Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Federal Higher Authority subordinated to the Ministry of Transport,
Building and Urban Development

Investigation Report 413/10

Marine Casualty

Personal accident on the aft manoeuvring station of the hopper dredger WATERWAY while making fast in the port of Emden on 21 September 2010

1 March 2012

The investigation was conducted in conformity with the law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law - SUG) of 16 June 2002 in the version applicable prior to 30 November 2011.

According to said act, the sole objective of this investigation is to prevent future accidents and malfunctions. This investigation does not serve to ascertain fault, liability or claims.

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to the aforementioned version of art. 19 para. 4 SUG.

The German text shall prevail in the interpretation of this Investigation Report.

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1 Summary

At about 0745[1] on 21 September 2010, an accident involving a person occurred on the aft manoeuvring station while making fast the Cyprus registered hopper dredger WATERWAY in the Port of Emden.
The chief officer, who was operating the starboard hydraulic winch and had switched it to hauling, was caught by the line being wound onto the drum while attempting to clear it at the same time with his right foot. He let go of the spring-loaded operating lever of the winch, which then clicked back to the neutral position properly. Due to the winch's technically induced stop delay, it did not stop immediately after the operating lever was released, but – as subsequent tests concluded – only about 3.5 seconds later because of its design. This time delay resulted in the officer being dragged onto the winch by the line. In the process, he suffered a femoral neck fracture and other non-life threatening injuries.

[1] All times shown in this report are local = CEST = UTC + 2 hours.

2 SHIP PARTICULARS

2.1 Photo

Figure 1: Photo[2]

2.2 Vessel particulars

Name of vessel:	WATERWAY
Type of vessel:	Trailing suction hopper dredger
Nationality/Flag:	Cyprus
Port of registry:	Limassol
IMO number:	9240005
Call sign:	5BGD2
Owner:	Royal Boskalis Westminster N.V., Papendrecht
Year built (keel laying/handover):	2000/2001
Shipyard/Yard number:	Merwede Shipyard/686
Classification society:	Bureau Veritas
Length overall:	97.70 m
Breadth overall:	23.00 m
Gross tonnage:	5,395
Deadweight:	6,605 t
Draught (max.):	5.72 m
Engine rating:	6,370 kW
Main engine:	2 x Wärtsilä 6L32
(Service) speed (max.):	12.5 kts
Hull material:	Steel
Minimum safe manning:	15

[2] Source: www.boskalis.com.

2.3 Voyage particulars

Port of departure:	Eemshaven
Port of call:	Emden
Type of voyage:	Merchant shipping/International Dredging work on the Ems
Manning:	15
Draught at time of accident:	./.
Pilot on board:	Yes

2.4 Marine casualty information

Type of marine casualty:	Marine Casualty Accident while operating a mooring winch
Date, time:	21/09/2010, 0745
Location:	Emden Seaport
Latitude/Longitude:	φ 53°20.4'N λ 007°11.0'E
Ship operation and voyage segment:	Berthing manoeuvre
Place on board:	Aft manoeuvring station
Consequences:	One severely injured person

Excerpt from nautical chart 87 (INT 1413), BSH[3]

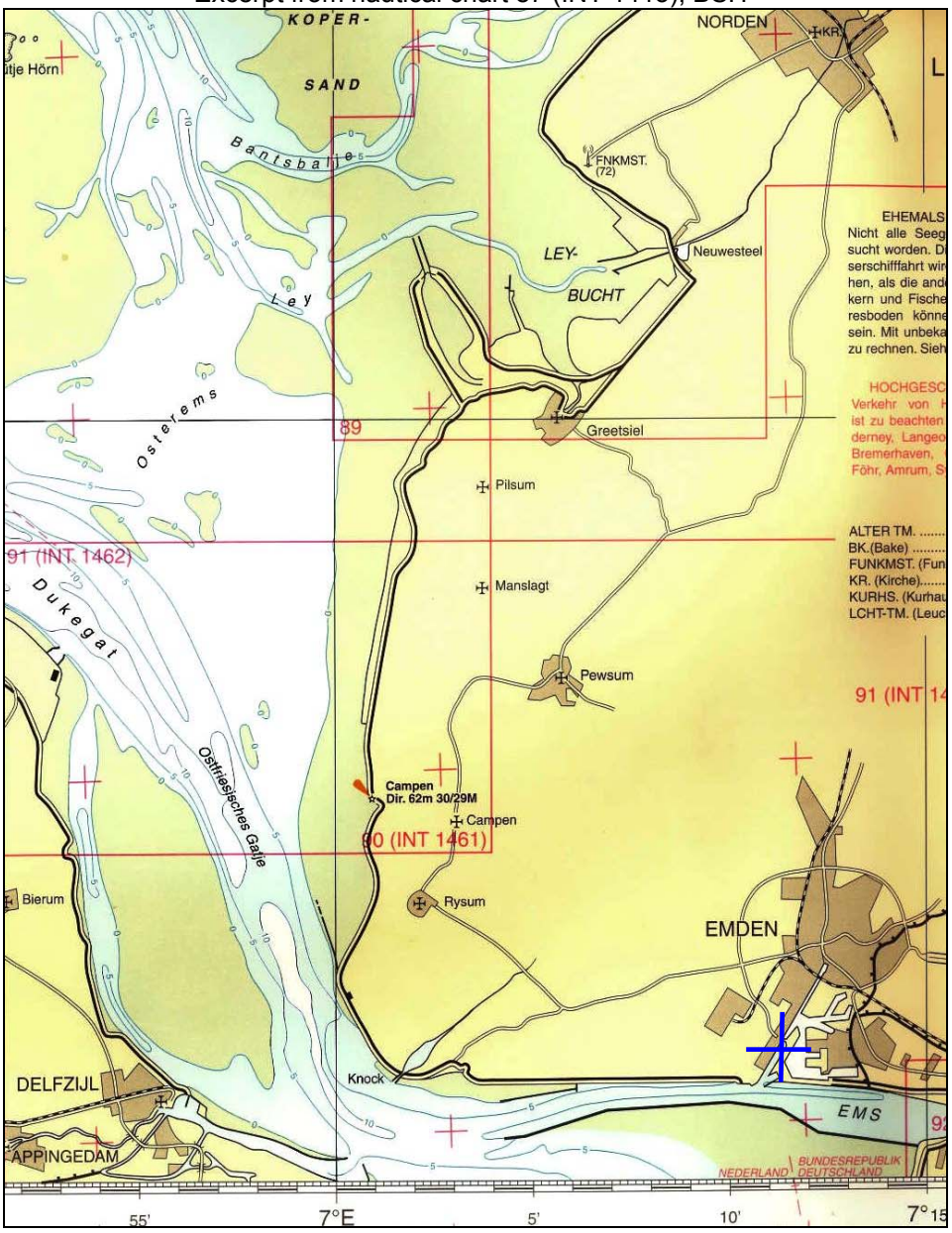


Figure 2: Nautical chart

[3] BSH = Federal Maritime and Hydrographic Agency.

2.5 Shore authority involvement and emergency response

Agencies involved:	Shore-based emergency services
Resources used:	Emergency doctor and ambulance
Actions taken:	First aid at the scene of the accident, emergency services alerted, casualty taken to hospital
Results achieved:	Casualty stabilised and discharged from hospital about 3 weeks later

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

On the day of the accident, the hopper dredger WATERWAY moored at her berth with port side to shore in the port of Emden at about 0745. The stern of the dredger was to be made fast with two stern lines and one spring. The chief officer, third officer, chief engineer and third engineer were working at the aft manoeuvring station. The crew of the manoeuvring station were in contact with the bridge of the dredger by means of two VHF radios, which were carried by the third officer and chief engineer.
To begin with, the third officer and third engineer deployed the spring; the slack was taken in using the capstan head of the port winch. The chief officer and chief engineer took care of the simultaneous deployment of the two stern lines immediately afterwards. The eyes of the two lines were tied with a messenger line and then passed ashore together. To this end, the cable drums on the port and starboard aft winches were disengaged by the chief engineer and chief officer, so that these were free-running and enabled the stern lines to be unwound toward the shore side bollard. After the eyes of the two stern lines were ashore on a bollard, the slack in the lines was to be taken in using the hydraulic winches. However, on the port winch it was first necessary to stop the spring still located on the capstan head in order for it to then be possible to secure it on a bollard on deck.[4] The work necessary for this was undertaken by the third officer and third engineer.

At the same time and without further assistance, the chief officer began to take in the slack on the starboard stern line. Initially, he pulled the slack[5] from the line, which was sagging as low as the water, on deck by hand. After that, he began to haul in the section of the stern line now on deck with the winch. His position was not visible from the port side of the manoeuvring station. While doing this, the chief officer noticed that the slack on deck was beginning to form a loop, causing a risk of the line being wound onto the drum tangling. To counter this risk, the officer attempted to remove the loop by kicking it with his right foot while the winch was in motion. In the process, his foot got caught in the loop, which dragged him towards the still hauling winch. The officer automatically let go of the winch's spring-loaded operating lever, which then clicked back to the neutral position. However, due to the technically induced stop delay, the winch did not stop immediately, but only a few seconds later, causing the officer to be dragged nearly two metres across the deck. When the winch stopped, the loop in the stern line together with the trapped right leg of the officer had already reached the winch drum. As a result of this, the entire body of the casualty had been dragged onto the winch and he was now 'tied up' and completely immobilised, but fully conscious on the cable drum.

[4] Mooring winches usually consist of a cable drum, which can be engaged and disengaged, and a permanently rotating capstan head. Therefore, before hauling in the line on the cable drum or paying out slack, it is necessary to slacken a line located on the capstan head, respectively, secure it on a bollard on the deck.
[5] 'Slack' = nautical term for lines or parts of lines that are not under tension.

Fortunately, the winch came to a standstill just before the casualty's upper body was strangulated on the winch, which in all likelihood would have been fatal.

To begin with, the other people on the manoeuvring station were not aware that the accident had happened. As already discussed, they were handling the lines on the port side of the dredger, from where they had no visual contact with the scene of the accident. It was merely noted that the starboard stern line – presumably as it should – tightened.

The chief officer tried to draw attention by calling for help. Regardless of that, the steward and the cook came out of the superstructure at this point to inform themselves about the progress of the berthing manoeuvre and found the chief officer in his helpless state. The steward followed the instructions of the officer and hurried to the winch to take the tension out of the line. At the same time, the cook ran to the bridge to inform the master about the accident. In the meantime, the master heard the screams coming from astern and instructed the third officer by radio to immediately cast off all the lines.
The third officer, who still had no knowledge of the accident, ordered the chief engineer to go over to the starboard side to inform the chief officer of the instruction to cast off all the lines.
The chief engineer reached the starboard side at the exact moment that the steward was releasing the chief officer from his 'restraints' by operating the winch. However, the steward briefly moved the operating lever of the winch in the wrong direction by mistake, causing the officer to be pulled slightly further onto the winch. The chief engineer sprang forward and corrected this error. Due to the subsequent slackening of the line, the chief officer was carried from the winch and came to rest on the deck.
The master and other crew members reached the scene of the accident shortly after and rendered first aid. In the meantime, the pilot had alerted the emergency doctor, who arrived at the scene a short time later together with an ambulance.

3.2 Consequences of the accident

3.2.1 Personal injuries

The chief officer suffered a femoral neck fracture of the right leg and fall-related injuries to his back as a result of the accident. There was no danger to life.

3.2.2 Material damage

There was no material damage.

3.2.3 Environmental pollution

The environment was not affected by the accident. No pollutants escaped.

3.3 Investigation

3.3.1 Preliminary note

Despite the relatively mild outcome of the accident, the Federal Bureau of Maritime Casualty Investigation (BSU) found it necessary to investigate it thoroughly. Here, the main focus of the investigation was not put on the conduct of the chief officer – kicking a loop in the line being hauled – which contradicted the principles of good seamanship and caused the accident, but rather on evaluating the stopping time of the winch as only this is what made the accident potentially fatal and witnesses described it as being exceptionally long.
Since shortly after the accident and before being deployed to South Africa a stay was planned for the dredger in the Dutch shipyard Damen Shiprepair Rotterdam B.V. in Schiedam for fitting out, the BSU commissioned a Dutch engineering company to examine the winch's stop delay.

3.3.2 Description of the scene of the accident

The aft manoeuvring station of the dredger WATERWAY consists of two identical work areas on the port and starboard side of the main deck (see **Figs. 3 ff)**, each with a hydraulic winch, two twin bollards and a guide pulley. Only a narrow passage (bounded by the aft railing) is situated behind the superstructure in the aft section of the vessel via which the two work areas of the manoeuvring station are connected. Visual contact between the operating positions of each winch does not exist due to the superstructure between them.

Figure 3: Aft manoeuvring station, starboard side (1)[6]

[6] Taken in the direction of the aft section.

Figs. 4 ff below illustrate the position of the chief officer at the operating lever of the winch at the time of the accident (see white marking).

Figure 4: Aft manoeuvring station, starboard side (2)[7]

Figure 5: Close-up of the starboard winch's control station

[7] Taken in the direction of the fore section.

Figure 6: Starboard winch, top view

Fig. 7 (see below) illustrates the structural features of the aft section of the WATERWAY, especially the arrangement of the aft manoeuvring stations in two separated work areas, which are relatively far apart on the port and starboard side of the dredger. The visibility on the aft section and the affect of operating noises offer a reasonable explanation as to why the cries of the chief officer and his helpless state were not noticed by the crew members working in the port work area, while this was possible for the master from the outer area of the bridge deck.

Figure 7: Long shot of the aft section of the WATERWAY

3.3.3 Assessment of the stopping time of the winch

The expertise of the Dutch engineering company D. TOUW EXPERTISE- EN INGENIEURSBUREAU B.V. Rotterdam (hereinafter referred to as 'engineering company') of 22 October 2010 is reproduced (editorially revised) below.

3.3.3.1 Subject matter of the assessment

On 6 October 2010, the engineering company was commissioned by the BSU to clarify whether the starboard aft winch and its controls were in proper working order and whether the system-induced stop delay of the hydraulic winches fell within a permissible/acceptable range of tolerance.

To answer these questions, the engineering company inspected the technical drawings relevant to the hydraulic system and the manual of the winch manufacturer.[8]

On 11 October 2010, various measurements were carried out on the winch's operating system on board the dredger WATERWAY at the Damen Shiprepair Rotterdam B.V. shipyard in Schiedam. The series of measurements was conducted on behalf of the engineering company by the company JVS Scheeps- en Industrietechniek B.V.[9]

On the same day, the engineering company's expert, the owner's technical inspector, the master and the chief engineer discussed the problematic nature of the winches on board the dredger. Moreover, the expert was in direct contact with the manufacturer of the winches, the Belgian company Brusselle Enterprises (Marine Industries) NV.

3.3.3.2 Description of the winches

The winches on board the WATERWAY operate with a closed oil-lubricated reduction gear, which is driven by a hydraulic motor. The reduction gear drives a cable drum, which can be engaged and disengaged as well as set by means of a mechanically operated band brake. In addition, a permanently rotating capstan head is positioned on the drive shaft. The winch has a hydraulic spring-loaded disk brake, which acts on the drive shaft of the hydraulic motor.

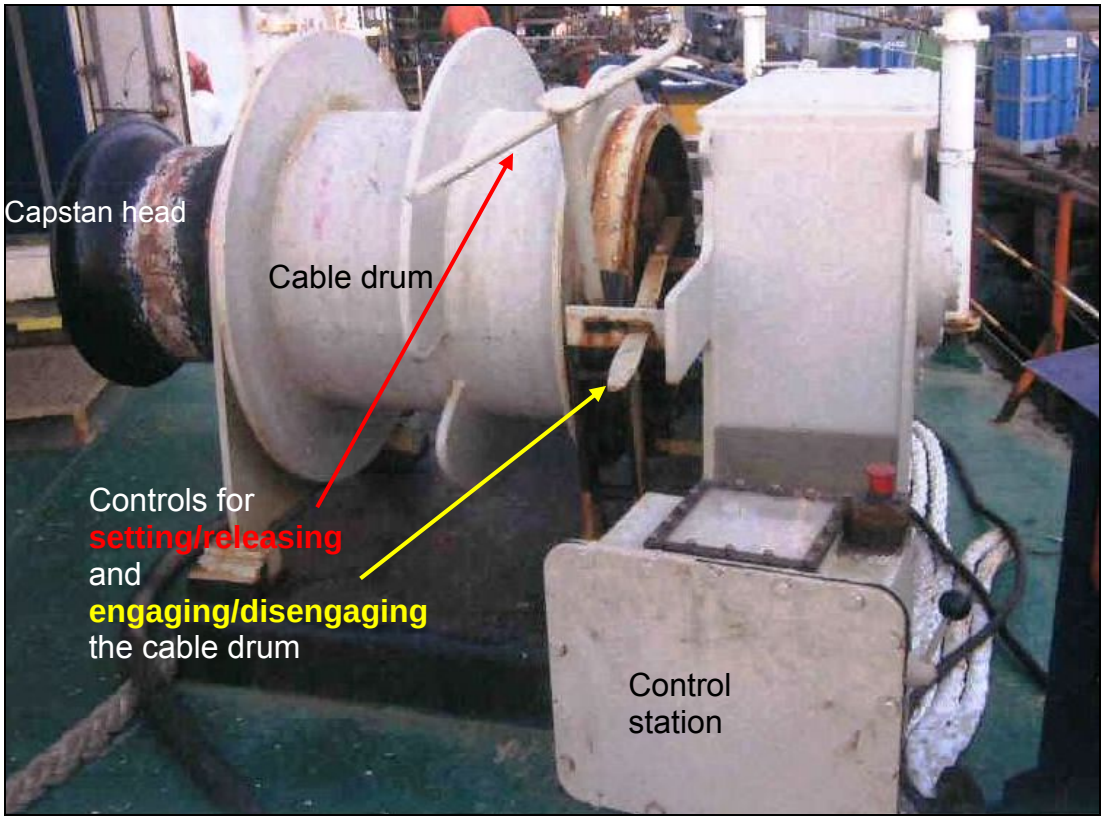


Figure 8: Winch

[8] See the technical documents of the winch manufacturer referred to, respectively, excerpts thereof in the appendix to this report (Appendix I A – D of the expertise).
[9] See measurements report in the appendix to this report (Appendix V of the expertise).

The winch is controlled by means of a control station. A horizontally adjustable, spring-loaded operating lever is mounted on the side of this control station, which – based on its vertical starting position – can be moved about 60 degrees back and forth in the fore and aft direction. A red emergency stop button and a window with a power-on lamp are positioned on the top of the control panel (see **Fig. 9** below)

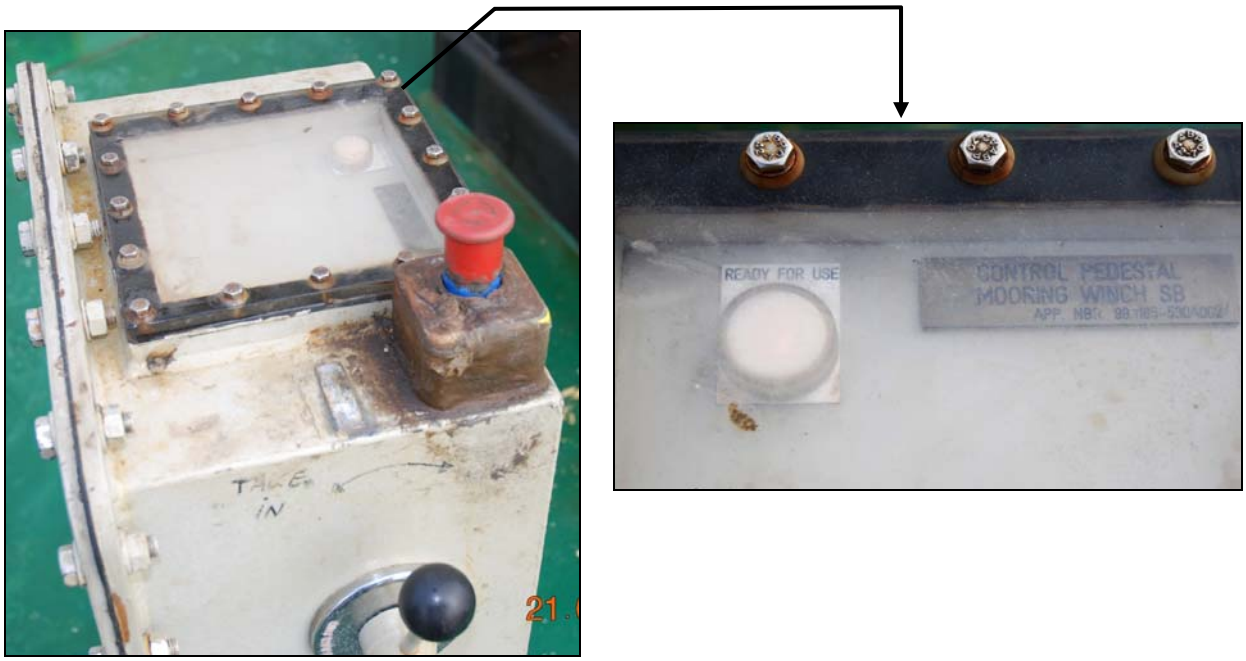


Figure 9: Control station (close-up)

3.3.3.3 Technical data

Winch manufacturer/Type	Brusselle Marine Industries N.V. / MO 08/1-1S-1	
Year built	2001	
Drum dimensions	Diameter 1,250 mm / 820 mm x 770 mm	
Capstan head dimensions	Diameter 800 mm / 630 mm x 530 mm	
Drum capacity	Diameter 860 mm	80 kN
	Speed	10 m/min
	Maximum tensile force	120 kN
	Maximum speed	30 m/min
Capstan head capacity	Diameter 720 mm	95 kN
	Speed	8.4 m/min
	Maximum tensile force	143 kN
	Maximum speed	25.2 m/min
Hydraulic motor Manufacturer/Type	Rexroth / A6V – M107 HA 1 / 63 W – VAB010	
	Maximum flow volume	69 l/min
	Maximum pressure	230 bar
Hydraulic brake Manufacturer/Type	Ortlinghaus / 0-022-509-31-002-108 Spring applied multi plate brake	

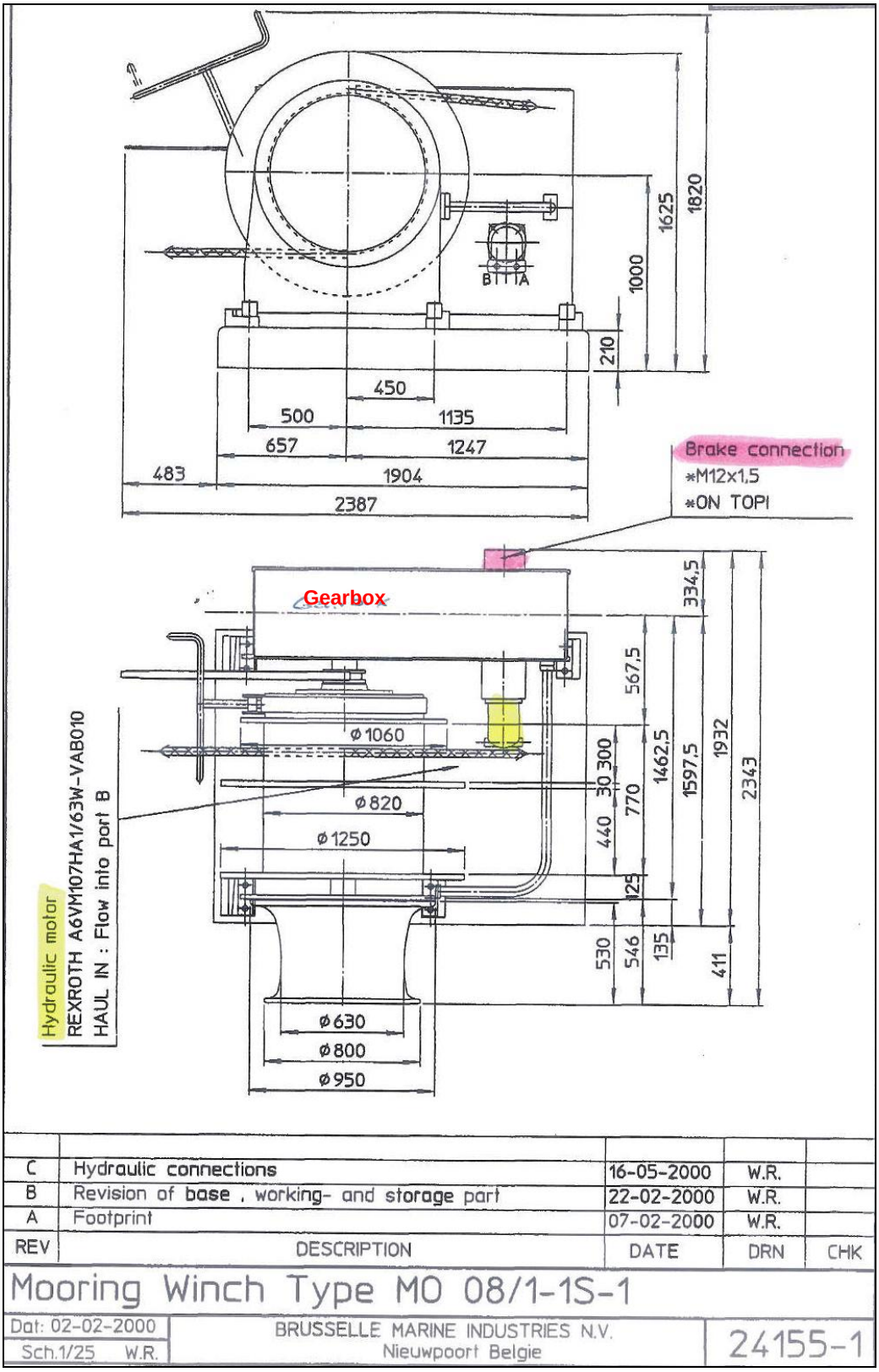


Figure 10: Technical drawing – hydraulic winch[10]

[10] Colour highlighting added by the expert.

3.3.3.4 Operating principle

The winch obtains the oil for its drive and the brake from the general hydraulic system of the hopper dredger, which supplies all the other hydraulically operated equipment on board with the necessary oil pressure. The direction of the oil flow for the starboard aft winch is controlled by the valves Y57h and Y58p. The hydraulic brake is controlled electronically via the valve Y59.[11] In the uppermost (vertical) position of the operating lever, which is horizontally adjustable by about 60 degrees, no oil is pumped to the winch's hydraulic motor. If – in relation to the fore and aft direction – the operating lever is moved backwards, a stern line is hauled in and if the lever is moved forwards, a stern line is slackened. The speed of the winch is controlled by setting the lever to the appropriate angle (that the stern line is not hauled, but slackened when the lever is moved towards the winch seems odd at first glance. However, if the spring (runs towards the fore section) is hauled in or slackened with the help of the capstan head, the operating lever's direction of movement matches the rotation of the winch).
When the operating lever is released, a spring returns it to the neutral position. The oil flow in the system is 'short circuited' and after a built-in delay, the brake on the reduction gear is activated by a spring due to the lack of oil pressure.

3.3.3.5 Measurements performed and the results[12]

The 10 measurements below were carried out on the starboard aft winch to determine the stopping time of the winch:

a) three identical measurements with only the starboard aft winch in operation. The period between the operating lever, which was set to maximum hauling speed, being released and the winch coming to a standstill as well as the corresponding rotation angle of the drum was measured

b) three identical measurements with only the starboard aft winch in operation. The period between the emergency stop button being pressed at maximum hauling speed and the winch coming to a standstill as well as the corresponding rotation angle of the drum was measured

c) three identical measurements with all four winches in operation. The period between the operating lever, which was set to maximum hauling speed, being released and the winch coming to a standstill as well as the corresponding rotation angle of the drum was measured

d) one measurement with all four winches in operation. The period between the emergency stop button being pressed at maximum hauling speed and the winch coming to a standstill as well as the corresponding rotation angle of the drum was measured

[11] For details see Appendix I A – D of the expertise in the appendix to this report.
[12] For details see Appendix V (Report 10.0541) to the expertise in the appendix to this report.

It can be concluded from the measurements that the **stopping time of the winch** constantly stands at **about 3.5 seconds** after the operating lever is released and that during this period the winch's angle of rotation is 210 degrees. Contrary to initial assumptions, the measured values are not affected by the number of winches in operation.
If the **emergency stop button** is pressed immediately after the operating lever is released, the **stopping time** stands at **about 1 second.** According to the expert, the reason for this period is likely to be the delay between releasing the operating lever and pressing the emergency stop button.

3.3.3.6 Conclusion of the expertise

A stopping time of 3.5 seconds is very long. The engineering company is not aware of statutory or class standards for reaction times. The winch manufacturer is also not in possession of corresponding standards.

With respect to the system's inertial resistance (mechanical and hydraulic), a certain delay before the winch comes to a standstill is desirable to prevent large reaction forces caused by a (regular) stop operation that is too abrupt.

The engineering company concludes that the delay (stopping time) of the system on board the dredger WATERWAY can be explained by an electronic setting (probably on the PCB of the control electronics). It was not possible to establish why this was set at a value of 3.5 seconds. A modification to the delay value to about 2 seconds should be possible for the winch manufacturer or an authorised service operation without excessively complex technical implications.

3.3.4 Human factors

Apart from the fundamental violation of a basic rule of seamanship, to keep clear of and especially not move into running rigging, the investigation brought to light no evidence of further human factors that would facilitate the accident in the person of the casualty. Fatigue and/or alcohol were not detected.

The chief officer has many years of professional experience and was very well informed about the specifics of the procedures on the manoeuvring station due to periods of service on the dredger WATERWAY totalling more than 8 years.

4 ANALYSIS

4.1 Handling lines and deck machinery; communication

The chief officer risked life and limb by making an ill-considered foot movement towards a line that was being hauled in. This finding applies regardless of whether the stopping time of the winch was within reasonable limits, or not. That one and the same person controlled the winch and cleared the line being wound onto the drum simultaneously also contradicts the principles of good seamanship. Finally, to abstain from carrying and using a radio while working in one of the two separate work areas, between which face-to-face communication is not possible, appears to be highly problematic regardless of the aforementioned shortcomings. For safe execution of a berthing manoeuvre, it is essential that information can be exchanged at all times between the various work areas of the manoeuvring station, but also between the work areas and the bridge, in particular.

An additional, but apparently inconsequential problem arose from the momentary incorrect operation of the winch by the steward when he hauled in the line instead of paying out slack while providing assistance. However, it should be noted that the situation in which the steward was acting was very exceptional. The steward does not normally have the authority to control the winch or a corresponding necessity on board the vessel. Nevertheless, the accident shows that it is easily possible to confuse the winch's direction of rotation and that doing so can prove fatal.

The handwritten and only partially readable 'label' on the winch's control station shows that uncertainty with respect to the direction of rotation of the winch in relation to the respective lever position apparently also existed before the accident (see **Fig. 11**).

'TAKE IN' aims to indicate that setting the lever in the corresponding direction causes the stern line to be hauled in. The red labels 'HAULING' and 'PAY-OUT' stamped on by the manufacturer also refer only to handling a stern line, but do not account for the fact that the necessary direction of rotation of the winch and thus the direction of the operating lever reverse when hauling in/paying out a spring (i.e. a line that runs in the direction of the fore section) using the capstan head.

Figure 11: Operating lever 'label'

4.2 Stopping time of the winch

4.2.1 General risks and hazards

The expertise of the appointed engineering company proves beyond doubt that at 3.5 seconds and a corresponding rotation angle of the winch drum of 210 degrees, the winch manufacturer was indeed overly generous when calculating the stopping time of the otherwise perfectly functioning winch system. With an overall diameter of 890 mm resulting from that of the drum and line, a rotation angle of 210 degrees means that about 1.63 metres of line is still wound onto the drum or paid out after releasing or quickly switching the operating lever from the maximum to the neutral setting.

Nevertheless, in the course of normal operating procedures the calculated stopping time should not pose a particular risk to the personnel on the manoeuvring station, especially since the winch can be stopped in hazardous situations in one second by means of the emergency stop button. It should also be noted that with respect to the system's inertial resistance (mechanical and hydraulic), a certain delay is actually desirable to prevent large reaction forces caused by a stop operation that is too abrupt.

However, it should be considered that the exceptionally long stopping time generally complicates or even renders impossible the sensitive line handling that may be necessary in certain cases for the winch operator. An excessive stopping time could also expose the crew of the manoeuvring station and possibly also tug personnel or linesman ashore to at least indirect danger. This is particularly true if a situation requires a quick change in the direction of pull and this change is unnecessarily prolonged by the winch's long stop delay.

4.2.2 Legal and technical standards

Both the statement by the expert and the findings of the BSU's own research indicate that it can be assumed that neither legal nor technical standards of the Administration and/or shipyards/owners exist that cover the maximum value for the stopping time of a winch. However, an inquiry made by the BSU to a leading winch manufacturer revealed that this company sets its winches so that the drum comes to a standstill after a maximum rotation of 1/4. Based on the winch dimension on board the dredger WATERWAY, this would have resulted in the line moving forward about 0.7 metres. Consequently, the winch would have come to a standstill before it could drag the chief officer up to the cable drum. This finding does not alter the fact that rather than the stopping time, the accident under investigation was triggered by the conduct of the casualty, which stood in contrast to the principles of good seamanship.

The winch manufacturer, who was not affected here, further explained that when developing brake systems one of the factors to be taken into account is that brakes operating more efficient and therefore faster make the overall system inevitably more expensive. For the construction, therefore, the principle applies that brakes must operate as fast as necessary and not as fast as possible.

Since the hydraulic brake on board the WATERWAY could bring the winch to a standstill without any problem and time lag after activation of the emergency stop

button, it is to be assumed, that the brake was sufficiently dimensioned by the winch manufacturer.

Apparently – as usual[13] – two different settings were designed for the brake system:

1) "Emergency stop" = immediate standstill of the winch, irrespective of the mechanical load applied on the winch system by this

2) "Normal stop" = slow brake in order to avoid excessive wear.

4.3 Actions taken

The shipping company operating the dredgers had the opportunity to comment[14] on the draft investigation report within the statement period prior to the publication of the investigation report.
The draft investigation report addressed both of the following safety recommendations to the operator:

1. Occupational safety on the manoeuvring stations
The Federal Bureau of Maritime Casualty Investigation recommends that the owner of the hopper dredger WATERWAY, Royal Boskalis Westminster N.V., Papendrecht (Netherlands), perform a comprehensive risk analysis and risk assessment with respect to the operating procedures on the manoeuvring stations and the functionality of the mooring winches installed, in particular, with regard to their stopping time, on the vessels it operates. If necessary, the owner's safety management system should be revised accordingly.

2. Contact winch manufacturer
The Federal Bureau of Maritime Casualty Investigation recommends that the owner of the hopper dredger WATERWAY, Royal Boskalis Westminster N.V., Papendrecht, contact the manufacturer of the winches installed on board the dredger and discuss the possibility/necessity of shortening the stopping time.

The statement to the draft investigation report submitted by the vessel's operator contains the following actions that were taken as an immediate consequence of the accident:

1. *Boskalis SHE-Q-Department[15] carried out the internal investigation of the accident.*

2. *Boskalis created a safety newsflash and sent it out to all vessels of Boskalis and to IMCA[16].*

[13] Information supplied by the winch manufacturer not involved in the case.
[14] Note: The winch manufacturer as well as all other parties affected by the investigation report had the opportunity to comment on the report, but did not exercise their right to do so.
[15] SHE-Q = **S**afety, **H**ealth and **E**nvironment **Q**uality Management = certified quality management system of the company.
[16] IMCA = **I**nternational **M**arine **C**ontractors **A**ssociation. Association of companies active in the offshore, marine and underwater engineering industry for promoting offshore safety, addressing technical matters and on a variety of other issues.

3. *The control units of the winches on the stern of the WATERWAY and her sister ship COASTWAY have been moved to a different position and each equipped with a safety cage for the winch driver (s.* ***Figs. 12 ff****).*

4. *Meanwhile, the mooring/unmooring activities are an inherent part in the standard risk assessment on board of all company vessels.*

5. *Responsibilities for the mooring operations are displayed on board.*

6. *Boskalis is in contact with the manufacturer of the winch to reduce the stopping time of cable drum after stop function.*

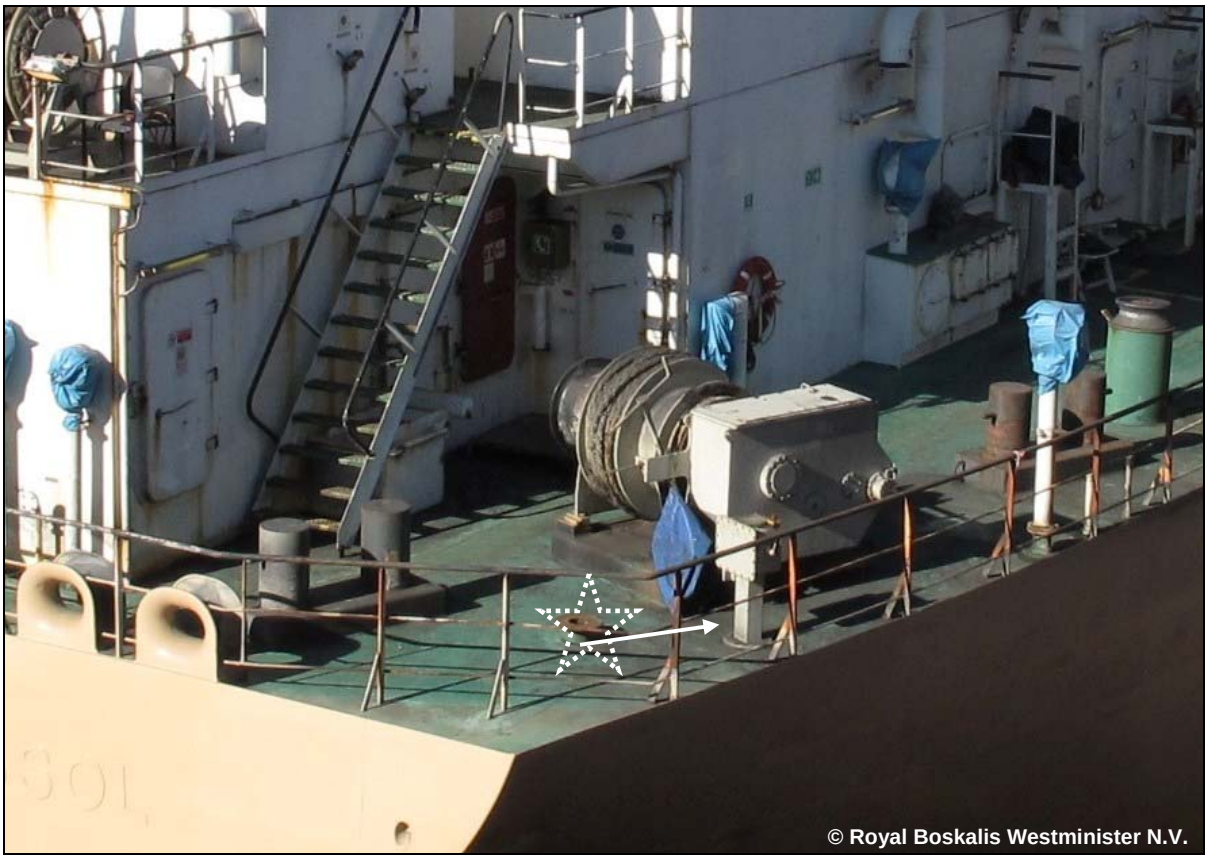


Figure 12: Old and new position of the control unit of the winch[17]

[17] Movement of the position of the control unit: See white marking from the author of the report!

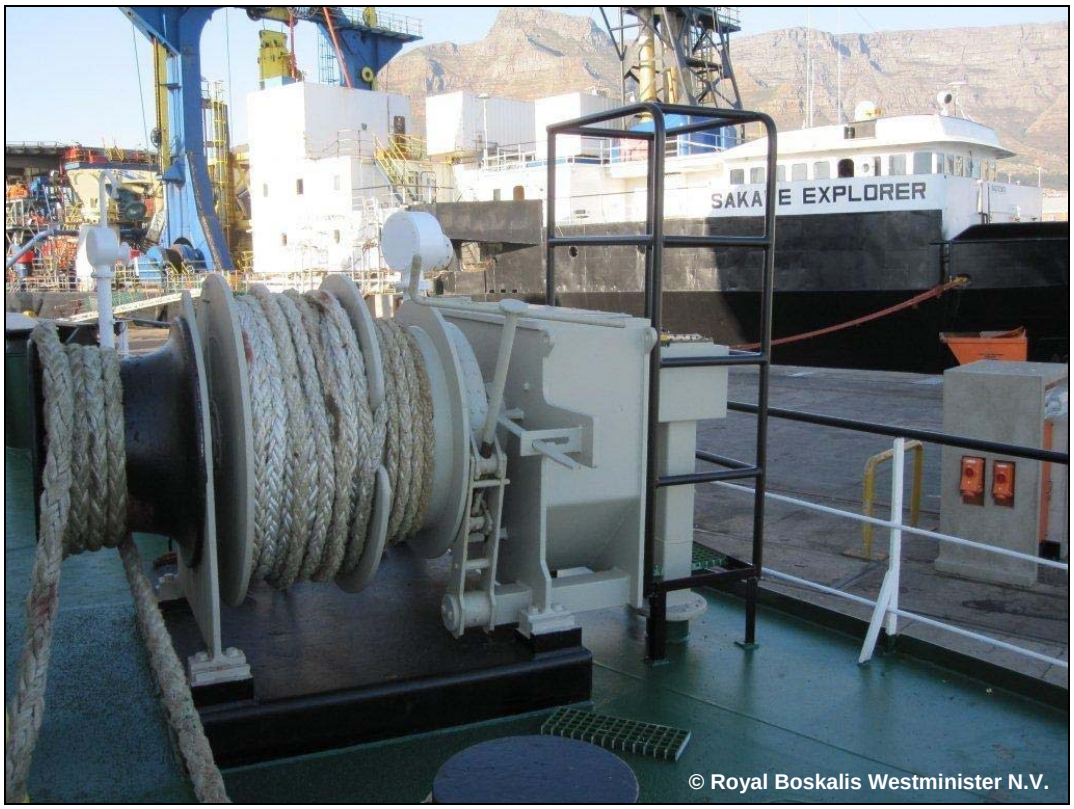


Figure 13: New position of the control unit of the winch with safety cage (1)

Figure 14: New position of the control unit of the winch with safety cage (2)

5 CONCLUSIONS

This accident demonstrates once again the grave dangers that even highly qualified and experienced persons are exposed to when handling mooring lines on board. A rash, quick action (in this case, a short foot movement) almost resulted in a fatal accident.

However, the winch's stopping time incorporated by the manufacturer should also be critically evaluated. It is evident that stopping a winch in normal operation too abruptly can lead to unnecessarily high reaction forces, and that, additionally, excessive wear of the winch system in every day work should be, as far as possible, avoided for economic reasons. However, it should not be the case that instead of the winch operator it is ultimately the control electronics, which he can neither understand nor modify, that determines when a winch comes to a standstill in spite of the operating lever being set to neutral.

An informal inquiry made by the BSU to the German flag State Administration[18], which is not responsible for the Cyprus flagged dredger WATERWAY, has revealed that the absence of internationally binding legal standards for the stopping time of winches is supposedly justified. The very different practical demands on winch systems, for example, in relation to the dimensions of a vessel and type of line used, would make it almost impossible to lay down practical and universally binding rules.
The BSU accepts this reasoning. However, it should be stressed that the absence of binding standards for the stopping time of winches does not give rise to a legal vacuum in this regard. Rather, as part of its obligation under the ISM Code[19] to perform risk analyses and risk assessments for any task on board which involves risk, it is the responsibility of the company to carefully consider the functionality of the winches used and the operating procedures associated therewith. In this context, the 'label' on the control station of the winch is also open to criticism.

The various and exemplary lessons learned from the accident by the vessel's operator are to be emphasized. The actions taken even exceed the safety recommendations addressed to the vessel's operator in the draft investigation report. Therefore the BSU refrains from including them in the final investigation report. Finally the willingness of the vessel's operator to cooperate in the course of the complete investigation merits special mention. The BSU did not approach the Netherland based operator of the Cyprus flagged dredger with Flag State authority. However, the legal task to investigate was respected from the beginning and supported without any reservation in the sense of a real safety partnership.

[18] Ship Safety Division (BG Verkehr).
[19] ISM Code = **I**nternational **S**afety **M**anagement Code = International Management Code for the Safe Operation of Ships and for Pollution Prevention; internationally binding under Chapter IX SOLAS.

6 SAFETY RECOMMENDATIONS

The following safety recommendations do not constitute a presumption of blame or liability in respect of type, number or sequence.

Winch manufacturer

6.1 Review design principles for the stopping time

The Federal Bureau of Maritime Casualty Investigation recommends that the winch manufacturer, Brusselle Enterprises NV Nieuwpoort (Belgium), perform a critical review and risk analysis on the hydraulic winch systems it has developed with respect to the design principles for the stopping time.

6.2 Contact shipyards and shipowners

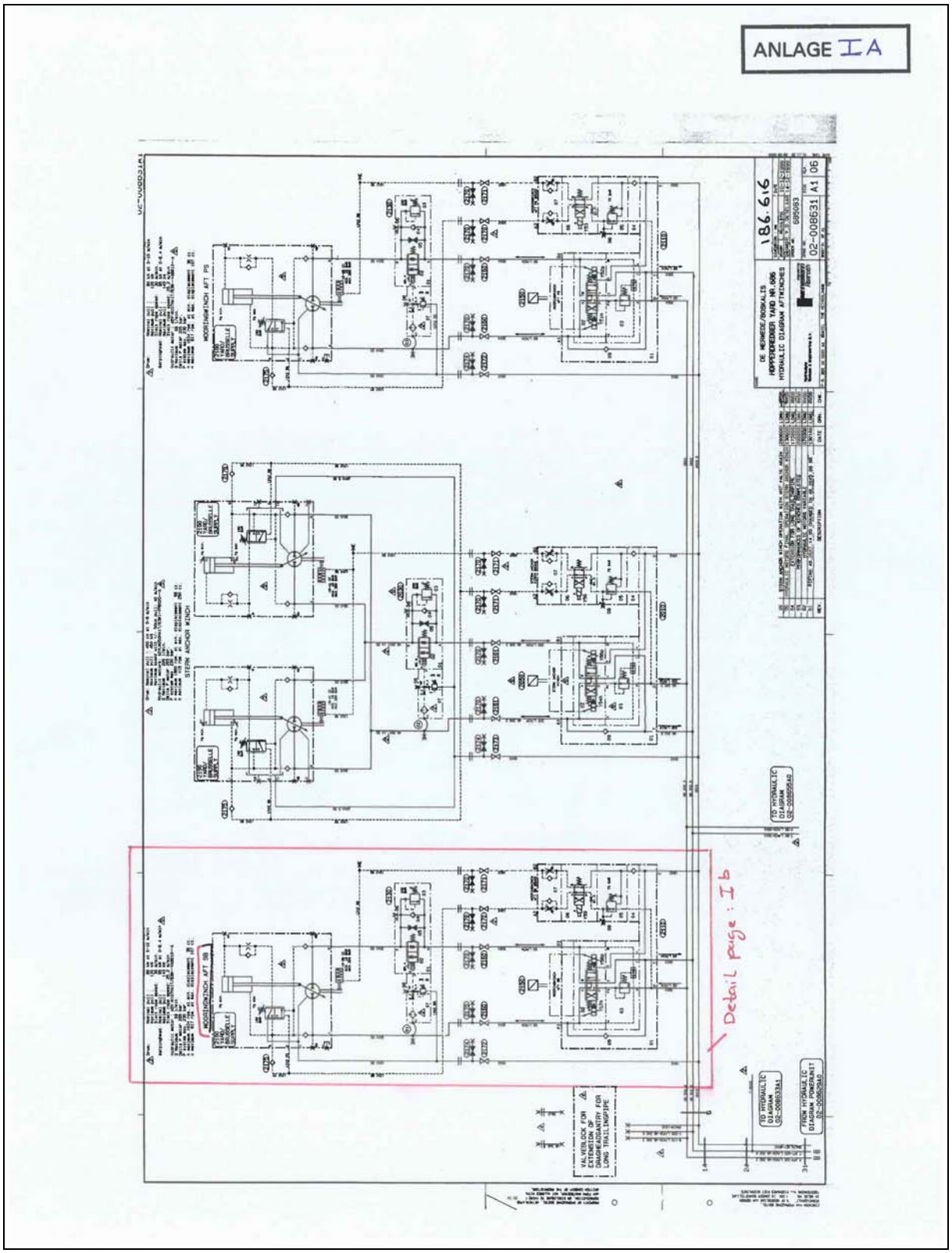
The Federal Bureau of Maritime Casualty Investigation recommends that in the event of necessary conceptual revisions to the pre-set stopping times, the winch manufacturer, Brusselle Enterprises NV Nieuwpoort (Belgium), contact shipyards and shipowners in order to initiate any modifications to the stopping times of winches placed on the market.

7 SOURCES

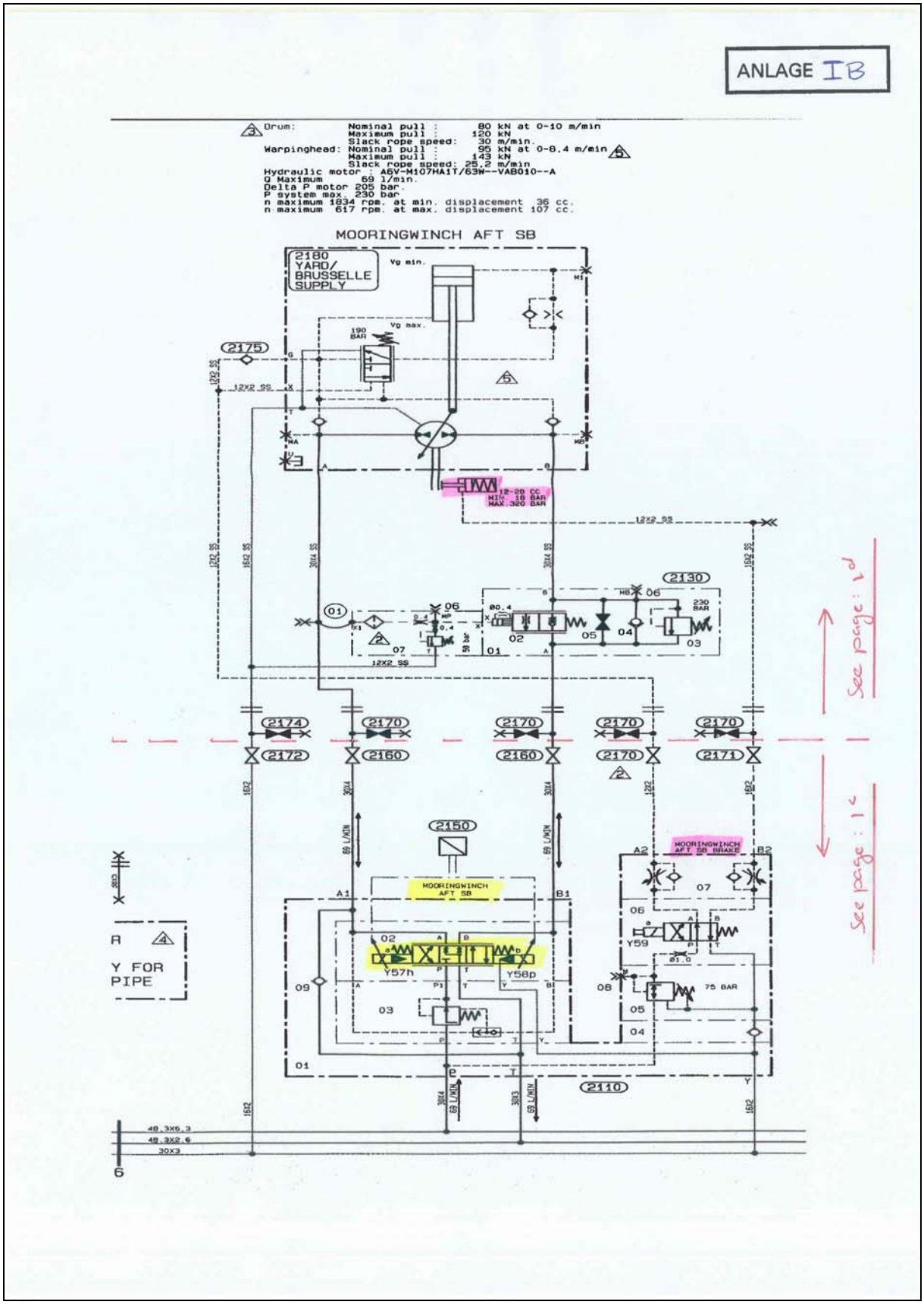
- Findings/Photos of Waterway Police (WSP) Emden
- Oral, partly written statements by crew members of the dredger WATERWAY
- Website of the owner
- Vessel's operator statement to the draft investigation report
- Expertise on the winches on board the dredger WATERWAY, D. TOUW EXPERTISE- EN INGENIEURSBUREAU B.V. Rotterdam / Marine and Non-Marine Surveyors & Consultants of 22 October 2010
- Technical documentation of the winch, Brusselle Enterprises (Marine Industries) NV Nieuwpoort (Belgium)
- Hasenpusch Photo-Productions and Agency, Hamburg
- Nautical chart, Federal Maritime and Hydrographic Agency (BSH)

8 Appendix

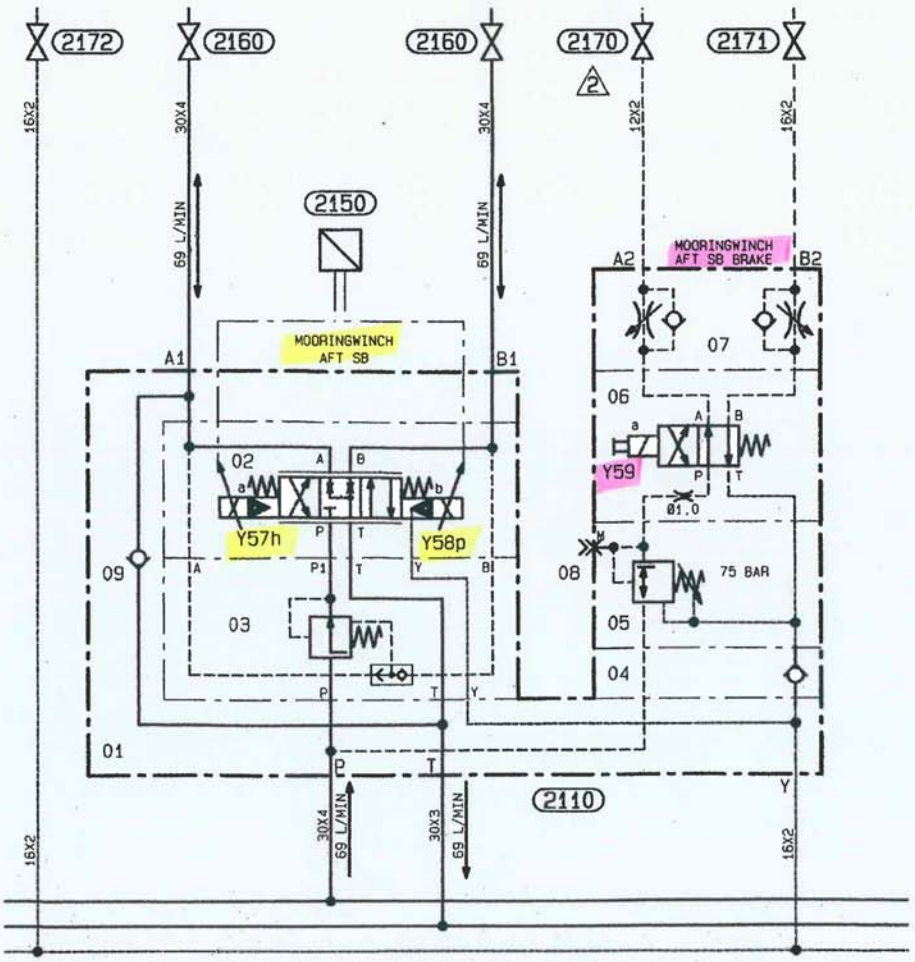
The following appendices were part of the expertise produced for the BSU by the Dutch engineering company D. TOUW EXPERTISE- EN INGENIEURSBUREAU B.V. Rotterdam on 22 October 2010 and quoted in the report.



ANLAGE IB


Drum: Nominal pull : 80 kN at 0-10 m/min
Maximum pull : 120 kN
Slack rope speed: 30 m/min.
Warpinghead: Nominal pull : 95 kN at 0-8.4 m/min
Maximum pull : 143 kN
Slack rope speed: 25.2 m/min
Hydraulic motor : A6V-M107HA1T/63W--VAB010--A
Q Maximum 69 l/min.
Delta P motor 205 bar.
P system max. 230 bar.
n maximum 1834 rpm. at min. displacement 36 cc.
n maximum 617 rpm. at max. displacement 107 cc.
MOORINGWINCH AFT SB
2180 YARD/ BRUSSELLE SUPPLY
Vg min.
Vg max.
190 BAR
2175
12X2 SS
12-20 CC MIN. 10 BAR MAX. 320 BAR
2130
230 BAR
2174
2170
2172
2160
2171
2150
MOORINGWINCH AFT SB
MOORINGWINCH AFT SB BRAKE
Y57h
Y58p
Y59
75 BAR
2110
69 L/MIN
R
Y FOR PIPE
48.3X5.3
48.3X2.6
30X3
see page : 1 d
see page : 1 c

ANLAGE Ic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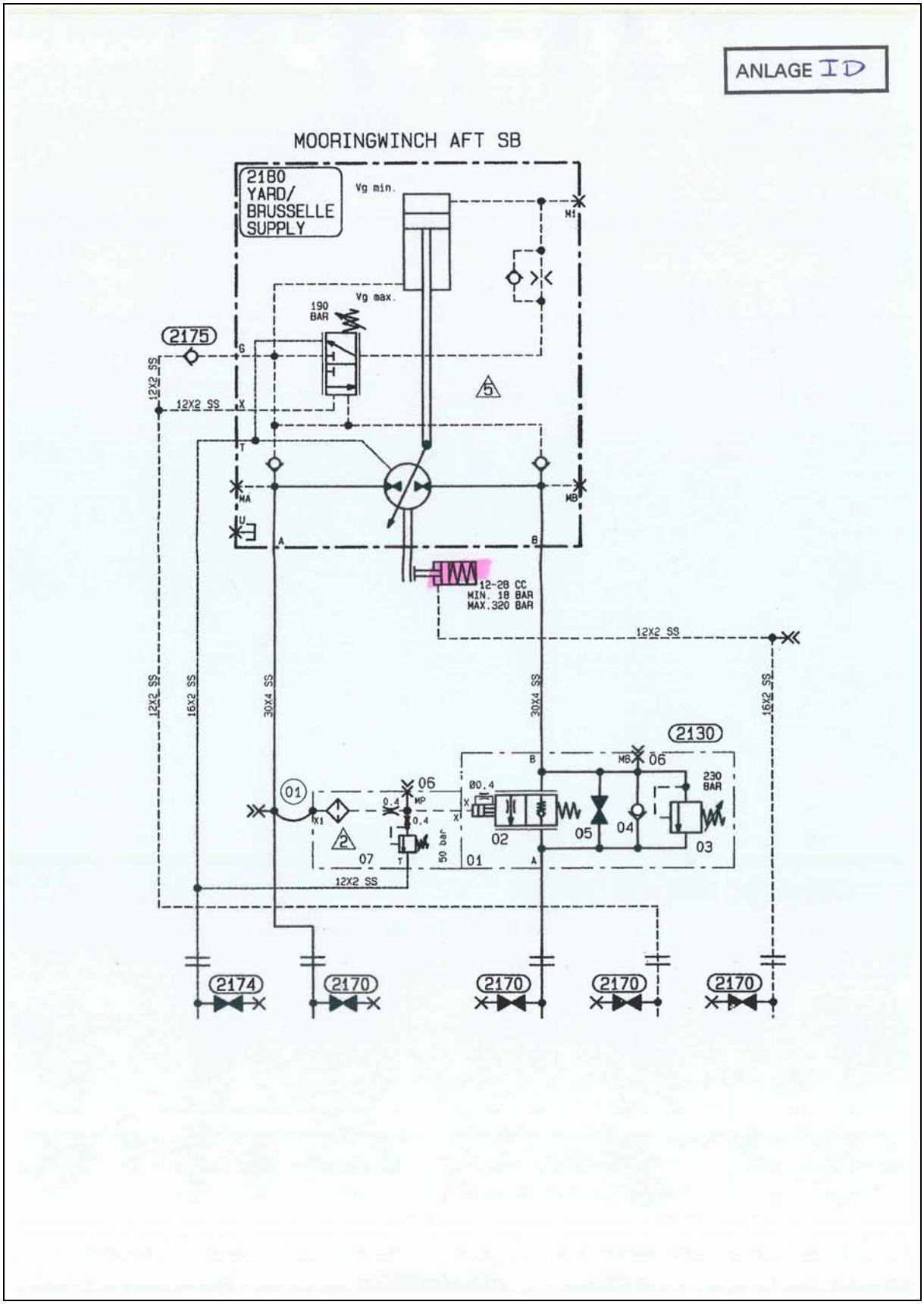
2160
2160
2170
2171
2150
16X2
30X4
69 L/MIN
30X4
69 L/MIN
12X2
16X2
MOORINGWINCH
AFT SB
MOORINGWINCH
AFT SB BRAKE
A1
B1
A2
B2
07
06
02
Y57h
Y58p
Y59
Ø1.0
09
08
75 BAR
03
05
04
01
2110
30X4
69 L/MIN
30X3
69 L/MIN
16X2
16X2


ANLAGE ID
MOORINGWINCH AFT SB
2180
YARD/
BRUSSELLE
SUPPLY
Vg min.
Vg max.
190
BAR
2175
12X2 SS
12X2 SS
5
MA
MB
12-28 CC
MIN. 18 BAR
MAX.320 BAR
12X2 SS
16X2 SS
30X4 SS
30X4 SS
16X2 SS
2130
06
Ø0.4
230
BAR
01
0.4
0.4
2
07
50 bar
02
05
04
03
01
12X2 SS
2174
2170
2170
2170
2170

ANLAGE V

JVS

Report 10.0541

HD Waterway
Winch starboard aft
Stop-delay measurements

JVS

Vessel name	:	HD Waterway
Installation	:	Winch starboard aft
Subject	:	Stop-delay measurements
Ordered by	:	D. Touw Expertise- en Ingenieursbureau BV Waalhaven zz 10 3088 HH Rotterdam The Netherlands
Test date	:	Oktober 11th 2010
Order number JVS	:	10.0541r

Papendrecht, Oktober 13th 2010

Signed : C. Florijn

Approved : A.J. van Roij

JVS Scheeps- en Industrietechniek B.V. 2

Contents

JVS

1. Introduction

JVS Scheeps- en Industrietechniek B.V. has been ordered by D. Touw Expertise- en Ingenieursbureau BV to carry out stop-delay measurements at the winch starboard aft on the HD WATERWAY.

The measurements were requested for the investigation of an accident.

The following measurement program has been executed:

- 3 measurements with only the starboard aft winch in normal operation, hauling.
- 3 measurements with only the starboard aft winch in normal operation, hauling, using the emergency stop button.
- 3 measurements with all winches (2 aft and 2 front) in normal operation, hauling.
- 1 measurement with all winches (2 aft and 2 front) in normal operation, hauling, using the emergency stop button.

The measurements have been performed at Damen Shiprepair Schiedam date October 11th 2010.

2. Technical data

Winch

Make	:	Brussele Marine Industries
Type	:	MO 08/1-1s-1
Drum diameter	:	820 mm

Hydrolic motor

Make	:	Rexroth
Type	:	A6VM107HA1/63W-VAB010

JVS

3. Measurements

3.1 Measuring equipment

The following instrumentation was used for the measurements:

Data Recorder
Make : Sony
Type : PC208

Inductive sensor
Make : Turck
Type : Ni10-M18-LIU-H1141

Infrared sensor
Make : Turck
Type : MINI-BEAM

JVS

4. Measurement method

To measure the rotation of the drum 12 reflecting stickers have been mounted on the drum at equal distances (12 times 30°). The diameter at the point of mounting is 820 mm.
The reaction time of the drum on a stop or an emergency stop was measured by the number of pulses that passed after the handle was released.
The position of the handle was determined by an inductive sensor.

During the measurements all data was recorded and later analysed at the office using data-analysis software.
Unfortunately one reflector was not recognized by the pick up this has been taken into account in the results.
The results are presented as a function of time.

5. Measurement results

In the following table all measurements have been presented.

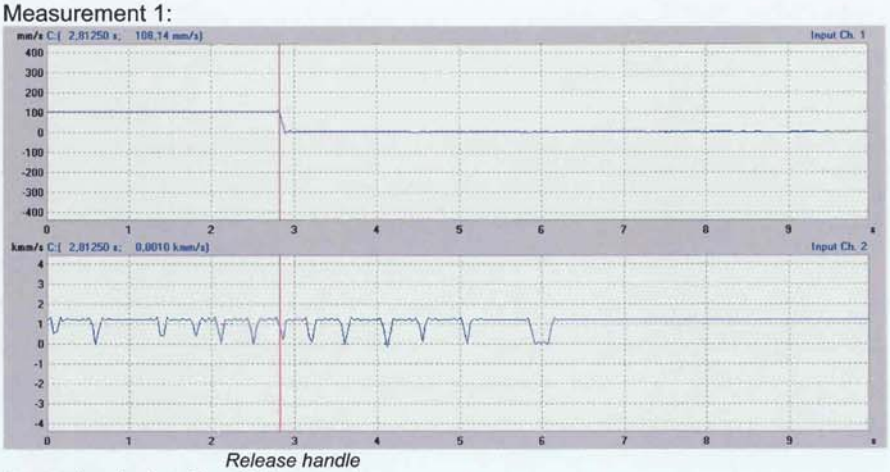
Condition	Measurement	Approx. Duration In seconds	Approx. Distance In meters
1	1	3.5	1.5
	2	3.5	1.5
	3	3.5	1.5
2	1	1	0.5
	2	1	0.5
	3	1	0.5
3	1	3.5	1.5
	2	3.5	1.5
	3	3.5	1.5
4	1	1	0.5

From the measurements we can conclude that there is no visible difference between running with only 1 winch or with all winches.

6. Results measurements as function of time

Condition 1: Normal operation, hauling, only starborad aft winch in operation.

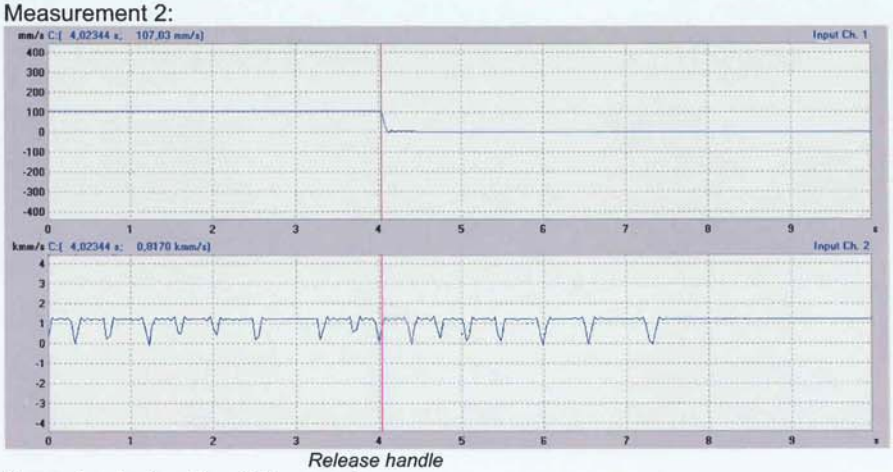
Measurement 1:



Release handle

Approximate duration: 3.5 seconds.
Approximate distance: 1.5 meters

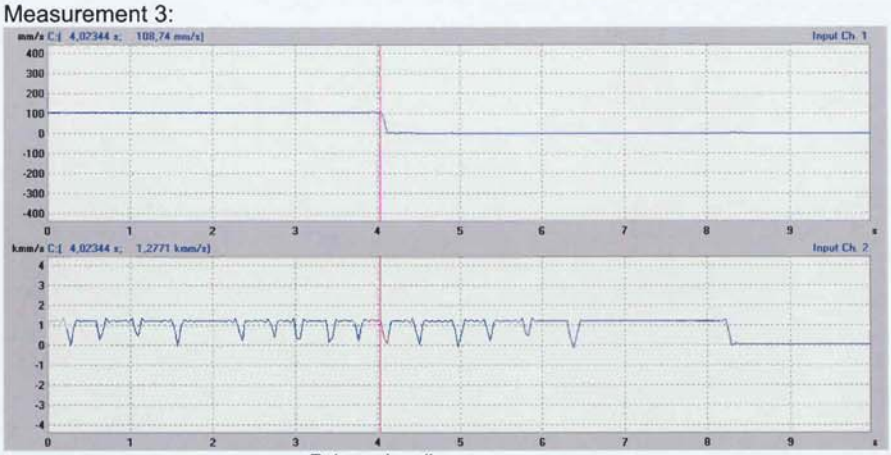
Measurement 2:



Release handle

Approximate duration: 3.5 seconds
Approximate distance: 1.5 meters

Measurement 3:

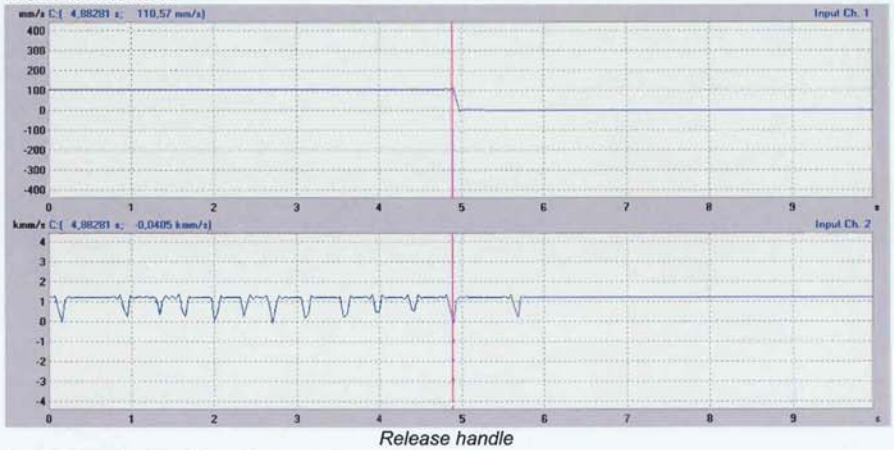


Release handle

Approximate duration: 3.5 seconds
Approximate distance: 1.5 meters

Condition 2: Normal operation, hauling, only starboard aft winch in operation, using emergency stop button.

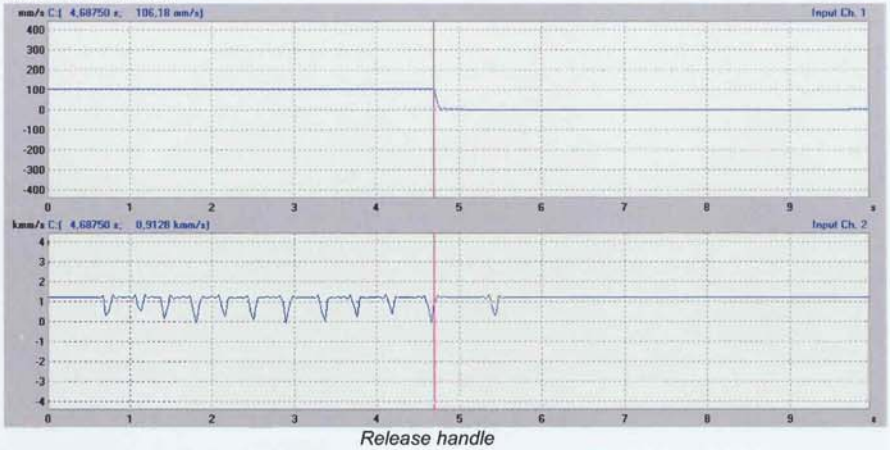
Measurement 1:



Release handle

Approximate duration: 1 second
Approximate distance: 0.5 meters

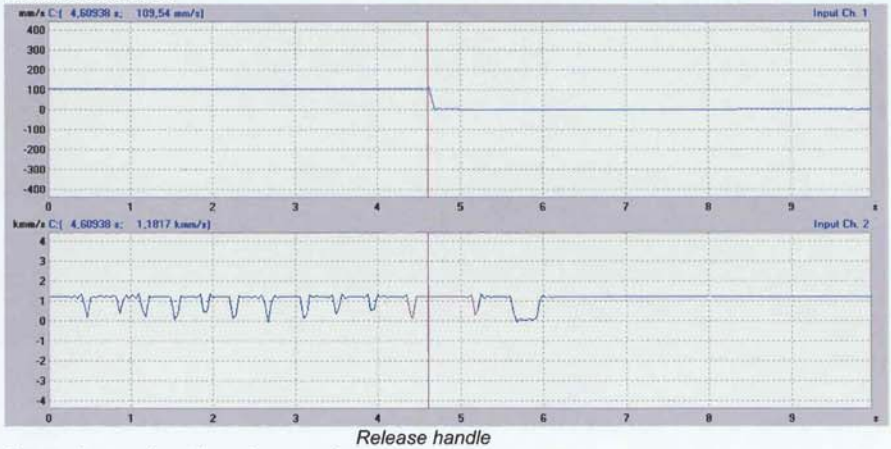
Measurement 2:



Release handle

Approximate duration: 1 second
Approximate distance: 0.5 meters

Measurement 3:

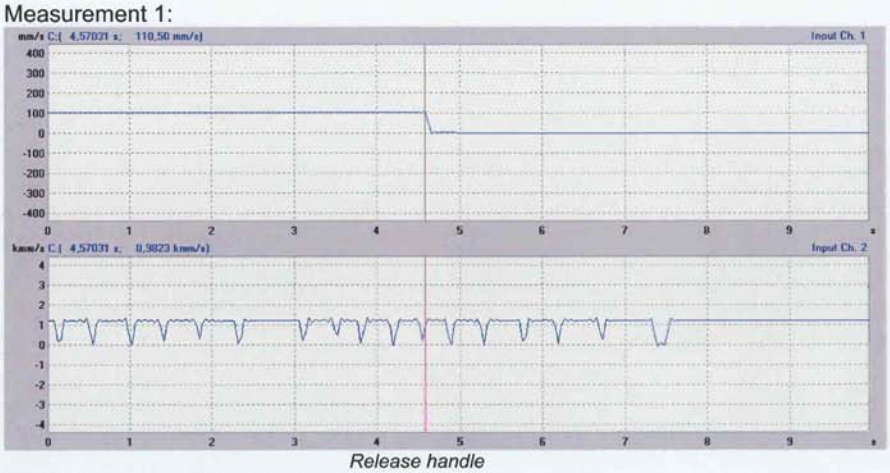


Release handle

Approximate duration: 1 second
Approximate distance: 0.5 meters

Condition 3: Normal operation, hauling, all winches in operation (2 aft and 2 front).

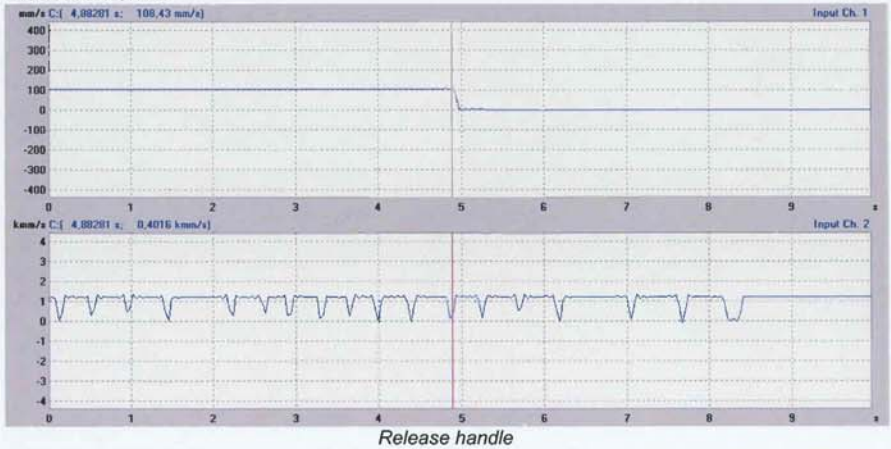
Measurement 1:



Release handle

Approximate duration: 3.5 seconds
Approximate distance: 1.5 meters

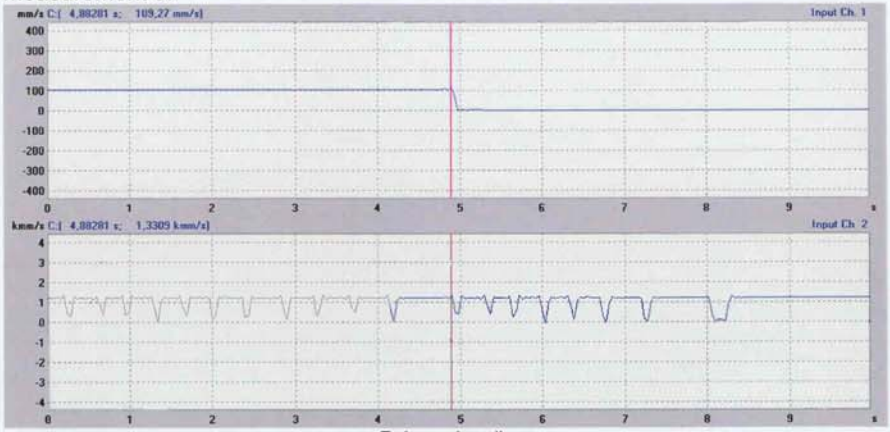
Measurement 2:



Release handle

Approximate duration: 3.5 seconds
Approximate distance: 1.5 meters

Measurement 3:

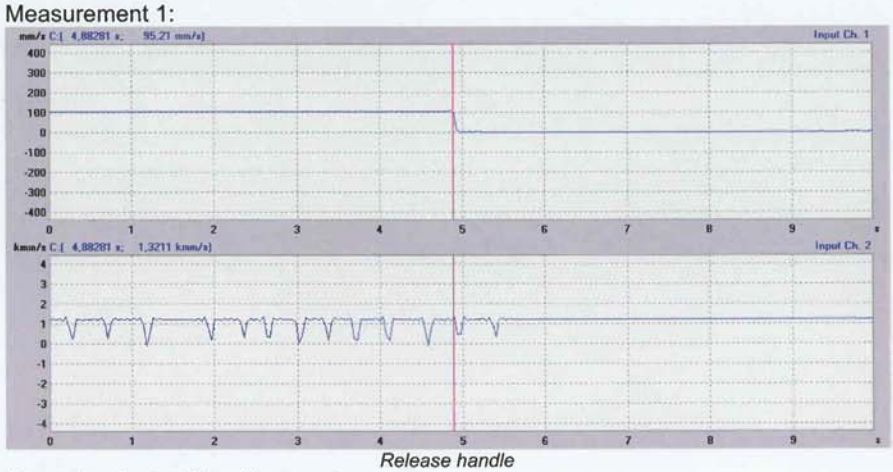


Release handle

Approximate duration: 3.5 seconds
Approximate distance: 1.5 meters

Condition 4: Normal operation, hauling, all winches (2 aft and 2 front) in operation, using emergency stop button.

Measurement 1:



Release handle

Approximate duration: 1 second
Approximate distance: 0.5 meters