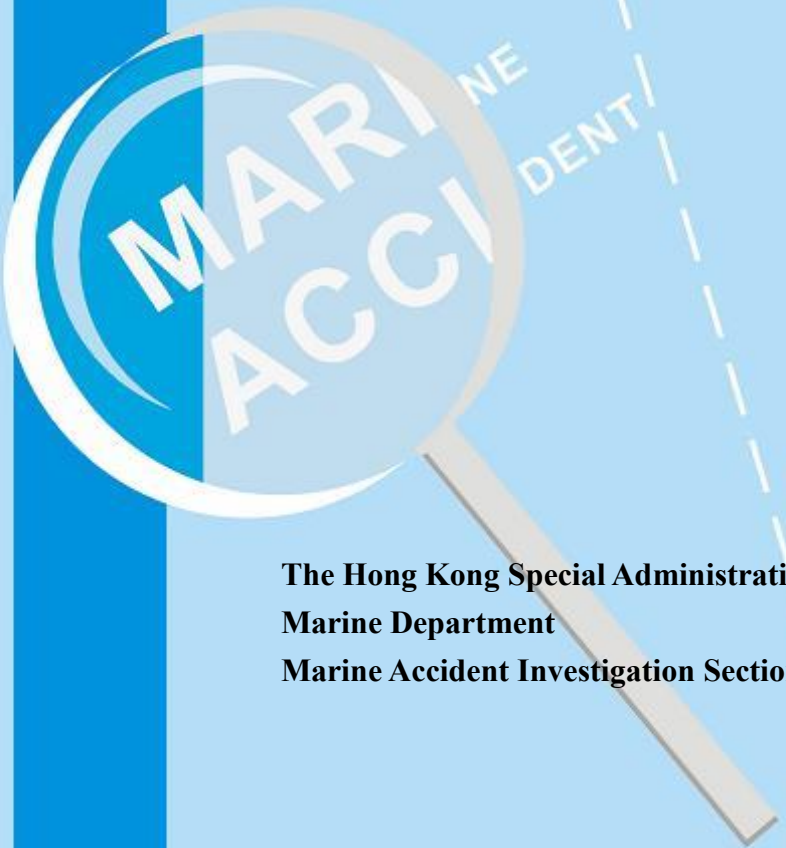
Report of investigation into the fatal accident of a fitter on board the Hong Kong registered gas carrier "*Pacific Mars*" at sea on 27 July 2020



The Hong Kong Special Administrative Region
Marine Department
Marine Accident Investigation Section

23 August 2021

Purpose of Investigation

The purpose of this investigation, conducted by the Marine Accident Investigation Branch (MAIB) of Marine Department, is to determine the circumstances and the causes of the incident with the aim of enhancing the safety of life at sea and avoiding similar incidents in future.

It is not intended to apportion blame or liability towards any particular organization or individual except so far as necessary to achieve the said purpose.

The MAIB has no involvement in any prosecution or disciplinary action that may be taken by the Marine Department resulting from this incident.

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Summary

At about 0900 hours on 27 July 2020, a fatal accident happened on board the Hong Kong registered gas carrier "Pacific Mars" (*the vessel*) at sea in approximately position 07°59.9'N 082°33.3'W, during her voyage from Kaohsiung, Taiwan to Houston, United States of America (USA) via Panama Canal.

In the accident, the deck fitter accompanied by a deck fitter trainee (*the trainee*) intended to replace the filter element of a double oil filter (*the filter*) for the cargo refrigeration system in the compressor & motor room as routine maintenance. After opening the top cover of *the filter*, the filter element suddenly ejected out while the deck fitter on the top of the filter casing was scrapping the gasket. The deck fitter's forehead was hit by the filter element and fell backwards lying on the walkway grating. *The trainee* noticed the deck fitter was wounded with bleeding from his forehead and was unconsciousness. He then immediately called the bridge to seek assistance. The deck fitter was transferred to the ship's hospital for first aid treatment. Medical advices from shore were sought and applied to the deck fitter when *the vessel* was diverting her course to pick up paramedics. Finally, the deck fitter was declared dead by the paramedics getting onboard on the same day.

The investigation revealed that the main contributory factors of the accident were lack of safety awareness and underestimating the risk of replacing filter element by not strictly following the maker's safety instructions.

1. Description of the vessel

Ship name	:	*Pacific Mars* (Figure 1)
Flag	:	Hong Kong, China
Port of registry	:	Hong Kong
IMO number	:	9714642
Type	:	Gas carrier
Year built, shipyard	:	2019, Nantong Sinopacific Offshore & Engineering Co., Ltd.
Gross tonnage	:	19,205
Net tonnage	:	5,762
Summer deadweight	:	23,708 tonnes
Length overall	:	159.95 metres
Breadth	:	25.2 metres
Engine power, type	:	5,670 kW, MAN B&W 5S50ME-B9.3-TII
Classification society	:	DNV GL
Registered owner	:	Cheer Grand International Holding Limited
Management company:		PG Shipmanagement Pte. Ltd.

Figure 1 *The vessel*

2. Sources of evidence

2.1 The information provided by the crew and the management company of *the vessel* (the Company).

3. Outline of events

(All times were local time UTC -5 hours)

3.1 On 4 July 2020, *the vessel* completed cargo discharge of liquefied ethylene and departed Kaohsiung, Taiwan, for Houston, United States of America (USA), for loading the same cargo. *The vessel* was planned to arrive at Balboa, Panama, for Panama Canal transit on 28 July 2020.

3.2 At 0800 hours on 27 July 2020, the Chief Officer finished the navigation watch on the bridge and proceeded to the cargo control room to carry out a toolbox meeting for the deck crew, including the deck fitter and *the trainee*. In the meeting, the deck fitter informed the Chief Officer that he was planning to replace the filter element of the double oil filter (*the filter*) of the cargo refrigeration system in the compressor & motor room on the main deck.

3.3 At about 0820 hours, the deck fitter and *the trainee* went to the compressor & motor room to carry out the planned maintenance job to replace the filter element. The deck fitter ordered *the trainee* to isolate *the filter* by closing the inlet valve A1 and outlet valve A2. The deck fitter checked and confirmed that the valves were in a fully closed position by using a spanner. He then opened the drain valve A3 to drain the oily effluent and release the pressure inside *the filter*. Upon noticing no effluent spout from the drain valve A3, the deck fitter closed the valve and opened the ventilation valve A4 to release pressure inside *the filter* (Figure 2).

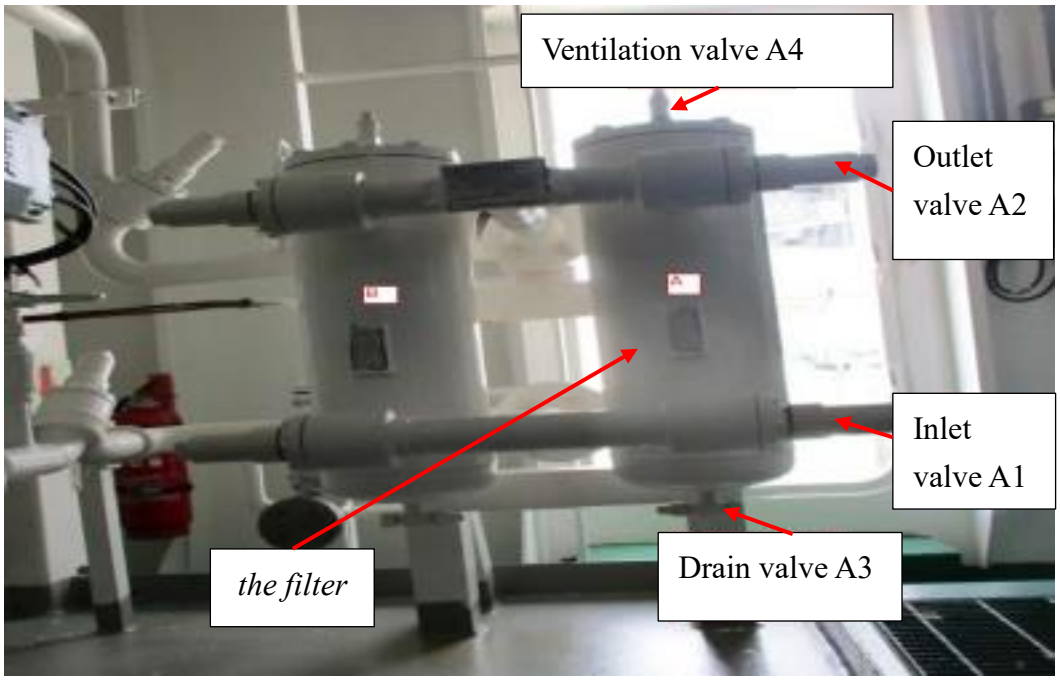

Figure 2 Overview of *the filter*

3.4 After noticing that there was no gas emitted from the ventilation valve A4, the deck fitter commenced to slacken the bolts and removed the top cover of *the filter*. The deck fitter then screwed down a bolt onto a nut attached to the top of the filter element in order to lift up the filter element by hand but in vain (Figure 3). The filter element was jammed hardly in *the filter* and failed to be taken out. Subsequently, the deck fitter took a crowbar trying to lift the filter element but also failed.

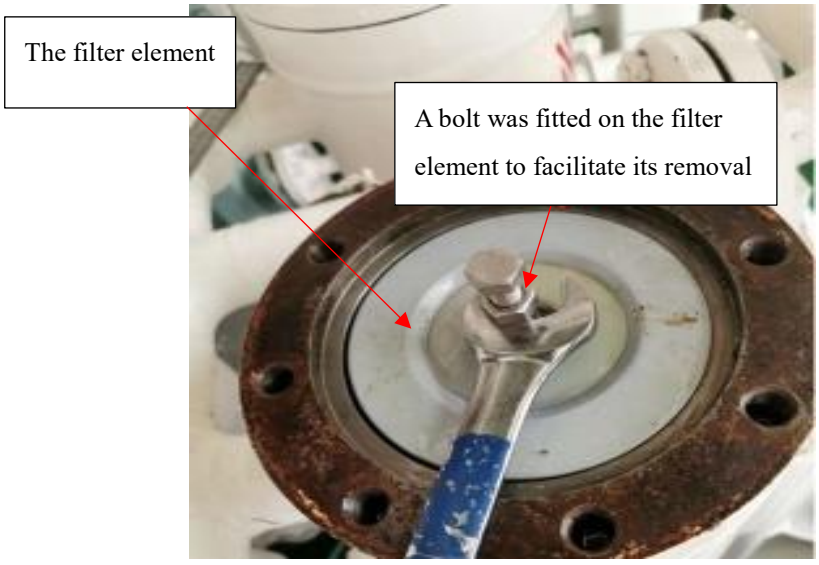

Figure 3 Top view of the filter element with the gasket removed

3.5 After failing to take out the filter element, the deck fitter tried to scrap the gasket in order to free the filter element. In the meantime, he asked *the trainee* to bring a pair of calipers from the engine room workshop to measure the size of the gasket. *The trainee* took the calipers from the workshop and returned to the compressor & motor room when the deck fitter was busy in scrapping the gasket.

3.6 At about 0900 hours, when *the vessel* was approximately at position 07º59.9'N 082º33.3'W, the filter element suddenly freed from the filter casing and hit the deck fitter on his face when he was on top of *the filter* scrapping the gasket. The deck fitter was hit by the filter element and fell backwards lying on the walkway grating. *The trainee* noticed that the deck fitter was wounded with bleeding on his forehead and lost consciousness. *The trainee* immediately ran to call the Third Officer on watch at the bridge for help by the telephone inside the gymnasium room.

3.7 The Third Officer informed the Master about the incident through a portable radio. In the meantime, the Chief Officer also noticed the incident through his portable radio and proceeded to the scene to render assistance.

3.8 At 0906 hours, the deck fitter was transferred to the ship's hospital by stretcher for first aid treatment. The vital signs of the deck fitter were monitored continually.

3.9 At 0940 hours, the Master contacted the Company and Telemedical Assistance Service (TMAS) for medical assistance. The medical advice from TMAS was followed and applied to the deck fitter.

3.10 At 1200 hours, the Master altered *the vessel's course,* proceeding to the meeting point for a rescue boat to evacuate the deck fitter ashore.

3.11 At 1510 hours, a rescue boat came alongside *the vessel*. Paramedics and police attended on board to check the deck fitter. According to the paramedics' advice, the deck fitter's condition might not be suitable for boat transportation.

3.12 At 1530 hours, *the vessel* proceeded to Charco Azul, Panama, to

evacuate the deck fitter.

3.13 At 1635 hours, the deck fitter's pulse dropped, and cardio-pulmonary resuscitation (CPR) was applied to him but in vain.

3.14 At 1645 hours, the deck fitter was declared dead by the paramedics on board before arriving at Charco Azul, Panama.

4. Analysis

Certification, training and experience

4.1 The statutory trading certificates of *the vessel* were valid and in order. *The vessel* was manned by 22 crew including the Master.

4.2 The Master had worked in the Company for about 8 months and joined *the vessel* on 1 March 2020. He had about 3 years of experience as a master. He possessed a Class 1 Certificate of Competency issued by the India Directorate General of Shipping valid until 30 December 2021.

4.3 The Chief Engineer had worked in the Company for about 6 years and joined *the vessel* on 30 December 2019. He had more than 1 year of experience as a chief engineer. He possessed a Class 1 Certificate of Competency issued by the China Maritime Safety Administration (MSA) valid until 24 August 2022.

4.4 The Chief Officer had worked in the Company for about 5 years and joined *the vessel* on 21 June 2020. He had more than 2 years of experience as a chief officer. He possessed a Class 2 Certificate of Competency issued by China MSA valid until 10 January 2022.

4.5 The deck fitter had worked in the Company for about 7 months and joined *the vessel* on 8 December 2019. He had more than 8 years of experience on gas carrier as a deck fitter.

4.6 The deck fitter trainee had worked in the Company for about 5 years and joined *the vessel* on 21 June 2020. He had more than 2 years of experience as a deck fitter trainee.

4.7 There was no abnormality noted with regard to the certification and experience of the crew concerned.

Weather and sea conditions

4.8 The weather was sunny with south-westerly wind of Beaufort force 3. The sea was slight and the visibility was about 12 nautical miles. The

weather and sea conditions should not be the contributory factors of the accident.

Fatigue, alcohol and drug abuse

4.9 There was no evidence to show that any crew on board suffered from either fatigue at work or abuse of alcohol and drugs.

Cause of death

4.10 The death report revealed that the cause to death of the deck fitter was severe head trauma which was consistent with the accident.

Arrangement of the filter

4.11 *The vessel* was issued with "International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk" by Classification Society (Class) on the day of her delivery on 30 July 2019.

4.12 To prevent the loss of liquefied cargo and ensure the cargo maintaining the required range of temperature or pressure, a cargo refrigeration system using Freon as the refrigerant was installed onboard. After passing through the refrigerant compressor and condenser, refrigerant was liquefied and was used to cool down the cargo liquid.

4.13 *The filter* was used to filter any dirt from the liquefied refrigerant of the refrigeration system and was constructed in accordance with the European Standard (EN 12284) "Refrigerating systems and heat pumps - Valves - Requirements, testing and marking" as accepted by the Class.

4.14 The cross sectional diagram of *the filter* assembly as shown in figure 4 indicating that a ventilation valve A4 was fitted on the filter cover. Of the gap between the filter cover and the casing, a gasket was placed such that the gasket would be compressed and embedded with its inner periphery into the gap when the top cover was closed and tightened by bolts. In doing so, the gasket separated the interconnection between the inlet and outlet sides of *the filter* forcing refrigerant to pass through the filter element and preventing the refrigerant from leakage.

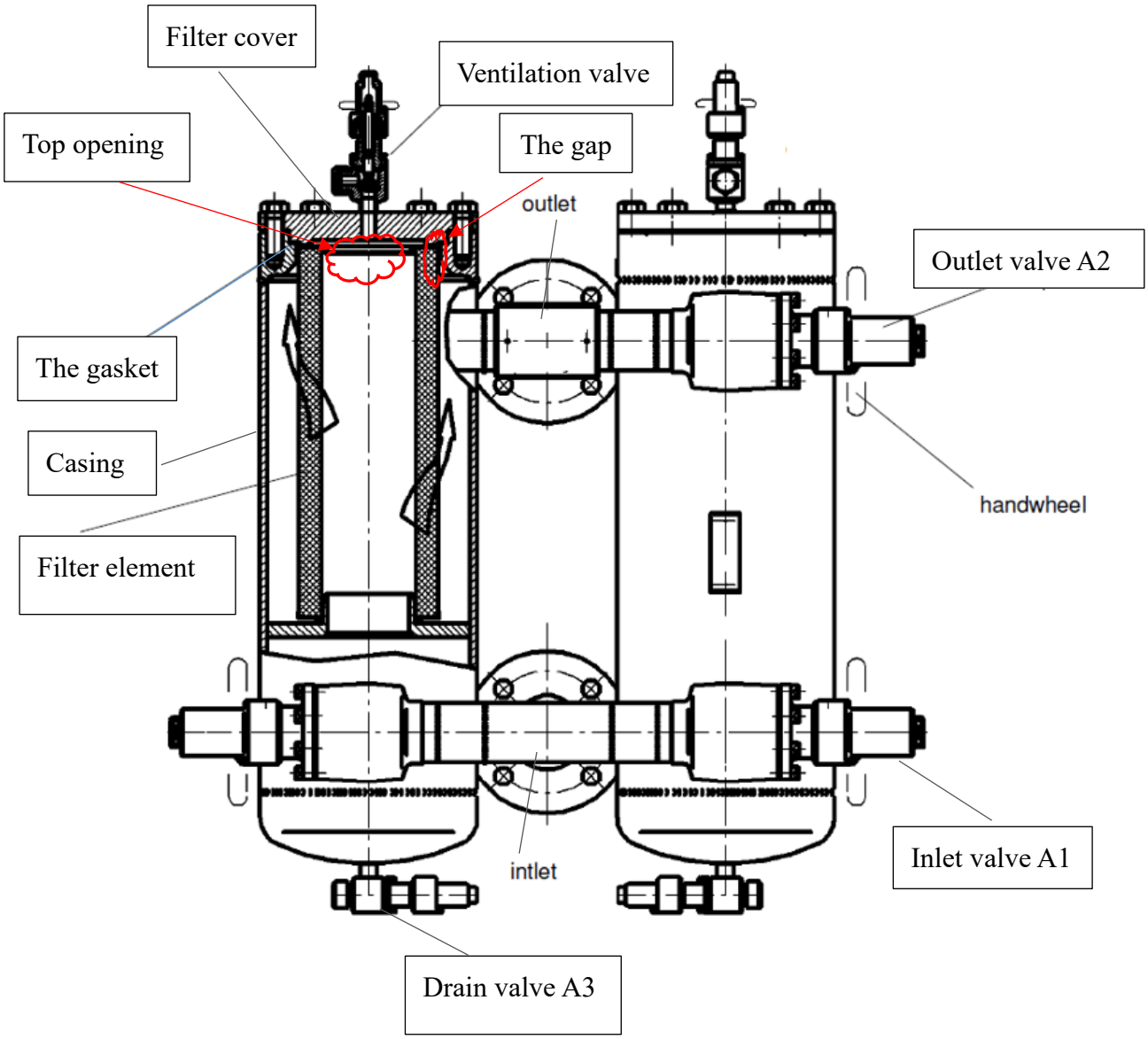

Figure 4 The cross sectional diagram of *the filter* assembly

4.15 The investigation noticed that some minor damages, including nicks and scratches, were found on the casing in the way of the gasket. These might be caused by the crew during routine maintenance or by the filter element being tilted to one side during assembling (Figure 5).

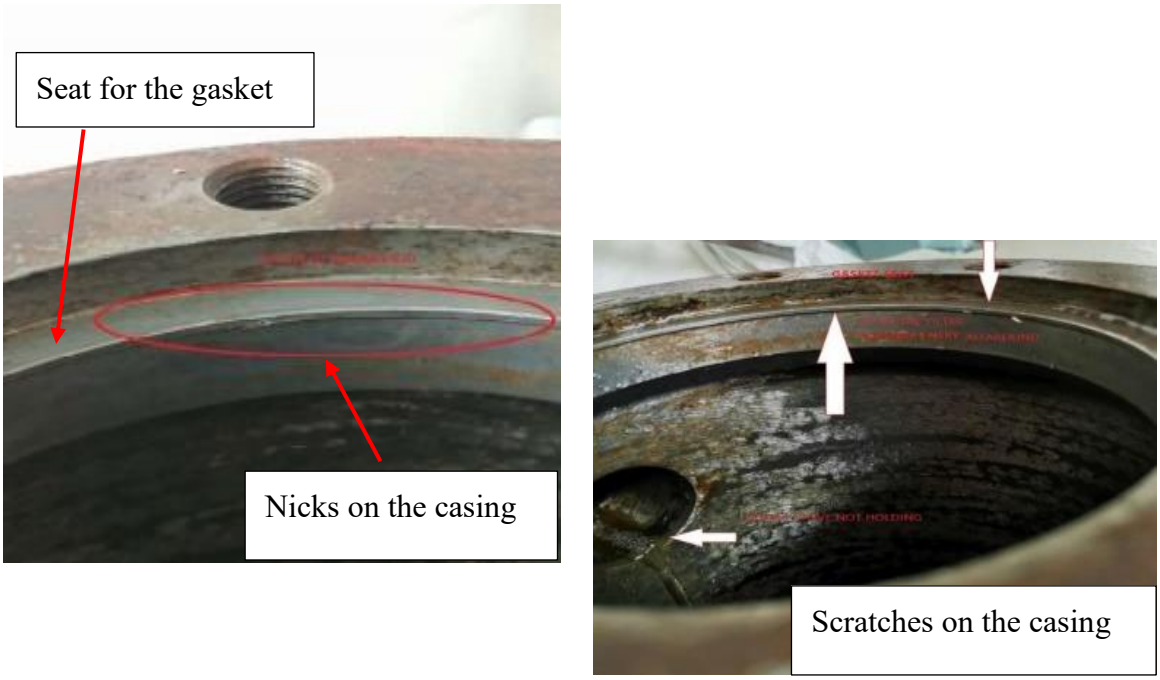

Figure 5 Minor damages on the casing of *the filter*.

Experience of the deck fitter to handle the filter

4.16 The deck fitter had more than 8 years of experience working on gas carrier with the same duty to inspect and handle filters in a similar design of other cargo refrigeration systems. The deck fitter received familiarization training when he joined *the vessel* in December 2019, and he also received shipboard training on handling liquefication cargo equipment in March 2020. The deck filter also replaced the duplicate filter element of the cargo refrigeration system on board without any problem in June 2020. As such, the deck fitter was considered an experienced fitter to carry out routine maintenance of *the filter*.

Probable cause of the accident

4.17 The top of the filter element was welded with a nut to facilitate lifting up the filter element in normal routine maintenance (Figure 6). However, the presence of the nut did not match the top part design as shown in the maker's manual (Figure 4). It could not be determined if the nut was a design feature from the maker.

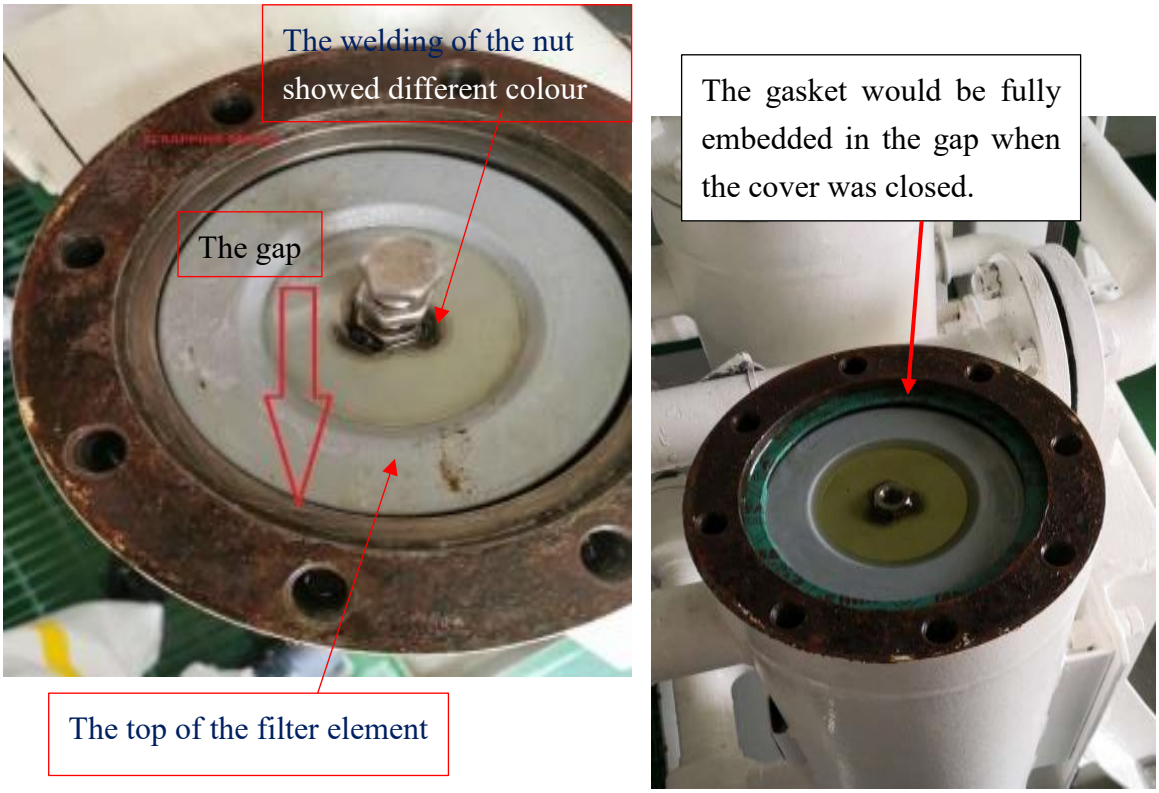

Figure 6 Top view of *the filter* when opened

4.18 Figure 7 shows the cross section of *the filter* with the valves' positions during the maintenance. According to the maker's manual, the drain valve A3 and the ventilation valve A4 should be kept open when replacing the filter element. However, the deck fitter had closed the drain valve A3 in the maintenance (Figure 7).

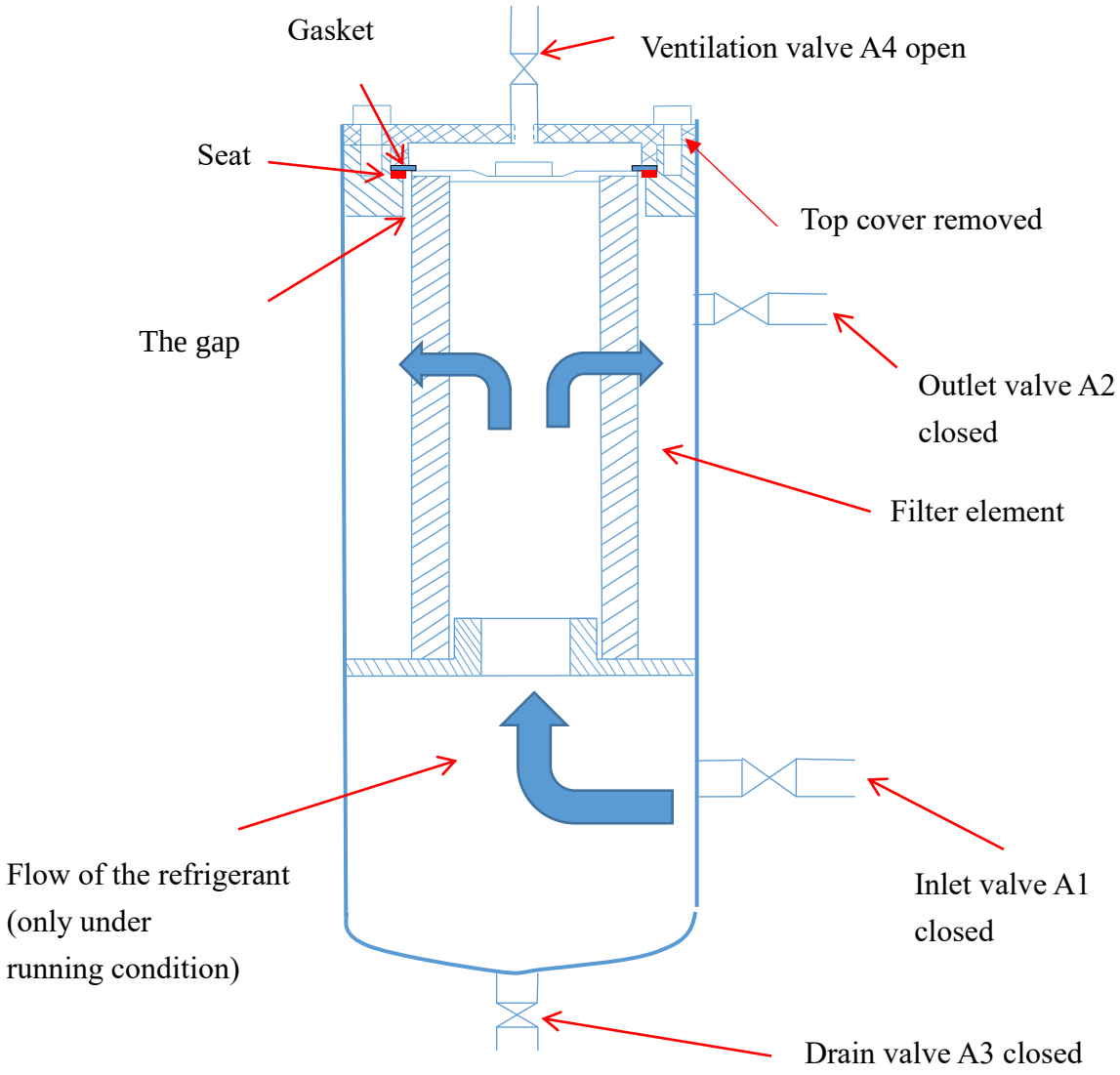

Figure 7 Cross section of *the filter* with valves' positions during the maintenance

4.19 With the inlet valve A1, outlet valve A2, and the drain valve A3 in closed position, the residual oil and the refrigerant inside *the filter* would generate refrigerant vapour which could build up pressure inside the filter element. As sealed by the gasket, the gas pressure inside *the filter* could not be released properly even though the ventilation valve A4 was opened and that the cover of *the filter* was removed.

4.20 When the deck fitter tried to scrap the gasket, he might accidentally free the gasket thus releasing the gas pressure in a sudden to eject the filter element. As a result, the deck fitter was hit by the filter element on his forehead and died.

4.21 In accordance with the safety instructions of the maker manual, the drain valve A3 should be kept in open position in order to ensure that the filter casing was depressurised and adequately ventilated when replacing the filter element. However, these instructions were not followed possibly due to insufficient safety awareness and underestimating the risk of replacing filter element.

5. Conclusions

5.1 On 27 July 2020, a fatal accident happened on board *the vessel* at sea during her voyage from Kaohsiung, Taiwan to Houston, USA, via the Panama Canal. The deck fitter accompanied by *the trainee* intended to replace the filter element of *the filter* for the cargo refrigeration system as routine maintenance. The filter element suddenly ejected out while the deck fitter was at the top of the filter casing trying to scrap the gasket. The deck fitter's forehead was hit by the filter element and fell backwards lying on the walkway grating. The deck fitter was subsequently transferred to the ship's hospital for first aid treatment. The shore medical advices were sought and applied to the deck fitter when *the vessel* was diverting her course to pick up paramedics. Finally, the deck fitter was declared dead by the paramedics getting onboard on the same day.

5.2 The investigation revealed that the main contributory factors of the accident were lack of safety awareness and underestimating the risk of replacing filter element by not strictly following the maker's safety instructions.

6. Recommendations

6.1 The management company of *the vessel* should issue circulars informing all Masters, officers, and crew of its fleet of the findings of the investigation and lessons learnt from this accident, and instruct them to:

(a) conduct maintenance work for refrigeration system strictly in accordance with the maker's safety instructions; and

(b) enhance the safe working practices onboard, especially to ensure that any pressurised equipment and system should be completely depressurised before the commencement of maintenance work.

6.2 A Hong Kong Merchant Shipping Information Note is to be issued to promulgate the lessons learnt from this accident.

7. Submission

7.1 The draft investigation report, in its entirety, had been sent to the management company and the Master of *the vessel* for their comments.

7.2 By the end of the consultation, there was no comment received from the above mentioned parties.