



SIMPLIFIED SAFETY INVESTIGATION REPORT

201507/023

REPORT NO.: 16/2016

JULY 2016

The Merchant Shipping (Accident and Incident Safety Investigation) Regulations, 2011 prescribe that the sole objective of marine safety investigations carried out in accordance with the regulations, including analysis, conclusions, and recommendations, which either result from them or are part of the process thereof, shall be the prevention of future marine accidents and incidents through the ascertainment of causes, contributing factors and circumstances.

Moreover, it is not the purpose of marine safety investigations carried out in accordance with these regulations to apportion blame or determine civil and criminal liabilities.

NOTE

This report is not written with litigation in mind and pursuant to Regulation 13(7) of the Merchant Shipping (Accident and Incident Safety Investigation) Regulations, 2011, shall be inadmissible in any judicial proceedings whose purpose or one of whose purposes is to attribute or apportion liability or blame, unless, under prescribed conditions, a Court determines otherwise.

The report may therefore be misleading if used for purposes other than the promulgation of safety lessons.

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MV MARIBELLA **Engine-room fire** **In position 34° 49' N 122° 58' W** **27 July 2015**

Course of events

The Maltese registered MV *Maribella* sailed from Pittsburgh, San Francisco Bay, on 26 July 2015. She was bound for Long Beach, California with 41,171 tonnes of pet coke. On 27 July 2015, at approximately 2013 (LT), a fire alarm indicated a fire in the engine-room. At the time, *Maribella* was in position 34° 49' N 122° 58' W. One generator was running and the vessel's engine-room was on UMS mode.

The second engineer, who was on duty, entered the engine-room and immediately discovered a fire on and around auxiliary engine no. 1. Shortly afterwards, the fixed overhead water mist fire extinguisher was triggered and the emergency generator fired up. All crew members were mustered at the muster station and they promptly shut the ventilation system. The emergency fire

team observed that the fire had been contained in a relatively small area and practically doused in water. Nonetheless, the team used portable CO₂ fire extinguishers to ensure that the fire had been completely extinguished.

Preliminary assessment of the area indicated damage around auxiliary engine no. 1. Overhead electrical cables and wires leading to the fixed fire and flame detection systems were burnt. Both systems were rendered inoperative. No pollution, injuries and cargo damage were reported.

Other plant equipment and machinery were also checked. Nos. 2 and 3 auxiliary engines were switched on and monitored for performance. By 2320, all shipboard functions were found normal and *Maribella* resumed her voyage to Long Beach.

Extent of damage

An assessment of damage by the attending Class surveyor was carried out on 29 and 31 July 2015. No direct fire damage was found on auxiliary engine no. 1. However, the associated components were severely damaged, specifically:

- starting air motor and air transducer;
- governor;
- lube oil primer motor;
- junction box for alarms/trips, pressure switches and temperature sensors;
- smoke and water mist detectors above auxiliary engine no. 1 and related electric cables and wires; and
- smoke damage on the engine cover.

Cause of fire¹

It was observed that the vent plug (Hexagon Socket Head Bolt) on no. 2 fuel oil injection pump had slackened during operation and marine gas oil feeding the auxiliary engine splattered on the exhaust pipe. The engine had been in operation for only 200 hours since last overhauled on 15 July 2015. At the time of damage survey in Long Beach, the cause of loosening of the vent plug had not been identified. The ship's managers, however, advised that during the overhaul of the generator's fuel oil pumps, the crew had replaced the copper washer before tightening the vent plug.

Laboratory examination

In view of the premature easing of the vent plug, the MSIU requested that the loose vent plug is collected from the accident site for detailed laboratory tests. The purpose was to provide the safety investigation with a

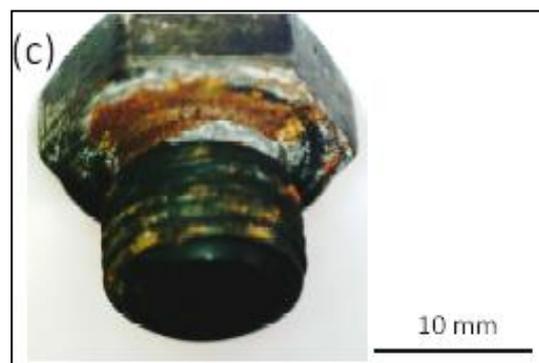
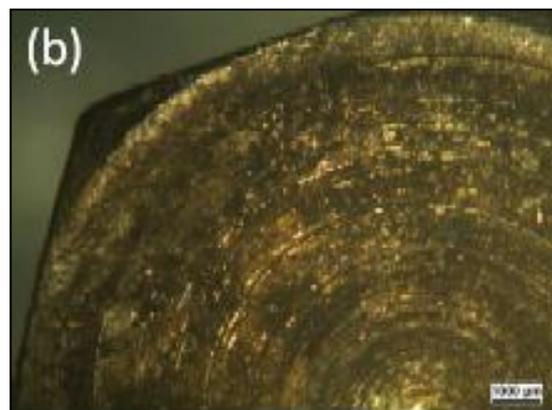
¹ The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties and incidents from occurring in the future.

technical analysis for the failure of the vent plug, if any.

Probable cause of the failure of the vent plug

Both the vent plug and a metallic washer were subjected to microscopical imaging using a *Nikon* stereomicroscope in combination with a fast-acquisition *Leica* camera.

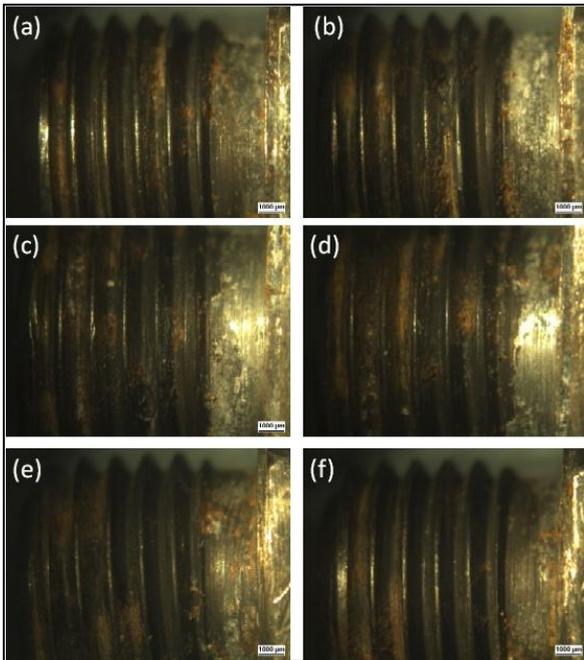
No significant damage beyond minor signs of corrosion were identified (Figures 1a to 1d).





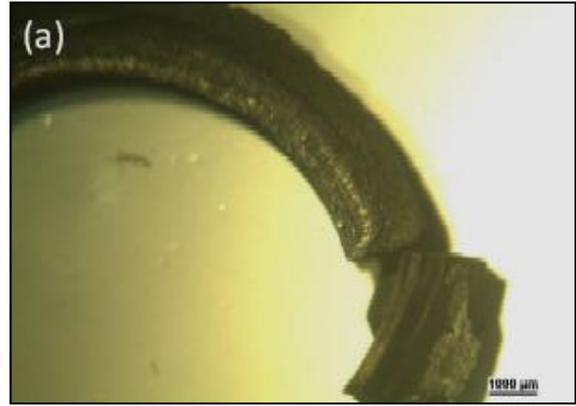
Figures 1a to 1d: Stereomicrographs of the bolt plug head/top and point surface

Moreover, no damage, stripping, surface cracking and deformation of the thread were identified at the set magnification (Figures 2a to 2f).



Figures 2a to 2f: Bolt thread at each of the six facets of the plug

The metallic washer, however, was found severely damaged, cracked and extensively deformed. It appeared brittle and was fragmented into four sections (Figures 3a and 3b). It is known that the hardening of copper washers usually occurs during ‘crushing’, in this case, between the bolt and the pump housing.



Figures 3a and 3b: Micrographs of the metallic washer

Technical analysis and maintenance related factors

The microscopy examination suggested that the bolt had not been damaged. Moreover, it was considered unlikely that the plug would have come loose had it been appropriately tightened. The bolt neither showed signs of previous over-torquing nor any other damage. To this effect, it was deduced that the bolt should have maintained tension following its (proper) installation.

The absence of damage on the bolt’s thread also suggested that anomalous operation of the pump (say, overpressure) did not cause the failure. It was therefore reasonable to attribute failure to spontaneous bolt loosening from, either:

- i. the installation of the plug had not been carried out in accordance with the recommended practices, thereby achieving a lower torque than necessary,

and thus allowing for vibration loosening of the bolt during the operation of the fuel pump; or

- ii. the metallic washer installed during the final bolt assembly prior to the eventual failure had already been significantly deformed and damaged from prior use. This soon deteriorated allowing for premature loosening. The brittle state of the washer suggested that this may have been re-used, possibly multiple times. Once the washer fractured, the bolt would have easily loosened up due to the normal vibrations during the operation of the pump and the engine.

Whilst it is not excluded that the plug was tightened at a lower torque (*i.e.* option 'i. '), the safety investigation concluded that option 'ii.' would have meant that a damaged washer (not simply brittle) would have been installed. This was considered to be highly unlikely.

Research in maintenance errors, carried out in domains other than the maritime, made reference to what has been defined as 'less than adequate' (LTA) maintenance. Even more, these types of errors have been classified into two main generic classes, *i.e.*,

- introduction of discrepancy that was not there before the maintenance activity had been initiated; and
- damaged and wrong components were not detected during the maintenance process.

The studies indicated further that LTA maintenance is most likely to be observed during the reassembling of parts rather than the disassembling process.

Following the results of the technical analysis, it was concluded that there may have been two potential sources of errors:

1. the sequence and procedure to box-up the fuel oil injection pump was correct but then not followed, say, by omitting

a step (*e.g.* the replacement of the metallic washer)² or not torqued to the required specifications; or

2. the procedure was not correct in that there was never the intention to replace the old metallic washer with a new one. It was also not excluded that this may have been the result of previous similar (yet successful) experiences where hardened metallic washers had not been replaced but no consequences reported.

The safety investigation was unable to conclude with absolute certainty the psychological origin of the actions taken when the fuel oil injection pump was boxed up again. However, considering that the technical analysis revealed a brittle metallic washer, it was considered more plausible that there was never the intention to replace the old metallic washer during the assembly of the pump.

RECOMMENDATIONS

Chandris (Hellas) Inc., is recommended to:

16/2016_R1 Bring this simplified safety investigation report to the attention of crew members on board Company vessels;

16/2016_R2 issue a Fleet Circular prohibiting the re-use of metallic washers and emphasise the importance of correct tightening procedures on installed equipment and machinery.

² The MSIU is of the view that it was also possible for whoever assembled the pump, had erroneously picked up the 'used' metallic washer. This was, however, considered to be less likely (although not impossible) since a 'used' metallic washer will be much darker in colour than a 'new' metallic one.

SHIP PARTICULARS

Vessel Name:	<i>Maribella</i>
Flag:	Malta
Classification Society:	NKK
IMO Number:	9316672
Type:	Bulk carrier
Registered Owner:	Maribella Maritime Co. Ltd.
Managers:	Chandris (Hellas) Inc., Greece
Construction:	Steel
Length Overall:	224.94 m
Registered Length:	217.97 m
Gross Tonnage:	39736
Minimum Safe Manning:	14
Authorised Cargo:	Dry bulk

VOYAGE PARTICULARS

Port of Departure:	Pittsburgh, USA
Port of Arrival:	Long Beach, USA
Type of Voyage:	Short International
Cargo Information:	Pet coke (41,171 tonnes)
Manning:	19

MARINE OCCURRENCE INFORMATION

Date and Time:	27 July 2015 at 20:15 (LT)
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	34° 49' N 122° 58' W
Place on Board	Engine-room
Injuries / Fatalities:	None
Damage / Environmental Impact:	None
Ship Operation:	On passage
Voyage Segment:	Transit
External & Internal Environment:	The weather was clear with visibility 10 miles. The Northwest wind was 25 knots. The sea state was rough and the Northwest swell was 2.50 m. The air and sea temperatures were 22 °C and 21 °C respectively.
Persons on board:	19