



THE DUTCH  
SAFETY BOARD



Breaking of mooring lines whilst mooring  
m.v. Edisongracht between two mooring buoys  
in the port of Soyo, Angola, 1 April 2010

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Photo m.v. Edisongracht (Source: Shipping company)

The Hague, May 2011

Investigation of very serious marine casualties is mandatory through international regulations from the International Maritime Organization and the European Union. The Dutch Safety Board has started an investigation into the accident on-board of the Edisongracht on 1 April 2010 in Angola to comply with this obligation.

The Dutch Safety Board did not have an opportunity to perform an on-site investigation, as it was not possible to travel to the accident site within a reasonable period of time after the accident. Information regarding the accident and the circumstances of the accident were requested through (registered) letters, faxes, e-mail and/or telephone from the Ministry of Transport, Maritime Institute of Ports of Angola (IMPA) in Angola itself as well as through the Consulate in Rotterdam and the Embassy in Brussels. No responses on these requests were received. This report is therefore mainly based on information from written and oral statements of the crew members, telephone interviews and e-mails from the Captain, the company's internal accident report and interviews with representatives of the shipping company's office in the Netherlands.

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## 1 SUMMARY

During a mooring manoeuvre of mv Edisongracht between two mooring buoys<sup>\*1</sup> in the port of Soyo, Angola on 1 April 2010 at around 9:00 a.m. (LT\*)<sup>2</sup>, a mooring line slid off a guide roller and subsequently broke. The mooring line hit two crew members. One crew member was fatally injured to his head and a second crew member suffered from a broken leg and a head injury. It was the third time in a month that this crew would moor this vessel between the buoys in the port. The crew on the forecastle and the procedures to be followed were the same as those during the preceding two mooring manoeuvres on 2 and 15 March 2010. Due to the late arrival of the pilot\*, the mooring manoeuvre was initiated 2.5 hours later than planned. As a result, the manoeuvre was performed when the tidal current, was nearly at its peak: the moment at which the current is at its strongest. The speed of the current, it was spring tide, upon arrival at the buoys was estimated at 2–4 knots by the Captain<sup>3</sup>.

In the Pululu approach channel of Kwanda Base, which is a part of the port of Soyo, two mooring buoys, specifically placed for the delivery of the cargo, were present, between which the vessels of the shipping company could moor. The distance between the mooring buoys was approximately 350 metres. Partly in view of the distance to the mooring buoys, the length of the fixed mooring lines and the current, the crew deemed it desirable to extend the fixed mooring lines on the winch drum at the forecastle just before initiating the mooring manoeuvre.

After the crew had secured two mooring lines from the forecastle to the mooring buoy, both mooring lines did not immediately attain an equal tension. The mooring lines had namely not been secured to the mooring buoy at the same time, but shortly after each other. Due to the strong lateral current, the vessel was already drifting away during this operation. Consequently, the mooring lines could not be set to the same tension in due time, as a result of which all forces were borne by the starboard mooring line only, which was secured first.

While the tension on the starboard mooring line was increasing, a few of the crew members were in the area between the winches and the released mooring lines and were therefore within the danger zones of these lines, should they break.

Before the starboard mooring line attained the maximum load, the mooring line slid off from the vertical mooring line guide and hit at great speed and subsequently broke a spindle of the anchor chain stopper on deck. Two crew members were injured, one of which fatally, by mooring line parts that flew off as the line broke.

The portside mooring line broke approximately five minutes after the starboard mooring line had broken, due to overloading. The crew members had left the foredeck by this time and consequently the breaking of the portside mooring line did not cause any further injuries

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<sup>1</sup> Terms that are marked by an asterisk (\*) are further explained in the glossary.

<sup>2</sup> All times specified in this report are local times (LT).

<sup>3</sup> One knot\* is equal to one sea mile per hour. One sea mile is 1852 metres.

## 2 DATA SUMMARY

### 2.1 General information

Identification number:	M2010SV0401-01
IMO* Classification:	Very serious marine casualty
Date and time of the incident:	1 April 2010, 9:00 a.m.
Location of occurrence:	Kwanda Base, in the port of Soyo, Angola

### 2.2 Vessel particulars

Name:	m.v. Edisongracht
Call sign*:	PDUJ
IMO number*:	9081289
Flag state*:	the Netherlands
Official vessel number*:	9378 ZA 1994
Vessel type:	General cargo with container capacity
Loading and unloading capability:	3 fixed cranes positioned on deck
ISM* manager:	Spliethoff Agency & Forwarding B.V.
Registered owner:	Transport Qamutik, Canada
Bareboat charterer*:	C.V. Scheepvaartonderneming Edisongracht, Amsterdam
Home port:	Amsterdam
Classification society*:	Lloyd's Register of Shipping
Year of built:	1994
Length overall (LOA)*:	137.16 metres
Length between perpendiculars (LPP)*	127.14 metres
Breadth:	18.90 metres
Max. draught (summer)*:	8.51 metres
Deadweight (summer):	12754 tons
Gross tonnage*:	8448 gt
Net tonnage*:	4651 nt
Minimum required crew:	10
Last survey:	26 August 2008
Vessel certificates:	All valid

### 2.3 Voyage particulars

Destination:	Unloading location, between mooring buoys in Kwanda Base, in the port of Soyo
Departure:	Anchoring location, near the port of Soyo
Crew:	18
Voyage type:	International trade
Cargo:	Pipes for local offshore project
Pilot on-board:	Yes

### 2.4 Weather and current data

Wind direction:	East
Wind speed:	10 knots
Current:	spring tide
Current direction:	North-East
Current speed (estimated):	2-4 knots

High tide time/water level<sup>4</sup>: 05:37 a.m./1.8 metres (on 1 April, 2010)  
Low tide time/water level: 11:29 a.m./0.5 metres (on 1 April, 2010)

## 2.5 Port characteristics

Location: Kwanda Base (see figure 1), part of the port of Soyo at the mouth of the Congo River in Angola. The Congo is the fifth largest river of the world with regard to length but the world's second largest river with regard to water volume. The river can be navigated up to 80 miles inland by ocean-going vessels.

Sailing area properties: Tidal port, twice-daily tide: twice a day high tide and twice a day low tide with intervening times of approximately six hours.

Compulsory pilotage: Compulsory pilotage for vessels from 500 GRT (Admiralty Sailing Directions (Africa Pilot Vol. II, edition 2007))<sup>5</sup>.

Details: Large differences can occur between surface currents and undercurrents.  
Warnings are issued that navigation data for this area can be unreliable.  
An LNG (Liquefied Natural Gas) terminal is under construction at the port site, south-east of the mooring buoys.



Figure 1: Local map of Kwanda Base, including the location of the mooring buoys<sup>6</sup>  
(source: Google Earth, map data: 18 September 2009)

<sup>4</sup> Source: Admiralty Tide Tables, Volume 2, 2010

<sup>5</sup> An information booklet for seamen that includes details regarding navigation, buoyage systems, meteorological data, pilotage data, regulations and port facilities.

### **3 FACTUAL INFORMATION**

#### **3.1 Before the accident**

A few weeks before the accident the vessel had sailed from Europe to the anchoring location at the port of Soyo, loaded with cargo (pipes) for a local offshore project. Several vessels of the shipping company had undertaken this voyage before, and had also moored between the mooring buoys at unloading location. These mooring buoys in Kwanda Base were specifically placed for the delivery of the cargo for this project.

The vessel left its berth in the vicinity of Soyo, Angola on 1 April 2010 around 07:30 a.m. Since its arrival in Angola, the vessel was moored between the mooring buoys two times prior to the day of the accident (on 2 March and 15 March 2010) to discharge part of its cargo. The cargo, that consisted of cement-coated pipes, could not be unloaded to the pontoon, for which tug assistance was present for the transfer to the specialised pipe layer, in one instance due to logistical reasons. After each time that a part of the cargo was discharged, the vessel returned to the anchoring location awaiting the next (partial) unloading. The discharge operations were planned and prepared by the offshore company.

The local authorities and the offshore company had agreed that the pilot would come on board in the approach channel at 6:00 a.m. to moor the vessel between the mooring buoys during slack tide. The Captain was also aware of this agreement. The pilot, however, did not arrive at the vessel at the agreed time. Around 8:00 a.m., the vessel, without the pilot on board and at a low speed, entered the approach channel with permission of the port authorities and with the assurance that the pilot would soon arrive (see figure 2 below). The pilot came on board at around 8:30 a.m., at which time the vessel had nearly arrived at its destination.

By this time, the mooring preparations on the forecastle and aft deck had already been completed. The second officer was in charge on the forecastle. He was assisted by the boatswain and three AB's. The third officer was in charge at the aft deck. He was assisted by two AB's and an apprentice.

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<sup>6</sup> Local map is the most recent Google Earth version and shows the situation about seven months before the accident. It could not be determined whether relevant changes have been made to the waterways.



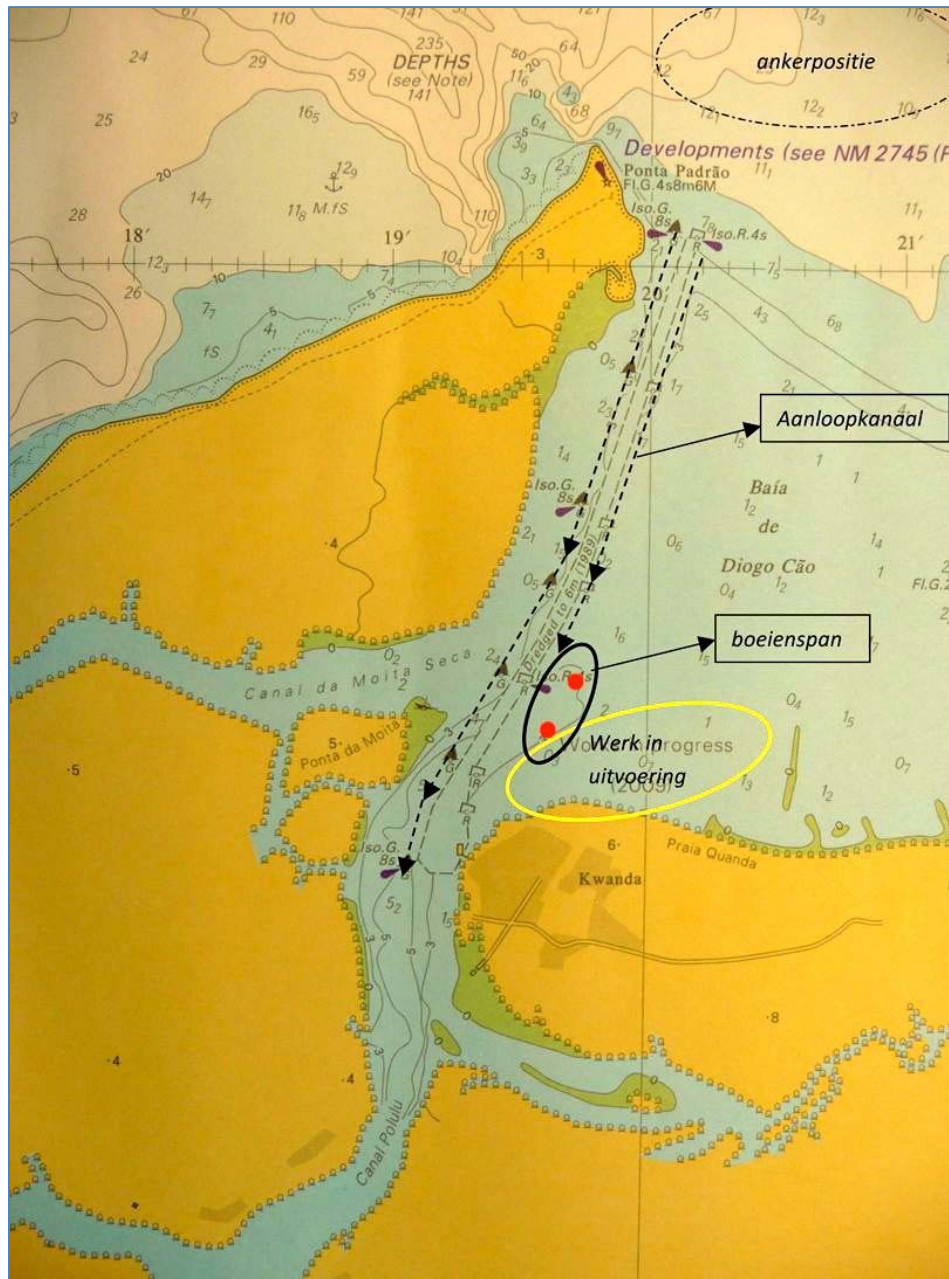


Figure 2: Local map of Pululu approach channel, including the mooring buoys and Kwanda Base (source: BA 658 sea chart, issued 22 May 2008)

### 3.2 Mooring between the mooring buoys

The intention was to execute the mooring manoeuvre in a similar way as the two previous times the vessel was moored between the mooring buoys. The only difference was that the mooring lines would now be released through the centre lead\* because difficulty was experienced the previous two times with keeping the mooring lines at the same tension.

### 3.3 Tug assistance

The vessel would be assisted by two tugs during turning and positioning between the mooring buoys. (For a schematic representation of the performed manoeuvres see figure 3 below.)

The vessel was turned around, under pilot's advise in the channel near the mooring buoys (see position 2 in figure 3). The two tugs, on standby, assisted as found necessary.

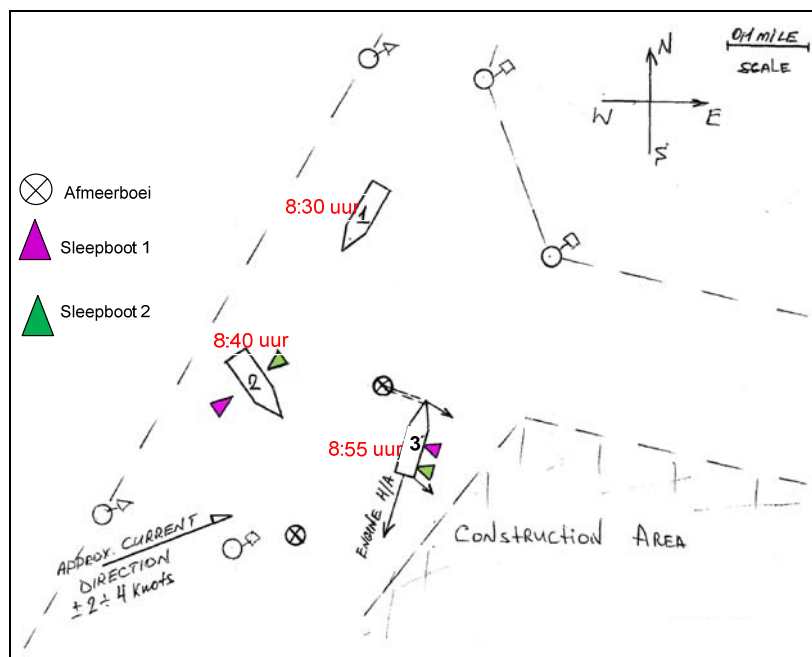


Figure 3: The performed manoeuvres (source: shipping company)

### 3.4 Setting out the mooring lines

The vessel was positioned between the mooring buoys with the assistance of the tugs. Similar to the two previous times, both the fore and stern would be secured to the mooring buoys, with the bow of the vessel facing the northern direction. In order to bridge the distance to the mooring buoy, which was approximately 90 metres, the fixed starboard mooring line on the winch drum was extended with another mooring line with a minimum breaking load (MBL<sup>7</sup>) of 36.3 tons (see figure 4) through a steel shackle with a Safe Working Load (SWL<sup>8</sup>) of 20 tons. Synthetic mooring lines with a maximum strain of 18% were used on board the vessel.



Figure 4: Example of a comparable mooring line extension as used during the mooring manoeuvre

Around 8:50 a.m., the extended starboard mooring line was released through the centre lead of the forecastle and brought to and secured to the mooring buoy by boatmen\*, using a motorboat. A second mooring line that had been extended in the same way as the starboard mooring line and originated from the fixed port winch was also released by the centre lead and secured by the boatmen to the mooring buoy. In the meantime, the pilot directed the tug from port to starboard in order to prevent the vessel from being drifted away by the current, aiming to keep the vessel at its

<sup>7</sup> SWL = Safe Working Load: the maximum allowed load for lifting tools such as shackles and cranes.  
<sup>8</sup> MBL = Minimum Breaking Load: the minimum load a mooring line should be able to withstand without breaking. For a mooring line the MBL is generally determined through a combination of designer calculation and testing (trial and error). The SWL is subsequently determined by applying a safety factor on an MBL.

position. Both tugs on the vessel's starboard were next instructed to push at "full power". The vessel's main engine was put to "slow astern" and shortly after to "half astern" aiming to stop the vessel from drifting away. The bow thruster was not used to keep the vessel's bow near the mooring buoy. The Captain wanted to prevent the stern from going too far towards the quay under construction, on the vessel starboard side.

### 3.5 The accident

Despite all efforts, the vessel could not be kept in position with the assistance of the tugs after it had been positioned between the mooring buoys. Ultimately, as a result of the strong current the vessel drifted away from the front mooring buoy to the south and, later, to the south-east (see position 3 in figure 3). Due to this, the two mooring lines that were released through the centre lead were not directed straight ahead, but veered sharply to port. The crew could not keep both mooring lines under equal tension. Consequently, the starboard mooring line was put under considerable tension, slid off from the stand roller fairlead and hit with great force a spindle of the anchor chain stopper on deck (see figures 5 and 6).

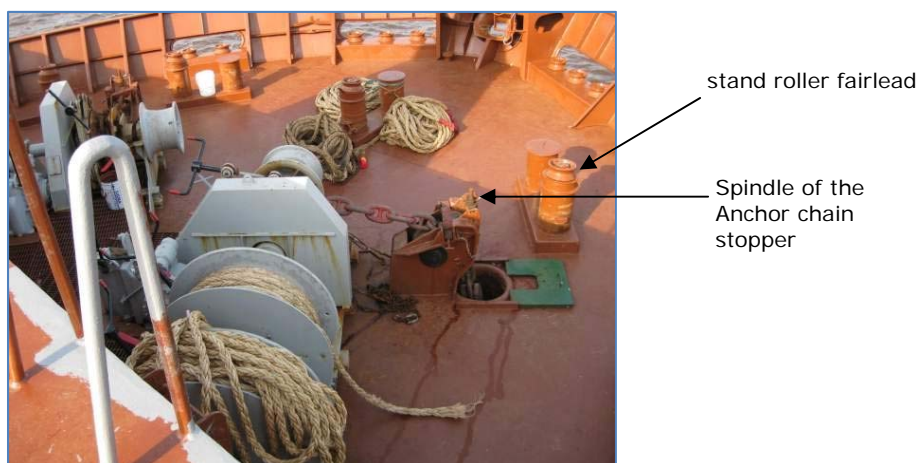
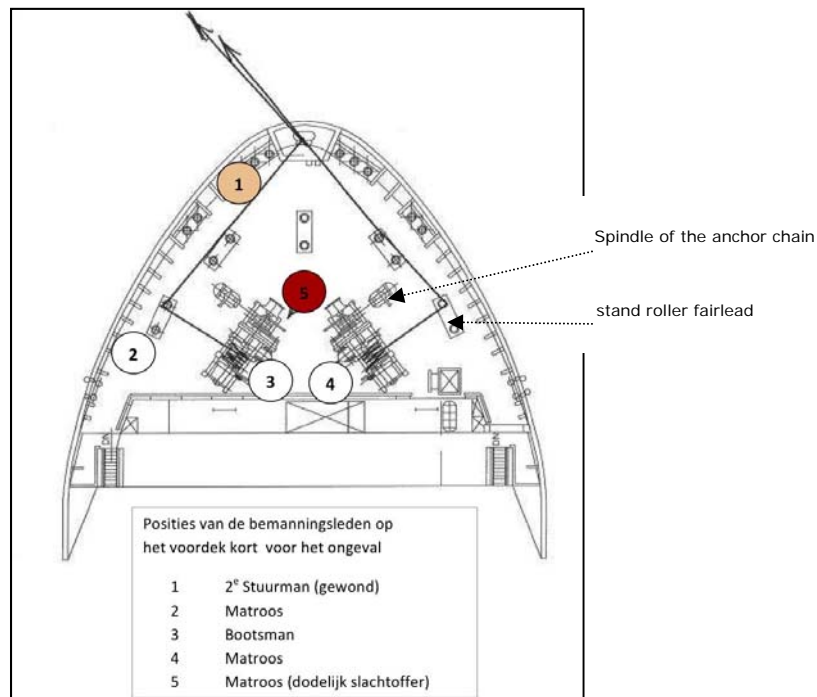


Figure 5: Photo of the foredeck of the m.v. Edisongracht



*Figure 6: Crew member positions and cover of the mooring lines just before the accident*

As a result, the mooring line immediately broke in half. The break occurred just behind the splice of the mooring line's eye. One of the AB's was fatally injured by parts that flew off the mooring line. The parts also hit the second officer, who fractured his upper leg and sustained a head injury from falling on the deck.

After this, the vessel was only secured by the mooring line from the port winch. The tension on this mooring line became too high and, ultimately, the line broke as a result of overloading. The end of the broken starboard mooring line showed a nearly straight sharp break (see figure 7). The port mooring line, on the other hand, showed a frayed break pattern (see figure 8).



*Figure 7: Photo of the starboard mooring line fracture surface*



*Figure 8: Photo of the port mooring line fracture surface*

After both mooring lines had broken, the Captain manoeuvred the vessel to the north of the mooring buoys to ensure the vessel would not drift away and hit the quay that was being built. The vessel was finally moored at another quay at 10:05 a.m.

## **4 ANALYSIS**

### **4.1 Before the accident**

Work is being performed in Kwanda Base to build a new LNG terminal. The most recent sea chart for this area (BA 658), which was also available on board of the m.v. Edisongracht, specifies that due to these continuous adjustments to the port there is no general up-to-date and reliable information (i.e. water depths, buoyage systems, current profiles, port facilities, etc.) about the local situation. Up-to-date information needs to be obtained from the local port authorities. A warning specifically for this area is provided in the Admiralty Sailing Directions (Africa Pilot Vol. II), which was available on board the m.v. Edisongracht, that vessels may be very difficult to manoeuvre or not be manoeuvrable at all as a result of the large differences between surface currents and undercurrents.

The Captain could only find reliable information about the time of high and low water with the fall in the tide tables. The Captain was therefore aware that it would be spring tide<sup>9</sup> that morning. For the required voyage planning the Captain also received information from the local representative of the offshore company. Also, information issued by the shipping company was used. This information was based on earlier experiences gained in Kwanda Base during the previous voyages that were performed for this project. It was the third time that the Captain performed this manoeuvre. As such, he as well as the other crew had experience with the mooring manoeuvre to be performed between the mooring buoys. The Captain also knew that using the anchor during the mooring manoeuvre was not allowed in the port.

The Captain had been informed by the shipping agent that the offshore company with permission from the port authorities, had arranged that the pilot would come on board in the Pululu channel at 6:00 a.m. This would mean that the vessel could execute the mooring manoeuvres at approximately 6:00 a.m., at which time it would be nearly slack tide. During slack tide there is no appreciable tidal current. The Captain had tried to contact the port authorities almost every hour that morning as from 4:00 a.m. He was told by the port authorities that the pilot would not board the vessel at the agreed time. A reason was not given. After the Captain was assured by the authorities that the pilot would board soon, he was given permission to already sail into the Pululu Channel. He started to haul in the anchor at approximately 06:50 a.m. At that moment the Captain knew that he could not execute the mooring manoeuvres on slack tide. Next, at around 07:30 a.m. he set course to the entrance of the channel. The vessel reached the entrance of the channel at 07:50 a.m. The Captain, still waiting for the pilot, kept the vessel running and tried to contact the pilot station several times. The pilot station assured the Captain each time that the pilot would board soon.

The pilot eventually arrived on board that morning at around 8:30 a.m. when the vessel was already sailing near the mooring buoys. Due to the late arrival of the pilot, the mooring manoeuvre was initiated 2.5 hours later than planned. As a result, the mooring manoeuvre was executed when the tidal current was nearly at its peak: the moment at which the current is at its strongest. Moreover, the current was also more stronger than usual because of the spring tide (outgoing/ingoing tide approximately 1-3 knots on average and, with spring tide, 2-4 knots<sup>10</sup>). This spring tide also caused the current flow not to run in the North-South direction of the channel, as

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<sup>9</sup> Spring tide: When the Sun, Moon and Earth form a straight line (which occurs twice a month), they combine their forces and attract more water. The level of the water is then higher with high tide and lower with low tide. More flow is created between the tides than with the normal tide due to this difference in fall.

<sup>10</sup> Source: Admiralty Sailing Directions (Africa Pilot Vol. II, 2007 edition).

usual, which would have been parallel to the heading of the vessel, but to run somewhat crosswise to the vessel. This lateral current was caused by the additionally high water level, through which sandbanks were washed over and water could flow into the channel without being hampered. The current estimated by the Captain on arrival between the mooring buoys was 2-4 knots<sup>11</sup>.

The moment at which the mooring manoeuvre between the mooring buoys initiated, was unsuitable due to the very strong tidal current that was present when the accident occurred. These unfavourable conditions were encountered as a result of the decision to moor the vessel between the mooring buoys despite the delay of 2.5 hours.

The Captain knew that he would not be able to execute the mooring manoeuvre during slack tide as a result of the postponed departure and that a spring tide would be present. What the Captain possibly could not have known and the pilot should well have known, is that this spring tide would now run slightly crosswise of the vessel. Normally, this current would run in the North-South direction of the channel and therefore lengthwise of the vessel. This unusual diagonal current was the result of water running over the sandbanks, which could now flow freely without any obstacle. It could not be determined whether or not the Captain was informed about this.

The Captain, who has the ultimate responsibility, must have sufficient information to ensure he can safely manoeuvre. In this instance, the Captain was to a large extent depending on local knowledge and judgements of the pilot and port authorities. The Captain was - as transpired later - repeatedly incorrectly informed about the arrival time of the pilot and was not or insufficiently informed by the pilot that the moment chosen to initiate the mooring manoeuvre was unsuitable.

#### **4.2 Mooring between the mooring buoys**

In the port of Kwanda Base two mooring buoys that were specifically placed for this project were present between which the vessel had to moor. The distance between the mooring buoys was approximately 350 metres. The location between the mooring buoys is used to speed up the unloading of the cargo. This way, the transfer of the pipes to the work boats can take place on both sides of the ocean-going vessel with its on board cranes. It was deemed desirable by the crew to extend the mooring lines by using mooring lines with the same breaking load (36.3 MBL) due to the length of the m.v. Edisongracht, the length of the fixed mooring lines on the winches and the current that was flowing. The mooring lines were, however, connected using a shackle with a lower maximum allowed load (20 SWL). This means that these parts (i.e. the mooring lines and shackle) were not properly matched.

#### **4.3 Tug assistance**

It was the third time in a month that this crew would moor the vessel between the mooring buoys in the port. Just like the previous two times the vessel was assisted by two tugs that sailed alongside the vessel in standby mode during the mooring manoeuvre between the mooring buoys. These tugs were stationed at the port of Soyo. Under the conditions that prevailed at the previous two times (average tide and little to no current), the performances of the tugs were sufficient to turn the vessel around, to stop it between the mooring buoys and to ensure it stayed in that position.

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<sup>11</sup> The Guidelines of Port Entry of Kwanda (review: 01-12-2008) specify that current speeds of more than five knots can be present at Kwanda Base.  
For reference purposes: The average peak current speed as a result of the effect of the tides on the Nieuwe Waterweg (Port of Rotterdam, the Netherlands) is approximately 2.7 knots.



The pilot communicated with the Captains of the tugs about their task during the manoeuvres. As during the previous two times, it was decided not to fasten the tugs to the vessel but only have them push the vessel upon request. This working method was used during both the manoeuvre to turn the vessel around as well as the manoeuvre to position the vessel between the mooring buoys. The turn-around was, in first instance, performed according to plan by the vessel without the assistance of the tugs. The tugs were, however, on standby, one on each side of the vessel. After turning, however, the vessel started drifting to starboard due to the strong (lateral) current. Consequently, assistance of both tugs was requested. The pilot asked the tug that was still on the portside of the vessel after the turn-around manoeuvre to sail around to starboard and along with the other tug to push the vessel on its starboard side. However, the tugs could not keep the vessel in position between the mooring buoys.

#### **4.4 Setting out the mooring lines**

The crew on the forecastle was to the same as the previous two times. In advance, it had been discussed on board that the mooring procedure would be very similar to the previous times but with the difference that the forward mooring lines would be passed through the centre lead. The Captain wanted this because during the previous times it had emerged that it was difficult to keep the mooring lines at tension when they were passed through the side leads. The intention was to first give two mooring lines of the forecastle followed by four of the stern and, to conclude, another two mooring lines from the forecastle to the mooring buoys. On both sides the mooring lines were guided under a square angle along the stand roller fairleads (see figure 5) on deck and through the centre lead. The two mooring lines on the fore were released approximately two minutes after each other. This was necessary because the motorboat that was used by the boatmen could not handle two mooring lines at the same time. They waited with bringing the first mooring line under tension until the second mooring line was also secured to the mooring buoy. This was to prevent the mooring buoy being pulled under water, which would make it impossible to secure the second mooring line. Both mooring lines did not directly attain equal tension after having been secured to the mooring buoy, in part because the released lengths of the mooring lines turned out not to be the same. As a result, all forces were borne by the starboard mooring line only. According to the second officer's statement, he informed the Captain about this. The Captain who could not see the foredeck was under the impression that both mooring lines had been released under equal tension and that no further action was required. The second officer, in turn, instructed the other crew members on the forepeak that they should prevent the mooring lines from veering out.

A number of crew members were still on the foredeck between the winches and the released mooring lines (see figure 6) whilst the tension on the starboard mooring line was further increasing as the vessel was drifting away due to the strong current. In case of a breaking mooring line, this is a very dangerous situation due to the unpredictable behaviour of a mooring line.

Only when the second officer noticed that the mooring line was at the point of breaking and he warned his colleagues about this, did the crew members try to find a safe place to go to. However, there turned out to be insufficient time for this. Due to the thickening and deformation of the mooring line connection (i.e. the splices, mooring lines' eyes and the shackle) the mooring line no longer fitted properly in the profile of the guide roller at that moment in time, due to which it slid off the stand roller fairlead and broke when hitting the spindle of the anchor chain stopper (see figure 5). The starboard mooring line swept over the deck after it broke.

The shape of a guide roller determines the maximum mooring line diameter to be used. The extended mooring line could run off the guide roller because the splices, the mooring lines' eyes and the shackle, with their increased diameter and irregularities, were not kept free, but were guided through the guide roller.

The crew on the foredeck has not realised that by extending the mooring line the risk was increased that the mooring line would slid off the stand roller fairlead and subsequently break.

Approximately five minutes after the starboard mooring line broke because it slid off the fairlead, the port mooring line also broke due to overloading.

The fracture surface of the starboard mooring line was sharp, which indicates a local load (cutting and/or damage). The fracture surface of the port mooring line had a frayed end, which is typical for a fracture due to overloading.

#### **4.5 The Voyage Data Recorder**

The m.v. Edisongracht was equipped with a functioning Simplified Voyage Data Recorder (S-VDR) at the moment of the accident. The recorded data of an S-VDR contains relevant factual information useful for accident investigations such as ship's positions, directions and bridge communication. In case of a serious accident this data has to be secured manually. Without intervention the data is automatically overwritten after a certain period of time. For the S-VDR of the m.v. Edisongracht, without intervention, recorded data is overwritten after 12 hours. Unfortunately, the Captain omitted this procedure of securing the VDR data. Data regarding the ship's navigation and VHF-conversation were not available for use in the accident investigation. The lack of this data has hampered the investigation with regard to the reconstruction of the manoeuvres and communication. Although there are no legal obligations with regard to the securing of VDR data and also no procedure was included in the company manuals, this omission has impeded the independent investigation.

Although the vessel was equipped with a Simplified Voyage Data Recorder (S-VDR), the data was not stored and therefore no data regarding the manoeuvres and communication was available for use in the investigation. This omission has impeded the accident investigation.

#### **4.6 Safeguarding safety on board the vessel by the shipping company**

##### *4.6.1 The Risk Assessment of the shipping company*

The shipping company had a "Risk Inventory and Evaluation" (RI&E)\* and a Safety Management System\*. However, at the time of the accident, these documents did not contain any additional procedures or guidelines for mooring and unmooring between mooring buoys when a current is present. The accident has been a reason for the shipping company to pay special attention to this. Attention has now been paid in the supplement to the Workplace risk assessment of 14 April 2010 to the risks that exist when mooring and unmooring between the mooring buoys in Kwanda Base. The shipping company has used the Health and Safety Sheet Mooring and unmooring (D101)<sup>12</sup> as the starting point, but further expanded this. In this Health and Safety Sheet the specific measures

<sup>12</sup> Health and Safety Sheets are part of the health and safety catalogue for ocean shipping. Health and Safety Sheets are meant to be used by employers to meet the obligations arising from the Dutch Working Conditions Act. Employees can subsequently use the Health and Safety Sheets as a checklist. The Health and Safety Sheets describe the measures that must be implemented to ensure that work can be performed safely.



are described that must be implemented on board ocean-going vessels to ensure that work is performed safely. However, this Health and Safety Sheet describes the procedures and measures for mooring at the quay: the specific mooring and unmooring *between mooring buoys (and in presence of currents)* is not described. The shipping company has, therefore, not only expanded the general measures for use on their own vessels with mooring and unmooring between mooring buoys but has also tightened these measures by assigning the complete forecastle deck\* in its RI&E as a danger zone (snap-back\* zone).

Due to the often complex lashing of mooring lines over mooring line guides (amongst others), the location of a mooring line failure and subsequent behaviour are unpredictable. It is therefore difficult to determine safe places for crew members to stand clear.

#### *4.6.2 The internal accident investigation by the shipping company*

The shipping company started an internal investigation after the accident. The Dutch Safety Board has received the shipping company's internal investigation report. The internal investigation report indicates that the cause for the breaking of the first mooring line is the sliding off of the mooring line from the stand roller fairlead due to the increasing tension. Next, the mooring line, that was still under tension, hit a spindle of an anchor chain stopper and broke on the point of contact. The port mooring line then broke due to overloading. The fracture surfaces of the starboard and port mooring line correspond to the statements of the shipping company and crew regarding the accident.

The Dutch Safety Board, after analysing of the data regarding the accident, agrees with the direct cause of the accident as found by the shipping company. During the course of the investigation, the Dutch Safety Board was informed by the shipping company of some additional measures that were taken to try to prevent accidents from occurring in the future. The shipping company did not only extend the RI&E almost immediately after the accident to include measures specifically for mooring and unmooring between mooring buoys, but also tailored the general information from the applicable Health and Safety Sheets for ocean-going vessel for use on their own vessels. The Dutch Safety Board has, however, observed that safety when mooring and unmooring between mooring buoys is not yet sufficiently safeguarded for all parts despite this tightening and expanding of measures. During the accident, the mooring line broke because it had been extended and, because of the shackle that was used and the thick mooring line splices, was no longer led through the stand roller fairlead correctly. When the mooring line was put under tension, it slid off from the fairlead's roller, just behind the splice of the mooring line's eye. The company's own accident investigation report has paid attention to the lengthening of mooring lines. It is stated lengthening lines should be avoided by using longer lines. In the "workplace risk assessment/ JSA" and the "safe working manual" however, lengthening of lines is not addressed.

## 5 CONCLUSIONS

- The moment at which the mooring manoeuvre between the mooring buoys initiated, was unsuitable due to the very strong tidal current that was present when the accident occurred. These unfavourable conditions were encountered as a result of the decision to moor the vessel between the mooring buoys despite the delay of 2.5 hours
- The Captain, who has the ultimate responsibility, must have sufficient information to ensure he can safely manoeuvre. In this instance, the Captain was to a large extent depending on local knowledge and judgements of the pilot and port authorities. The Captain was - as transpired later - repeatedly incorrectly informed about the arrival time of the pilot and was not or insufficiently informed by the pilot that the moment chosen to initiate the mooring manoeuvre was unsuitable.
- The crew on the foredeck has not realised that by extending the mooring line the risk was increased that the mooring line would slid off the stand roller fairlead and subsequently break.
- The shipping company has made a recommendation in their accident investigation report that lengthening of lines should be avoided. However no specific procedures in the ISM\* related documents have been provided in case mooring lines do need to be extended.
- Due to the often complex lashing of mooring lines over mooring line guides (amongst others), the location of a mooring line failure and subsequent behaviour are unpredictable. It is therefore difficult to determine safe places for crew members to stand clear.
- The shape of a guide roller determines the maximum mooring line diameter to be used. The extended mooring line could run off the guide roller because the splices, the mooring lines' eyes and the shackle, with their increased diameter and irregularities, were not kept free, but were guided through the guide roller.
- There are no (inter)national legal obligations with regard to securing (S-)VDR recorded data. There were also no company procedures included in the ship's instructions on when to store (S-)VDR recorded data. As a result, the relevant data was overwritten, which has impeded the accident investigation.

Note: This report has been published in the English and Dutch language. If there are differences in interpretation the Dutch text prevails.
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## ANNEX 1: GLOSSARY

Bareboat charter	Vessel chartering arrangement where the people chartering pay a specific sum for just the vessel <i>without</i> crew. All additional costs such as those related to insurance and crew are borne by the people chartering the vessel.
Boatmen	Quayside personnel who assist when mooring and unmooring of ocean-going vessels in a port.
Call sign	The radio call sign of a vessel that is used to identify from whom a radio call originates. The call sign for Dutch ocean-going vessels starts with the letters PA to PI followed by two letters.
Call sign	The radio call sign of a vessel that is used to identify from whom a radio call originates. The call sign for Dutch ocean-going vessels starts with the letters PA to PI followed by two letters.
Centre lead	Central opening in the upright wall -the bulwark- of the foredeck for passing through mooring lines.
Classification society	Organisation that determines the rules regarding the build and equipment of vessels and supervises this through surveys. Classification societies may be recognised by flag states to perform work for certifying purposes on behalf of the flag state.
Flag state	State to which a vessel belongs and is, therefore, entitled to wave the relevant flag.
Forecastle deck	The deck where the mooring and anchoring gear of the fore is set up.
Gross tonnage (GT)	Vessel size based on which it is determined which legislation applies to a vessel.
IMO	International Maritime Organization
IMO number	Unique international vessel identifying number consisting of 7 digits that is allocated when newly built and does not change when registration changes.
ISM	International Safety Management
Knot	One knot is one sea mile per hour (1.852 km/hour)
KVNR	Royal Dutch Shipowners Association
LOA (Length overall)	Maximum length of the hull of a vessel measured over the water.
LPP (Length between perpendiculars)	Length between perpendiculars – length size of a vessel based on which it is determined which legislation applies to a vessel.
LT	Local time
Maximum draught	Maximum allowed draught up to where a vessel may be loaded. A distinction is made into summer, winter and tropical areas as well as fresh and salt water for certification purposes.
Minimum Breaking Load (MBL)	Minimum breaking load that can be resisted by a mooring line before it breaks.
Mooring buoys	Berth where the vessel is moored between mooring buoys without any further contact with other port mooring facilities.
Nautical mile	1,852 km
Net tonnage (NT)	Vessel size for the loading capacity.

Official vessel number.	National registration number.
Pilot	The person who advises the Captain of an ocean-going vessel or who replaces him with regard to navigation due to his or her knowledge of the fairway.
RI&E	Risk Inventory and Evaluation: an investigation into the risks within operational management with regard to health and safety of employees that is mandatory in accordance with the Dutch Working Conditions Act.
Safe Working Load (SWL)	A size for the maximum allowed load of lifting tools such as shackles, wires and cranes.
Safety Management System (SMS)	The International Safety Management Code sets minimum requirements with regard to the mandatory safety management system (generally known as the Safety Management System) on-board and its goal is to promote safe operational management on-board and to prevent contamination by vessels.
Snap-back zone	Zone in which the snap-back of a broken mooring line may take place. The snap-back zone may be large and unpredictable especially when mooring lines are set out under an angle.
SOLAS Convention	(International Convention for the Safety of Life at Sea ) - international treaty that falls under the IMO in which requirements are set regarding vessel safety.
Spindle	Shaft with screw thread.
Voyage Data Recorder (VDR)	A mandatory system in accordance with the SOLAS Convention* used on board that records prescribed data of the vessel (such as radar images, position and communication on the bridge) where the intention is that this data can be used for an investigation into the causes of an accident. A Simplified Voyage Data Recorder (S-VDR) is a simplified option for which less strict design and recording requirements exist.

## **ANNEX 2: INFORMATION SOURCES**

- Internal investigation report into the accident on board the m.v. Edisongracht on 1 April 2010 at Soyo, Angola (Spliethoff, final version, 14 July 2010)
- Workplace risk assessment/JSA Shipping company with regard to offloading to barges at Soyo Bay, Angola (14-04-2010)
- Safety Management System of the shipping company
- Drawings showing the position of objects during manoeuvres
- Crew statements: Captain, officer, boatswain, mates (2)
- M.v. Edisongracht crew list
- Photos of the accident site
- Photos of mooring line fracture surfaces
- Mooring line certificate copy
- Crew member work lists
- Mooring and unmooring, Health and Safety Sheet D101
- Admiralty Sailing Directions (Africa Pilot Vol. II, 2007 edition)
- Guidelines of Port Entry of Kwanda (review: 01-12-2008)
- Admiralty Charts and Publications, 658, Entrance to River Congo, 2008 (latest chart)
- Admiralty Tide Tables, Vol. 2, NP 2020-10, 2010-10-21
- Mooring arrangement, Acergy (06 May 2009)
- Internet Google Maps (consulted during the investigation in 2010)
- Vessel's logbook
- Load plan
- ISM report to the Inspectorate
- Anchoring, mooring and towing operations (MSCP01/Ch25/Rev1.03)

## ANNEX 3: HEALTH AND SAFETY SHEET MOORING AND UNMOORING



# D101

This ARBO chapter is part of the Health and Safety Index for the shipping industry.

It is intended to help employers to comply with the requirements of health and safety legislation. It may be used as a checklist by employees.

It contains the necessary measures to be taken in order to safely carry out certain work-related activities.

Compliance with these regulations, or alternative regulations offering an equivalent level of protection, is essential.

This chapter contains health and safety regulations to ensure safe mooring and unmooring procedures.

### Employees' checklist

- Always use an adequate number of crew when mooring/unmooring
- Make each other aware of unsafe situations
- Familiarise yourself with the equipment used in order to be able to spot any wear and tear at an early stage
- Provide supervision at stem and stern whilst mooring/unmooring
- Has the mooring plan been discussed?
- Use well-working communication equipment
- Do not carry out more than one aspect of the job at any one time (like manning winch and handling ropes)

## Mooring and unmooring

This chapter contains the measures that must be taken to ensure the safe mooring and unmooring and to minimise potential hazards.

### PPE to be used



### Various factors in mooring/unmooring vessels:

In order to safely moor/unmoor seagoing ships, a number of factors will have to be taken into consideration. In addition, equipment, experience and on-board organisation are vital in ensuring smooth mooring/unmooring:

- Availability of sufficient (experienced) crew
- Mutual supervision
- Preparation
- Communication
- Sound division of labour and appropriate supervision
- Maintenance of all equipment

### Be vigilant

In many instances accidents do not happen because of the complicated nature of a manoeuvre, but rather because of lack of care and attention whilst carrying out a (simple) job:

- You have a legal obligation to point out unsafe routines and/or incorrect usage of protective equipment to the people you work with.



# D101



## Organisation and safety

- ✓ Communication equipment has been tested and agreement has been reached on the division of labour; the crew has been briefed on the mooring plan.
- ✓ All supervising officers are familiar with the nature of the equipment used. Experience and vigilance are vital in the prevention of accidents
  - Supervising officers shall have a working knowledge of:
    - The characteristics of the ropes, springs and warps used
    - The ropes' breaking strength
    - The criteria for condemning ropes, springs and warps
    - Operating winches
    - Communication
    - Holding power brake band
    - Winches' self tensioning properties
    - Winches' heavingpower
    - The mooring plan
    - The location of capstans and hawsoles and the correct handling of mooring ropes along them
    - The work to be carried out
    - The snap-back zones (see schedule of danger zones)
- ✓ Supervision over and operation of winches and capstans should be in the hands of experienced crew.
- ✓ Officers in charge should have an overall picture of the situation at all times
- ✓ Preparation of the work space is vital to safety at work.
- ✓ Work should only be carried out by authorised persons.

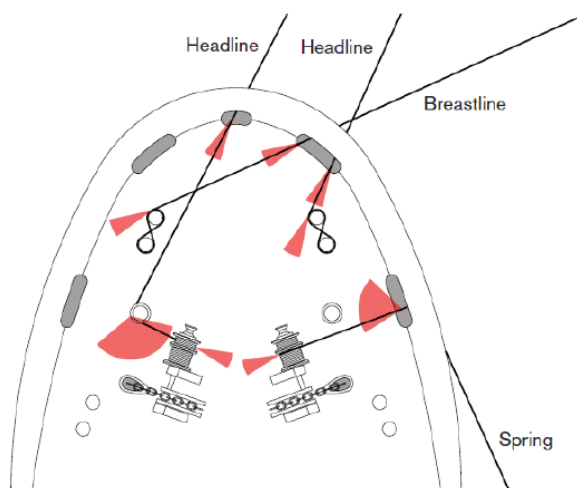
## Equipment



- ✓ All tools and equipment used should be inspected and maintained regularly.
- ✓ All of the mooring gears movable parts should be current.
- ✓ The surfaces of all hawsoles, fairleads, cable guides, bollards and warping ends should be kept clean and in good working order
- ✓ Ropes and warps should be in good condition and should have been inspected

# D101

By being familiar with the danger zones on deck, crew members will become aware of the potential hazards present.

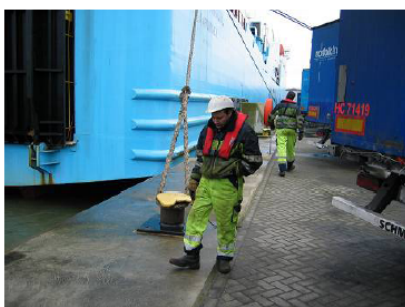


Marked zones: snap-back zones.



- ✓ Care, control and maintenance are of prime importance, however, always be aware that ropes may snap at any time.
- ✓ Lay-out and equipment –and therefore the mooring plan too– are different on every ship. For that reason make sure to study a ship's lay-out on boarding.
- ✓ The operational direction will have been clearly marked, both on the drum and the handle
- ✗ Unclear workspaces increase the risk of accidents.

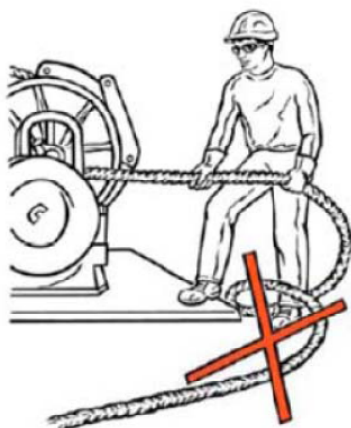
## Mooring and unmooring



- ✓ An adequate number of experienced crew will be available
- ✓ Whilst moored, regular checks should be carried out to ensure that the vessel is still alongside safely ("mooring rounds")
- ✓ Crew will take into account the effects of:
  - The wind
  - The current
  - Suction from passing ships
  - Waves and swell
  - The tide
  - The ships movements as a result of cargo operations
- ✓ Always maintain a safe distance from warping ends/drums to prevent becoming trapped. (keep hands and fingers free)



# D101



- ✓ Sound communication between ship and shore (and tug if and when applicable) is of the essence
- ✓ Wear stout protective gloves to ensure a strong grip as rope burns and steel cables have burrs
- ✓ Be vigilant of observers whilst mooring and unmooring: ropes may snap at any time
- ✗ Do not ever lay ropes and warps around sharp corners. When using a winch, the angle to the hawsole should be as large as possible.
- ✗ Do not ever stand close to taut ropes or warps and stay clear of the snap-back zone.
- ✗ As much as possible, stand behind the warping end when handling ropes; avoid the side of the taut rope.
- ✗ Do not ever stand inside a bend or loop of any rope or warp.
- ✗ Stay clear of moving parts.
- ✗ Beware of heaving lines being thrown aboard from tugs or shore

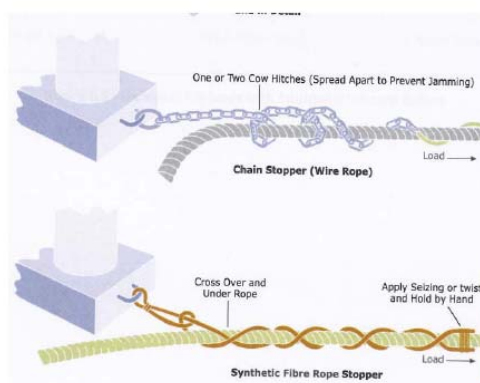
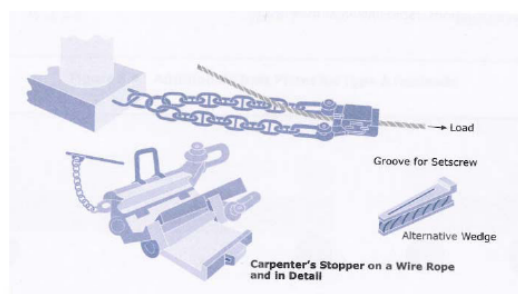
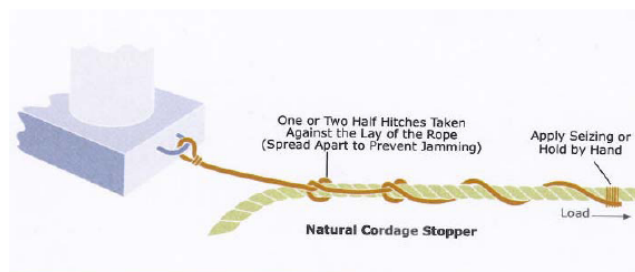


## Stopping and belaying ropes

- ✓ For preference, do not just belay a rope by using figures-of-eight: instead first hitch it twice around the lower side of the bollard (see picture)
- ✓ Using a winch to handle ropes and warps should never be done by one single person.
- ✓ Level out stress on ropes as much as possible
- ✓ Be aware of the different elasticity of the various materials
- ✗ Do not leave stoppers attached to rope after use (see picture)

# D101

Some options for stopping ropes



# D101



- ✗ Avoid too many turns on the drum (picture)
- ✗ Steel cables must not be belayed on top of ropes.
- ✗ When using 'split drum' never allow a double layer on the working part to avoid fouling and/or trapping/damaging ropes.

## Steel cables

- ✓ Steel cables must be stopped with chain stoppers which should run in the opposite direction to that of the cable in question.
- ✓ Steel cables must not kink whilst being ran out or heaved up
- ✓ Only special shackles should be used to connect steel cables to ropes (e.g. Tonsberg)
- ✗ Beware of burrs: use stout leather gloves.

## Physical strain

- ✓ When using mooring gear, the availability of sufficient manpower to reduce physical strain is vital
- ✗ Avoid manual pulling on ropes as much as possible to avoid straining – and possibly injuring – the back.

## Storage

- ✓ After use, ropes should be stored clear of the deck (picture)



# D101

## Further information / documentation used

- ✓ Arbeidsomstandighedenbesluit en beleidsregels  
(Netherlands' Labour Conditions Decree and Policy Rules)
- ✓ "Dat is juist / Safety first"
- ✓ IMCASF P&I publications Jan 2009 Mooring incidents
- ✓ Effective Mooring (OCIMF)
- ✓ Mooring Equipment guidelines Sec edition 1997 OCIMF
- ✓ MCA Code of Safe Working Practice for Merchant Seamen

#### **ANNEX 4: COMMENTS BY INVOLVED PARTIES**

A draft version of this report has been submitted to all involved parties in accordance with the Kingdom Act concerning the Dutch Safety Investigation Board. These parties have been asked for comments and were requested to verify the correctness of the report.

The draft version of this report has been sent to:

- The shipping company;
- Employers' organization Royal Dutch Shipowners Association;
- Trade union Nautilus International;
- The master of m.v. Edisongracht
- The second officer of m.v. Edisongracht
- The Angolan Embassy in Brussels, Belgium

Only the shipping company commented on the draft report.

The Dutch Safety Board has incorporated all received comments in the final report.

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