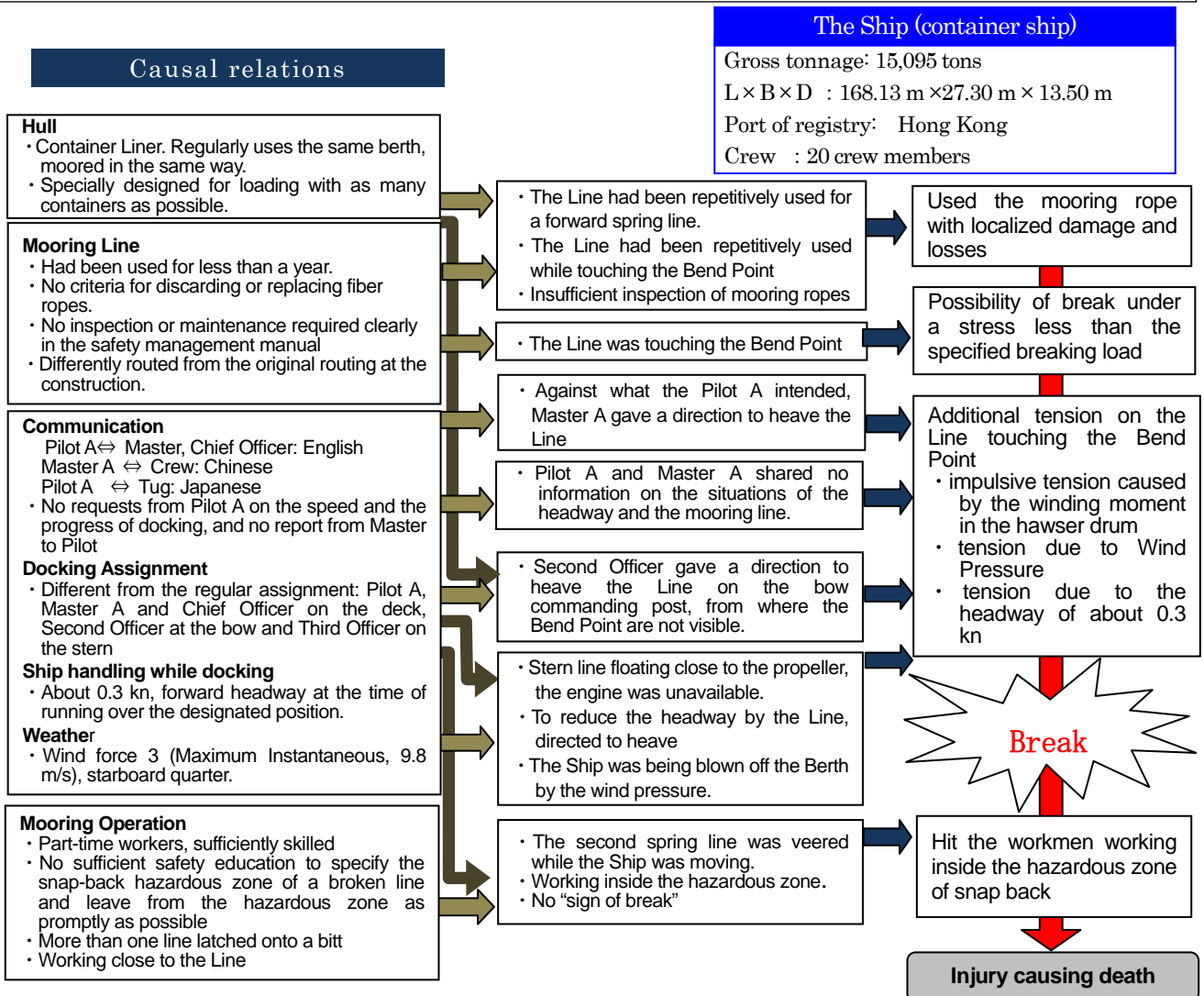


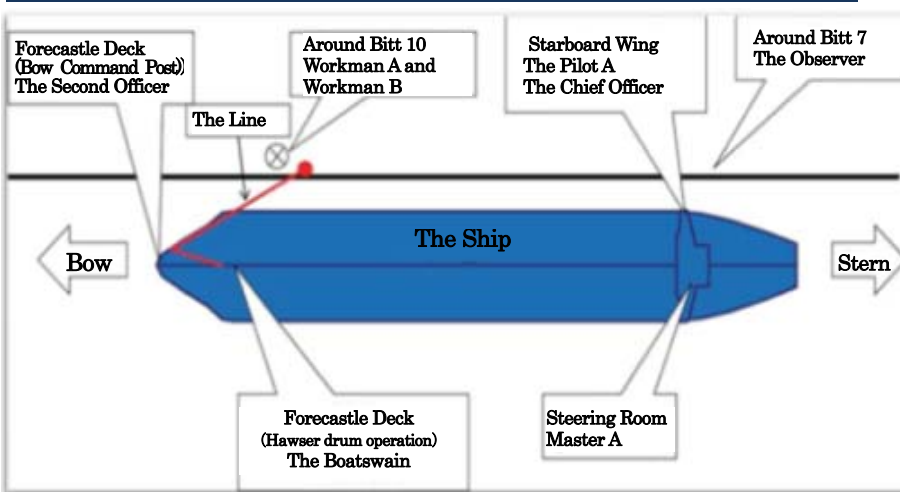
Serious Accident : Case 2

While in docking operation for a container ship, a mooring rope attached onto a bitt on the berth broke, and snapped back, hitting mooring workers, and took their lives

Outline: the container ship (the Ship) was docking at Port Island Container-Berth 18 at about 0736 hrs, May 20, 2009, when a mooring rope attached onto a bitt on the berth broke, snapped back and hit two workmen engaged in mooring work. Both of them died.



Positions of the workman and the crew when the Accident



weather at the time of the accident

average wind speed: 3.6~3.7m/s
 max. instantaneous wind speed: 9.8m/s
 wind direction: NE



the break of the mooring

A "spring line" is a mooring line taken backward from the bow, or taken forward from the stern.

A "hawser drum" is a rotating drum that can wind up a rope about 200m in length, and is used for heaving or veering a mooring rope.

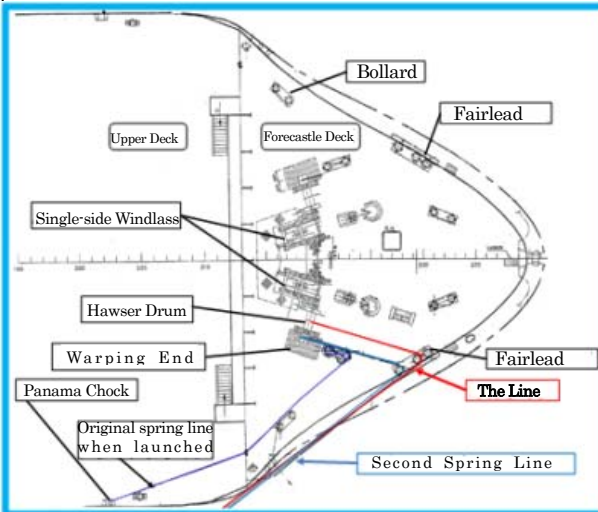
A "bollard" is a post installed on the deck used for latching mooring ropes. Generally, a pair of two posts is called a "bollard." On the other hand, a single post is called a "bitt."

Situations of Forward Spring Line and Safety Management Activities

Time of purchase and strength

It is considered probable that the Ship purchased a forward spring line (the Line) in June 2008 with a strength greater than the minimum breaking load specified in the IMO Guidance, and had used the Line since August 2008.

The route of a forward spring line



At the time of launching, a forward spring line was to run from the bollard on the forecastle deck to the panama chock on the upper deck, and to run to a bitt on a berth.

For adjusting the length of the forward spring line to the route as above, at least two workmen—an operator of the warping drum and a handler of the mooring line—are generally required.

A forward spring line is often veered out first for the purpose of decreasing the forward inertia in cases where there is no sufficient room in the forward direction. Therefore, the length of the line is required to be adjusted depending on the situations of displacement of the ship.

As regards the Ship,

- the berthing point was designated
- that four crew members beside the commanding officer were on the docking operation at the bow allocation
- a head line would be veered out to the quay following the forward spring line.

Route of Forward Spring Line

It is considered probable that the Line, wound on the hawser drum, was used as a forward spring line for operational efficiency.

The use of the Line

It is considered probable that the Line had been repeatedly used for the forward spring line, and therefore, it is considered probable that the Line's strength had degraded upon damage caused by repetitive touching the Bend Point, such as yarns sticking-out and breaks and fluff in the portion of 20m–34m from the end of the eye.

It is considered somewhat likely that the Ship continued using the Line although it sustained wear, because it had been used for less than a year.

The inspection of the Line

It is considered probable that the check list in the safety management manual developed by the ship management company (Company B) required no inspection or maintenance of mooring ropes.

It is considered somewhat likely that the Chief Officer and the Boatswain had not inspected the Line while referring to the "Inspection and Replacement of Fiber Ropes" described in the "The Mooring Equipment Guidelines, 2nd edition" published by OCIMF (the Oil Companies International Marine Forum), and its revised document as the 3rd edition, although had regularly conducted a visual inspection of the mooring ropes, including the Line.

Refer to the information on the handling of mooring ropes (p.11)

Situations of the Mooring Workmen

- ① It is considered probable that part-time workmen, Workman A and Workman B were winding-in the second spring line, standing about 10m from Bitt 10 toward Bitt 13, in order to prevent the Line from getting in under the fender.
- ② It is considered highly probable that the Line, upon breaking, hit the left side of Workman A's face, and the right side of Workman B's face and the his neck.

○ It is considered probable that Company A had provided part-time workmen with safety management orientations at the time of hiring, had used seals to show the skills and the progress in learning, and had made squad leaders provide safety training at the job-sites by explaining actual accident situations and other matters, and that squad leaders had involved part-time workmen in site-work depending on their progress in gaining skills.

○ It is considered probable that Company A had not provided mooring workmen with practical safety instructions, by giving information specifying extension of snap-back hazardous zone of a broken rope under tension, and by giving directions, in the case of working close to a rope put under tension, to complete the work as swiftly as possible and to move away from the snap-back hazardous zone as soon as possible.

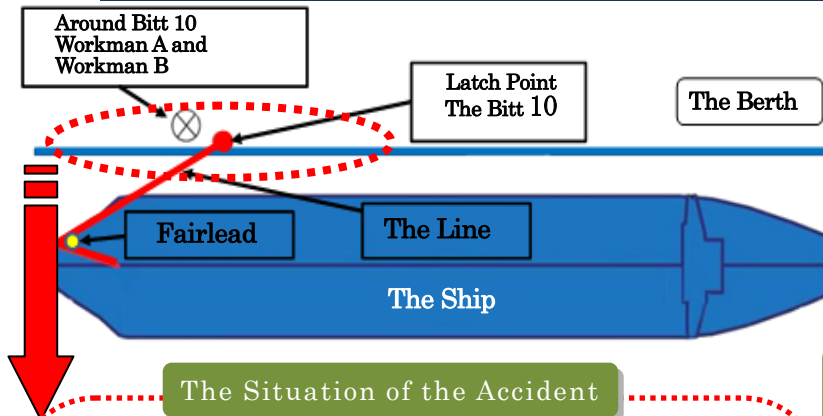
✦ A "panama chock" is equipment for the leading rope, and is installed on the side of the deck.

✦ A "warping drum" is a rotatable drum in a windlass that winds up ropes using friction.

Information on the Handling of Mooring Ropes

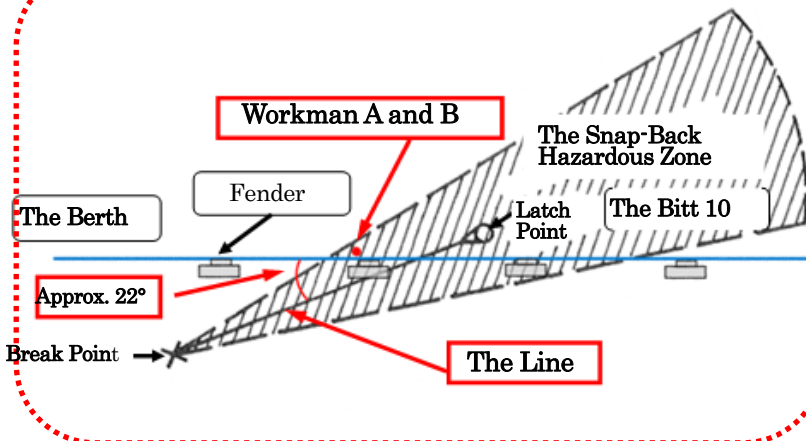
Source: (OCIMF "The Mooring Equipment Guidelines, 2nd and 3rd editions")

The Situation of the Accident and the Snap-Back Hazardous Zone

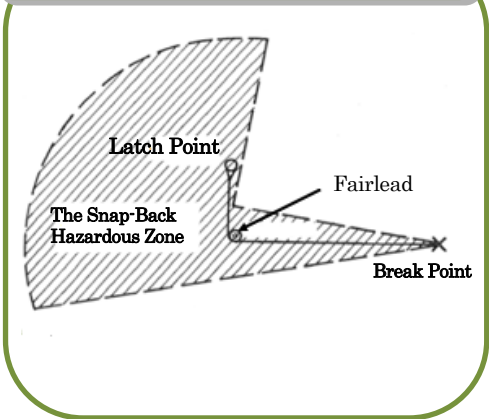


📌 snap-back: the sudden release of the static energy stored in the stretched synthetic line when it breaks

The Situation of the Accident



< reference chart >
In case of Break of a Mooring Line bent at a Fairlead



* The chart for the situation of the accident shows a snap-back hazardous zone when a break point is between a latch point and a fairlead. In the case of the Ship, as in the reference chart, the mooring line was bent at the fairlead, although a snap-back hazardous zone will extend further if a break point is between a fairlead and a latch point.

Risk associated with mooring ropes

Handling of mooring lines has a higher potential accident risk than most of other shipboard activities. The most serious danger is a snap-back.

- Synthetic lines normally break suddenly and without warning.
- Unlike wires, they do not give audible signals of imminent danger before completely parting; nor do they exhibit a few visible broken elements.

As a general rule, there is danger at any point in a conical zone of the synthetic lines enclosed by the circumference with an angle of 10° from the break point.

A broken line will snap back beyond the point at which it is secured, possibly to a distance almost as far as its own length.

- It is not possible to predict exactly where a snapback could happen .
- If the zone is suspected as potentially dangerous, keep away from any rope under tension.

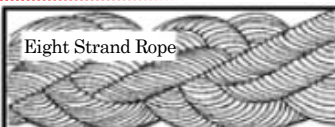
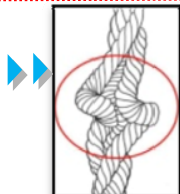
Countermeasures

If you must work near a line under tension, do so quickly and leave the danger zone as soon as possible.

Handling of fiber ropes

Winch-mounted synthetic lines should be end-for-ended about every two years to distribute points of wear.

📌 A "hockling" is a word referring to a deformation found only in twisted ropes



Structure of Fiber Rope

Inspection and replacement of fiber ropes

- Synthetic lines should be checked for obvious signs of deterioration before each use and undergo a thorough inspection at least once each year.
- Some signs of damage such as hockling, cuts, surface abrasion and fusion are readily visible. Others are not as evident. While it is not possible to prescribe definitive retirement criteria, the following sections discuss the types of damage and wear experienced by ropes and providing general guidelines.

Types of damage and wear and general guidelines for replacement

① Cuts

In general, any cut which penetrates through 25% of the area of one or more strands critically weakens the rope. The rope should be cut and spliced (*), or retired.

② External abrasion

External abrasion is evident as a general fuzzy appearance. If abrasion reduces the solid diameter by more than about 5%, then the rope should be retired.

When the abrasion on any one strand penetrates more than about 15% of the strand area, the rope should be cut and spliced.

③ Internal abrasion

Internal abrasion is caused by the strands and yarns rubbing against each other as the rope undergoes cyclic loading. If the abrasion has progressed to the extent that some yarns are worn through, the rope should be renewed.

✔ "Splicing" is to join the ends of two ropes by interweaving their strands.

Inspection and Retirement of Mooring Ropes

Inspection of mooring ropes

If there is no actual fiber damage or distortion, there is no positive method by which the residual strength of used rope can be determined visually, but in synthetic fiber ropes, the amount of strength loss is directly related to the amount of broken fiber at the rope's cross-section.

Retirement of fiber mooring ropes

- Factors such as load history, abrasion, bending radius and chemical attack need to be considered when assessing retirement criteria.
- In the absence of other information, mooring ropes should be replaced when their residual strength has reached 75% of the original max breaking load.

Make sure of the conditions of abrasion, gloss, glaze, and discoloration as well as change of strand diameter and softness by means of a regular visual inspection.

For a conventional fiber mooring rope, 25% damage to a yarn at the rope's cross-section means 25% loss in the strength of the rope.

Proposals (Safety Recommendations)

The Board, based on the results of the accident investigation, recommended the operator and ship management company (Company B) to consider the following and take necessary actions, and Marine Department, The Government of Hong Kong to supervise the company mentioned above.

Recommendations to Company B and Marine Department, the Government of Hong Kong

The accident occurred when the mooring line with wear broke due to the additional tensions on the mooring line, which was touching the Bend Point, including the impulsive tension due to the winding moment in the hawser drum, the tension caused by the forward headway of the Ship and that caused by the wind pressure, and hit the two mooring workmen, causing them to die.

The safety management manual developed by Company B requires inspection of the mooring equipment while berthing to confirm that such equipment is in good condition. In the case of the accident, judging from the state of wear to the forward spring line, it is considered highly unlikely that the line was in a "good condition," as stated in the manual mentioned above.

Therefore, it is recommended to clearly state and require to pay attention to the route of mooring ropes and the bits to moor the ropes onto in order to prevent mooring ropes from touching corners such as the Bend Point to the extent possible and obtain safe and effective mooring forces, and to place a person in charge to take command of operations in such a position from where the person can acquire the knowledge of the overall conditions of mooring ropes. At the same time, it is recommended to make all the ships under management comply with such requirements.

In order to Prevent Recurrence

In order to prevent recurrence of similar accidents, mooring rope manufacturers and line handling service providers are requested to be reminded of the following:

It is desirable that manufactures of mooring ropes establish guidelines to replace or discard their products by examining their appearance and provide users of the ropes with the guidelines.

It is desirable that line handling service providers provide their mooring workers with information on extension of the snap-back hazardous zones of ropes when broken under tension, and give them instructions such as to avoid working inside the zone unless necessary and to complete the work swiftly and leave from the snap-back hazardous zones as promptly as possible.

Also, the Board has requested the industry and organizations involved in manufacturing mooring ropes and providing line handling services to familiarize the parties concerned with this report and remind them further of the replacement and retirement guidelines for mooring ropes as well as the risk in carrying out such works.

The investigation report of this case is published on the Board's website (issued on April 22, 2011)

http://www.mlit.go.jp/jtsb/eng-mar_report/KuoChang.pdf

(This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.)