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

Summary Investigation Report 31/09

Very serious marine casualty

Accident with subsequent loss of life on board the fishing vessel TANJA on 6 February 2009 at the port of Burgstaaken (Fehmarn)

1 December 2009

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.

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

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

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

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1 Summary of the marine casualty

On 6 February 2009 at about 1620[1], a fatal accident occurred on board the fishing vessel TANJA. At that time, TANJA was situated in the local port of Burgstaaken (Fehmarn). The skipper was transferring an IBC[2] container carrying nets weighing approximately 320 kg to the shore using the shipboard cargo-handling gear. In the process, the lifting eye on the cargo block attached to the boom head broke suddenly. The container, which at that time was hovering just a few centimetres above the ground, crashed to the ground. Fragments of the block hit the skipper on the head and injured him fatally.

[1] All times shown in this report are CET = UTC + 1
[2] IBC = Intermediate Bulk Container

2 Scene of the accident

Type of event:	Very serious marine casualty
Date/Time:	6 February 2009, at approximately 1620
Location:	Burgstaaken local port
Latitude/Longitude:	φ 54°25.3'N λ 011°11.4'E

Excerpt from nautical chart 36 (INT 1352), BSH[3]

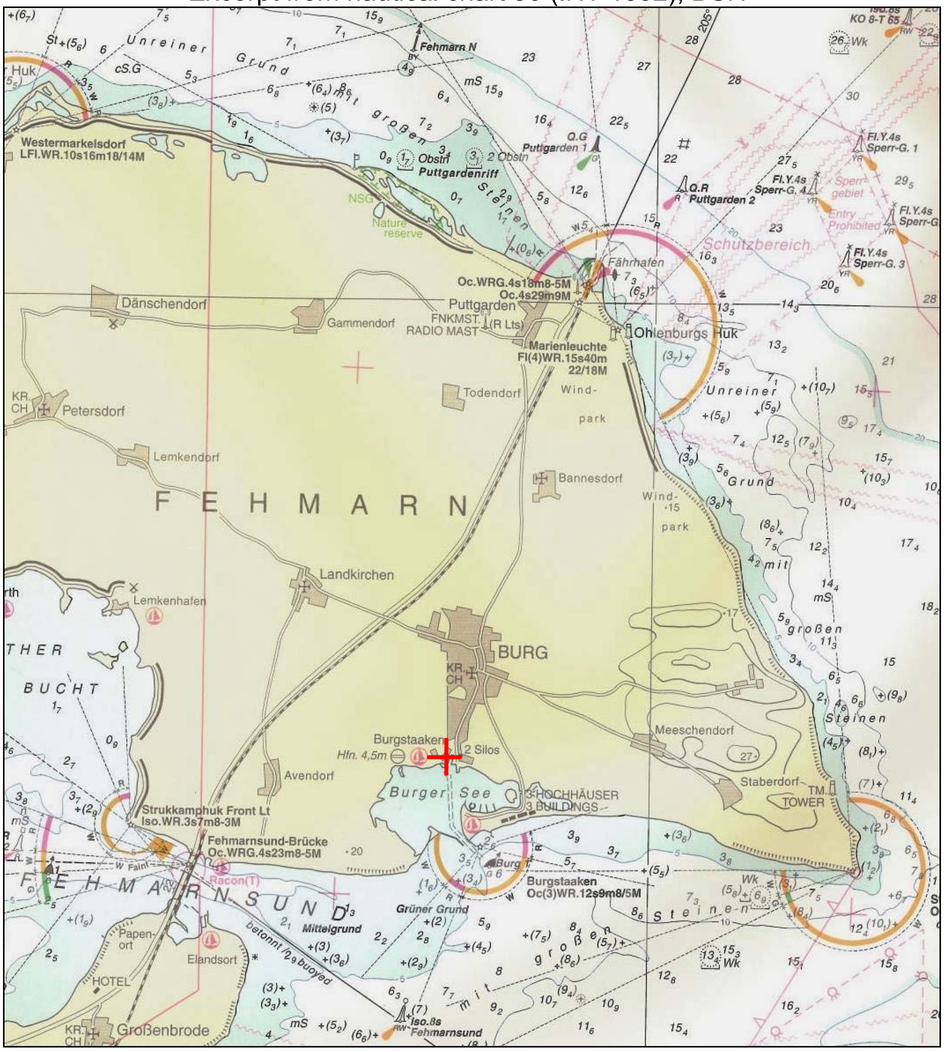

Figure 1: Scene of the accident

[3] BSH = Federal Maritime and Hydrographic Agency

3 Vessel particulars

3.1 Photo

Figure 2: Photo

3.2 Particulars

Name of the vessel:	TANJA
Type of vessel:	Fishing vessel
Nationality/flag:	Germany
Port of registry:	Burgstaaken (Fehmarn)
IMO number:	None
Call sign:	DD5198
Fisheries code:	BUR 004
Vessel operator/Form of operation:	None/Inshore part-time commercial fishing
Year built:	1975
Shipyard:	Faaborg Vaerft, Denmark
Classification society:	None
Length overall:	9.12 m
Breadth overall:	3.25 m
Draught:	1.35 m
Gross tonnage:	5
Engine rating:	46 kW
Main engine (type/manufacturer):	FL 12 Deutz air cooled
Hull material:	GRP
Number of crew:	1

4 Course of the accident

4.1 Accident

According to a witness, on the morning of the accident the 84-year-old part-time commercial fisherman subsequently involved in the accident used the cargo-handling gear to load an IBC container packed full with set gill nets on board. This was put on the main deck on the cover of the fish compartment. Since the IBC container was wider than the cover of the fish compartment, the bearing surface was temporarily extended with plastic crates (see **Figs. 3** and **4**).

Figure 3: Cover of fish compartment with extended bearing surface

Figure 4: IBC container

The fisherman subsequently sailed – in line with usual practice – alone to the inshore fishing grounds, where he laid about one third of the nets and then returned to port. Two witnesses who happened to be in the vicinity helped him transfer the IBC container ashore. To that end, while the fisherman operated the hydraulic drive of the cargo-handling gear's winch, which was on the starboard side of the forward edge of the wheelhouse (see **Fig. 5**), and used it to raise the load, the two witnesses hauled the container onto the pier.

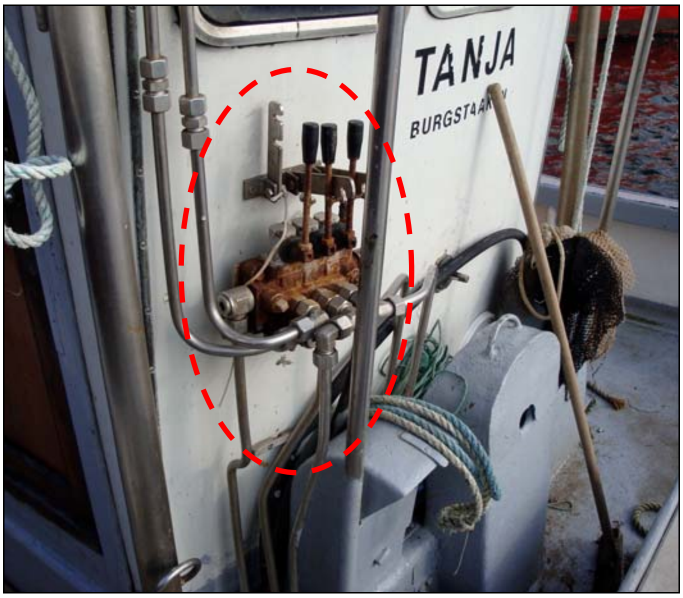

Figure 5: Operator console for the cargo-handling gear hydraulics

During this lateral move, the ring of the cargo block, with which this was attached to the boom head, broke suddenly. Parts of the falling block hit the fisherman on the head, whereupon he immediately fell to the ground. At that point, the container itself was just a few centimetres above the pier and thus fell to the ground without causing injury to the witnesses or damage to the vessel or the container itself.

4.2 Consequences of the accident

The victim was hit on the head by falling parts of the block. The injuries he suffered were so severe that an emergency doctor immediately summoned could only confirm the death of the casualty at 1700.

5 Investigation

5.1 Course, sources, particulars

The Federal Bureau of Maritime Casualty Investigation (BSU) was informed about the accident by the local waterway police shortly after it occurred. In addition to the investigative findings, other key-sources for the investigation were predominantly the information acquired by the investigation team in a witness interview during an on-site survey on 3 March 2009 and inspection of the ship files of the See-Berufsgenossenschaft (See-BG). However, the investigation focused on an appraisal of the fragments of the cargo block by an expert, because ultimately the only possible causes of the accident were material fatigue, (over-) loading of the block and/or faulty construction thereof.

5.2 Weather and sea conditions

The weather conditions were not investigated in detail because the calm winter weather on the day of the accident was clearly of no relevance to the accident.

5.3 Area of use/Crew

According to the current Sailing Permit (FES), the TANJA may be used on inshore fishing grounds. The FES contains a further provision that the fishing vessel may only be used for part-time commercial fishing in the area surrounding the island of Fehmarn, in Lübeck Bay and in Hohwachter Bay at a distance of up to 3 nautical miles from the coast and only in good weather and calm seas.

The Minimum Safe Manning Certificate provides for only two positions, skipper and chief engineer, where the skipper may set sail without an engineer if he holds an appropriate qualification. The skipper possessed the necessary qualifications and had decades of experience in fishing.

5.4 Description of the cargo-handling gear/Technical approval

The lifting gear used on board is of a lightweight tubular construction; it was probably installed subsequently in the 1990s and functions on the principle of a swinging boom (see **Fig. 6**). The mast structure consists of two vertical supports which run port and starboard along the forward edge of the deckhouse and are each bolted on the main deck with a foundation plate (see **Fig. 8**). These supports are interconnected above the deckhouse by a crossbar; they then meet in a Y-shape further above and support the actual mast, which is welded onto the crossbar. The topping lift block is attached to its upper end. The topping lift[4] consists of a combination of wire and fibre cordage (outlined red in **Fig. 7**), clews[5] and load rope consist of fibre cordage.

[4] Topping lift: Rope for hoisting and lowering the cargo boom vertically.
[5] Clews: Ropes for swinging the cargo boom horizontally.

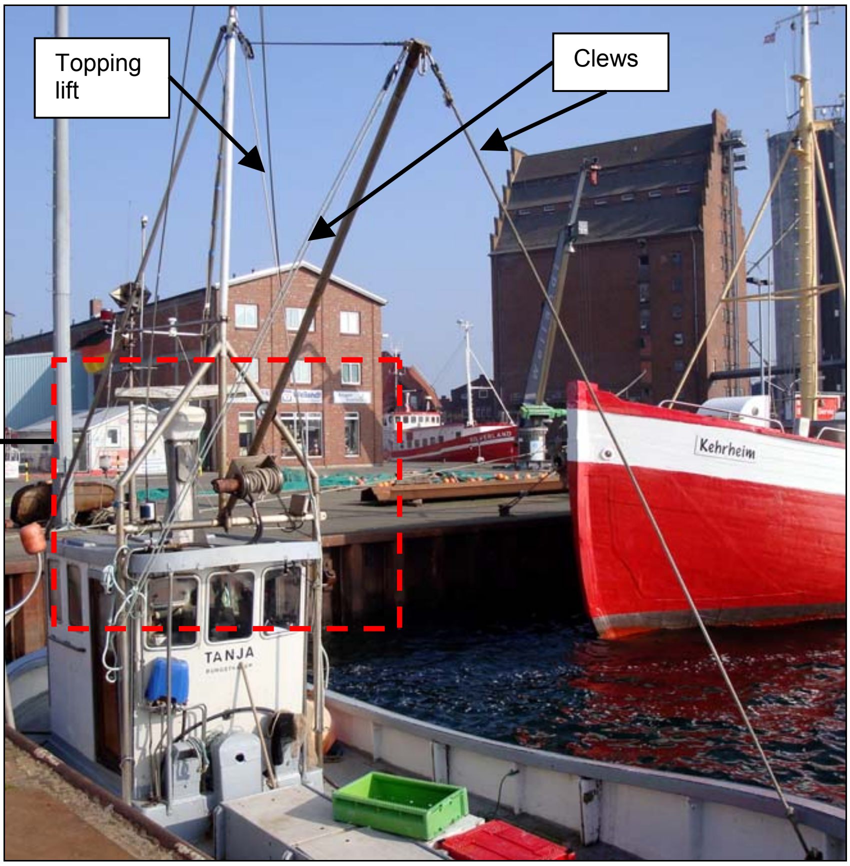

Figure 6: cargo-handling gear (complete)

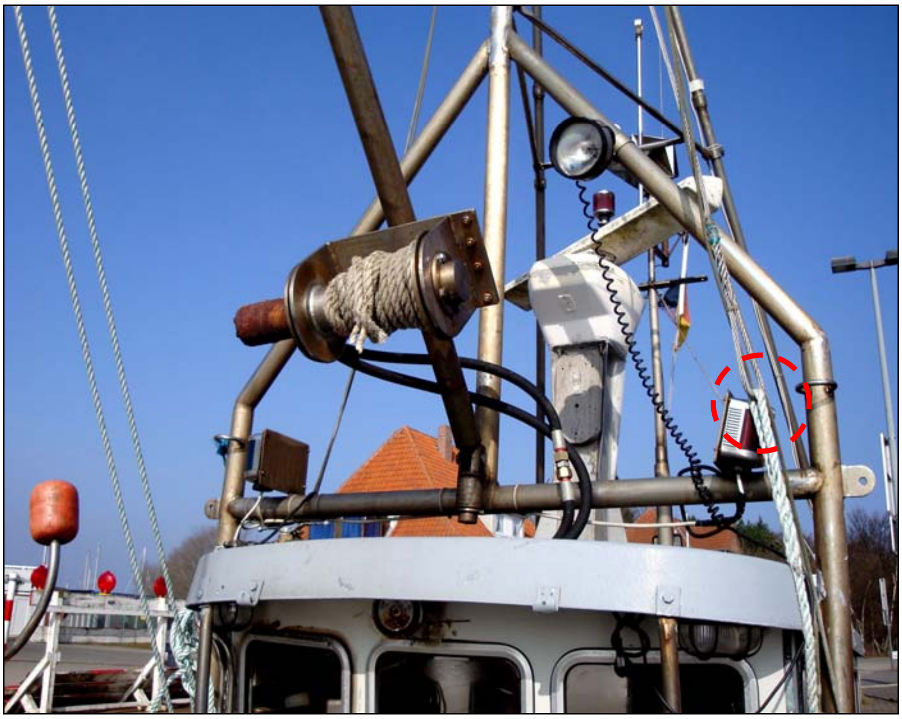

Figure 7: cargo-handling gear (close-up, crossbar of the mast)

During the visual inspection of the mast structure it was noted that the foundation plate of the starboard support was bolted to the floor of the main deck at only two of four possible points (see **Fig. 8**).

Figure 8: Foundation plate of the starboard mast support

The cargo block with its ring that broke during the accident as well as the starboard clew tackle and the eyelet of the port guy was fitted to the boom head with a so-called security link, which was equipped with a screw lock (see **Fig. 9**).

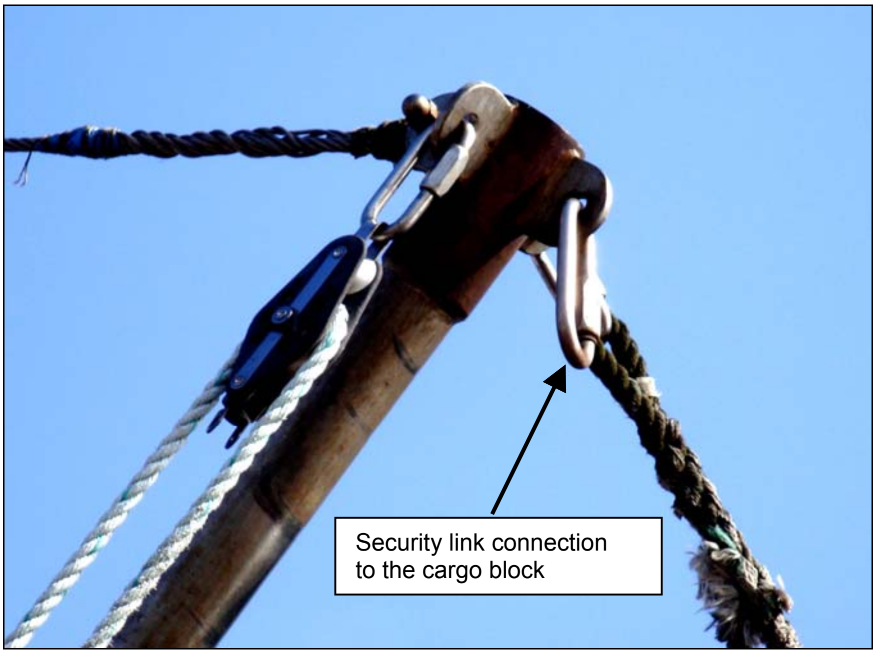

Figure 9: Boom head with attached security link

The BSU was unable to obtain technical documentation on the construction or evidence relating to installation of the lifting gear or exact date thereof. However, it has been established that the cargo-handling gear was installed by a mechanic, who was said to have assisted fishermen in the port of Burgstaaken in small and more significant structural modifications to their vessels for financial remuneration or payment in kind (fish) for years during his spare time while on holiday or after retiring.

The cargo-handling gear was not technically approved. At no time was the lifting gear recorded during periodic surveys (every four years, see art. 45 para. 1 (2) UVV See[6]) of the fishing boat by the See-BG or Germanischer Lloyd (GL) on its behalf. Accordingly, in the last survey report of the See-BG dated 7 August 2008 as well as in all previous reports, the number '2' (= 'not applicable') was entered under 'Lifting gear for fishing operations'.
There are only two possible explanations for that. Either it was dismantled by the owner of the boat before each survey; however, that would be unlikely in light of the associated effort. At any event, even if the equipment was dismantled, it would have left traces, for example, in the form of various loosened screw connections on the mast element on the deck and deckhouse and the hydraulic drive together with its operating console, which would have occasioned a more precise investigation. Therefore, it is more likely that the lifting gear was not given further consideration during the surveys. This could be because the respective inspector was not aware of the necessity to classify it as 'Lifting gear for fishing operations' requiring approval and survey within the meaning of and pursuant to the provisions of art. 258 UVV See, since the equipment in question is not an essential requirement for the actual fishing operations in terms of laying and recovering gill nets.

5.5 Expertise by the Institute of Materials Science and Welding Technology (IWS)

The BSU arranged for the cargo block, its broken lifting eye and the load hook to be examined by an expert at the IWS of the University of Applied Sciences, Hamburg, Prof Jochen Happ. Excerpts from Test Report No. G 146 – 09 submitted on 8 April 2009 are shown below in partly edited form.

5.5.1 Visual findings

The block is made of stainless steel. A lifting eye can be found on one side of the block (see **Fig. 10**).

[6] UVV See = Accident Prevention Regulations for Shipping Enterprises. The cross-industry accident prevention and insurance association regulation BGV A1 (principles of prevention) has been mandatory for shipping enterprises since 1 April 2008. To a large degree this has replaced the hitherto applicable UVV See (see art. 34 BGV A1). Nonetheless, the UVV See provisions cited in this report remain in effect.

Figure 10: Cargo block with lifting eye

A bushing joint is fitted to the screw that holds the block together on the side of the ring. Another screw is welded onto this bushing joint, the head of which is inserted in the base plate of the ring (see **Fig. 11**).

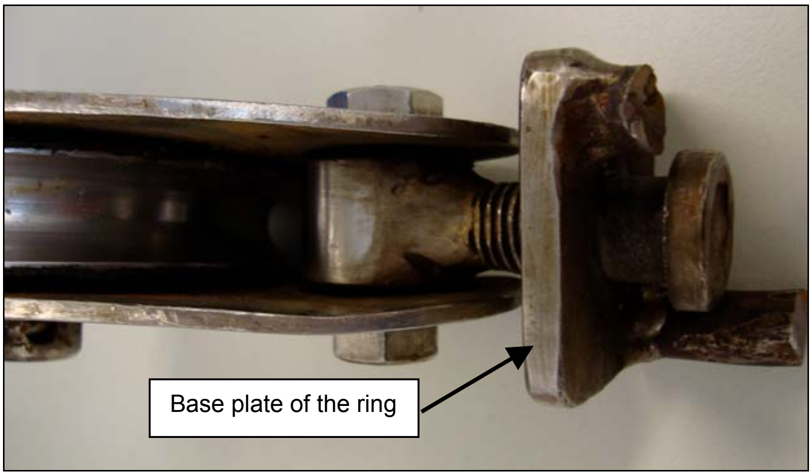

Figure 11: Ring mounting (close-up from the side)

The screw welded onto the bushing joint is a socket screw, the head of which is largely ground down (see **Fig. 12**).

Figure 12: Ring mounting (top view of fracture)

Figure 13 shows the foundation plate of the ring with the rest of the welded and broken ring bracket. The primary fracture is located close to the weld on the left side.

Figure 13: Foundation plate of the ring (side view)

The fracture surfaces of the bracket are shown in **Figs. 14** and **15**. The primary fracture (**Fig. 14**) is partly rusted. When looking through a magnifying glass, a crystalline structure is visible in both the non-rusted and rusted area. Evidently, the fracture happened in two stages, where the older part of the fracture is slightly rusty. The secondary fracture (**Fig. 15**) is about 20 mm from the weld. The position and direction of the fracture corresponds with the expected behaviour of the bracket after breaking on the opposite side.

Figure 14: Close-up of the primary fracture surface

Figure 15: Close-up of the secondary fracture surface

The load hook is made of austenitic chromium-nickel steel and can be seen together with the short piece of rope in **Fig. 16**. Upon examination we initially see that the safety clip, which every hook must have according to DIN requirements, is missing.

Figure 16: Hook with rope tied on with a knot

Evidently, the hook has been manually machined. Rough grinding marks of the kind caused by an angle grinder are present (**Fig. 17**).

Figure 17: Close-up of load hook

The geometry does not match that of a standard hook. **Figure 18** shows a diagram of a load hook with a large ring according to DIN 7541. The comparison in the following table shows the differences. Hooks of this size have a load capacity of 12.5 kN.

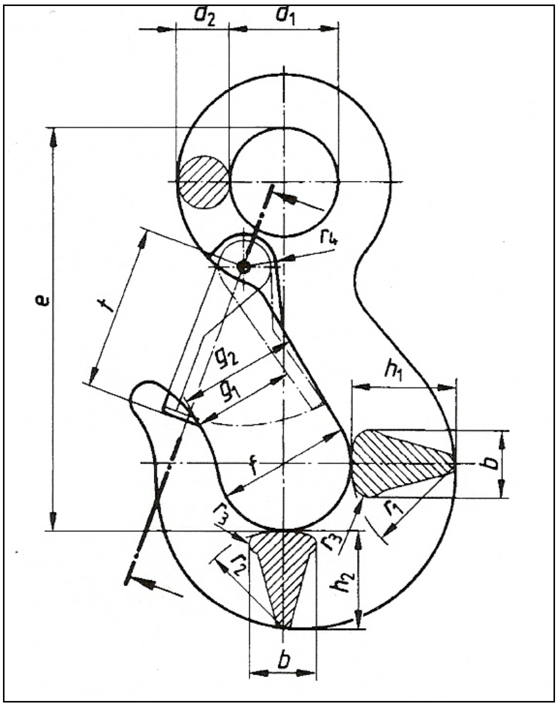

Figure 18: Load hook according to DIN 7541

Comparison:

	Specimen	According to DIN 7541*	According to DIN 7540**
d_1	28	28	16
d_2	12	14	10
h_1	30.5	30	26
h_2	23	26	22.5
b	12	21	17
e	104	112	85
f	34.5	37.5	31

*Large ring according to DIN 7541
**Small ring according to DIN 7540

The rope is made of synthetic fibre and has three strands. The ends of the rope were sheared and the strands had loosened. The rope showed clear signs of wear (**Fig. 19**). Rather than being spliced, the rope was attached to the hook with a knot (**Fig. 16**). Measured close to the knot, the rope diameter is about 15 mm. A burning test showed that it is a polyamide rope. According to DIN ISO 1140, it concerns a Synthetic Fibre Rope Form A with three strands, a nominal diameter of 16 mm and a minimum breaking strength of 51.8 kN.

Figure 19: Worn rope

5.5.2 Investigation

Samples were taken from the broken ring for chemical and metallographic analysis. For the elements listed, the spectroscopic analysis showed the following proportions:

Element		Foundation plate	Ring
Carbon	C	0.041%	0.18%
Silicon	Si	0.72%	0.50%
Manganese	Mn	1.01%	0.57%
Phosphor	P	0.018%	0.018%
Sulphur	S	0.012%	0.011%
Chromium	Cr	17.00%	16.33%
Nickel	Ni	9.13%	2.19%
Miscellaneous, especially iron	Fe	72.069%	80.201%

Only negligible traces of other elements were present. The composition shows that the steels are as follows:
Base plate: X 5 CrNi 18-9, W.- No. 1.4301, austenitic chromium-nickel steel
Ring: X 20 CrNi 17-2, martensitic chromium steel, heat treatable.

The metallographic analysis showed the typical pattern for the two materials. A fillet weld was used around the bracket. Increased hardness due to the welding was not visible. Intergranular corrosion had occurred next to the melting line and in the area of the primary fracture (**Fig. 20**).

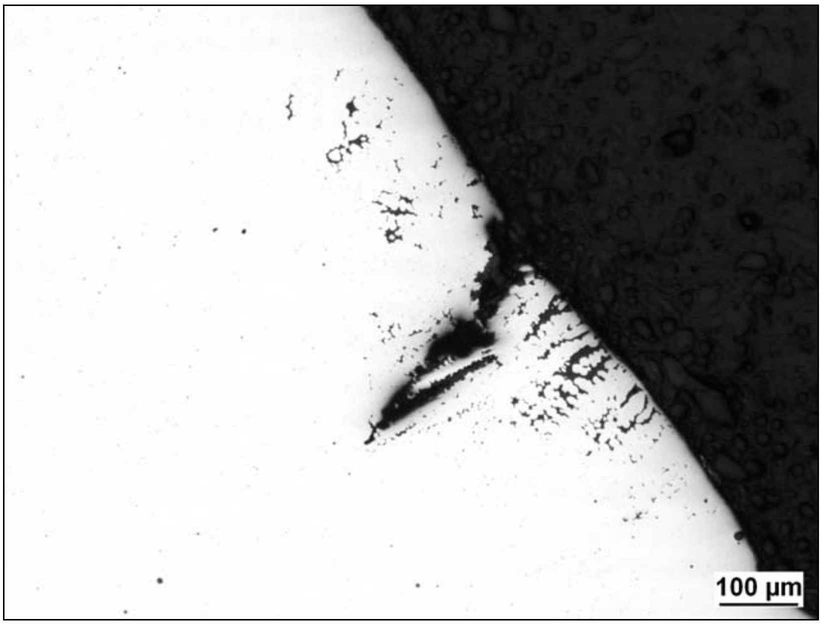

Figure 20: Intergranular corrosion

A load test was conducted on the load hook. To that end, it was clamped in a tensile testing machine with two shackles and pulled. The hook began to bend outwardly at a load of approximately 20 kN. The test was aborted at a tensile load of 30 kN.
The surface of the hook was then machined in the area of the ring. The machined surface was finely ground and a macroetch was created. The main deformation direction in the hook was thus determined. Moreover, the etching revealed a corrective weld at the ring of the hook. The hook can be seen in **Fig. 21** on the next page of this report. The corrective weld (outlined in red in **Fig. 21**) stands out clearly from the base material above the ring.[7] The deformation direction was visible only through a magnifying glass. It is marked in the photo with black ink.

[7] Note: A corrective weld is the subsequent application/addition of material by means of welding to achieve the required material shape and thickness.

Figure 21: Hook with corrective weld (outlined in red) and rolling direction[8]

5.5.3 Results

Normal production procedures were not used for either the hook or the ring attached to the block. The ring consisted of austenitic steel with good welding properties and chromium steel not suitable for welding. Several serious problems emerge when welding chromium steels such as this, which often lead to cracks immediately after the welding process. In addition, welding causes these steels to be prone to intergranular corrosion. This type of corrosion resulted in damage to the bracket, which then fractured under load without deformation. The welding of this ring is to be regarded as a serious error and the primary cause of the damage.

As can be seen from the analysis of the rolling direction, the hook was made from a metal sheet. The absence of the safety clip should, at any event, have been challenged. The first plastic deformation of the hook begins at 20 kN. For hooks, a test load of 1.5 times the load capacity is typically used. The first deformation occurs at just above the test load. Therefore, it can be presumed that the load capacity of the hook is some 1.2 t.

The load rope was tied to the ring of the hook with a knot. This knot does not meet the requirements for cargo-handling gear since experience shows that knots reduce the load capacity of rope by one third.

Usually a safety factor against breakage of 5 is applied for rope used for running rigging. The hook and rope would have thus had a load capacity of about 1.2 t if a splice was used for the connection. The load capacity was reduced to approximately 0.8 t because of the knot.

[8] Note: The visible outward bend of the hook was caused by the load test.

6 Conclusion

Even a cursory survey of the cargo-handling gear of the TANJA would have shown clearly that this would in no way meet the requirements of a technical approval. For example, a dubious combination of fibre and wire ropes was used for the topping lift. The load hook on which the load rope was tied did not have the required safety clip. The attachment of the mast to the deck was inadequate. Information concerning maximum permissible loads was not shown on the lifting gear. Technical documentation on the installed 'home-produced' equipment did not exist.
Contrary to art. 45 para. 3 UVV See in conjunction with the provision adopted for its application, the owner did not exhibit the conversion with verifiable records to the See-BG for approval. Moreover, since the cargo-handling gear, the temporary dismantling of which is conceivable but highly unlikely, was probably not identified as lifting gear within the meaning of art. 258 UVV See during the periodic surveys (every four years) of the fishing vessel, the separate surveys of the lifting gear also required by this regulation (every two years) did not take place. Therefore, the latent risk potential, if only because of the dubious nature of the exterior construction, originating from the cargo-handling gear remained unnoticed by the authorities.
The primary cause of the accident, which was the improper welding of the ring on the cargo block, could be clearly identified due to the expert's opinion. Due to the fact that the approval and technical inspection of the lifting gear was not performed at all, this flaw was a fortiori not accounted for by the authorities.

Ultimately, the investigation of the accident did not result in new lessons of any significance for improving maritime safety, but in many respects tragically confirmed important findings of the BSU acquired during the investigations into the capsizing of the fishing vessels NEPTUN[9] and HOHEWEG[10] very clearly.
The main cause of these two accidents involving fishing vessels was also, or is suspected of being, unprofessional conversions carried out independently, which were neither registered with nor accounted for by the See-BG during the periodic surveys.[11] Despite not being the cause of the accident, a correlation with the TANJA even exists in terms of the insufficient knowledge of the respective skipper/owner about the importance of the stability of a vessel, which had fatal consequences in the cases of FC NEPTUN and FC HOHEWEG.

[9] See Investigation Report 'Foundering of FC NEPTUN on 30 July 2003 in the port entrance of Norddeich' dated 5 March 2004, Ref.: 226/03.
[10] See Investigation Report 'Foundering of the Fishing Vessel HOHEWEG on 8 November 2006 in the Alte Weser area, western Nordergründe' dated 15 March 2008, Ref.: 564/06.
[11] Note: It was not possible to clarify conclusively whether the modifications were actually the main cause of the accident involving the HOHEWEG.

For the owner of the TANJA clearly did not consider what impact it could have on the righting behaviour of the fishing vessel if, for example, the IBC container, which was temporarily placed on the cover of the fish compartment, toppled over or if the vessel was exposed to non-calculated heeling moments while using the swinging boom.

For the aforementioned reasons, it is again made clear just how important the survey by the See-BG and/or the appointed employee of the GL is in the context of identifying hazards.

Owners of vessels, including and especially in the fisheries sector, must be (become) aware of the fact that regulatory requirements, in particular in respect of structural modifications to the vessel, are to be observed, that they do not constitute unnecessary or even pointless bureaucracy, but that they are provisions which if disregarded can very quickly cost lives, also one's own.

7 Sources

- Report by WSP Heiligenhafen
- Ship files of the See-Berufsgenossenschaft
- Witness accounts
- Test Report No. G 146 - 2009 dated 8 April 2009 by the Institute of Materials Science and Welding Technology (IWS), University of Applied Sciences Hamburg, Prof Jochen Happ
- Nautical chart and vessel particulars, Federal Maritime and Hydrographic Agency (BSH)