



SAFETY INVESTIGATION REPORT

201905/014

REPORT NO.: 11/2020

May 2020

MT ALYARMOUK

**Damage to equipment, leading to a fall from a height on deck,
in position 06° 20' N 079° 34' W
10 May 2019**

SUMMARY

MT *Alyarmouk* was drifting in the vicinity of the Panama Pacific Lightering Area, awaiting commencement of cargo operations.

As no cargo operations were scheduled on 10 May 2019, it was decided to carry out scheduled routine maintenance of the hose handling crane.

The bosun was perched on a bosun's chair, to carry out maintenance on the head of the crane's jib, while three other seafarers were assisting him from other locations. The chief officer was supervising the task.

As attempts to complete the job

were proving to be unsuccessful, it was decided to suspend the task and complete it at a later stage. While lowering the bosun's chair, the rope, by which it was suspended, parted and the bosun, in spite of wearing a safety harness, fell down a height of about 3.7 metres onto the main deck.

Following medical evacuation, it was reported that the bosun had suffered from a fractured left heel and three fractured ribs.

The MSIU has issued two recommendations to the Company aimed at preventing recurrence of such accidents on board their vessels.



FACTUAL INFORMATION

Vessel

MT *Alyarmouk* (Figure 1) was a 61,342 gt oil tanker, built in the Republic of Korea in 2008. She was owned by Libyan Voyager Ltd. and managed by V. Ships U.K. Ltd. At the time of the accident, the vessel was classed with Class NK.

The vessel had a length overall of 248.96 m, a moulded breadth of 43.80 m, a moulded depth of 21.00 m, and a summer draft of 14.88 m, which corresponded to a summer deadweight of 166,038 metric tonnes.

Propulsive power was provided by a 6-cylinder, four-stroke, single-acting, direct drive MAN-B&W 6S60MC-C marine diesel engine, producing 13,560 kW of power, at 105 rpm. This drove a fixed-pitch propeller, enabling *Alyarmouk* to reach an estimated speed of 15 knots.

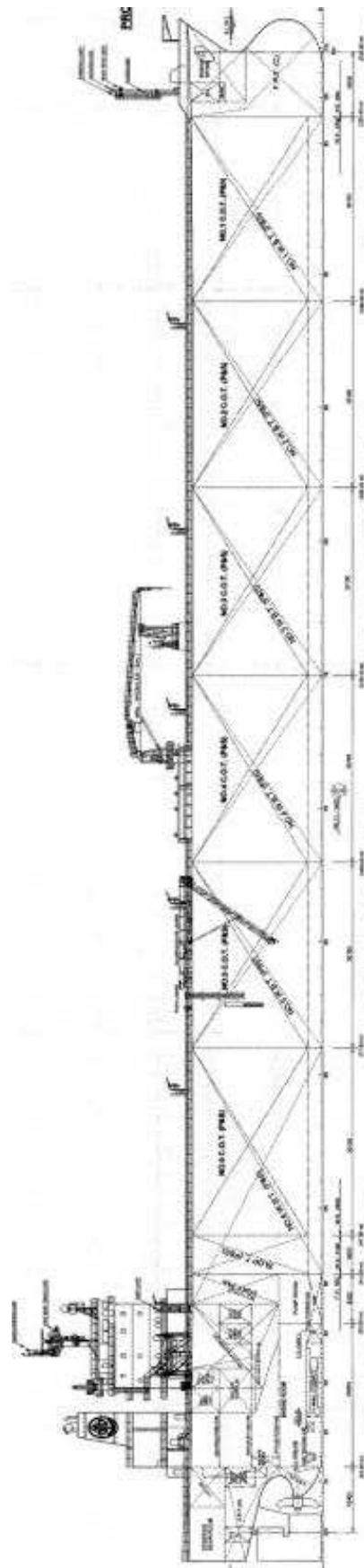
Crew

The Minimum Safe Manning Certificate of the vessel stipulated a crew of 15. At the time of the accident, the complement of the vessel was in excess of these requirements. The crew members were nationals of Russia, the Philippines, Ukraine, and Georgia.

The injured seafarer, a national of the Philippines, had a total of 9.9 years of seagoing experience, 3.1 years of which were served in the rank of a bosun. He held STCW II/5 qualifications as an able seafarer deck, and had joined *Alyarmouk* on 13 February 2019, from the port of Esmeraldas, Ecuador.

Assessment of risk and permit to work

A job safety analysis for 'routine maintenance of the hose handling crane' was carried out on 09 May 2019. This analysis included a risk assessment for 'work at height/overside'. The hazards identified through this assessment included, failure of



**Figure 1: General Arrangement Plan
MT *Alyarmouk* (Scale: 1:300)**

the bosun's chair or staging, fall from height and fatigue. The analysis of the risk assessment form is included further below.

A permit to work was authorised by the master on the morning of 10 May 2019. This permit contained the signatures of all crew members involved. The designated team leader, who was the injured seafarer, signed to confirm completion of the final checks prior to commencement of the task.

Arrangements made for the task

The task was planned to be carried out using a bosun's chair¹ (Figure 2) suspended by a rope (rope 'A'); while the seafarer would be perched on the chair, wearing a safety harness (Figure 3) secured to another rope (rope 'B').



Figure 2: The bosun's chair



Figure 3: The safety harness

¹ A seat consisting of a board and rope, intended to carry a person to work aloft or over the side of a vessel.

The ropes used were manila (natural fibre). The equipment was rigged by passing rope 'A' over the lower course of the guard rails, which were fixed to the jib of the crane, through a pad eye on the jib and tied to the bosun's chair (Figure 4).

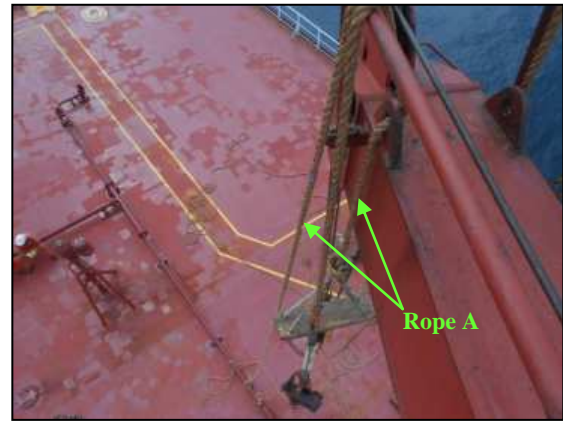


Figure 4: Simulation of rigging arrangement for the bosun's chair

For the safety harness, rope 'B' was passed over the opposite guard rails and then over the same lower course of the guard rails as rope 'A'. As an additional precaution, rope 'B' was secured onto the opposite guard rail (Figure 5).

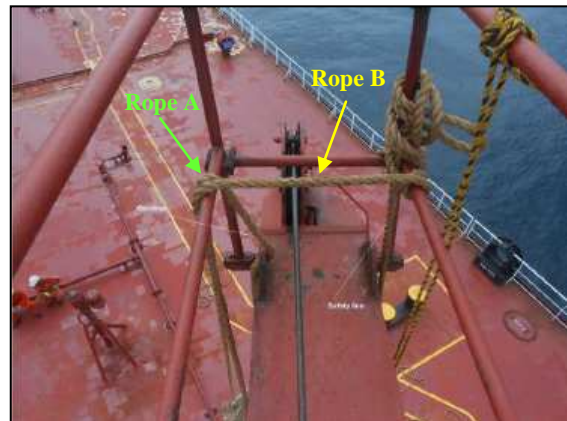


Figure 5: Simulation of rigging arrangement for the safety harness (the yellow-black line was used to hoist/lower tools for the task).

The free ends of ropes A and B were secured to a crude oil washing (COW) branch line of the vessel, which ran on the main deck, as seen in Figure 6.

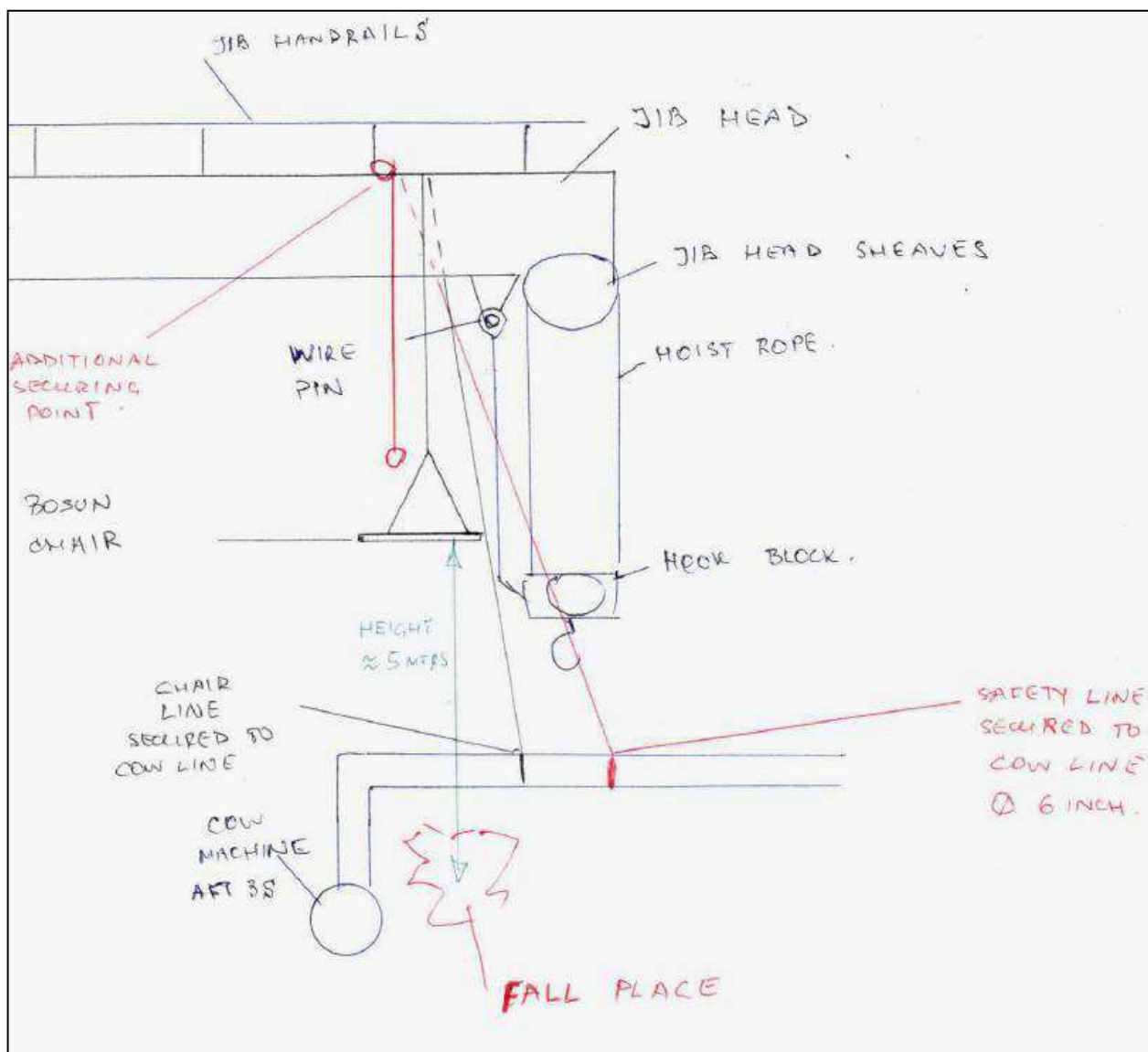


Figure 6: Rough sketch, showing the entire bosun chair's arrangement

Certification of the rigging equipment

From the information received, it was determined that ropes 'A' and 'B' were three-strand manila ropes. Each had a circumference of 69.85 mm and a length of 220 m. The ropes were received on board the vessel in May 2017. However, it was made known to the safety investigation that the certificates for ropes 'A' and 'B' were not available, due to which the original strength of the ropes could not be ascertained. In fact, these certificates were neither requested at the time of procurement nor received at the time of delivery on board.

The bosun's chair was marked with a safe working load (SWL) of 100 kg (Figure 2); however, there was no evidence available to the safety investigation which could help indicate how this SWL had been determined.

Testing of the equipment

Evidence suggested that ropes 'A' and 'B' were put into use only in February 2019, and that all equipment used for working at a height/overside is inspected at least three times a month. The form used to maintain a record of these inspections indicated that

the ropes and harnesses were to be checked to confirm that they were free of solvents paints and chemicals, examined for any signs of damages, and tested to at least four times the potential load.

Prior to being used for the task, on the same day, the bosun's chair and ropes 'A' and 'B' were reportedly tested by suspending a load of 250 kg from the rigging equipment, for a period of 10 minutes. Bags of cement, weighing 50 kg each, were used as the load (Figures 7, 8 and 9).

The safety harness was reportedly inspected for fraying, discolouration and damages, the buckles and their connections were inspected, and the lanyard was checked for fuzzy, worn, broken or cut fibres.

The initial statement by the chief officer only indicated that a visual inspection of the equipment was carried out before this task. Nonetheless, the inspections were reportedly completed with satisfactory results.



Figure 7: Cement bags used for the test



Figure 8: Simulation of the test



Figure 9: Simulation of the test arrangement

Personal Protective Equipment (PPE)

At the time of the accident, the injured seafarer was wearing the appropriate PPE required for the task *i.e.*, a hard hat with a chin-strap, overalls, safety gloves and safety shoes. In addition, as mentioned earlier, he had worn a safety harness, which was secured to rope 'B'.

Storage of the ropes

It was reported that the ropes in use at the time of this accident, were stored on racks in one of the vessel's stores (Figure 10).



Figure 10: Storage space of the ropes

Records of hours of work/rest

The injured seafarer's records of hours of work and rest indicated that he had rested for a period of 14 hours, prior to commencing work at 0800 on 10 May 2019.

Environment

On the day of the accident, the weather was clear. The wind was blowing at a speed of about 9 knots, the air temperature was recorded to be 28 °C, and the sea state was slight, with a swell of about 1.0 m being observed.

Narrative²

Alyarmouk had departed from the port of Esmeraldas, Ecuador, on 08 May 2019, carrying 103,840.3 metric tonnes of Oriente crude oil, bound for the Panama Pacific Lightering Area, off the Western coast of Panama.

On arrival, on 09 May, the vessel was informed that cargo operations would not be commenced immediately, and so the engines were stopped and the vessel remained adrift. Since routine maintenance of the vessel's hose handling crane (Figure 9) was due on 11 May, and since the weather was favourable, the master and the chief officer discussed and decided to carry out this task on the following day *i.e.*, 10 May.

A twist in the runner wire of the crane, which was noticed earlier, was also planned to be rectified during the maintenance. The rectification of the twist required disconnection of the end of the wire which was secured to the head of the jib (marked with the red arrow in Figure 11) and would, therefore, require work to be carried out while being suspended from a height.

² Unless specified otherwise, all times mentioned in this report are in Local Time (UTC – 5).



Figure 11: The hose handling crane

On the same day, a job safety analysis was conducted and it was decided that four crew members *i.e.*, the bosun, an able seafarer and two ordinary seafarers, would be assigned for this task.

During the morning of 10 May, the crew members inspected the equipment to be used for the task and at 1000, the master reportedly authorised the permit to work at a height. During the morning coffee break (between 1000 and 1030), the chief officer reportedly held a meeting with the crew members.

It was decided that the bosun would disconnect the end of the wire while being suspended on a bosun's chair. One of the ordinary seafarers would be positioned on the crane's jib to assist the bosun, the other ordinary seafarer would be on the main deck, tending to the rope connected to the bosun's safety harness (rope 'B'), and the able seafarer would also be positioned on the main deck, tending to rope 'A'.

The equipment was rigged (Figure 6) following which, the bosun, who was the assigned team leader, conducted the final checks of the work area and of the PPE. At 1035, the bosun descended onto the bosun's chair, wearing a safety harness secured to rope 'B' (Figure 12). In order to enable access to the secured end of the crane's wire,

the bosun's chair was then lowered down to adjust it to the desired height (about 1.3 m below the jib).

After about 20 minutes, it became apparent that the bosun was unable to disconnect the end of the wire, and therefore the chief officer decided to cancel the task and ordered for the bosun's chair to be lowered down to the deck.

The bosun released the safety harness from rope 'B', following which, the end of rope 'B' was lowered to the main deck. The bosun tied a clove hitch around a point along the length of rope 'B' (Figure 13), and the able seafarer and the ordinary seamen, who were positioned on the main deck, then started to slowly lower the bosun's chair.



Figure 12: Simulation of safety harness secured to rope B during maintenance.



Figure 13: Simulation of safety harness secured to rope B during lowering.

At around 1105, when the bosun's chair was lowered by about 3.0 m, rope 'A' parted from about 1.5 m above the point where it was connected to the chair. This resulted in the bosun's chair and the bosun, falling to the main deck (Figure 14) from a height estimated to be about 3.7 m (Figure 15), while the knot of the safety harness slid down along the length of rope 'B'.

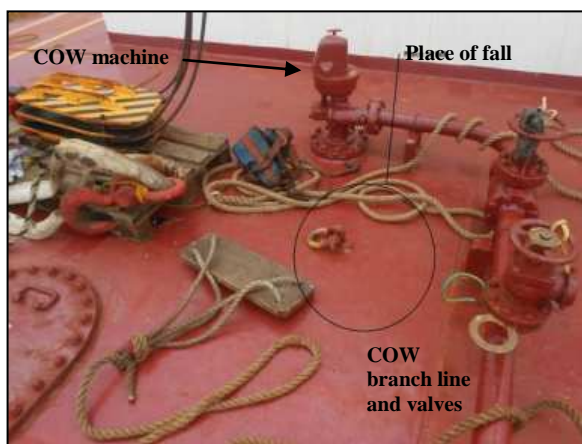


Figure 14: Location where the bosun fell



Figure 15: Height from which the bosun fell

Post-accident actions

Following the accident, medical aid was administered on board while the master notified the International Radio Medical Centre. The master was advised by the International Radio Medical Centre to administer a pain killer to the injured crew member and to transfer him to a hospital ashore. Following advice by the Company, the master altered course towards the port of Balboa, Panama.

The vessel arrived at the port limits of Balboa on 11 May, at 0330, where the master was provided with further instructions on the evacuation of the injured crew member. The vessel's local agent arranged for the injured crew member to be picked up by a boat and taken to a hospital ashore.

Injuries sustained by the bosun

During his initial interview at the hospital, the bosun complained of pain in his left hip, his left heel, the left side of his chest and the lumbar area.

Imaging and scans of the bosun, at the hospital, revealed fractures of the 6th, 7th and 8th left ribs, and a comminuted fracture (shattered bones) of his left heel.

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.

Immediate cause of the fall

The bosun fell onto the main deck following the failure of rope A, from which the bosun's chair was suspended, while he was perched on the bosun's chair.

Furthermore, the bosun had re-secured the safety harness to rope B using a clove hitch, before the bosun's chair was lowered. The securing knot slid along the length of rope B and did not arrest his fall.

Cause of the injuries sustained

The comminuted fracture of the bosun's left heel was synonymous to a fall from a height³. In all probability, the bosun's left heel was his first point of contact with the main deck.

The fractured ribs were most probably caused by the various fittings, such as the COW machine, branch line, valves, manhole cover, *etc.*, which were in the proximity of his fall (Figure 14).

Laboratory analysis of failed rope 'A'

Following the accident, sections of the rope from either side of the point of failure were requested by the MSIU and were sent to a laboratory for a technical analysis to determine the potential cause(s) of the failure. These sections of the rope were visually inspected and were later examined using microscopic imaging.

Visual inspection of the rope sections showed signs of fraying, weathering and the presence of some damages, in the form of worn down or cut fibres and strands, along their lengths (Figures 16 to 20).



Figure 16: Failed fibres



Figure 17: Failed strands



Figure 18: Failed strands

³ <https://orthoinfo.aaos.org/en/diseases--conditions/calcaneus-heel-bone-fractures/>



Figure 19: Failed and worn down fibres and strands



Figure 20: Failed and worn down fibres and strands

Low-magnification stereomicroscopy of the rope filaments revealed extensive damages in the vicinity of the point of failure. Individual filaments of the rope sections were either broken or had a furry appearance, both of which are common signs of abrasion (Figure 21). No signs of extensive weathering or rotting were observed, which suggested that the rope had experienced damage primarily in and around the ultimate point of failure.

Conclusions of the laboratory analysis

The laboratory analysis concluded that the failure of the rope was caused by localised abrasive damage.

While some signs of fraying and overall signs of wear were noticed along the entire lengths of the two rope sections, fragmentation of fibres was observed close to the point of failure. This fragmentation of fibres and the texture of the rope indicated localised contact with a hard surface, which caused severe abrasive damage and led to failure of the rope.

The rubbing of a rope against a surface may lead to progressive weakening of the fibres, particularly if the rope is loaded, thus partially unwound, and bent at the same location along its length.

The point of failure of the rope was found to lie in the vicinity of the pad eye of crane jib through which the rope was passed to carry out the task (Figure 4).

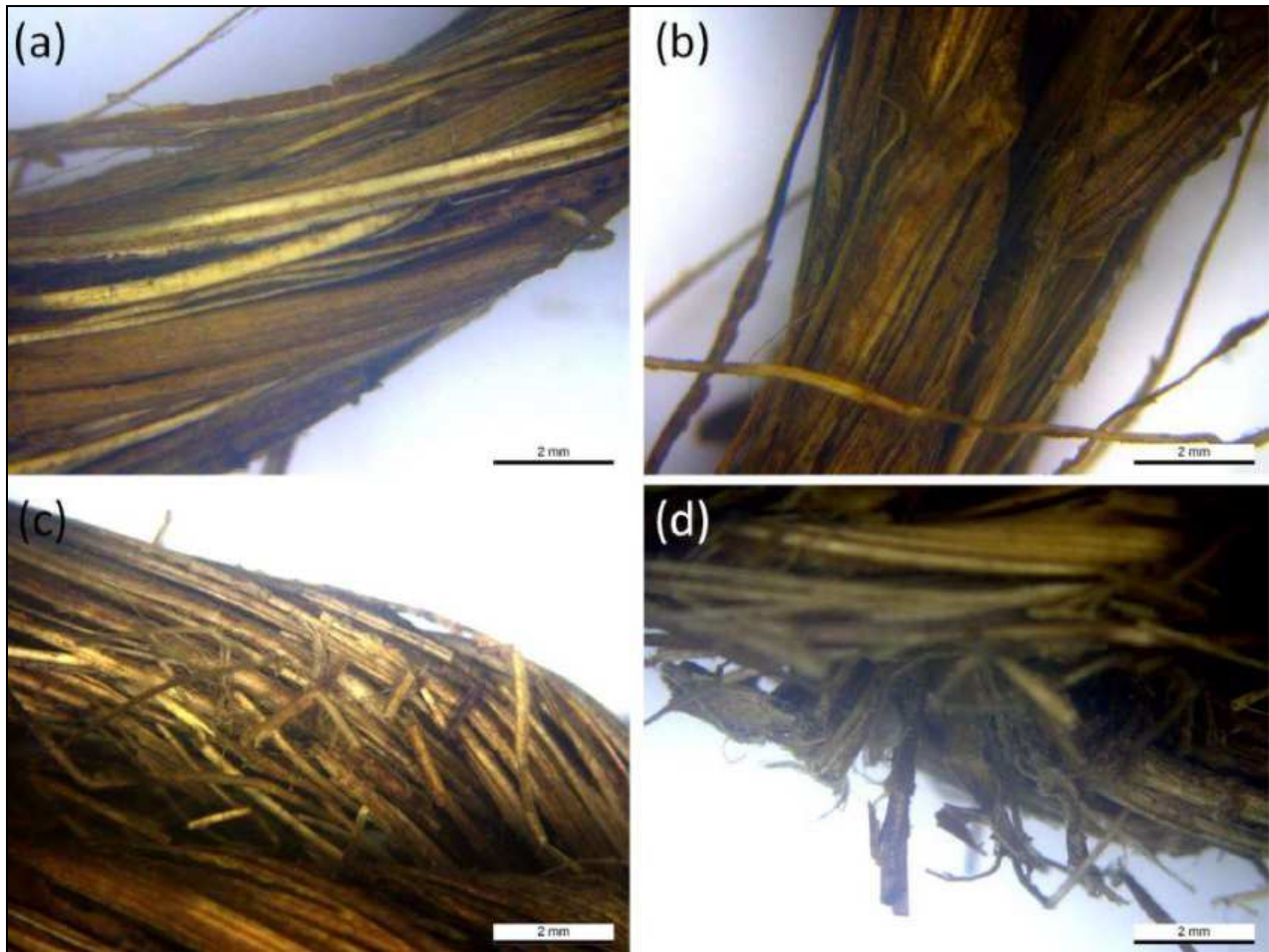


Figure 21: (a) Undamaged internal strands; (b, c and d) abraded fibres near the point of failure

Release of the safety harness and re-securing to rope ‘B’

As mentioned earlier in this safety investigation report, the bosun released the safety harness from rope ‘B’, following which, the end of this rope was lowered to the main deck.

While the exact reason for the above actions was not clear to the safety investigation, the MSIU believes that the crew members intended to focus on the lowering of the bosun’s chair. If the safety harness was still secured to the end of rope ‘B’, at least one crew member would have to tend to rope ‘B’ by lowering it down at the same time that rope ‘A’ was being lowered.

When the end of rope ‘B’ was lowered to the main deck, the bosun re-secured the safety

harness along the length of rope ‘B’. This indicated that the crew members were aware that the safety harness would still be required to prevent an accident and subsequent injury to the bosun. However, a clove hitch was used to re-secure the safety harness.

A clove hitch is a common, easy-to-tie (and untie) knot used to secure a rope to a horizontal pole or a ring. However, as it would tend to slip, especially when repeatedly subjected to varying levels of load, this knot is not recommended to be used on its own. Moreover, when secured to a vertical pole or along a freely hanging rope, it will have a tendency to slide down the surface in the absence of any tension on it.

The safety investigation believes that a clove hitch was chosen by the crew members as it would tend to slide down easily along the length of the rope while the bosun's chair was being lowered, thereby removing the requirement for rope B to be tended to. Evidence suggested that the bosun expected the clove hitch would have been sufficient to arrest a fall.

Risk assessment

The risk assessment prepared by the vessel addressed the hazard of a fall from a height for this particular task. The existing control measures included the fitting of additional safeguards, such as safety nets. Such safeguards were not in place when the task was being carried out.

The safety investigation is of the view that had such safeguards been in place, taking into account the fittings on deck that were located in the vicinity below the workspace, the fall of the bosun could have either been arrested or cushioned, thereby reducing the severity of the injuries suffered by him.

The safety investigation hypothesized that perhaps, as this task was a non-labourious one, the crew members perceived that the work required to install these additional safeguards would not justify the actual risk associated with the task.

Storage of the ropes

Evidence available to the safety investigation did not suggest that the location and method of storage of the ropes had a direct bearing on this accident.

Fatigue or consumption of drugs and alcohol

The injured seafarer had a rest period of 14 hours, prior to resuming his duty at 0800 on the day of the accident. Although the quality of those rest hours cannot be confirmed, it met the relevant requirements of the STCW

Code⁴ and MLC, 2006⁵. Furthermore, in the absence of any evidence which could have indicated that the crew members' actions or behaviour were symptomatic of fatigue, fatigue was not considered as a contributory factor to this accident.

An alcohol test was carried out on all crew members involved in this task, immediately after this occurrence, and the results of this test were reported as negative. Furthermore, the hospital reports did not suggest that the bosun was under the influence of any drugs and/or alcohol. Based on the aforementioned, the safety investigation concluded that neither drugs nor alcohol had contributed to this accident.

Other findings

The rope and the bosun's chair were subjected to a load test of 250 kg, although the certified strength of the rope was not known and the SWL of the bosun's chair was identified at 100 kg. Although this test (250%) had no direct bearing on this accident, the safety investigation believes that unless the minimum breaking strength and the safe working load of the rope and the bosun's chair are known, overloading during such tests may occur, potentially weakening and damaging the equipment.

In the risk assessment carried out on the vessel, one of the existing control measures to minimise the hazard associated with crew unfamiliarity with the Company's procedures, was that "UK registered vessels" were recommended to have "a copy of MGN 410 on board." The safety investigation believes that this indicates that this risk assessment was a generic one prepared by the Company and was not amended by the vessel's staff in order to make it specific to *Alyarmouk* and the planned task.

⁴ Seafarer's Training, Certification and Watchkeeping Code, as amended.

⁵ Maritime Labour Convention, 2006, as amended.

Furthermore, an existing control measure, to minimize the hazard associated with the failure of the bosun's chair, was that the rigging was to be in accordance with Chapter 15 of the Code of Safe Working Practices for Merchant Seafarers. However, this Code was amended in October 2018, and the amended Code was published in December 2018⁶. Chapter 15 of the amended Code addresses 'Entering Dangerous (Enclosed) Spaces'. This emphasised that the risk assessment was neither reviewed nor updated prior to carrying out the task.

Paint residue was noticed on the sample of the rope received by the MSIU – at a distance of about 0.8 m from the point of failure (Figure 22). This indicated that the ropes were not free of paint, as was indicated in the inspection records and the risk assessment, raising doubts on the thoroughness of the on board inspections.



Figure 22: Paint residue on rope sample

⁶ <https://www.gov.uk/government/publications/code-of-safe-working-practices-for-merchant-seafarers-coswp-2018>

CONCLUSIONS

1. The injured seafarer fell while he was being lowered from a height at which he was working, and suffered serious injuries as a result of the fall.
2. The fall was caused by the parting of the rope used to suspend the bosun's chair on which the seafarer was perched, while his safety harness, secured by a clove hitch, failed to arrest the fall.
3. The rope parted due to localised abrasive damage in the vicinity of the part which was passing through the pad eye of the cranes' jib, while the task was being carried out.
4. Additional safeguards, as identified by the risk assessment and which could have either arrested or cushioned the fall, were not in place.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION⁷

During the course of the safety investigation, the Company adopted the following safety actions, with the aim of preventing recurrence of similar marine accidents:

1. agreed to review and revise its procedures to ensure that all ropes used to carry personnel or loads are supplied with certificates;
2. agreed to review its procedures to include references to relevant sections of the Code of Safe Working Practices for Merchant Seamen;
3. compiled a reflective training module, based on this accident, which was used as a training tool on board its

⁷ Safety actions taken shall not create a presumption of blame and/or liability.

fleet of vessels, as well as during crew seminars; and

4. published a safety bulletin, applicable to all of its fleet, based on this accident.

RECOMMENDATIONS

V. Ships U.K. Ltd., is recommended to:

11/2020_R1 draw the attention of its shipboard staff on the importance of a vessel specific risk assessment.

11/2020_R2 review and update the relevant job safety analysis (risk assessment) form prepared for working at a height, to ensure that it reflects the latest guidelines and the industry's best practices for working at a height.

SHIP PARTICULARS

Vessel Name:	<i>Alyarmouk</i>
Flag:	Malta
Classification Society:	Nippon Kaiji Kyokai
IMO Number / Official Number:	9356438
Type:	Oil Tanker
Registered Owner:	Libyan Voyager Ltd.
Managers:	V. Ships, U.K. Ltd.
Construction:	Steel
Length Overall:	248.96 m
Registered Length:	240.63 m
Gross Tonnage:	61,342
Minimum Safe Manning:	15
Authorised Cargo:	Oil in bulk

VOYAGE PARTICULARS

Port of Departure:	Esmeraldas, Ecuador
Port of Arrival:	Panama Pacific Lightering Area, off Panama
Type of Voyage:	Short International
Cargo Information:	Oriente Crude Oil – 103,840.3 MT
Manning:	22

MARINE OCCURRENCE INFORMATION

Date and Time:	10 May 2019 – 1105 LT
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	06° 20' N 079° 34' W
Place on Board	Freeboard deck
Injuries / Fatalities:	One serious injury
Damage / Environmental Impact:	Parting of working rope / None
Ship Operation:	Drifting
Voyage Segment:	Arrival
External & Internal Environment:	Weather: Clear. Visibility: 12 nm. Wind: Beaufort Force 2. Sea State: Slight. Swell: 1 m.
Persons on board:	22