



Mooring station with effective hazard markings

Maintenance

An A/B was seriously hurt when a roller fairlead detached from its pedestal whilst under the influence of a mooring line under tension. The A/B was standing in the snap-back zone and was struck by the rope, which hurled him into the foremast causing head injuries.



The rope hurled the roller fairlead 20 feet from the ship to the quayside.

The angle or directional lead of a rope should be considered when using leads in order to prevent incidents like this. But this particular incident also highlights the importance of proper maintenance of mooring equipment.

Do not forget to include in the maintenance schedule the checking of all grease nipples on mooring equipment (deck machinery) to ensure the nipples remain usable. It is a good idea to highlight grease nipples in order to prevent them from being overlooked.

Not only should moving parts be greased, and surfaces suitably coated, but metal that is wasted should be



replaced and not simply painted over.

The image (left) shows a pedestal fairlead that is well maintained. There is evidence that it has recently been turned and greased and the grease nipple on top is highlighted.

In what condition is mooring equipment on board your ships?

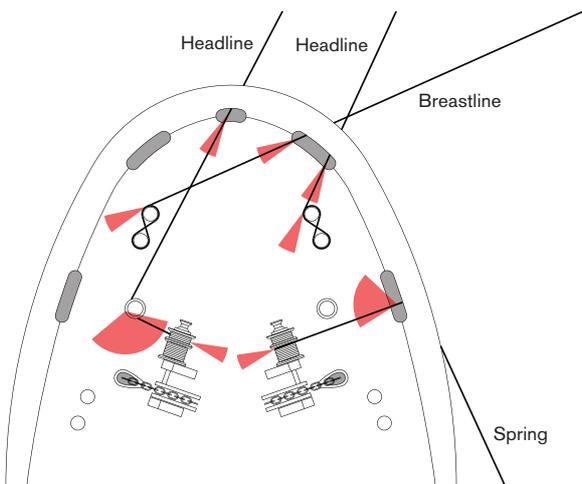
Mooring equipment that has suffered severe wastage will not perform to the certified standard. This also applies to the steel to which the equipment is welded. The image shows mooring bits that are badly wasted. The deck is in equally bad condition and there is a danger of the bits being torn from the deck.



Snap-back zones

The majority of serious incidents in mooring areas involve parting lines!

Qualified seafarers are aware of the fact that a snap-back zone exists when a mooring line is under tension. It is, however, a rare thing to see crew taking this into account when they are working mooring lines on deck.

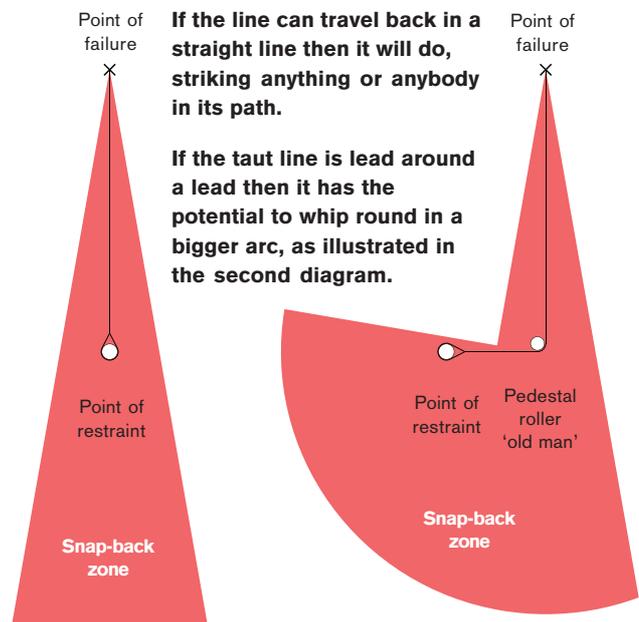


If snap-back zones are painted on the deck then crew will be alerted to the danger when they notice they are standing in a highlighted zone.

Painting these areas also helps supervising officers instruct crew to keep clear when lines are coming under tension.

Highlighting mooring line snap-back zones ensures that crew can visibly see the danger areas without having to purposely think about them while working.

When a line under tension parts, it will whip back to the remaining point of tension.

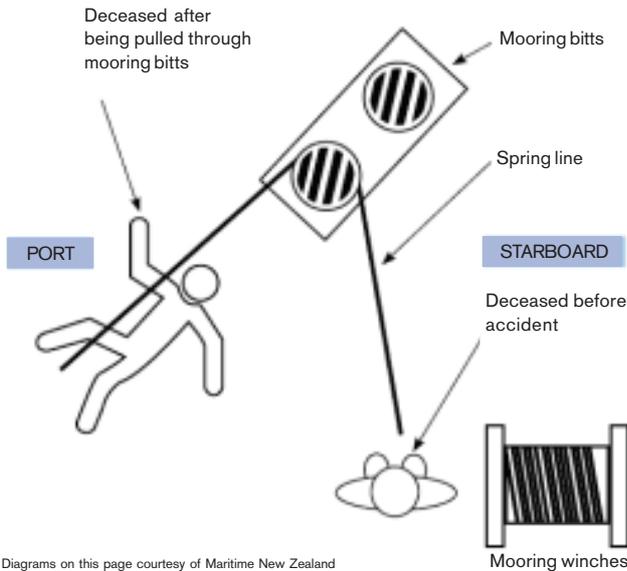


Diagrams on this page from MCA Code of Safe Working Practice for Merchant Seamen

Awareness of bights

Trained deck hands understand the dangers of standing within a bight or coil of rope and it is therefore surprising that a significant number of personal injury incidents during mooring operations involve seamen doing just that.

The diagram forms part of an investigation report into the death of an A/B who was dragged through a set of bitts by a mooring line.



Diagrams on this page courtesy of Maritime New Zealand

This incident also highlights procedural and awareness issues because the mooring party forward informed the bridge that all lines were clear when they were in fact still in the water. Nobody noticed that as the vessel was manoeuvring away from the berth, one of the lines became snagged on one of the wharf buttresses.

The unfortunate seaman was recovering the line but stepped in a bight of the mooring line as it became taut and was then dragged through the bitts as the fouled line ran from the vessel.

Bights don't always look like bights. Here a seaman has inadvertently stepped over the line and put himself at risk



Who is at the mooring station?



Mooring operations are dangerous to crew on board because of the great loads that the mooring lines will carry, and the danger of them breaking while taking up this tension.

Only personnel involved in mooring operations should

be present at mooring stations during mooring operations.

It should be policy on board that inexperienced personnel such as cadets in the early stages of their training, who are to be involved in mooring operations, should be under the supervision and direction of an experienced seafarer. Effectively, someone should be appointed to ensure the safety of the inexperienced person, and both should be aware of who is undertaking that duty.

Everybody on board should be aware that only personnel directly involved in mooring operations may visit mooring stations during mooring operations. This is best done with safety notices and implementation into on board policies.

The number of crew found on board is often the minimum required to safely operate the vessel. Although some ships may find themselves stretched for manpower, mooring operations should never be undertaken with less crew than is considered necessary to do the job safely.

There should always be a minimum of two people to each mooring station throughout the operation. Even where automatic mooring systems are installed, a second person should always be present in case something goes wrong.

Crew should not be allowed to operate a windlass or capstan and handle the rope at the same time. This is a two person job. Fixing a lanyard to an operating lever and pulling on it from the rope-handling position should strictly be forbidden. If only two crewmembers are on deck for mooring operations then they should work together on the lines at one end of the vessel and then the other.

Incident!

A vessel moored alongside during cargo operations was fully laden with her deck level below the dock level. It was noticed from the quayside that the forward spring was caught under a padeye located on the ships side. The spring, a wire rope, was taut and there was concern that in this position it might break.

An attempt was made to free the line by slacking and hauling it on the windlass but due to the curvature of the forward hull section, and the extremely long lead of the spring line, it would not free. The line was heaved taut in the hope that it might jerk free. When the line did free itself the tension it was under caused it to oscillate up and down, passing 5 feet inboard of the ships rail and striking a young engineering apprentice in the head.

The engineering apprentice was not involved in the operation and nobody involved was aware of his presence until after the accident. He was also not wearing a hard hat.

In this incident the spring line had an extremely long lead. A bollard was available closer to the bow of the ship but this was not used. It was found that if the nearer bollard had been used then the line would probably still have become caught under the padeye, but it is unlikely that it would have jumped inboard of the ships rail upon freeing from the padeye.

This incident highlights the need for control over people present at mooring stations, the wearing of PPE and efficient mooring arrangements.

Mooring arrangements

Bad mooring arrangements can also be responsible for claims for damage to cargo handling equipment, docks and other structures. In these incidents it is often the case that the vessel surged extremely or broke her lines because of strong currents or the influence of passing vessels.

The image below shows a vessel considerably overhanging her berth. She is therefore unable to lead any stern lines aft of the ship. The image shows one line in particular being lead an extremely long distance, rendering it pretty much useless.



The ship has correctly put out as many lines as possible but should also consider the use of the anchor and mooring lines running aft from either the main deck or other suitable areas. In situations like this it is important to analyse local tidal and weather patterns in order to predict how the vessel will be affected. The vessel owners should be informed and cargo operations stopped (or not commenced) if conditions do not appear safe.

The following image shows insufficient mooring arrangements ashore and the vessel is forced to pay out an extremely long lead on the stern lines. In this event, the master should protest to the port authority, take photos and inform the owners.



Personal Protective Equipment (PPE)

When struck on the head by a parting mooring line, the wearing of a hard hat will be the life or death deciding factor. A hard hat should be worn at all times when involved in mooring operations, as well as appropriate safety footwear and boiler suit (or other protective full-length clothing).



It has been the general opinion on some vessels that the wearing of gloves when handling mooring ropes is an unsafe practice. This is due to concern that loose gloves may become trapped under a line on a windlass drum and haul the crewmember over it. Gloves should be worn but crew need to be aware of the dangers associated with ill-fitting gloves when handling ropes.

The photo below shows a chart that highlights the compulsory PPE to be worn for various operations on board. This can be devised on board and is a very useful aid to crew when posted in changing rooms or mess areas.

	Safety Helmets	Safety Boots / Shoes	Coveralls Boiler suit
deck			
machinery Space			
Mooring Operations			
Cargo Operations			
Boiler Operation			

Mooring practices

Professional seafarers must be monitored during mooring operations to ensure they do not become complacent in their work; putting themselves and others in a dangerous situation.

Deck officers monitoring mooring operations must be actively watching for hazards and give instructions to ensure hazards are controlled.

Mooring operations should be conducted in a safe manner. In the image below:

- The line on the windlass drum is being handled safely. The crewmember at the drum is keeping his hands clear of the turns and positioned so as not to become fouled in coils of rope.
- The crewmember operating the windlass has a good line of sight of the rope and the man handling it.
- Both crew are appropriately attired in correct personal protective equipment.



Correct use of stoppers

UK Club ship inspectors often notice when boarding Club vessels, that stoppers have been left on lines after they have been secured. This bad practice puts unnecessary strain on the stopper as the line continues to tighten on the bits. It may also result in the stopper rope tightening to the point where it can't be released.



The second image (right) shows a chain stopper setup for use with polypropylene ropes. Only rope stoppers should be used with rope mooring lines; chain stoppers are for use with wires.



Consult an on board seamanship manual for proper seamanship practices.

Wire to rope



A rope mooring line should never join a metal line without the use of a thimble.

The condition of the rope and wire in this example is poor and the lack of a thimble increases the likelihood of the rope breaking.

An eye in the end of a wire

If it is necessary to create an eye in the end of a wire, then it would be worth investing in crimping equipment. Many ships prefer the use of bulldog-grips for creating an eye in the end of a wire rope, but there is a correct way of doing this:

- An allowance of 150 mm should be made between the last bulldog grip and the end of the 'dead' wire. It is important to ensure that the lashing wires are not cut short immediately next to the bulldog grips.



- Bulldog grips have a grooved surface in the bridge piece which is suitable for a standard wire of right-hand lay having six strands. Crosby grips have a smooth surface in the bridge piece. The grips should not be used with ropes of left-hand lay or of different construction.
- The first grip should be applied close to the thimble or at the neck of the eye if a thimble is not used.

Other grips should be placed at intervals of at least one clear grip (albeit a distance of six rope diameters apart is suggested) between each other.

- The grips must all face in the same direction and must be fitted with the saddle or bridge applied to the working or hauling part of the rope. The U-bolt must be applied to the tail or dead-end of the rope. If the grips are not applied as indicated above, the effectiveness of the eye can be seriously affected.

Secure to bitts

Windlass drums are not designed for taking the weight of mooring lines for a long period of time. If windlass drums are used for this purpose then over a period of time they will suffer damage and be in need of repair.



This windlass drum suffered bearing damage and is being overhauled



Once ropes have been hauled tight they should be secured to bitts as in the good example on the left

Care and maintenance of ropes

In order to preserve the usage life of ropes, ensure they are protected from the elements and not subjected to unnecessary chaffing.

Do not store ropes on wet decks. Ensure they are

stowed off the deck and if possible away from precipitation and direct sunlight. If baskets or other storage devices are not available then ropes should be coiled down on pallets (see below).



Ropes correctly stowed off deck



Ropes badly stored on wet deck

Over time, ropes and wires will suffer wear and damage and the general condition will be evident in the rope as a whole. But a part of the rope may become particularly damaged at any time and it is important to check the rope at every opportunity.

A visual inspection should be performed every time before, during and after a rope has been used.

Flaking a rope on the deck ready for running is a good opportunity to look for damage which a part of the rope may have suffered, causing a weak point in the rope.

A general visual inspection can also be performed by the person handling the line on a windlass drum as it is received, hand over hand.