Marine Safety Investigation Unit

Transport Malta

SAFETY INVESTIGATION REPORT

202005/003 REPORT NO.: 09/2021 May 2021

This safety investigation has been conducted with the assistance and cooperation of the Dutch Safety Board.

MT *FT STURLA*
Serious injury to a crew member, during mooring operations in Westlius Lock, Terneuzen The Netherlands 01 May 2020

SUMMARY

At 1621, on 01 May 2020, two crew members on board the Maltese registered oil / chemical tanker *FT Furla*, were struck by a mooring rope. At the time of the accident, *FT Furla* was tying up on the Westslius Lock.

The Marine Safety Investigation Unit (MSIU) established that *FT Sturla* was gently moving ahead along the Lock, when the crew members ran out the stern line and forward back spring to make fast. The spring line came under heavy load and parted.

The analysis of the mooring rope revealed that the rope was in good condition, but its breaking load was markedly less than the certified breaking strength.

Taking into consideration the safety actions already adopted by the Company, the MSIU has issued no recommendations.

MT *FT Sturla*

FACTUAL INFORMATION

Vessel

FT Sturla was a 5,113 gt Maltese registered oil / chemical tanker built in 2008 by Adik Shipyard in Turkey and classed by Bureau Veritas (BV). The vessel was owned by Garanti Finansal Kiralama Anonim Sirketi and managed by Furtrans Tanker & Shipmanagement, Italy. The vessel's overall length was 119.86 m, with a breadth of 17.20 m and a summer deadweight of 7,596 tonnes.

Propulsive power was provided by a WARTSILA 8L32 engine, producing 4,000 kW at 750 rpm, and driving a controllable pitch propeller, enabling the vessel to reach a service speed of 15 knots. A midship section of the vessel is shown in Figure 1.

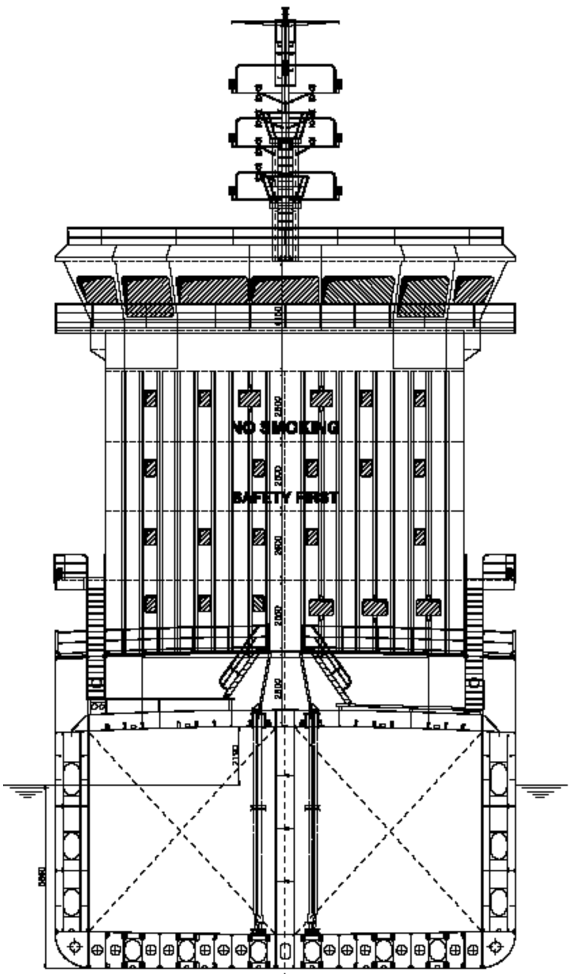


Figure 1: *FT Sturla*, midship section

Crew

FT Sturla was manned by a crew of 16. Her manning level was in excess of the Minimum Safe Manning Document issued by the flag State Administration. The officers and engineers were Turkish nationals, and the ratings came from the Philippines. The working language on board was English.

The master was 38 years old, holding an ocean-going master's certificate (STCW II/2), issued by the Turkish authorities. He had been employed by the Company for seven years. The chief officer was also 38 years old. He held an ocean-going chief officer's certificate (STCW II/I). He had been working at sea for 20 years, the last two years of which had been served as chief officer. He joined *FT Sturla* in Istanbul on 22 November 2019. The second officer was 29 years old, with an STCW regulation II/I Certificate of Competency.

The bosun and the injured able seafarer (AB) were 48 and 28 years old respectively. Both crew members had joined the vessel in Italy on 02 August 2019 and held STCW II/5 certificates, issued by the Republic of Philippines. The bosun started his career at sea in 1995. He had been working as bosun for five years. The injured AB worked at sea for six years, the last three and a half years were served as AB.

Narrative[1]

FT Sturla, laden with a cargo of coal tar, wash oil and crude benzene, was enroute to Zalzate, Belgium, on the Terneuzen Ghent Canal. At around 1615, on 01 May 2020, she approached the Westslius Lock, Terneuzen, under her own power. Her drafts were 6.60 m forward and 7.10 m aft.

The bridge was manned by the master, the second officer and the helmsman. A river pilot was also on board. The forward

[1] Unless otherwise stated, all times are local times (UTC + 2).

mooring station was manned by the chief officer, the bosun, one AB and one OS. All crew members were wearing their PPE. Communications between the bridge and mooring stations were conducted by VHF radios.

FT Sturla entered the lock on a heading of 148°. Her approach speed was two knots, and her main engine was set to dead slow astern. The crew members on the poop and forecastle decks were preparing to send out the mooring lines on the port side.

At 1618, the main engine was stopped. In accordance with the vessel's mooring plan, the forward back spring, reeled on the port winch drum, was run ashore through the Universal type roller fairlead on the bulwark. The winch was being operated by the bosun. The chief mate was monitoring the overside operations and communicating with the bosun using hand signals (Figure 2). Meanwhile, the headline from the starboard winch drum was run ashore. The OS guided the headline through the centre Panama chock, while the other AB operated the starboard winch.

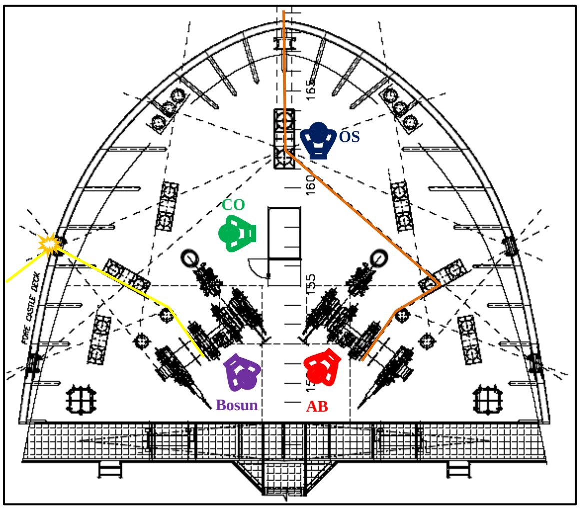


Figure 2: Mooring arrangement, spring line failure point and position of crew members

On arriving at the planned mooring position, the master instructed the mooring stations to hold the stern line and forward back spring. The chief mate hand-signalled the bosun to hold the spring and walked towards the starboard mooring drum. The engine was stopped, and the vessel was gradually slowing down. During the process, the back spring came under tension and a few seconds later, at 1621, it parted in the vicinity of the bulwark fairlead (Figure 2).

The recoil of the broken line grazed the bosun's arm but hit hard the AB working on the starboard winch control, knocking him to the deck. The accident details were relayed to the bridge and the pilot immediately summoned shore medical assistance.

Shortly afterwards, the vessel was fastened in the lock, where an ambulance and medics were waiting to treat the injured crew members.

Spring line

The spring line that parted (Figure 3) was an eight-stranded orange colour mooring rope, 44 mm in diameter and made of polypropylene fibres. The rope was supplied with protective canvas sleeve covering the spliced eyes at both ends. The Inspection Certificate supplied with the rope certified a breaking strength of 38,492 Kgf[2]. This test, attended by a DNV-GL surveyor, was performed on 24 December 2018 as per BS EN ISO 2307:2010[3]. The mooring rope was delivered to the vessel on 13 December 2019, and it was put into use on the same date as a forward back spring.

2 1 kgf is equal to 9.81 N.

3 The Inspection Certificate was based on test results of randomly selected rope samples.

Figure 3: Parted spring line

Company instructions required all mooring ropes to be inspected every month and prior to mooring operations. Detailed instructions and guidance were included in the vessel's SMS, which comprised also of a set of retirement criteria. Records held on board indicated that the forward back spring was inspected on 29 February and 31 March 2020. The last inspection was done a week before the vessel's arrival at Westslius Lock, and it was reported to be in good condition. Similarly, all ancillary mooring equipment was checked and greased during the monthly inspection.

The Universal-type roller fairlead, over which the spring line passed, was reportedly observed rotating freely during the mooring operations in the lock.

Environmental conditions

There was light to gentle Westerly breeze. The sea inside the lock was calm. Visibility was good and the air temperature was 12 ºC.

Extent of injuries

The bosun suffered superficial injuries on his arm and was treated on board by the medics. The AB was taken to a local hospital in Goes, where he was medically examined. He was found to have suffered head trauma with multiple fractures on the left side of his face and contusion hematoma to both eyes. Following initial treatment at the hospital, the AB could travel home in the Philippines for further medical treatment.

ANALYSIS

Aim

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties or incidents from occurring in the future.

Cooperation

During this safety investigation, the MSIU received all the necessary assistance and cooperation from the Dutch Safety Board.

Strength test and microscopic analysis

Following the accident, an outboard section of the mooring rope from the spliced eye to the failure point was collected and sent ashore for microscopic analysis and to determine its breaking strength.

The strength test (Figure 4) was conducted by CORDERIE DOR, Marseille on 25 May 2020.

Figure 4: Outboard section of the mooring rope undergoing breaking load test

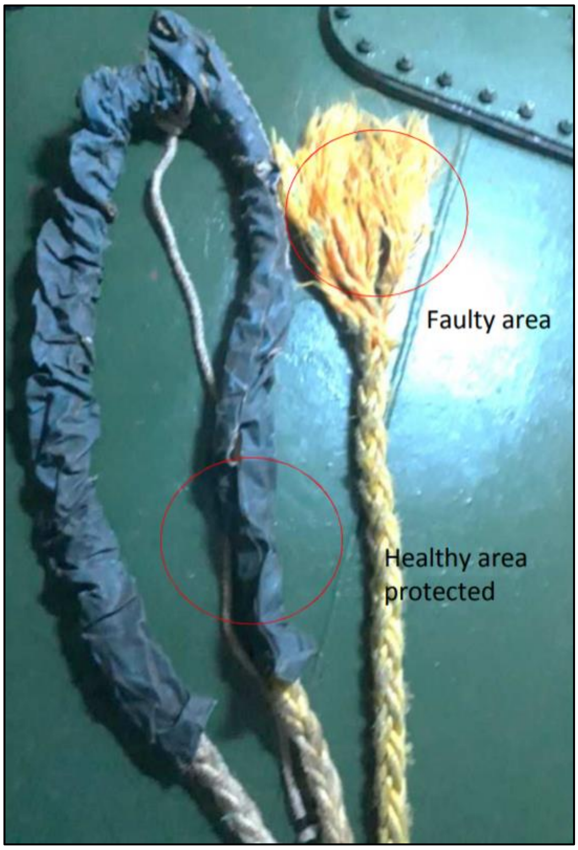


Figure 4: Area of the mooring rope under optical and SEM/EDX analysis

Subjected to a breaking load test, the rope parted two metres from the splice-end at 16,420 kgf. The results indicated that the percentage breaking strength of the mooring rope was about 42% of the certified breaking strength (38,492 kgf).

Microscopic analysis was performed by PolymEx, Marseille on 10 June 2020. The failure area (frayed and broken section) and a healthy area under the protective canvas sleeve (Figure 4) were examined under optical microscope and scanning electron microscope[4] (SEM).

The optical microscopy examination of the protected healthy section highlighted an area where the strands and the braid were complete, and an area where the strands have been frayed by the operator. The strands and braid in the faulty area were similar to the healthy area but included a section where faces of rupture were identified. Under the SEM/EDX microscopic examination, the polymeric fibres of strands of healthy protected area had a variable diameter (350 µm and 550 µm).

The polymeric fibres of strands in the faulty area also had a variable diameter of between 170 µm and 450 µm. In both cases, however, the surface of the fibres appeared smooth, non-porous and identified no fracture or crack apart from some grooves

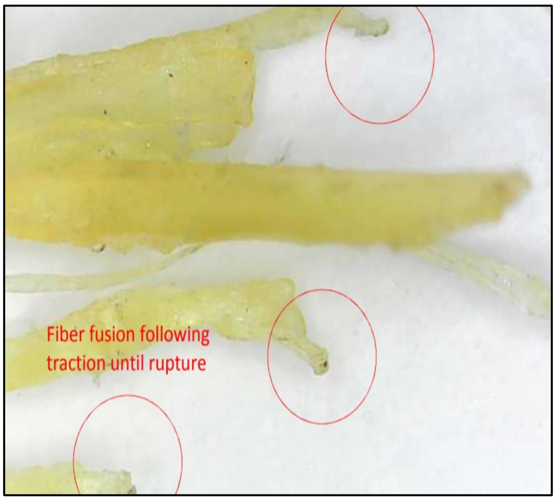
[4] In SEM, a focussed beam of high-energy electrons generates high resolution images. SEM is also used to identify elements present in the rope from the RX emission property in contact with electrons, referred to as energy dispersive X-ray (EDX).

and tears which had resulted from manipulation of the strands during manual delamination for analysis.

The optical and SEM/EDX microscopic examination concluded that the faces of rupture of the mooring rope (fault area) highlighted a phenomenon of fusion possibly due to the exothermic enthalpy (Figures 5a and 5b) resulting from excessive traction.

FT Sturla was fitted with a JRC model JCY-1800 voyage data recorder. However, the data covering the period around the time of the accident had not been saved by the ship's crew. Therefore, to form a detailed picture of events in the Lock, the safety investigation had to consult the vessel's bell-book, video of ECDIS playback, and CCTV images submitted by the Dutch Safety Board.

The safety investigation was able to ascertain the vessel had a slight headway when the chief officer hand-signal the bosun to hold the spring[5]. However, he lost effective oversight of the tension on the spring line when he moved away, and the winch drum prevented the line from rendering under the (generated) load.



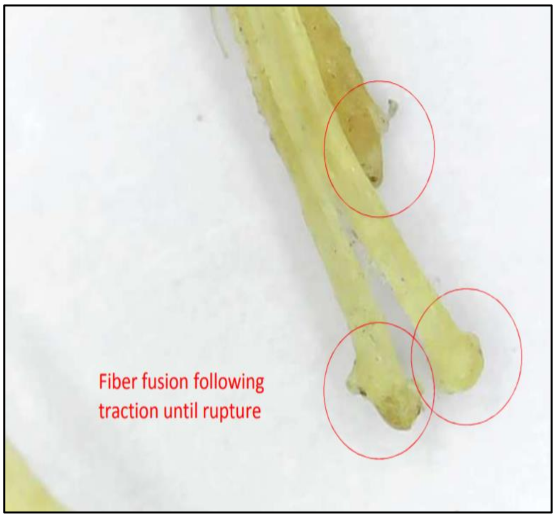


Figure 5a and 5b: Microscopic image showing rupture from fusion due to exothermic enthalpy

Assessment of mooring operations

In the absence of VDR audio data, it was neither possible to determine the extent of interaction between the pilot and the master, nor the precise sequence of events or orders conveyed to the forward mooring station. However, it seemed likely that there was insufficient time for the chief officer to act upon the pilot advice / master's subsequent instructions to ease the load on the spring line before it parted.

Spring line failure

From the documentary records submitted to the MSIU, it was evident that the spring line had been in use for about four months and had been frequently inspected by the crew.

The last inspection was carried out a week prior to the accident and it was reported to be in good condition. Optical and microscopic examinations of the parted section of the mooring rope identified neither cuts nor abrasion, pulled strands, fused fibres, or any other degradation from UV radiation, oil or chemical. However, the laboratory tests recorded a breaking strength of only 16,420 kgf. The results suggested a reduction in the breaking strength of more

[5] The pilot stated that vessels in Westslius Lock tend to veer to the middle of the lock and advised the master to put some tension on the back spring.

than 50% of the mooring rope's certified breaking load.

The safety investigation found it very unlikely that the mooring rope could have degraded to such an extent and in such a short period of time. Taking into consideration the above and the available information, including post-accident laboratory tests and microscopic analysis, the MSIU did not exclude the possibility of material defect in the mooring rope fibres, although this could not be confirmed.

Risk indicators

One of the issues identified during the analysis of the information made available to the MSIU, was the weak indicators available to the crew members during the mooring operation. No strong signals (identified in academia as 'leading (risk) indicators'), were identified during the safety investigation and it was concluded that these indicators were either latent and / or absent altogether.

This had a major effect on the dynamics of the accident because as much as all crew members would have been aware of the risks associated with a snapping mooring rope, they would not have had a full understanding of the (increased) risk, attributed to the significant reduction in the breaking strength of the rope.

Then, the risk of mooring rope operations remained affected by two critical factors – the lack of mechanical / electronic indicators to show the actual energy stored in the mooring rope (under tension), and the necessity of the crew members to be physically present in proximity of the mooring ropes; otherwise, no mooring operation would be possible.

Proactive measures

Crew members on duty at their respective mooring stations have significant limitations in taking proactive measures to prevent a mooring accident from happening. Visual inspections of mooring ropes may be carried out at regular intervals, but their outcome would not have revealed much, with respect to the residual strength of the mooring rope. Then, they will not indicate where the limit stands and what tensile load is permissible and what is not. The boundary between safe and unsafe situations remains blurred.

As already discussed, the indicators (or cues) are either soft and subtle, or undetectable due to, say, significant experience of mooring operations. The severity of the problem is therefore clear because notwithstanding the experience, skill, and knowledge which crew members may have acquired from numerous mooring operations, they remain in a situation where the 'elevated' risk of mooring rope failure stays undetected and, therefore, not addressed.

History of mooring rope accidents

A simple interrogation of maritime accident-related databases would reveal numerous mooring accidents, some of which with very serious consequences. A considerable number of these accidents have been investigated across the world, safety investigation reports published, and analysed at the IMO. There is therefore a significant amount of historical data available, and it is evidently clear that accident investigation bodies have spared no resources to investigate mooring accidents.

Yet, investigations into mooring accidents reveal identifiable trends, which have led to limited design reviews, if any.

The MSIU believes that the industry is missing on important lessons on how mooring accidents' dynamics evolve and, consequently, how these can be prevented. It appears that further discussions at IMO and EU levels are required to ensure that effective, preventive methods are employed.

It must be taken into consideration that the industry *per se* has recent knowledge of risks related to mooring operations, considering that these accidents remain on the investigation agenda of accident investigation bodies.

CONCLUSIONS

1. The failure of the mooring rope (fault area) was attributed to fusion due to the exothermic enthalpy resulting from excessive traction;
2. The mooring rope tensile test revealed a reduction of more than 50% of its original certified breaking load;
3. The optical microscopy examination of the strands and braid identified faces of rupture;
4. Visual inspections of mooring ropes carried out by the crew members at regular intervals, did not reveal much, with respect to the residual strength of the mooring rope;
5. The mooring equipment was not required to be fitted with mechanical / electronic indicators to show the actual energy stored in the mooring rope;
6. The probability of material defect of the mooring rope was not excluded by the safety investigation.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION[6]

During the safety investigations, the Company has issued a bulletin to share information on this accident with the fleet vessels. Information on the accident is also being discussed with joining masters. All mooring ropes deemed 'defective' have been replaced on all the fleet vessels.

The Company has also developed specific mooring procedures for lock operations and issued instructions to vessels on the saving and retrieving of VDR data in the event of an accident.

[6] **Safety actions shall not create a presumption of blame and / or liability**.

SHIP PARTICULARS	
Vessel Name:	*FT Sturla*
Flag:	Malta
Classification Society:	Bureau Veritas
IMO Number:	9447287
Type:	Oil / Chemical Tanker
Registered Owner:	Garanti Finansal Kiralama Anonim Sitketi
Managers:	Furtrans Tanker & Shipmanagement, Italy
Construction:	Steel
Length Overall:	119.86 m
Registered Length:	113.20 m
Gross Tonnage:	5,113
Minimum Safe Manning:	13
Authorised Cargo:	Oil / Chemical in bulk
VOYAGE PARTICULARS	
Port of Departure:	Riga, Latvia
Port of Arrival:	Zalzate, Belgium
Type of Voyage:	International
Cargo Information:	Coal Tar – 4,454 tonnes; Wash Oil – 1,003 tonnes; Crude Benzene – 1,251 tonnes
Manning:	16
MARINE OCCURRENCE INFORMATION	
Date and Time:	01 May 2020 at 1621 (LT)
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	51° 19.70′ N 003° 49.03′ E (Westslius Lock, Terneuzen) The Netherlands
Place on Board	Forecastle deck
Injuries / Fatalities:	One serious injury
Damage / Environmental Impact:	None
Ship Operation:	Mooring / Manoeuvring
Voyage Segment:	Transit
External & Internal Environment:	Light to gentle Westerly breeze. The sea state in the Lock was calm, visibility good and the air temperature was 12 ºC.
Persons on board:	16