MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY BULLETIN

SB1/2016

February 2016

Extracts from The United Kingdom Merchant Shipping (Accident Reporting and Investigation) Regulations 2012

Regulation 5:
"The sole objective of a safety investigation into an accident under these Regulations shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of such an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

Regulation 16(1):
"The Chief Inspector may at any time make recommendations as to how future accidents may be prevented."

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020 7944 4292

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NOTE

This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

All bulletins can be found on our website:
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Mooring line failure resulting in serious injury to a deck officer on board *Zarga* alongside South Hook LNG terminal, Milford Haven on 2 March 2015

Photograph courtesy of Fotoflite.co

Zarga

MAIB SAFETY BULLETIN 1/2016

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of information available to date.

The *Merchant Shipping (Accident Reporting and Investigation) Regulations 2012* provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

In co-operation with the Republic of the Marshall Islands, the Marine Accident Investigation Branch (MAIB) is carrying out an investigation into a mooring line failure resulting in the serious injury to a crewman on board the Marshall Islands flagged Liquefied Natural Gas (LNG) carrier *Zarga* at the South Hook LNG terminal, Milford Haven on 2 March 2015.

The MAIB will publish a full report on completion of the investigation.

Steve Clinch
Chief Inspector of Marine Accidents

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BACKGROUND

On 2 March 2015, a deck officer on board the LNG carrier, *Zarga*, suffered severe head injuries when he was struck by a mooring rope that had parted while repositioning the vessel at the South Hook LNG terminal, Milford Haven. The officer, who was in charge of the vessel's forward mooring party, was airlifted to a specialist head injuries trauma unit for emergency surgery.

In July 2015, MAIB issued Safety Bulletin SB1/2015 in relation to the same incident. The Safety Bulletin highlighted the dangers of snapback when a high-modulus, low elongation, mooring rope fails when it is connected to a high elongation tail that is intended to reduce excessive dynamic loads on the mooring line during normal or severe operating conditions. This Safety Bulletin should be read in conjunction with SB1/2015.

MOORING ROPE

The mooring lines fitted to *Zarga* were high-modulus polyethylene (HMPE) jacketed synthetic fibre ropes. They had a 44mm diameter and were 275m long with a minimum breaking load (MBL) when new of 137 tonnes. A close-fitting braided abrasion-resistant jacket encased the rope's HMPE load-bearing core, which comprised three, low twist construction strands. Each strand consisted of 32 rope yarns. The core was wrapped in a self-amalgamating tape that assisted in bonding the jacket to the core.

The failed mooring rope had completed 1342 operating hours; it was 5 years old and had been expected to last for at least 8 years. The rope had a documented history and its previous on board visual and tactile inspection assessed it to be in good condition. Through life information recorded for each of the vessel's 20 mooring lines included the port of use, and the prevailing ambient air temperatures and local weather conditions during use.

INITIAL FINDINGS

The rope failed at an indicative load of 24 tonnes. Subsequent non-destructive assessment of the rope by an industry expert did not identify any defects that would indicate that it had been used or operated incorrectly **(Figure 1)**.

When the close-fitting jacket was removed from the rope at each side of the failure point, the rope yarns in all three strands exhibited moderate to severe kinking. The Z-shaped kinks were visually apparent and were found at close intervals with, for example, 22 occurring over a length of 2.78m **(Figure 2)**.

During the rope's dissection, 12 of the 96 rope yarns were found to have separated. The rope yarns were found to have failed at kink points and had separated as if they had been cut with a sharp knife at 45 degrees **(Figures 3** and **4)**.

Following the identification of the kinking and failed rope yarns, a number of additional sections of the rope were inspected. Further rope yarn failures and damage to the rope yarns at filament level were seen **(Figure 5)**. The damage identified was consistent with axial compression fatigue.

Operating ropes around tight bend radii can exacerbate axial compression fatigue and also cause internal abrasion damage. In this case, the failed mooring rope had been run from its winch drum to the LNG terminal hook via a deck roller bollard and a ship's side roller fairlead. The diameters of the rollers for both the deck bollard and deck fairlead were less than the minimum recommended by the rope manufacturer for its 44mm HMPE jacketed ropes.


Figure 1
Failed end of rope

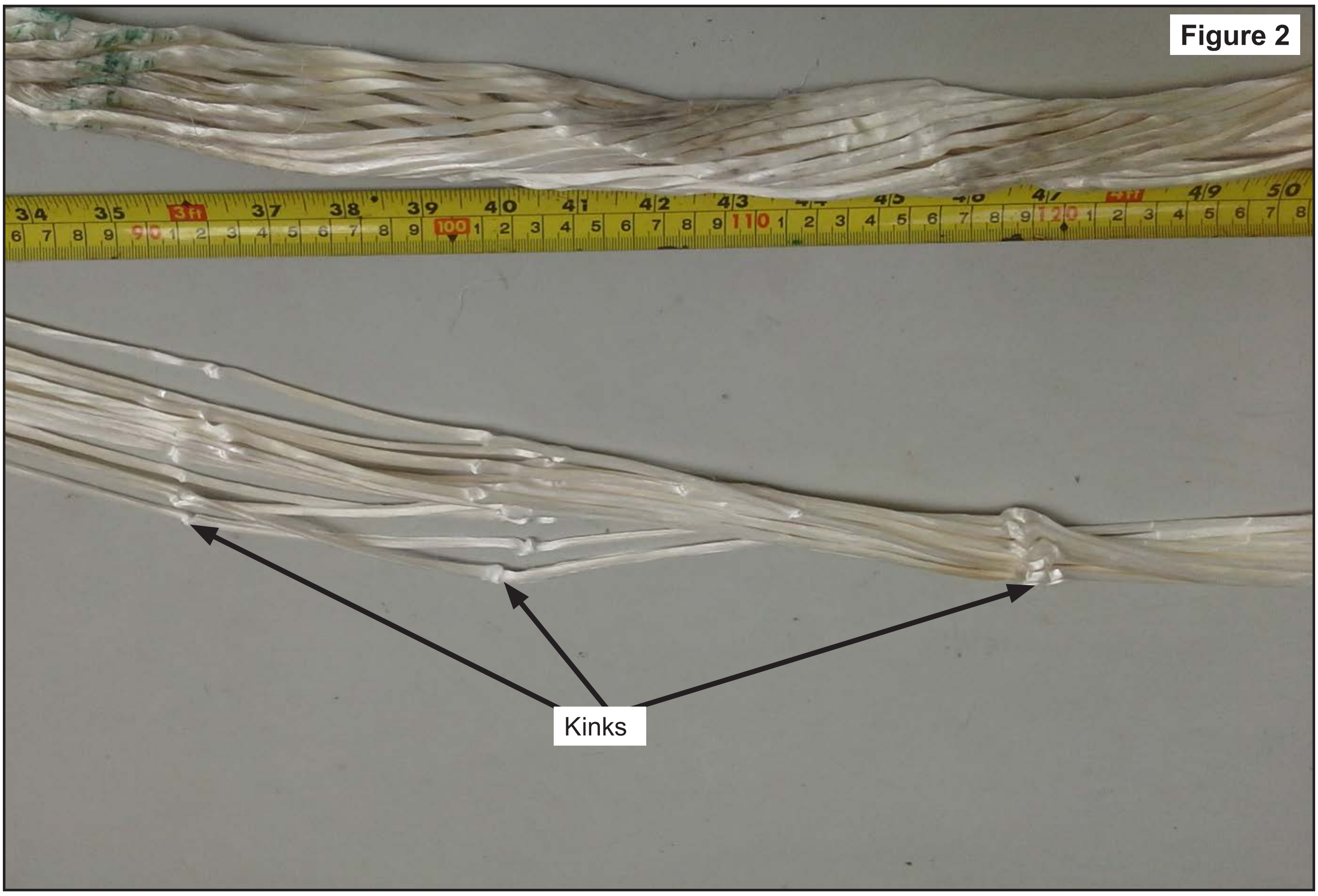
Figure 2
Kinks

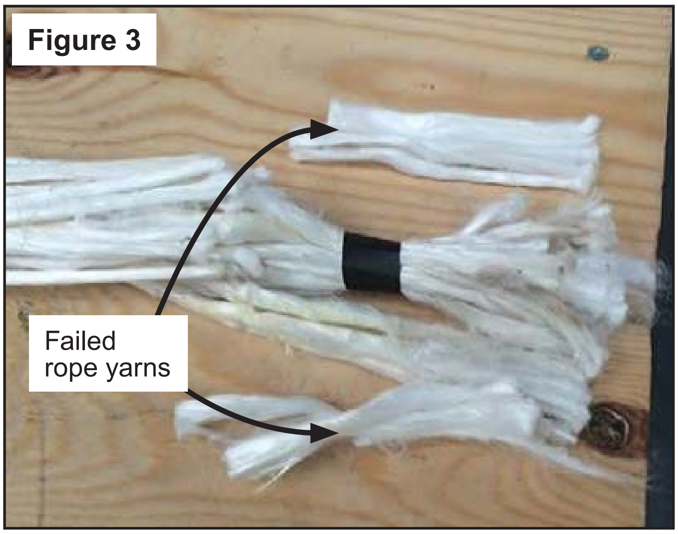

Figure 3

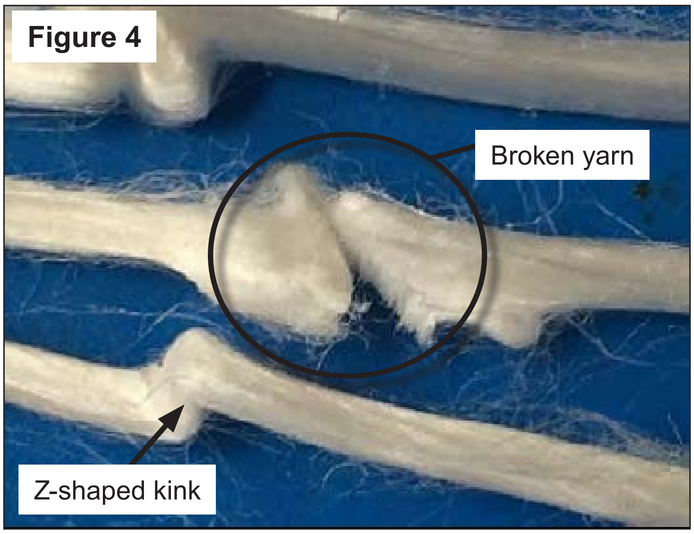

Figure 4

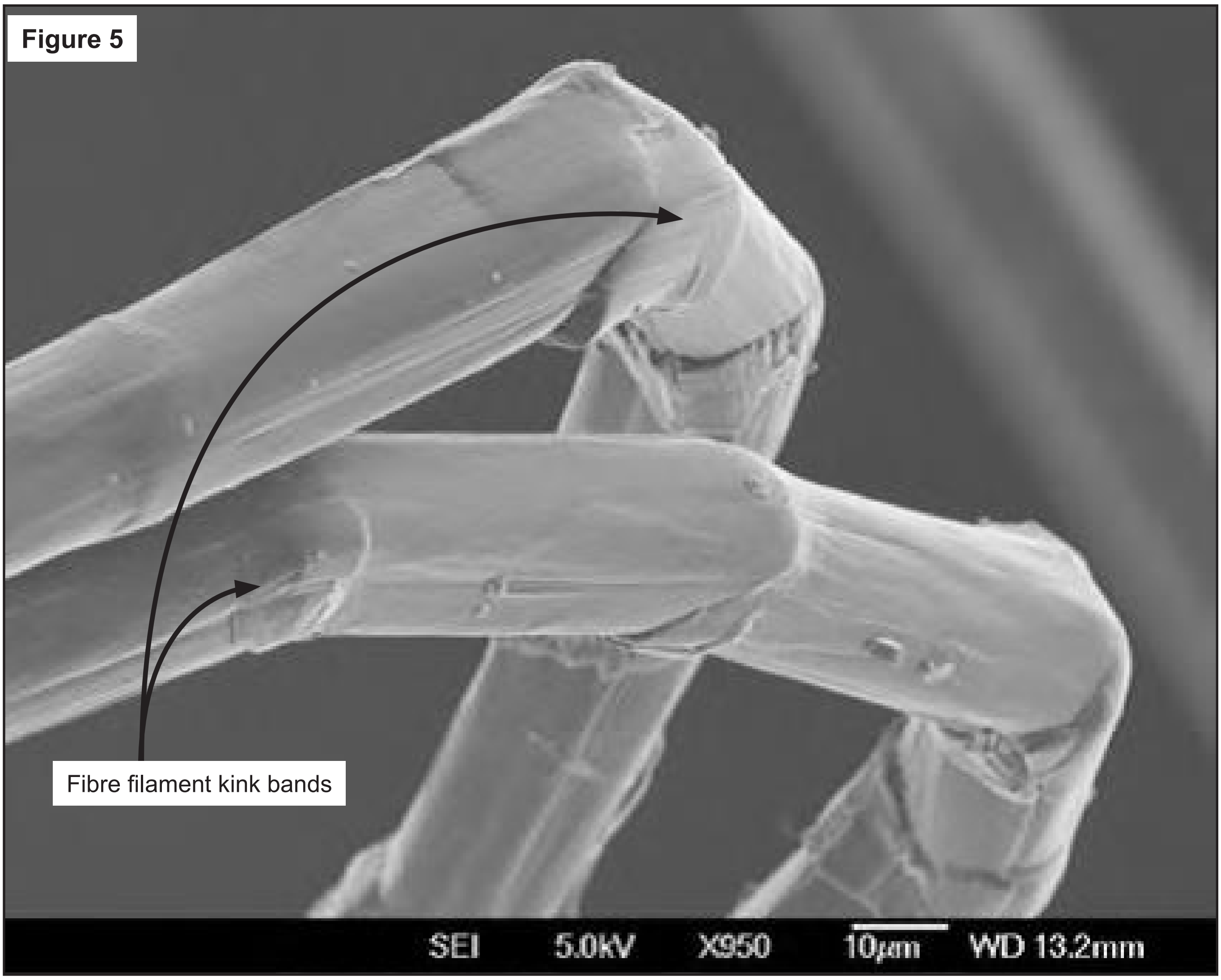

Figure 5

Close-fitting jackets prevent operators from visually inspecting these types of rope for core and yarn fatigue damage, and there are currently no non-destructive tests available to assess the level of fatigue degradation in fibre filaments in ropes. If it had been possible to visually inspect the load-bearing core of *Zarga*'s rope, the rope yarn kinks and the broken rope yarns would have been identified.

The HMPE rope failed at well below its certificated minimum breaking load and well before its anticipated lifetime prediction. This was the latest in a series of mooring line failures that had occurred on board large LNG carriers at, mainly, exposed berths over several years. The investigation into the causes and circumstances of the rope failure is ongoing and will be discussed in the full investigation report, along with other safety issues identified during the investigation.

SAFETY LESSONS

Close-fitting jacketed synthetic fibre ropes with low twist constructions are more prone to failure under normal operating conditions than other mooring rope constructions. This is especially the case where the diameter to diameter (D:d) ratio between a ship's deck fittings and its mooring ropes, is less than that recommended by the rope's manufacturer. The nature of the close-fitting jacket precludes visual inspection of the rope's core for signs of degradation. Operators of vessels using close-fitting jacketed synthetic fibre mooring ropes are strongly advised to contact the rope's manufacturer/supplier to:

- Confirm or otherwise that the rope is suitable for its intended use and envisaged operating conditions including, specifically, that it is compatible with the vessel's deck fittings, and,
- Ensure that an appropriate regime exists to monitor the condition of the ropes in use so as to maintain a high level of confidence that they can be replaced before they become materially weakened or degraded.

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