Marine Safety Investigation Unit

Transport Malta

SAFETY INVESTIGATION REPORT

2022002/007 REPORT NO.: 05/2021 February 2021

MV *TITANIA*

Serious injury to crew member while operating the on board lathe in position 35° 43.7' N 075° 10.5' W 04 February 2020

SUMMARY

On 04 February 2020, one of the fitters mounted a rod on the lathe to fabricate a new roller and shaft for the quarter gangway.

As soon as he started the lathe, one end of the rod slipped out of its securing point and struck him with significant force, knocking him down. He was found by the third engineer in the workshop and in great pain.

Assistance was immediately provided, and the fitter was transferred to the nearest shore hospital for further medical treatment.

The safety investigation found that the rod slipped from the tailstock while the lathe was rotating at a very high speed.

As a result of the safety investigation, the MSIU has issued three recommendations to the Company designed to ensure that the risks associated with the use of the lathe are adequately mitigated.

The safety investigation report does not carry the standard photo of the ship, following a request received from the vessel's managers on behalf of the ship owners.

FACTUAL INFORMATION

The vessel

MV *Titania* was a 74,255 gross tonnage vehicle carrier, built by Daewoo Shipbuilding & Marine Engineering, in the Republic of Korea, in 2011. She was owned by Wilhelmsen Lines Shipowning Malta Ltd. and managed by Wilhelmsen Ship Management Sdn Bhd, Malaysia. *Titania* had a length overall of 230.80 m, a moulded breadth of 32.26 m, and a moulded depth of 34.70 m. Her summer draught was 11.32 m. At the time of the occurrence, the vessel was on an even keel with a draught of 9.45 m.

Propulsive power was provided by a two-stroke, low speed, eight-cylinder, Doosan-MAN B&W 8S60 ME-C marine diesel engine, producing 19,040 kW of power at 105 rpm. This drove a fixed-pitch propeller, enabling *Titania* to reach an estimated service speed of 20 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 this requirement. The crew members were nationals of the Philippines and India.

The injured fitter was a Filipino national. He had signed on *Titania* at the port of Masan, South Korea, on 23 June 2019. He had 16 years of seafaring experience, 13 of which served in the present rank and with the current employer. The fitter was also certified as a rating forming part of the engineering watch, in accordance with the requirements of STCW[1] III/4. His normal hours of duty were from 0800 until 1700. His work and rest hours' records for the month of February were in line with the MLC, 2006[2] requirements.

Environment

At the time of the accident, the vessel was experiencing slight sea conditions. The sky was clear, and the winds were blowing 16 knots from a West Southwesterly direction. The air and sea temperatures were 13 °C and 11 °C respectively.

The lathe

The lathe was a DMTG CDL6251/1500 model. Figure 1 shows the various features and operating functions which were of interest to the safety investigation:

1. speed selecting lever;
2. spindle speed selecting lever;
3. high-low speed selecting lever;
4. tailstock sleeve moving handwheel;
5. tailstock clamp lever;
6. tailstock sleeve clamp lever;
7. three-jaw chuck (fitted at indicated location);
8. foot brake pedal;
9. emergency stop button; and
10. spindle control lever.

A technical manual for the lathe was also available on board. Moreover, the Company had provided general safety guidelines on the use and maintenance of power tools in the vessel's Safety Management Manual (SMM). The guidelines also referred to the lathe.

[1] IMO. (2001). *The international convention on standards of training, certification and watchkeeping for seafarers, 1978, as amended (STCW Convention)*. London: Author.

[2] ILO. (2006). *Maritime Labour Convention*. Genève: Author.

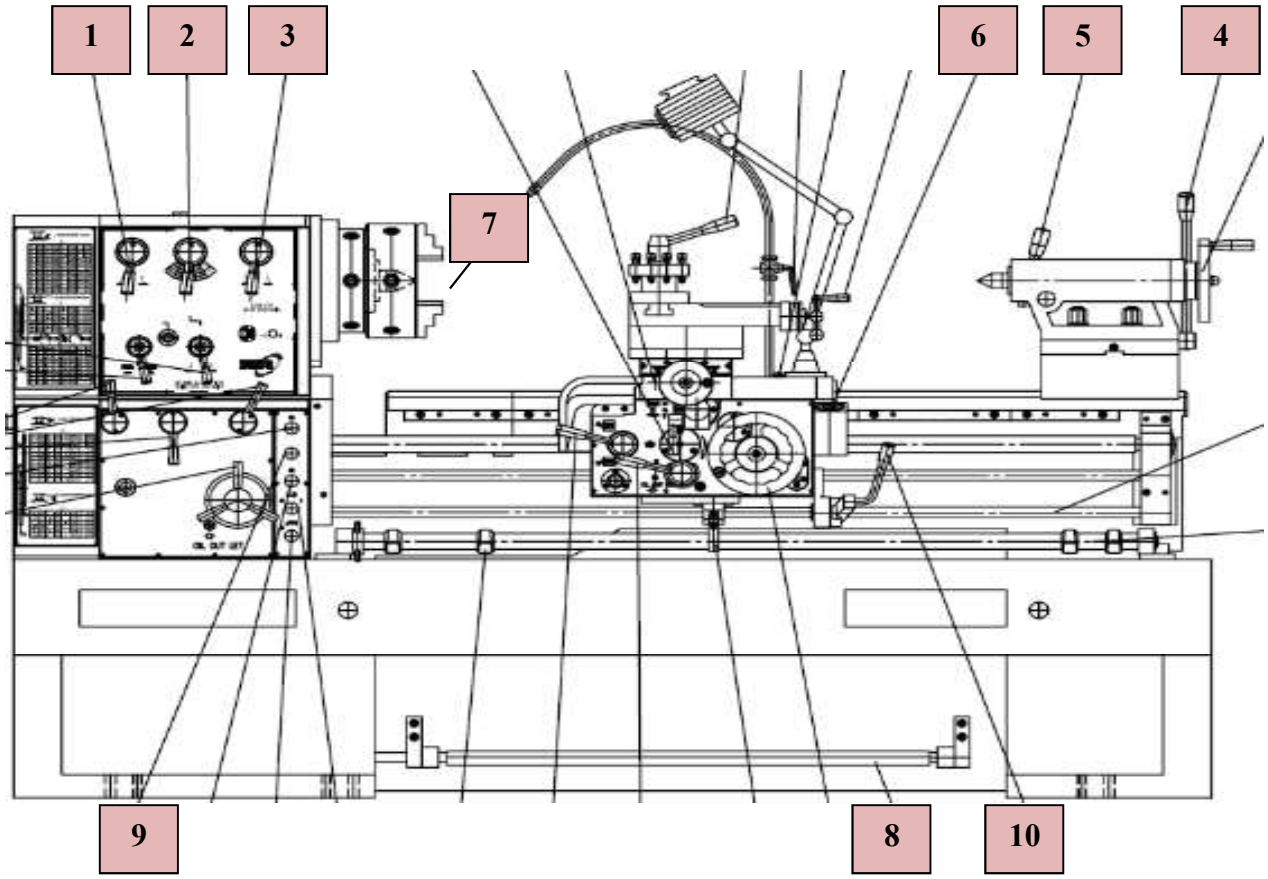

Figure 1: The lathe on *Titania*

Adapted from: The Operating Manual for the lathe

Further to the technical and operating manual, a generic risk assessment form for working on lathes was incorporated as part of the SMM. The risk assessment form identified 10 potential top events deemed hazardous to the user. This risk assessment was required to be discussed in the toolbox meeting before commencement of work.

The vessel's personal protective equipment (PPE) matrix indicated that the use of a safety helmet and a safety google was mandatory. It further required that a face shield, ear defenders and a dust mask were to be worn, depending on the nature of machining which had to be carried out.

Narrative[3]

Titania was on a Southbound passage, off the Eastern coast of the USA, in transit from the port of Baltimore, USA to the port of Savannah, USA.

At 0800 on 04 February 2020, a toolbox meeting[4] was convened. The meeting agreed that the fitter had to fabricate a roller for the quarter gangway. The reason for this job was that the gangway's original roller and its shaft had been damaged.

[3] Unless specified otherwise, all times mentioned in this safety investigation report are in Local Time (UTC - 5).

[4] The meeting was convened at 0800. It was attended by the second engineer, the third engineer, the electro-technical officer, the fitter and the two motormen. During this meeting, the chief engineer was resting to comply with the requirements of the work/rest hours.

By 1345, the fitter completed fabrication of the roller. Soon after, he brought a 2.35 m-long, 35 mm diameter cast iron rod from the engine-room store to the engine-room workshop. He used the electric rod cutter to cut the rod to the required 800 mm length.

After a momentary pause from the task, the fitter resumed his work at 1420, at which time the ETO[5] met the fitter in the engine-room workshop. The ETO noticed that the fitter had already mounted the rod on the lathe. One end was secured on the three-jaw chuck. The other end was supported by the tailstock. By 1425, the ETO had left the workshop.

The fitter was observed to have been wearing overalls, safety shoes, ear plugs, a dust mask and a face shield, as PPE.

At around 1430, the third engineer went into the engine-room workshop and found the fitter lying on the floor, bleeding, and holding the back of his head. The third engineer checked for a response from the fitter. Upon receiving one, he immediately went to the engine control room, alerted the chief engineer and subsequently, informed the bridge.

When the chief engineer went on site, he noticed that the fitter was lying approximately half a metre away from the lathe. Action was taken to control the bleeding from his right, lower neck area and his head, using clean rags and the application of direct pressure. He was then transferred to the vessel's hospital. The lathe was found stopped, with its breaker tripped.

Injuries suffered by the fitter

Soon after the occurrence, an Urgency message was broadcasted over VHF Channel 16. The United States Coast Guard (USCG) North Carolina sector acknowledged immediately.

The vessel diverted to a rendezvous position and by 1646, rescue personnel arrived on board to assess the condition of the fitter. At 1708, the fitter was winched to the rescue helicopter and taken to a local hospital.

Upon assessment by the shore hospital staff, his diagnosis was that he was suffering from an open fracture of the right clavicle (collarbone), closed fracture of multiple ribs on his right side, and a thoracic spine fracture. He had also sustained a minor injury to his head.

Condition of the lathe after the occurrence

After the occurrence, the chief engineer inspected the lathe and found it in the following condition:

- the speed selecting lever 1 set on 'X' (Figure 2);
- the spindle speed selecting lever 2 set to middle (Figure 2);
- high / low speed selecting lever 3 set on 'H' (Figure 2)
- the speed control levers were found in the positions depicted in Figure 2;
- the tailstock was secured tightly on the guideway of lathe;
- the length of the rod outside the chuck until the end that was supported by the tailstock was 734 mm;
- the distance from the chuck to the tailstock centre pin was 732 mm;
- while testing, the tailstock sleeve moving hand wheel was rotated clockwise but was noticed to turn anti-clockwise under its own weight, withdrawing the sleeve by about 2 mm;
- the tailstock sleeve clamp lever was noticed to have not been fully secured;
- the depth of the drilled point at the end of the rod that was supported on the tailstock was about 1.5 mm;

[5] Electro-technical officer.

- no indentations were found on the rod, which could have indicated an axial shift of the rod in the three-jaw chuck.
- the rod was found bent (Figure 3).
- the tool post securing bolts were found broken (Figure 4).
- the chuck guard was found in a closed position (Figure 3).
- the spindle control lever was found in the lifted position (which would cause the spindle to rotate forward, *i.e.*, counter clockwise) (Figure 5).

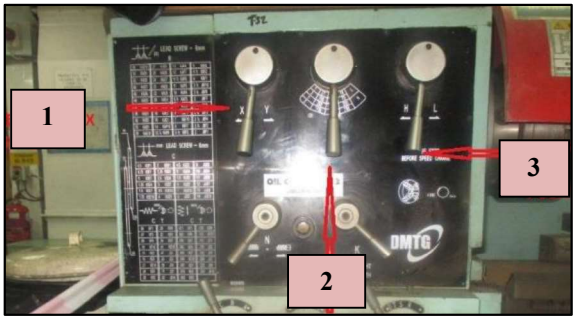

Figure 2: Settings of control levers.

Figure 3: Condition of rod after accident

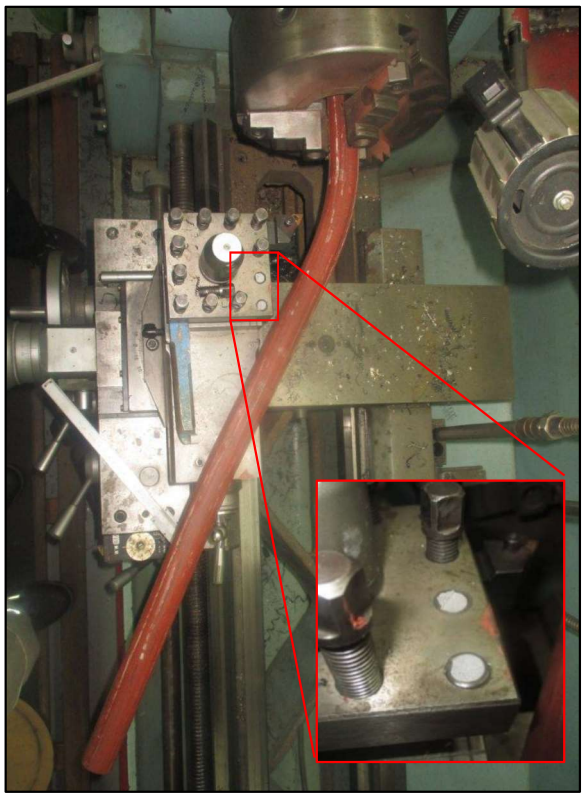

Figure 4: Tool post with two broken bolts

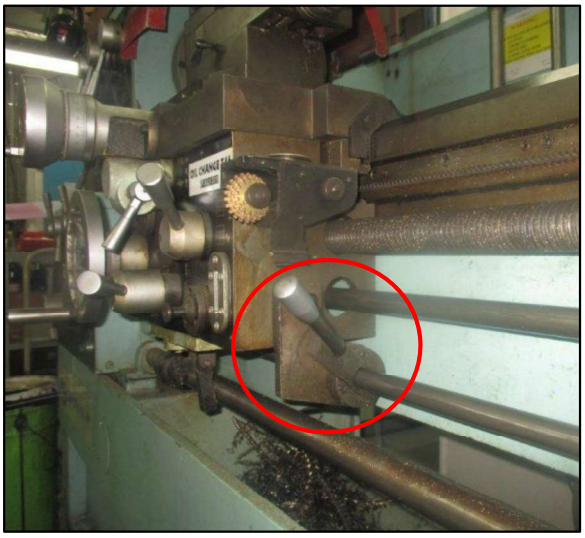

Figure 5: Spindle control lever in lifted position

Fitter's recollection of events

The fitter recalled being given a job order by the second engineer to fabricate a roller and shaft for the gangway. He also remembered centring the drilled hole on the rod in the lathe, sometime after 1310. He could also recall the open chuck guard (Figure 6), just

before he started working on the lathe. However, the fitter could neither remember switching on the machine, nor how he sustained his injuries. He had only regained consciousness while being transported to the shore hospital by helicopter.

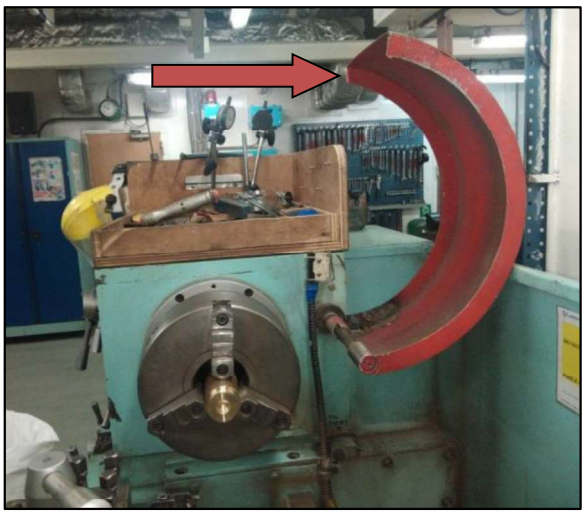

Figure 6: Chuck guard in open position

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 accident

The fitter was operating the lathe to machine a cast iron rod of 800 mm length and 35 mm in diameter. In the process, the rod slipped from the tailstock while the lathe was rotating at a very high speed. This caused the rod to bend and strike the fitter on his right shoulder region.

Hours of work / rest & consumption of alcohol

The injured fitter's hours of work and rest records indicated that he had enough rest hours as required by the MLC, 2006. In the absence of any indication that fitter was suffering from fatigue, fatigue was not considered as contributory to this occurrence.

The safety investigation had no indications that the injured fitter was intoxicated at the time of occurrence. Therefore, the possibility that he was acting under the effects of alcohol was not considered.

Safety gear

At the time of occurrence, it was reported that the fitter was wearing overalls, safety shoes, ear plugs, a dust mask and a face shield. The PPE matrix required a safety helmet and safety googles to be worn. However, considering that the fitter was wearing a face shield, this did not necessitate the donning of safety googles. Additionally, the type of face shield worn by the fitter was not designed to be used in conjunction with a safety helmet (Figure 7).

Figure 7: Simulation of fitter wearing face shield

It was considered probable that a face shield was deemed to be more suitable than a pair of safety googles for the task that was being carried out by the fitter. Additionally, a face shield provided protection for the entire facial area and not just the eyes. Considering

that the task at hand was in front of the fitter and that no risks of falling objects were foreseen, doing away without a safety helmet was accepted by the fitter.

The absence of a safety helmet may have contributed to the fitter's minor head injury.

Possible accident dynamics

As mentioned elsewhere in this safety investigation report, the tailstock sleeve clamp was not locking the sleeve properly. This may have allowed the tailstock sleeve moving handwheel to rotate counter-clockwise, either under its own weight or by vibrations generated by the rotating chuck. Consequently, the sleeve would have withdrawn by about 2 mm (approximately half a turn on the handwheel). Given that the depth of the drilled hole in the rod was 1.5 mm, it was highly likely that the rod slipped out of the tailstock end during rotational movement.

The safety investigation considered two scenarios.

The settings on the lathe at the time of the accident generated a high rotational speed of approximately 1600 rpm. The safety investigation believes that due to the high rotational speed, the fitter's focus on the tool post, and the position of the cutting tool with respect to the rotating rod, he would have neither noticed in time that the rod had slipped from the tailstock, nor would he have had time to react. The combination of high speed and the inevitable proximity of the fitter to the machine, resulted in the fitter being struck by the loose, whipping rod.

The possibility that the fitter may have tried to stop the rotational movement of the rod by operating the spindle control lever on the body of the lathe was also considered. While doing so, the fitter was struck by the rotating (and deflecting) rod on his right shoulder, knocking him on the floor, and hitting his head (Figure 8). This possibility was, however, considered to be remote, given the short time that he would have had to react, unless he had noticed that something was not right with the rotating rod.

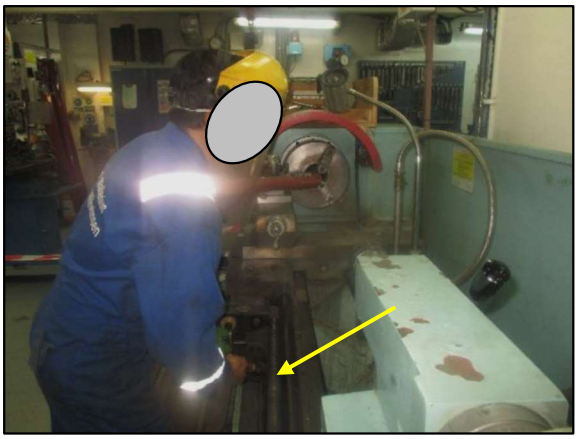

Figure 8: A photo simulation of fitter intending to operate the spindle control lever (yellow arrow) and being hit by the rod on his right shoulder

In the absence of witnesses, and due to the fitter's injury resulting in sparse recollection of events, the MSIU could not determine precisely how the fitter had sustained his injuries. However, when taking into consideration the high rotational speed and the proximity of the fitter to the rotating workpiece to carry out the task, the MSIU is convinced that he must have had extremely limited time to react, if any, to stop the lathe in time and prevent any damages and injuries.

Risk assessment and toolbox meeting

The generic risk assessment for working on lathes that was provided to the MSIU, was reportedly completed at around 0800 on the day of occurrence. The chief engineer and the second engineer were identified as the responsible persons. However, there was neither any indication that the work had been authorised, nor was the risk assessment signed by the assessment team.

Additionally, a toolbox meeting was also conducted at 0800 on the day of occurrence, at which point, the fitter was assigned the task on the lathe. The safety investigation

could not determine the extent of discussion and there was no evidence to indicate whether the risk assessment had been discussed during this meeting, considering that the available information indicates that both were carried out at the same time.

Regardless of the above, since none of the top events listed in the risk assessment identified the slipping of the workpiece from the lathe as a hazard, any concerns related to this hazard were, in all probability, neither brought to light nor discussed.

The chief engineer was neither present for the risk assessment nor for the toolbox meeting. The jobs listed in the Company's toolbox meeting form, and which had been discussed on the day of occurrence, may have necessitated the chief engineer's presence; the chief engineer may have been knowledgeable on the jobs listed in the toolbox meeting and he could have contributed key information during the discussion. However, following the previous day's manoeuvring, the chief engineer was unable to attend because he was resting, in compliance with the required work and rest hours.

Settings on the lathe

The lathe machine manual that was provided on *Titania* and which was available to the fitter, was technical and did not provide any operational guidance. Moreover, no specific operations and procedures were incorporated in the vessel's SMM on the use of lathe. When using the equipment's numerous settings, functions and tools, the fitter relied solely on his experience.

Following the accident, the Company suggested that the work should have started at a low speed setting so that the operator would have assessed the settings and positioning of the workpiece. However, it must be appreciated that the fitter may have perceived the task at hand as minor and which he may have executed many times. This experience may have given him the confidence to start the lathe immediately at high speeds, rather than increasing it gradually.

As mentioned elsewhere in this safety investigation report, the tailstock sleeve clamp lever was found not fully secured. The possibility that a malfunction had occurred with the machine was not considered plausible. It was reported that the lathe was tested by the crew members after the accident and no defects were found, which may have caused the tailstock sleeve clamp lever to slip. This may therefore suggest that the securing of the lever may have been overlooked by the fitter prior to starting the job.

Safety barrier systems

The chuck guard, installed on top of the three-jaw chuck, did not serve its purpose as a physical protective barrier. This was so because the deflection of the rod occurred at the other end, near the tailstock and away from the chuck guard. No other physical barriers were installed on the lathe. An analysis of the SMM indicated that a carriage guard (which would normally be installed on the main body of the lathe and moves with the tool post), was marked as an installed item. However, the safety investigation was unable to determine why the carriage guard was not installed on the lathe.

Symbolic barriers were not fitted in proximity of the lathe, suggesting that these may have not been considered as an effective preventive barrier system, neither by the Company nor by the crew members.

Other findings

Taking into consideration the thickness of the solid rod (35 mm in diameter), it would have sufficed to use a follower rest for the task. Several long slender shafts that tend to whip and spring during machining, require the use of a follower rest. Follower rests (Figure 9)

are fitted on lathes to minimise excessive rotating deflections by holding long workpieces steady during machining. They are attached to the saddle (the lathe component that holds the tool post) and move along with or 'follow' the lathe.

The follower rest, which was compatible with *Titania*'s lathe was designed for diameters of between 20 and 90 mm.

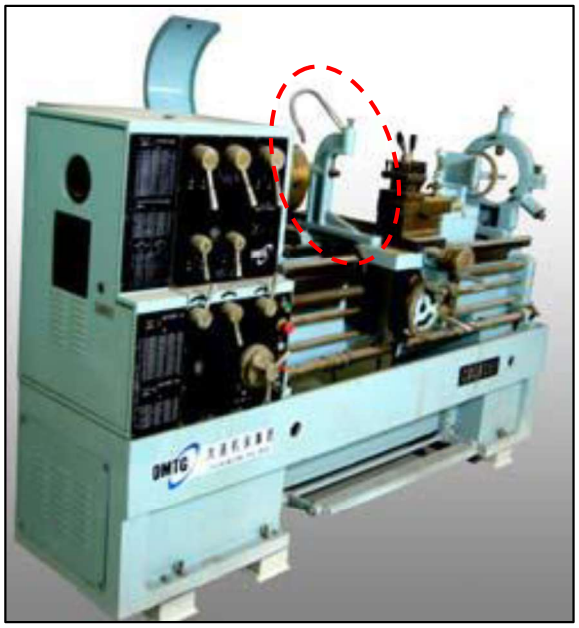

Figure 9: Follower rest installed on the lathe, as reproduced in the SMM

Whilst the SMM did not indicate the minimum lengths of workpieces for which a follower rest would have been required, it transpired that a follower rest was not available on board.

CONCLUSIONS

1. The rod, which slipped from the tailstock end while the lathe was rotating at a very high speed, deformed and hit the fitter;
2. In all probability, the fitter was focusing on the tool post when he was struck by the rod;
3. The tailstock sleeve clamping lever was not secured properly, allowing the tailstock positioning handwheel to rotate under its own weight/vibration and for the rod to slip out of the tailstock;
4. Evidence did not confirm that the risk assessment was discussed during the toolbox meeting;
5. The fitter was not involved in the risk assessment;
6. The chief engineer was neither present for the risk assessment, nor for the toolbox meeting;
7. A safety helmet could have minimised the severity of the head injury;
8. The fitter had no technical guidance on the speed settings of the lathe;
9. No preventive symbolic barrier systems were fitted in proximity of the lathe;
10. A follower rest was not provided on board.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION[6]

During this safety investigation, the following safety actions were taken by Wilhelmsen Ship Management Sdn Bhd:

- The Company's procedures were revised and a lathe training checklist compiled by the Chief Engineer whenever new fitters signed on has been introduced;
- A revision of the generic risk assessment was undertaken to include hazards related to dimensions of the workpiece and an additional control measure to determine and confirm the

[6] **Safety actions and recommendations shall not create a presumption of blame and / or liability**.

speed setting for the job in hand. The new assessment carried a cautionary note on excessive lathe's rpm;

- The Company confirmed that steady[7] and follower rests have been made available on board and were being used;
- A fleet wide experience exchange was carried out to ensure that the lessons learnt from this occurrence were promulgated and addressed.

RECOMMENDATIONS

Wilhelmsen Ship Management Sdn Bhd is recommended to:

05/2021_R1 Ensure that lathe operators are part of any lathe risk assessment procedure;

05/2021_R2 Fix a cautionary notice on the importance of appropriate settings and controls in proximity of the lathe.

[7] A steady rest has similar functions to a follower rest but is intended for workpieces with a thickness of between 80 mm and 200 mm.

SHIP PARTICULARS

Vessel Name:	*Titania*
Flag:	Malta
Classification Society:	Lloyd's Register of Shipping
IMO Number:	9505053
Type:	Vehicle Carrier
Registered Owner:	Wilhelmsen Lines Shipowning Malta Limited
Managers:	Wilhelmsen Ship Management Sdn Bhd
Construction:	Steel
Length Overall:	230.80 m
Registered Length:	222.69 m
Gross Tonnage:	74,255
Minimum Safe Manning:	15
Authorised Cargo:	Ro-ro (vehicles)

VOYAGE PARTICULARS

Port of Departure:	Baltimore, USA
Port of Arrival:	Savannah, USA
Type of Voyage:	International voyage
Cargo Information:	Cars and heavy equipment 6,018 mt
Manning:	24

MARINE OCCURRENCE INFORMATION

Date and Time:	04th February 2020 at 14:30 LT
Classification of Occurrence:	Serious marine casualty
Location of Occurrence:	35° 43.7' N 075° 10.5' W
Place on Board	Engine-room workshop
Injuries / Fatalities:	One serious injury
Damage / Environmental Impact:	None reported
Ship Operation:	Transit
Voyage Segment:	In passage
External & Internal Environment:	Clear weather with a gentle breeze from West Southwest direction. Air temperature was 13 °C and the sea temperature was 11 °C.
Persons on board:	24