MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY BULLETIN

SB1/2017 June 2017

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."

Press Enquiries:
01932 440015

Out of hours:
020 7944 4292

Public Enquiries:
0300 330 3000

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.

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For all enquiries:
Email: maib@dft.gsi.gov.uk
Tel: 023 8039 5500
Fax: 023 8023 2459

Auxiliary boiler explosion

on board the container ship

Manhattan Bridge

at Felixstowe container terminal, England

resulting in one fatality and one serious injury

on 19 January 2017

Image courtesy of Ron van de Velde

Figure 1: *Manhattan Bridge*

MAIB SAFETY BULLETIN 1/2017

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.

The Marine Accident Investigation Branch is assisting the Japan Transport Safety Board (JTSB) in carrying out an investigation into the auxiliary boiler explosion on board *Manhattan Bridge*, resulting in one fatality and one serious injury.

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

Steve Clinch
Chief Inspector of Marine Accidents

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BACKGROUND

At about 2304 on 19 January 2017, an auxiliary boiler furnace explosion occurred in the engine room on board the Japan registered container ship *Manhattan Bridge* **(Figure 1)** as it was berthing alongside a container terminal in Felixstowe, England. *Manhattan Bridge*'s second engineer and an engine room oiler were investigating a boiler flame failure alarm at the time and were caught by the blast. The oiler suffered severe injuries and died soon after the explosion. The second engineer suffered burn injuries to his face and right arm, which required a skin graft.

The Japan Transport Safety Board (JTSB) is conducting a full investigation into the causes and circumstances of the accident and, in accordance with the IMO Casualty Investigation Code, will publish its findings in due course. The UK Marine Accident Investigation Branch (MAIB) deployed inspectors to Felixstowe to conduct an initial accident site investigation. Its findings have prompted the MAIB to publish this safety bulletin, which is designed to raise awareness of a safety issue that might be linked to the initial boiler flame failures.

EVENTS LEADING UP TO THE ACCIDENT

Manhattan Bridge had been operating in the North Sea Sulphur Emission Control Area (SECA) for several days prior to the accident. In order to comply with international emissions control standards[1], the auxiliary boiler fuel supply had been switched from heavy fuel oil (HFO) to marine gas oil (MGO). The MGO was loaded at Rotterdam in November 2016 and was declared as meeting the quality standards set out in ISO 8217:2005 – *Petroleum products – Fuels (class F) - Specifications of marine fuels*.

In the hours leading up to the accident, the auxiliary boiler had cut out several times due to flame or ignition failures, and on each occasion, the fault was investigated and the boiler reset by the second engineer.

The boiler explosion occurred while the second engineer and the oiler were trying to restart the boiler burner unit following a flame failure cut-out. The force of the explosion blew open the boiler burner unit door **(Figure 2)** and propelled the burner's air diffuser into the engine room **(Figure 3)**. The oiler was standing directly in front of the burner unit and the second engineer was close by.

INITIAL FINDINGS

Following the incident, examination of the boiler fuel system by the burner unit manufacturer identified the build-up of waxy deposits in the supply filter, sufficient to restrict the fuel flow **(Figure 4)**. Samples of the MGO being burnt at the time of the accident were taken by the MAIB and sent to a laboratory for analysis. The samples were tested in accordance with specifications set out in the latest ISO 8217:2017 standard, which included Cloud Point (CP), Cold Filter Plugging Point (CFPP) and Pour Point (PP) tests.

The tests found that the fuel had a CFPP of 14°C and a PP of less than -9°C, requiring a minimum fuel operating temperature of 15°C. The ambient air temperature at Felixstowe on 19 January 2017 was about 4°C, low enough for wax formation. The CP of the fuel could not be obtained because the test samples had a dark appearance, which was attributed to the mixing of residual HFO deposits with the MGO in the system pipework.

[1] On 1 January 2015, the sulphur emissions limits within the designated maritime SECAs were reduced from 1.0% to 0.1% by mass, which has resulted in an increased demand for MGO bunkers across the shipping sector.

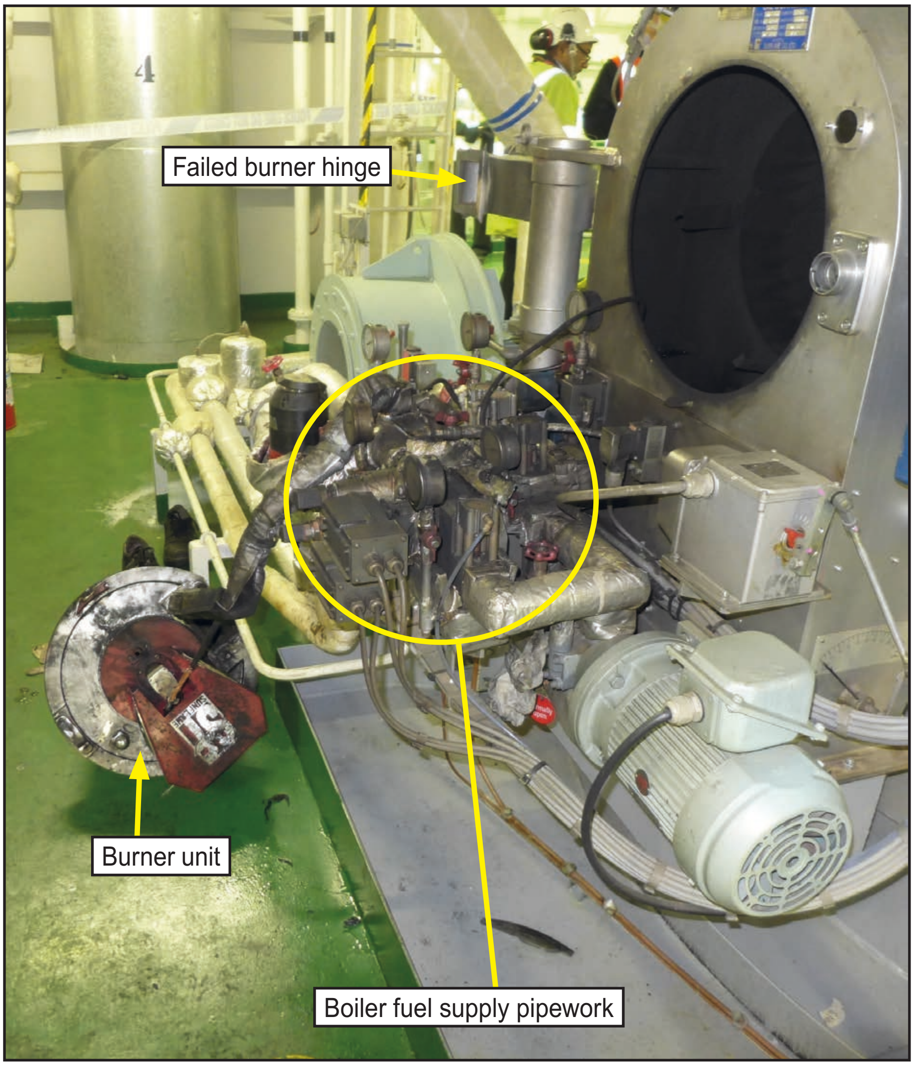
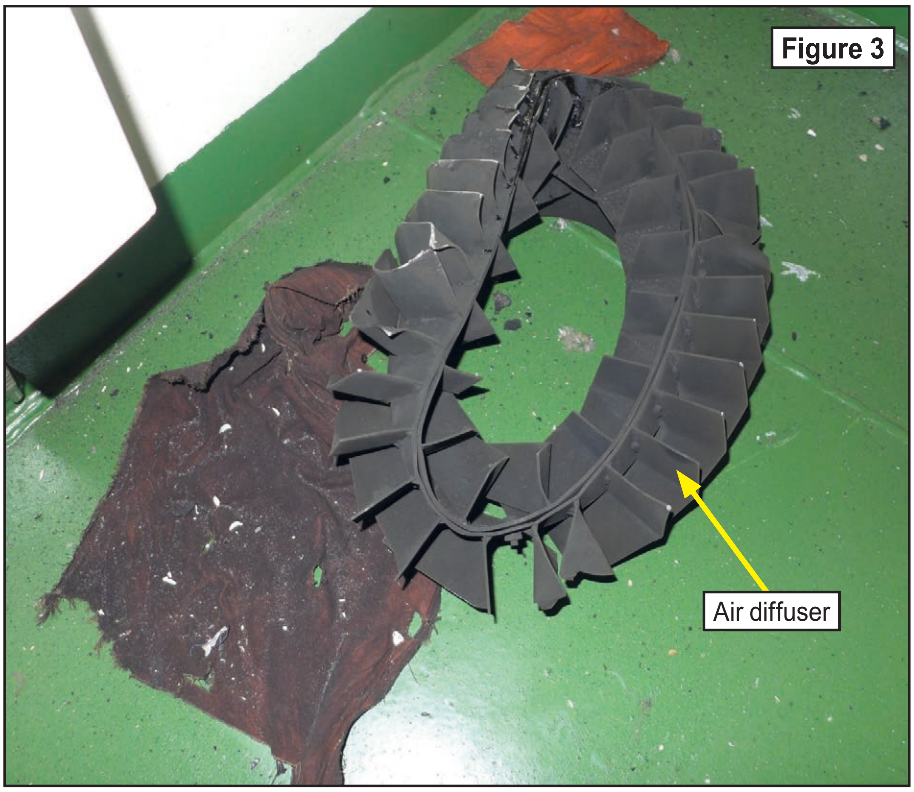
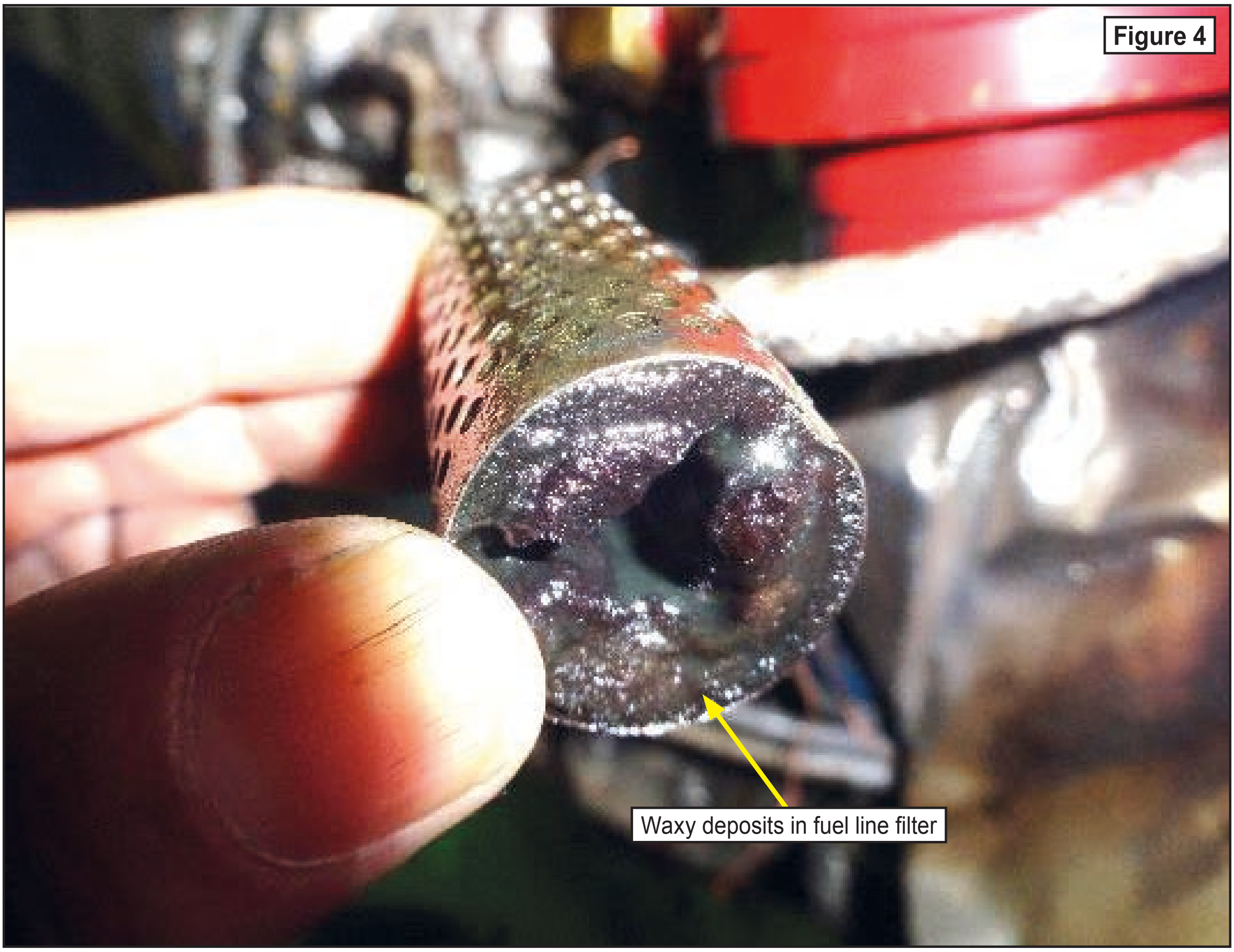


Figure 2: Boiler and burner unit





SAFETY ISSUE

Industry reports indicate an increased incidence of boiler and marine diesel engine performance problems in colder waters following the implementation of the more stringent sulphur emissions limit. This has been attributed to the increased paraffin content found in some low sulphur distillate fuels (MGOs) and the subsequent formation of waxy deposits or crystals as the fuel temperature falls. Restricted fuel flow due to wax deposits in filters and pipework can cause intermittent and incomplete combustion to the point of flame failure.

The paraffin content of MGOs varies globally due to the regional composition of crude oil and variation in refinery processes. There are three measurable stages in the waxing process for distillate fuels; these are CP, CFPP and PP. The first discernible stage, CP, is defined as the temperature at which wax crystals start to visibly form in the fuel and a transparent fuel becomes cloudy or hazy. The CFPP is the lowest temperature where the fuel of a set volume, drawn, by vacuum, through a standardised filter (45 micron) within a specified time (60 sec) still continues to flow. The PP is the lowest temperature at which the fuel will continue to flow when cooled. The PP does not provide any indication of the temperature at which filtration issues may occur.

Prior to March 2017, the ISO 8217 standard, often used by the shipping industry as the baseline specification when ordering and testing fuel oil bunkers, focused on PP and did not include test specifications for CP or CFPP. As a consequence, the MGO loaded on board *Manhattan Bridge* in Rotterdam was not subject to CP or CFPP testing.

SAFETY LESSONS

It is essential that vessel operators carefully consider anticipated ambient air and sea temperatures that will be experienced during the voyage when purchasing low sulphur MGO bunkers. Such information should be used to identify the required cold flow characteristics of the fuel being supplied using CP and CFPP as key metrics. When this is impractical, it is important to establish the CP and CFPP of the fuels carried on board through sample testing.

When operating in cold climates, the risk of waxy residue developing in the vessel's fuel lines can be controlled by:

- Closely monitoring the visual appearance of low sulphur MGO bunkers for signs of wax precipitation.
- Conducting regular fuel filter inspections and close monitoring of fuel system pressures.
- Maintaining the temperature of the low sulphur MGO in the vessel's tanks and pipework above the CP and CFPP temperatures to avoid the possibility of filter blocking.

The addition of *cold-flow improver* chemicals to the low sulphur MGO in the vessel's storage tanks should only be considered as a last resort under the strict guidance of an additive supplier.

More detailed guidance[2] on the cold flow properties of MGOs can be found on the International Council on Combustion Engines (CIMAC) website: www.cimac.com.

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[2] 01/2015 CIMAC Guideline: *Cold flow properties of marine fuel oils.*
06/2015 CIMAC Position Paper: *New 0.1% sulphur marine (ECA) fuels*.