



**Bundesstelle für Seeunfalluntersuchung**  
**Federal Bureau of Maritime Casualty Investigation**  
Federal Higher Authority subordinated to the Ministry  
of Transport and Digital Infrastructure

## **Investigation Report 32/19**

### **Serious Marine Casualty**

# **Grounding of MV BORE BANK after steering gear failure level with buoy 18 in the Rostock sea channel on 17 January 2019**

16 January 2020

This 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). According to said Law, the sole objective of this investigation is to prevent future accidents. This investigation does not serve to ascertain fault, liability or claims (Article 9(2) SUG).

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to Article 34(4) SUG.

The German text shall prevail in the interpretation of this investigation report.

Issued by:  
Bundesstelle für Seeunfalluntersuchung – BSU  
(Federal Bureau of Maritime Casualty Investigation)  
Bernhard-Nocht-Str. 78  
D-20359 Hamburg



Director: Ulf Kaspera  
Phone: +49 40 3190 8300  
posteingang-bsu@bsh.de

Fax: +49 40 3190 8340  
[www.bsu-bund.de](http://www.bsu-bund.de)

## Table of Contents

1	SUMMARY.....	5
2	FACTUAL INFORMATION.....	6
2.1	Photograph of the ship .....	6
2.2	Ship particulars.....	6
2.3	Voyage particulars.....	7
2.4	Marine casualty information.....	8
2.5	Shore authority involvement and emergency response.....	9
3	COURSE OF THE ACCIDENT AND INVESTIGATION .....	10
3.1	Course of the accident .....	10
3.2	Investigation .....	12
3.3	Actions taken.....	12
3.4	Further examples of unsolved steering gear failures.....	12
4	ANALYSIS.....	14
5	CONCLUSIONS.....	14
6	SAFETY RECOMMENDATIONS .....	15
6.1	Federal Ministry of Transport and Digital Infrastructure.....	15
6.2	Owner.....	15
7	SOURCES .....	16
8	ANNEX – AUTOPILOT SERVICE REPORT .....	17

---

## Table of Figures

Figure 1: BORE BANK .....	6
Figure 2: Scene of the accident .....	8
Figure 3: Steering gear control panel .....	11
Figure 4: Selector switch .....	11
Figure 5: Selection display.....	11
Figure 6: Collision of DANICA VIOLET with BERLIN .....	13

## 1 SUMMARY

The Finnish-flagged Ro-Ro/ship BORE BANK was en route from Kotka in Finland to Rostock on 17 January 2019. The pilot boarded in the morning at 0530 and the sea channel passage began. At 0547, the pilot noticed that he could not steer the ship and asked the third officer to take over the manual steering. The third officer then switched over but found he was unable to steer the ship with that, either. The rudder failed to respond.

The master then took hold of the joystick, with which everything is overwritten, and set the rudder to hard to port. The BORE BANK actually started to turn to port. Since the sea channel's eastern breakwater was already extremely close to the bow, the master and the pilot quickly decided – as demanded by the situation – that compensating for the turn to port would reportedly be too dangerous because the ship would strike the breakwater when she turned starboard back into the fairway. Consequently, the port turn was not interrupted and the BORE BANK's fore section ran aground.

The crew could not find any damage. Both the main engine and the steering gear operated properly.

The pilot informed VTS<sup>1</sup> Warnemünde that the ship had run aground and requested tugs.

The first tug (Bugsier 16) reached the BORE BANK at 0625. At 0645, the Bugsier 16 made fast at the bow and the Fairplay 6, which had arrived in the meantime, at the stern. A third tug was ordered because the first attempt at 0700 failed.

The Fairplay 12 also made fast at the stern at 0738 and the BORE BANK was refloated at 0740 with the assistance of her main engine.

The BORE BANK made fast at the pier at 0900 with the support of the tugs and the loading and unloading operation as well as the investigation into this accident began.

---

<sup>1</sup> VTS: Vessel traffic service

## 2 FACTUAL INFORMATION

### 2.1 Photograph of the ship



Figure 1: BORE BANK

### 2.2 Ship particulars

Name of ship:	BORE BANK
Type of ship:	Ro-ro dry cargo carrier
Flag:	Finland
Port of registry:	Helsinki
IMO number:	9160774
Call sign:	OJIE
Owner (according to Equasis):	Bore Ltd.
Owner:	Bore Ltd.
Year built:	1998
Shipyard:	Umoe Sterkoder AS – Kristiansund Yard
Classification society:	DNV-GL
Length overall:	138.50 m
Breadth overall:	22.65 m
Draught (max.):	7.07 m
Gross tonnage:	10,585
Deadweight:	7,300 t
Engine rating:	14,480 kW
Main engine:	Wärtsilä 16V46A
(Service) Speed:	20.0 kts
Hull material:	Steel
Hull design:	Single hull
Minimum safe manning:	11

### 2.3 Voyage particulars

Port of departure:	Kotka
Port of call:	Rostock
Type of voyage:	Merchant shipping/international
Cargo information:	Ro-Ro/cargo
Manning:	12
Draught at time of accident:	F: 6.90 m – A: 7.20 m
Pilot on board:	Yes
Canal helmsman:	No
Number of passengers:	0

## 2.4 Marine casualty information

Type of marine casualty: Serious marine casualty/ran aground  
 Date, time: 17/01/2019, 0550  
 Location: Entrance to the port of Rostock  
 Latitude/Longitude:  $\phi 54^{\circ}11.270'N \lambda 012^{\circ}05.532'E$   
 Ship operation and voyage segment: Estuary trading  
 Place on board: Fore section  
 Human factors: No  
 Consequences: External assistance required; only paint abrasions on the underwater hull

Extract from Navigational Chart INT 1354,  
 Federal Maritime and Hydrographic Agency (BSH)

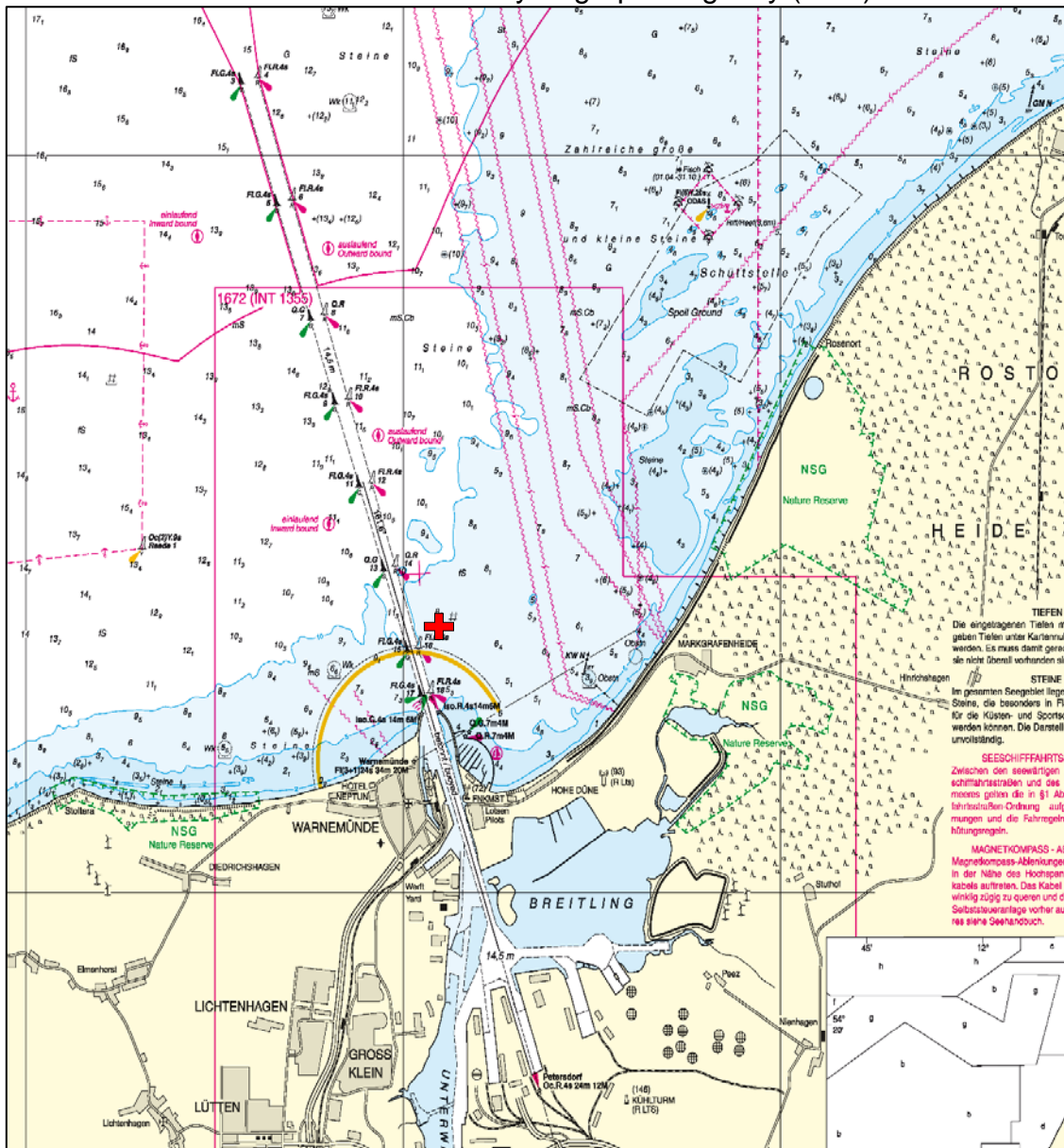


Figure 2: Scene of the accident



## **2.5 Shore authority involvement and emergency response**

Agencies involved:	VTS Warnemünde
Resources used:	Three tugs
Actions taken:	Towed astern, refloated and escorted to berth

### **3 COURSE OF THE ACCIDENT AND INVESTIGATION**

#### **3.1 Course of the accident**

The Finnish-flagged Ro-Ro/ship BORE BANK was en route from Kotka to Rostock on 17 January 2019. The pilot boarded in the morning at 0530 and the sea channel passage began. The bridge was manned by the pilot and the master at the starboard console and the third officer at the centre console. The ship was steered using autopilot and proceeding at about 7 kts. A strong easterly wind constantly pushed the BORE BANK to starboard. At 0547, the pilot noticed that he could no longer steer the ship using autopilot and asked the third officer to take over the manual steering. The third officer then switched over from autopilot to follow up steering but found that he could not steer the ship using that, either. The steering was evidently still operating on autopilot (see Figure 3 to Figure 5).

The master then took hold of the joystick, with which everything is overwritten, and set the rudder to hard to port. At 0547, the BORE BANK actually started to turn to port. Since the sea channel's eastern breakwater was already extremely close to the bow, the master and the pilot quickly decided – as demanded by the situation – that compensating for the turn to port would reportedly be too dangerous because although turning the ship starboard would move her back into the fairway, she could strike the breakwater in the process. Consequently, the decision was taken not to interrupt the port turn and the BORE BANK's fore section ran aground.

The crew was notified in order to identify any damage, especially in the engine room. The main engine and the steering gear operated properly.

The pilot informed VTS Warnemünde that the ship had run aground and requested tugs.

The first tug (Bugsier 16) reached the BORE BANK at 0625. At 0645, the Bugsier 16 made fast at the bow because her draught was shallower than the Fairplay 6, which had arrived in the meantime and made fast at the stern for that reason. The first attempt to refloat the vessel at 0700 failed. A third tug was ordered.

The Fairplay 12 also made fast at the stern at 0738 and the BORE BANK was refloated at 0740 with the assistance of her main engine.

The main engine, steering gear and bow thruster were successfully tested and the voyage to the berth then continued with the support of tugs Bugsier 16 and Fairplay 6. The BORE BANK was made fast at the pier by 0900, the loading and unloading operation began, and various agencies boarded to investigate the accident.

The damage to the ship was so minor that she could continue her voyage to Lübeck that coming night.



Figure 3: Steering gear control panel



Figure 5: Selection display

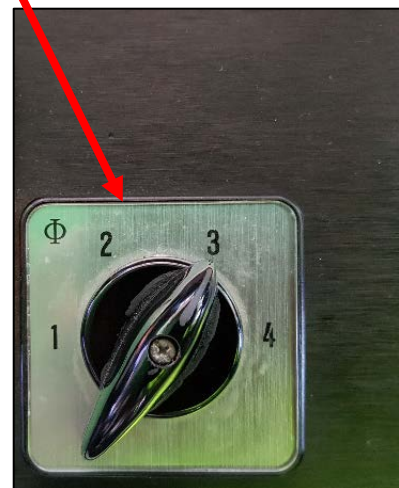


Figure 4: Selector switch

### 3.2 Investigation

Divers were immediately commissioned to inspect the underwater hull and assess it for possible damage after the ship had made fast in the port of Rostock. They only found paint abrasions, meaning the class could be reassigned.

Unfortunately, the personnel on board neglected to store the data on the VDR when the accident happened. Moreover, the owner failed to issue a corresponding instruction, too. This means that no direct data from the ship is available for analysis. Consequently, the reconstruction of the course of events leading up to and during the accident are largely based on witness testimony, supplemented by external data from the VTS.

The master later said (amongst other things) that there must have been errors in the switching process. He seems to remember that the indicator did not switch to follow up steering, which would mean the autopilot was not switched off. The master claimed that the autopilot could only be switched off when the rudder was at ZERO degrees. It was also stated that the installed autopilot had reportedly never been adapted for the ship but had operated on default settings since the ship entered service. Moreover, it has reportedly caused several false alarms since then, too.

The BSU is in possession of internal information from the owner, which indicates that the switchover process is reportedly abnormally complicated and therefore only understood by the regular crew. The replacement crew operating on board was reportedly not in possession of this particular knowledge, however.

### 3.3 Actions taken

A nautical superintendent from the owner visited the ship on Monday 21 January 2019 in the next Finnish port to assess the situation. Following that, the autopilot's manufacturer was asked to visit the ship to carry out repairs and adjustments. A technician boarded on 18 February 2019 and carried out tests and adjustments on the system until 21 February 2019. After that, the steering gear reportedly operated properly. The cause of the steering gear failure was not determined, however.

### 3.4 Further examples of unsolved steering gear failures

At about 1530 on Friday 1 November 2019, the DANICA VIOLET (Danish flagged) was sailing into the sea port of Rostock, when her steering gear failed causing her to turn to port level with the cruise terminal. The hard to starboard manoeuvre did not have any effect so that the engine (left-handed controllable pitch propeller) was set to full astern. However, this engine manoeuvre intensified the turn to port. Subsequently, DANICA VIOLET's bow collided with the port-forecastle of the outbound ferry BERLIN.

Nobody was injured and no environmental pollution occurred. At about 1600, both vessels were made fast at a berth and the waterways police embarked in order to start

the investigation of the incident. Repair works were carried out immediately on both vessels. DANICA VIOLET obtained a “Single Voyage Declaration” to shift to a yard in Gdynia in the afternoon of 2 November 2019. From 1718 on, the ferry BERLIN was allowed to resume her operation.

The results of the internal preliminary investigation carried out by the BSU revealed that DANICA VIOLET entered the sea channel using the autopilot. When the vessel all of a sudden was turning to port the vessels command attempted to operate the rudder manually, but did not succeed. Due to the age and dimension of the ship, the DANICA VIOLET does not have a VDR on board. However, a VDR does not record steering gear data. Immediately after the collision, the steering gear operated again enabling the DANICA VIOLET to berth without assistance. The service company called was unable to detect a cause, as was often the case with regard to such accidents. Once again, no technical recordings explaining the steering gear failure were available.



Figure 6: Collision of DANICA VIOLET with BERLIN

The BSU has been operating a database comprising all reported accidents since it was founded. The analysis of the steering gear failures of the last decade shows a significant majority of failures which could not be resolved. From 2007 to 2019, 113 steering gear failures, 70 of which could not be resolved, were recorded. The remaining steering gear failures were predominantly due to technical issues regarding other ship's systems. The possibility of erroneous operations undetected and not admitted, respectively, shall not be left unmentioned. Thus, the cause of 60 % of steering gear failures remain unsolved.

## 4 ANALYSIS

"Technical malfunctions are not directly related to the size of a ship but may occur on any vessel in spite of all the duplications of equipment and inspections prior to entering inland areas."

The BSU made this statement back in 2016 in the report it published when the CSCL INDIAN OCEAN ran aground in the River Elbe.<sup>2</sup> At that time, the steering gear on one of the largest ships in the world failed, arousing great public interest when she ran aground in the River Elbe. Fortunately, there were no injuries or damage to the environment.

There was no significant damage in the present case, either. Since the BORE BANK is much smaller and regarded more as an average freighter, public interest was limited. At the same time, it should be noted that this ship was also carrying quite a few tonnes of fuel (i.e. heavy fuel oil and diesel) on board and in the event of a grounding damage to the shell plating might have been such that this fuel could have escaped, causing major environmental pollution.

As with the CSCL INDIAN OCEAN, the fact that this did not happen is due only to fortunate circumstances.

To reduce the risk of environmental pollution due to steering gear failure, investigating authorities like the BSU need accurate information on why it failed.

In the course of the investigation carried out when the CSCL INDIAN OCEAN ran aground, steering gear manufacturers assured the BSU that equipping steering gear with a wide array of sensors and software so that monitoring was far more effective and malfunctions could be analysed in the first place would certainly be technically feasible.

Of course, it is also a question of cost, which in fairness should be divided equally amongst all the world's shipowners. The BSU therefore considers it necessary for the IMO to incorporate such changes in SOLAS.

## 5 CONCLUSIONS

The accident was caused by steering gear failure. It was not possible to establish a reason for nor the details of the failure (see test report by the steering gear's manufacturer in the Annex). Consequently, modern steering gear should keep a separate error log to make it possible to better analyse and avoid faults going forward.

---

<sup>2</sup> See Ref.: 34/16

## **6 SAFETY RECOMMENDATIONS**

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

### **6.1 Federal Ministry of Transport and Digital Infrastructure**

The Federal Bureau of Maritime Casualty Investigation recommends that the Federal Ministry of Transport and Digital Infrastructure urge the IMO to supplement SOLAS with an internal error logging requirement for steering gear, which should be analysed with the aim of minimising future steering gear failures and thus increasing safety at sea.

### **6.2 Owner**

The Federal Bureau of Maritime Casualty Investigation recommends that the owner ensure replacement crews are sufficiently familiarised with the technology of the ship they are to take charge of. Amongst other things, this should include in-service training and courses, as well as a comprehensive handover on board by the previous crew.


## 7 SOURCES

- Enquiries of the waterway police
- Written explanations/submissions
  - Ship's command
  - Owner
  - Classification society
- Witness testimony
- Navigational charts and ship particulars, BSH (Federal Maritime and Hydrographic Agency)



**8 Annex – Autopilot service report**

EMRI  
AUTOPILOT

<b>FURUNO</b>		<b>SERVICE REPORT</b>						
		H00415						
Your Reference	19/BAN804	Invoicing Address						
Contact Person	MASTER	Bore Oy						
Phone								
Port Of Service	Kotka-Rostock							
<b>BORE BANK</b>								
<b>FAULT DESCRIPTION:</b>								
Rudder response too slow or not effective enough.								
<b>WORK DONE:</b>			Continued <input type="checkbox"/>					
SEE SEPARATE REPORTS (Service report and Autopilot performance tests)								
<b>MATERIAL USED:</b>			Continued <input type="checkbox"/>					
<b>WORKING HOURS:</b>			Continued <input type="checkbox"/>					
<b>Date</b>	<b>Engineer</b>	<b>Waiting (h)</b>	<b>Arrival</b>	<b>Departure</b>	<b>Travel (h)</b>	<b>Km</b>	<b>Daily</b>	<b>Half-daily</b>
18.2.2019	MNI				2	160	<input checked="" type="checkbox"/>	<input type="checkbox"/>
18.2.2019	MNI		16:00	20:00			<input type="checkbox"/>	<input type="checkbox"/>
19.2.2019	MNI		8:30	16:00			<input checked="" type="checkbox"/>	<input type="checkbox"/>
20.2.2019	MNI		9:00	18:00			<input checked="" type="checkbox"/>	<input type="checkbox"/>
21.2.2019	MNI	6	6:30	12:30	5,5**		<input checked="" type="checkbox"/>	<input type="checkbox"/>
22.2.2019	MNI	Travelday, ferry					<input checked="" type="checkbox"/>	<input type="checkbox"/>
23.2.2019	MNI				2**	50**	<input checked="" type="checkbox"/>	<input type="checkbox"/>
** = According to actual								
21.2.2019		Engineer	Mika Nisukangas					
Date	Engineer	Customer						
<b>FURUNO FINLAND OY</b>				Taxi <input type="checkbox"/> Car Rental <input type="checkbox"/> Flight <input type="checkbox"/> Hotel <input type="checkbox"/> Other <input checked="" type="checkbox"/> Ferry ticket <input type="checkbox"/>				
Nilttyrinne 7, P.O.Box 74				Business ID: FI17546608				
FI-02271 Espoo, Finland				info@furuno.fi				
Phone: +358(0)9 4355 670 Fax: +358(0)9 4355 6710				www.furuno.fi				

## Service report H00415, Bore Bank autopilot adjustment. 18.-21.02.2019

### 18.2.

Travel from Espoo to Kotka. Came onboard, made some preparation for autopilot adjustment:

Took current parameters from autopilot etc. and check steering gear.

There is some difference if port or stb pump is in use for rudder angle repeaters. Not always, but sometimes difference is abt 2-3 degrees. Didn't found cause, maybe feedback potentiometers?

Rudder angle repeater in steering gear's pump room shows different values than repeaters on bridge. (at midship it shows abt. 5 deg stb)

### 19.2.

Pre-checks before sailing.

When sailing out from port of Kotka, noticed what Captain was mentioned about autopilot "on limit" warning and "off course" alarm and that it turns too much inside to curve. (Radius control in use, speed 7 kn)

When autopilot gives "OFF COURSE" alarm, it means that autopilot can't make wanted turn in Radius control. If vessel/crew keeps trying to make turn with Radius control even "on limit" alarm on, autopilot can't give counter rudder on time to stop turn.

Manufacturer's instruction: (Emri autopilot's user manual, page 6)

"If the rudder order is limited for a longer time during a manoeuvre:

- the ON LIMIT is lit
- the OFF COURSE ALARM is activated if the heading of the vessel cannot follow the tangential course of the curve defined by the radius setting
- the alarm buzzer sounds

Proceed in this condition by:

- cancelling the panel buzzer by pressing RESET
- and then dependent on the navigational situation:
  - either select the COURSE CONTROL mode
  - or select HAND control"

After reached more open waters, started to adjust autopilot. Noticed that it overshoots too much (abt.3-4 degrees sometimes), changed settings = rudder starts move little bit more aggressive, counter rudder more aggressive.

Tested heading keeping after adjustment (Loaded / Precise), speed abt. 16 kn:

- With two steering gear pumps, Radius control, 1,0NM radius, heading keeps +/- 0,2 – 0,3 degrees.
- With one pump, same settings, heading stays +/- 0,1 – 0,2 degrees.

### 20.2.

Adjusted autopilot:

- Changed On limit -> Of course alarm trigger time from 10 sec to 30 sec
- Changed adaptive rudder settings in max. speed from 10deg to 15deg. (this will effect also Automatic rudder limit at lower speeds, it will give more rudder angle in Radius control)

Made test turns according to Emri's "Normal course control performance verification", all good. (Wind was quite heavy (14-18 m/s) and pushing vessel from STB/AFT.)

Course keeping good and steady.

Made also tests with slower speed, 6-7kn. Good results, no "on limit" alarms and average overshoot less than 1 degree.

### 21.2.

When approach to Rsothock, no abnormalities found and autopilot responses to course changes. Asked Captain to observe in coming voyages if autopilot's best accurate is with two steering gear pumps, or with one pump. (and if there is any difference between Port/STB running)

Reporting, travel back to Finland.

Attached documents:

Current autopilot parameters, service report (working hours etc.), Autopilot performance tests


**Bore Bank, 20th Feb 2019, Baltic Sea**

Tests made according to Emri comissioning manual.

Normal course control performance verification:	
Select automatic rudder limit (speed dependet) and measure overshoot (deg) and time from start of the turn to being within 1 deg from final course (sec) in the following conditions:	
Course control, 10deg course change to SB	Overshoot
Course control, 10deg course change to PS	Time
Course control, 40deg course change to SB	2,0
Course control, 40deg course change to SB	36
Course control, 40deg course change to SB	-0,6
Course control, 40deg course change to SB	53
Course control, 40deg course change to SB	1,2
Course control, 40deg course change to SB	100
Course control, 40deg course change to SB	-1,1
Course control, 40deg course change to SB	105
Course control, 40deg course change to SB	2,2
Course control, 40deg course change to SB	42
Course control, 40deg course change to SB	0,3
Course control, 40deg course change to SB	55
Course control, 40deg course change to SB	2,1
Course control, 40deg course change to SB	103
Course control, 40deg course change to SB	-0,9
Course control, 40deg course change to SB	106
Average	0,6

Speed: 15kn  
 Wind: NW 14-18 m/s  
 Swell: NW 1-2m  
 Heading: 217 deg

"extra" tests with slower speed

"extra" tests with slower speed	
Course control, 10deg course change to SB	Overshoot
Course control, 10deg course change to PS	Time
Course control, 40deg course change to SB	0,4
Course control, 40deg course change to SB	91
Course control, 40deg course change to SB	0,4
Course control, 40deg course change to SB	104
Course control, 40deg course change to SB	0,5
Course control, 40deg course change to SB	158
Course control, 40deg course change to SB	1,2
Course control, 40deg course change to SB	176
Course control, 40deg course change to SB	1,1
Course control, 40deg course change to SB	78
Course control, 40deg course change to SB	0,7
Course control, 40deg course change to SB	84
Course control, 40deg course change to SB	1,3
Course control, 40deg course change to SB	280
Course control, 40deg course change to SB	2,2
Course control, 40deg course change to SB	282
Average	0,9

Speed: 6-7kn  
 Wind: SW 5 m/s  
 Swell: SW 1m  
 Heading: 232 deg

Note! Made 50deg turn.  
 Note! Made 50deg turn.

Note! Made 50deg turn.  
 Note! Made 50deg turn.

*Handwritten signature*  
 FINLAND OY  
 Mikko Mäkeläinen