Report on the Investigation of the

Failure of the hatch cover gantry crane on board

CIMBRIS

alongside in the port of Tekirdag, Turkey

resulting in one fatality

4th April 2008

Gibraltar Maritime Administration
Watergate House
2 /8 Casemates Square
Gibraltar

Extract from

The Gibraltar Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2006 – Regulation 5:

"The sole objective of the investigation of 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 an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 13(10) of the Gibraltar Merchant Shipping (Accident Reporting and Investigation) Regulations 2006, shall be inadmissible in any judicial proceedings whose purpose or one of whose purposes is to attribute or apportion liability or blame unless a court or tribunal having due regard to relevant factors determines otherwise.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AB	-	Able Seaman
DPA	-	Designated Person Ashore
GMA	-	Gibraltar Maritime Administration
KN	-	Kilonewtons
KW	-	Kilowatts
OS	-	Ordinary Seaman
SWL	-	Safe Working Load

SYNOPSIS

.1 On the 4 April 2008, the general cargo vessel Cimbris was alongside in the port of Tekirdag, Turkey undertaking cargo discharging operations. The hatch cover gantry crane was being used to move the hatchcovers under the supervision of the Chief Officer. Following a reported problem with cargo acceptance this operation was halted whilst the Chief Officer went to consult with the stevedores and the ships agent regarding the cargo stoppage.

.2 The hatch cover lifting operation was then restarted after approximately ten minutes in the absence of the Chief Officer with the AB (senior) standing on the tween deck hatch cover that was being moved, the hatch cover was hoisted approximately one metre and then halted as the cover was visually checked for clearance, upon recommencing the lift the hoist wires broke and the lifting frame fell onto the AB causing fatal injuries.

.3 Upon being alerted the Master requested an ambulance and proceeded to the cargo hold where a number of crewmembers had mustered to assist, paramedics arrived on the vessel within ten minutes of the accident with it being apparent that the AB had died as a result of the accident. The body of the deceased was moved ashore to a mortuary later that evening.

.4 The vessel was subsequently diverted to Gibraltar and was attended on the 14 April 2008 for the purposes of undertaking an enquiry into the death of the seaman under the Section 92 of the Gibraltar Merchant Shipping (Safety, etc.) Regulations. Coincident with this enquiry an accident investigation under the Gibraltar Merchant Shipping (Accident Reporting and Investigation) Regulations 2006 was also commenced.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF CIMBRIS AND ACCIDENT

Vessel Details

Registered Owner	:	Briese Schiffahrts GmbH & Co. KG MS 'OSTERRIFF'
Managers	:	Briese Schiffahrts GmbH & Co. KG
Port of Registry	:	Gibraltar
IMO No.	:	9281786
Type	:	General Cargo
Built	:	2003, Rousse Shipyard, Bulgaria
Classification Society	:	Germanischer Lloyd
Construction	:	Steel
Length Overall	:	98.90m
Gross Tonnage	:	3173
Engine Power	:	2880 KW
Service Speed	:	12.5 Knots

Accident Details

Time and date	:	17:15 on 4 April 2008
Location of accident	:	Tween deck whilst the vessel was alongside at Tekirdag, Turkey
Persons on board	:	10 Crew
Injuries / Fatalities	:	A.B. fatally injured
Damage	:	Hatch Cover Gantry Crane, No. 6 Tween Deck Hatch Cover

2 NARRATIVE

2.1 Chronology of the Accident

04/04/08 **10:40** Vessel alongside the port of Tekirdag, discharging of cargo commenced.

17:00 During the afternoon the Chief Officer was supervising the cargo and associated hatch cover movement as per normal practice. Following a reported problem with cargo acceptance the Chief Officer stops the gantry crane using the emergency stop and proceeds to the main deck to consult with the stevedores and also to retrieve a short ladder that was to be used for accessing the tween deck hatches during shifting.

After approximately ten minutes the senior AB advised the OS that there was a cargo stoppage and that they needed to move a tween deck hatch cover.

The OS then proceeded to the gantry crane controls to act as the crane driver and checked that the deck cadet was in position. The cadet was acting as a signalling man to confirm the vertical lift of the hatch cover in order to avoid the jamming of the tween deck hatch cover against the sides of cargo hold.

17:15 Senior AB gives verbal signal to lift number 6 tween deck hatch cover and the cover was raised approximately one meter. The lift was halted and the cover was checked for clearance to the hold sides with the OS asking the cadet with regard to the list (clearance).

Upon an affirmative answer regarding clearance the Senior AB asked for a little more hoist and upon recommencing the lift the crane hoist wires broke. Due to the hoist wires breaking the lifting frame that was integral to the crane fell, trapping and crushing the Senior AB who was standing on the hatch cover as it was been moved.

The Master and crew attended the scene of the accident and emergency paramedics arrived from the shore within ten minutes. It was evident due to injuries received that the crewman was deceased

19:20 Body of deceased removed ashore to a mortuary.

Figure 1. Cimbris (hatch cover gantry crane is shown in its aft stored position)

Figure 2. Side view of hatch cover gantry crane with the lifting frame in the stored position

2.2 Cargo Operations / Hatch Cover Movement

.1 At the time of the accident the main deck hatch covers were stacked on top of each other at the aft end of the cargo hold in order to permit cargo operations in the forward end of the cargo hold. The hold was subdivided into two by a transverse portable bulkhead with the aft tween deck hatch covers in place with cargo above.

.2 The forward hold tween deck hatch covers were stacked toward the forward end and at the time of the accident these tween deck hatch covers were being relocated to the aft part of the forward hold with the hatch cover being lifted the uppermost in a stack of three hatch covers.

2.3 Lifting Appliance Configuration

.1 The hatch cover gantry crane was manufactured by Coop & Nieborg of Hoogezand, Holland according to drawings approved by Germanischer Lloyd in 2003. The crane was supplied to Rousse Shipyard, Bulgaria where it was installed as part of the new building.

.2 The crane was designated as a Gantry Crane 2 x 15 KW and was intended for lifting and transporting pontoon hatchcovers to open and close cargo holds and to handle and position tween deck / grain bulkheads. The crane ran on a rail track fitted on the cargo hold hatch side coamings, the operation involved two functions, driving and hoisting.

Crane Manufacturers data (as per onboard operating manual)

Operation	:	Electric / Hydraulic 2 x 15kw
Load	:	Max pontoon hatchcover weight 13.5ton
S.W.L.	:	13.5tons
Driving speed	:	approx. 30 metre / min
Hoisting speed:		approx 4 metre / min

.3 The hoisting function is carried out by means of two hydraulic winches on the top / middle of the main frame of the crane with steel wires running from each winch drum over sheaves to the outboard of the crane and connected to a lifting frame.

.4 For movement of the main deck hatch covers this lifting frame attached to the hatch cover via four hoisting hooks. For moving the tween deck hatch covers the lifting frame is stowed and locked in position and the hoist wires were attached to a tween deck lifting beam, four steel wire slings are then rigged between the lifting beam and the tween deck cover and connected to the tween deck cover via four purposely designed T hooks.

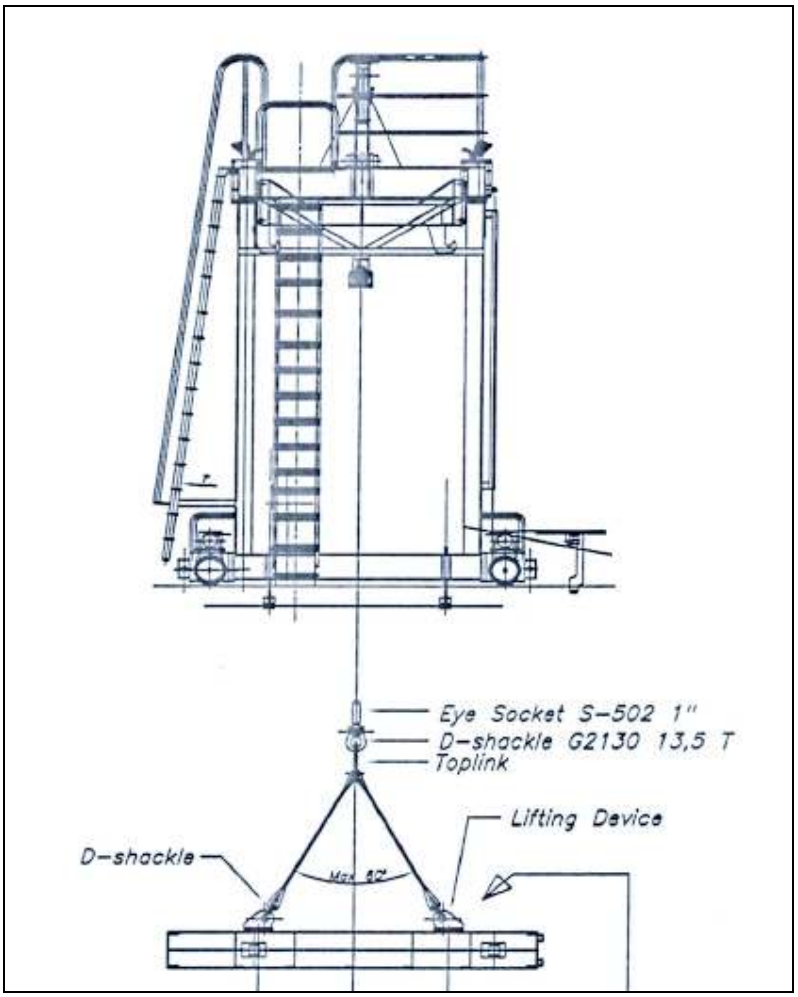

Figure 3. View of hatch cover gantry crane arranged for lift of tween deck hatch cover (as per manufacturers data provided onboard)

Figure 4. View of hoist wire connection at one end of the tween deck lifting beam

2.4 Lifting Appliance Certification

.1 The hatch cover gantry crane was issued with an inspection and test certificate by Germanischer Lloyd on the 10.04.2003 attesting to the witness of a satisfactory load test of the hoisting hooks for the hatch covers to a load of 1.25 x SWL (13.5).

.2 Certification was available onboard for the hoist wires issued by the wire manufacturer, dated 10.04.03 and indicating the supply of the wire to the crane manufacturer.

.3 The hatch cover gantry crane, the hoist wire and the associated loose gear had not been examined by a competent person since the vessel entered service in 2003, the vessel / company was also not aware that a load test of the crane was required by the 9th April 2008, within 5 days of the date of the accident.

2.5 Hoist Wire Construction

.1 The hoist wire certification gave the following information,

Description: drawn galvanised steel wire rope
Construction: 6 x 36 WS + STK
Direction and type of lay: Right hand ordinary lay
Tensile grade: 1960 N/mm2
Dimensions: 26mm
Proof load applied: 472 KN
Manufacturing Standard: ISO 2408

.2 The construction 6 x 36 (6-strand rope with each strand having 36 wires) with WS notation indicates a blend of Warrington (W) and Seale (S) patterns.

.3 Warrington (W) wire arrangement is characterised as having one of its wire layers made up of an arrangement of alternatively large and small wires. This arrangement provides good flexibility and strength but lesser abrasion resistance. Searle (S) wire arrangement is characterised as having equally sized wires in the outer layer with the same number of uniform but smaller sized wires in the inner layer around a central core wire. This arrangement provides good abrasion resistance but less fatigue resistance.

.4 Right hand ordinary (regular) lay denotes a rope in which the wires are twisted in one direction, and the strands in the opposite direction to form the rope. The individual wires appear to run roughly parallel to the centreline of the rope. Regular lay ropes are less likely to un-twist or kink and are also less subject to failure from crushing or distortion. Regular lay wires are the most common form of wire rope for cranes

.5 Following de-stranding of a section of the wire rope during analysis the construction of the strands of the rope that surround the steel core was confirmed as 6 x 36 WS + STK (14/7 & 7/7/1). This wire contains a number of small wires and provides for better fatigue resistance, which is important for wires that pass over sheaves or drums.

.6 Based upon the foregoing it is considered that the wire construction was correctly chosen for the particular application.

2.6 Lifting Appliance Maintenance

.1 The crane manufacturer manual / information booklet onboard the vessel provided some instruction concerning the maintenance of the crane. This information was limited to details concerning the lubrication of the wheel bearings and transmission gear. The only reference to the condition of the wire ropes was within a checklist for manoeuvring the main deck and grain bulkheads, which made the general point that equipment such as wire ropes, halters, clamps, locking-pins, are to be in good condition.

.2 As part of the vessels safety management system a maintenance list for the deck was required to be completed and sent to the company on a quarterly basis. The list made no reference to lifting appliances but did made reference to the requirement for weekly greasing of 'winches and davits'.

Figure 5. View of failed hoist wire at winch drum showing level of greasing present on wire during normal operation. Corrosion product is also visible on the de-stranded wires at the point of break.

SECTION 3 – ANALYSIS

3.1 Aim

.1 The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

3.2 Location of Hoist Wire Failure

The hoist wires failed at a distance of 4320 mm and 4440 mm from the end termination that connects the hoist wire to the main deck lifting frame or tween deck lifting beam. When the crane was not in use and in its stored position as per **(Figure 2)** the point of break would be approximately mid way between the hoist drum and the outboard sheave. The wire in the region of the break would therefore be subject to the weather when the vessel was at sea to a greater extent that the wire that was on the hoist drum.

When the hatch cover gantry crane was used for the movement of the main deck hatch covers the hoist wire would be lowered approximately 4 meters to attach the crane to the hatch cover. If upon hoisting the main deck hatch cover is then raised approximately 1.5 meters or greater as would be the case when stacking the hatch covers the point of break of the hoist wire would pass over the outer sheave during both lowering and when hoisting under load.

With the vessel having 11 main deck and 12 tween deck hatch covers requiring opening, closing and other movements when the vessel is in port the point of break of the hoist wires would pass over the outer sheave continuously during hatch cover movement operations.

3.3 Analysis of Failed Hoist Wires

.1 During attendance onboard the vessel, a sample of the failed hoist wire was identified and submitted for independent test and examination at an accredited rope-testing centre [1], the following illustrations and summarised findings are taken from this report.

.2 The analysis was undertaken in accordance with the following scope of work,

- Visual inspection of wire failure points and neighbouring areas.
- Undertake a wire break count and investigation of internal corrosion.
- Wire break characteristics at points of failure with respect to fatigue and forced breakage.
- Determination of residual breaking strength by tensile strength test.

[1] DMT GmbH & Co. KG report PO8-00359-e (b) dated 01.07.08 refers.

.3 The visual inspection findings at the points of failure of the wire may be summarised as follows,

- Due to extensive corrosion the cause of a large number of wire breaks at the points of failure of the wires could not be established, the failed ends of the wire showed only a few remnants of lubrication at the outer strands and no lubrication could be detected at all within the rope, **(Figure 6)**.

- Fatigue wire breaks were observed at locations throughout the wire including the outer strands, the next Warrington layer and the outer strands of the steel core and the core strand itself. Fatigue fracture being generally associated with a wire that is worked around a sheave or drum, **(Figure 7)**.

- Forced ruptures of the core wire could also be observed which will occur when a tensile overload of a wire occurs. Several wires also displayed shear damage, which is indicative of additional perpendicular compression by neighbouring wires during a tensile overload condition.

Figure 6. Wire breaks at an outer strand at the point of failure of the wire.

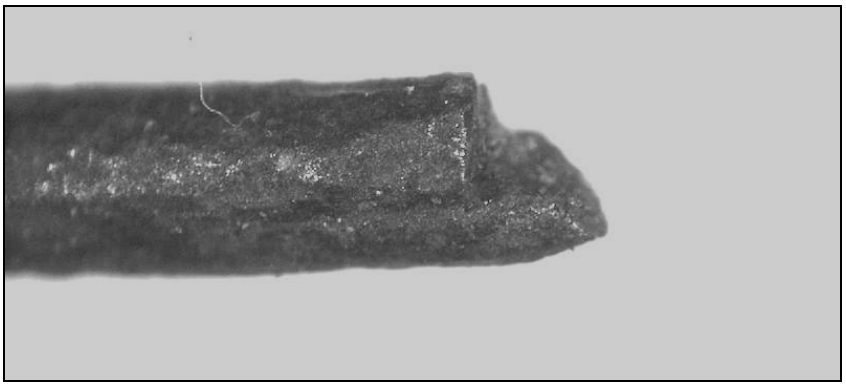

Figure 7. Fatigue wire break on a Warrington wire.

.4 The visual inspection findings adjacent to the points of failure of the wire may be summarised as follows,

- A number of wire breaks were found in the outer wires of the outer strands, with the wire break ends displaying acute corrosion and the presence of corrosion remaining within the strand space of the wire. Corrosion was found to extend into the core wires of the outer strands, no internal lubrication was found, **(Figure 8)**.

- The outer strands in which outer wire breaks were found were de-stranded, following which wire breaks were also found in the thin and thick Warrington wires, **(Figure 9)**.

Figure 8. Wire breaks located next to each other in the outer strand of the wire adjacent to the points of failure with evidence of acute corrosion.

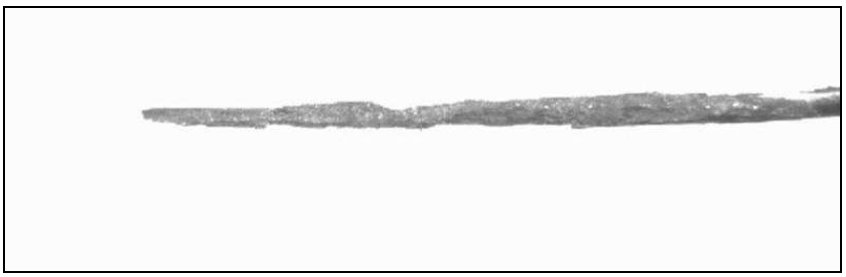

Figure 9. Wire beak of a thin Warrington wire with tapered corrosion.

- Upon opening the steel core, wire breaks were found to the outer strands of the steel core and the outer wire of the core strand, **(Figure 11)**. Corrosion was also found to have extended to the steel core with the wires of the steel core showing abrasion and dents **(Figure 12)**. Only very sporadic galvanizing residues were found on the steel core wires.

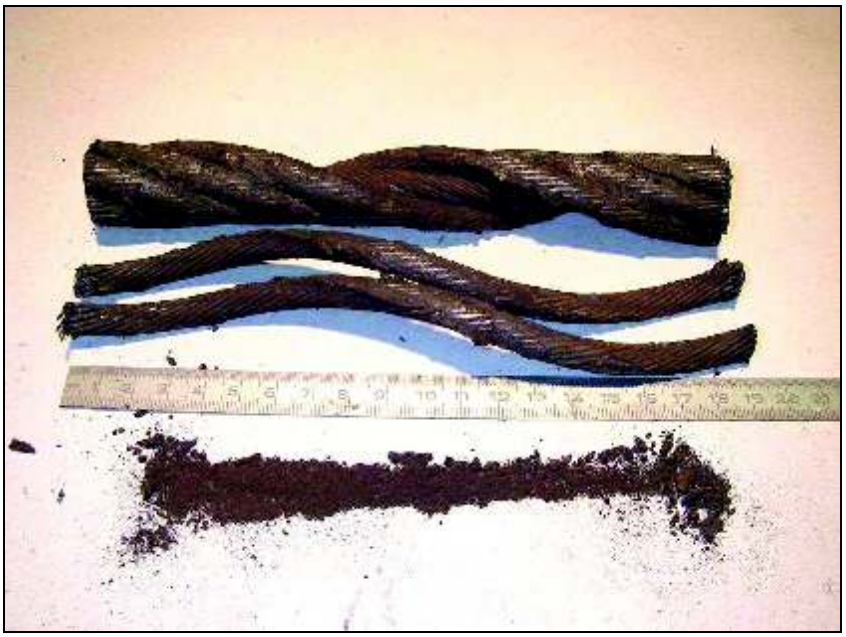

Figure 10. Wire Rope specimen with two separated strands showing the level of corrosion product found within the rope during de-stranding.

Figure 11. Outer wire of outer strand showing abrasion at the contact points as well as corrosion.

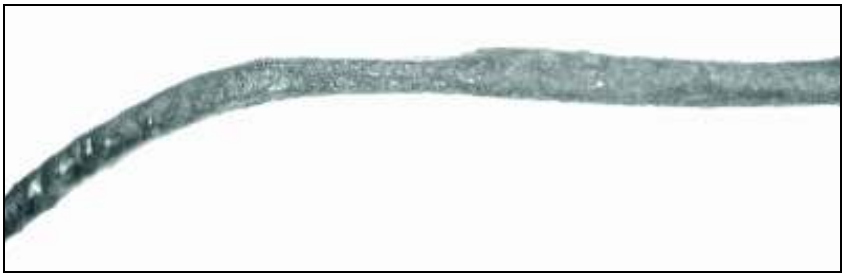

Figure 12. Abrasion on a contact point on an outer wire of the core strand of the steel core.

.5 The determination of the breaking load of the sample of wire identified onboard was carried out after removing a heavily corroded section of the wire from one end of the sample. The residual breaking strength of this sample was 423 KN; a further sample taken from the winch end of the hoist wire was also tested and provided a residual breaking strength of 478KN.

.6 The original wire certification gave the hoist wire as having a breaking strength of 472 kN. The identified sample therefore broke at approximately 90% of the original breaking strength.

3.4 Assessment of hoist wire failure mechanism

.1 The values of breaking load achieved for the samples indicated that these samples were too far away from the point of failure to provide a representative failure load for the wire. The failure of the hoist wires is considered to have occurred in a localised section of the wire with the breaking strength then increasing with the distance away from the failure point.

.2 The observation that a sample of the wire specimen had to be removed from one end of the identified sample prior to testing due to the presence of heavy corrosion is considered noteworthy. This section was removed as due to the level of corrosion a failure was expected to occur within the area of attachment of the wire to the testing machine. The resultant load upon failure of the sample in this area of

attachment could not have been considered as being representative of the sample under test.

.3 The hoist wires were considered to have failed due to a reduced cross section caused by extensive corrosion, extending to the core wires as well as abrasion. The residual cross section of the outer wires at the point of failure due to abrasion and dents was reduced by 75%. There was also no evidence of any lubrication at the point of failure or in the immediate vicinity of the failure.

.4 The majority of the damages to the wire and the heavy corrosion occurred within the rope.

SECTION 4 – DISCUSSION

4.1 Examination of wire ropes

.1 For the continued safe operation of lifting appliances it is essential that wire ropes are subject to periodic and through inspections by a competent person to ascertain their continued fitness for service. The interval of inspections should consider the application of the wire and its frequency of use.

.2 Each periodic inspection should include the whole length of the wire rope and use an established framework for inspection such as the International Standard ISO 4309 – "Cranes – Wire Ropes – Care, maintenance, installation, examination and discard."

.3 Discard criteria should also be determined in consultation with the manufacture of the lifting appliance. By using such criteria a competent and suitability trained person can establish a rate of deterioration that can be used to anticipate the need for wire replacement.

.4 Typical discard criteria for an external examination will include the number of broken wires, fractured strands, decrease in elasticity, external and internal corrosion, length of service, number of life-cycles, reduction in diameter and broken wires at termination points.

.5 Wire ropes should also be examined for signs of deterioration and damage on a daily basis when in use by ships staff.

.6 Inspection intervals, scope of inspection and inspection results should be documented and incorporated into the onboard safety management system.

4.2 Internal examination of wire ropes

.1 Corrosion of a wire rope is to be expected in a marine environment which will reduce the metallic cross-sectional area and diminish the breaking strength. Corrosion can also accelerate fatigue by causing surface irregularities which lead to stress cracking.

.2 Internal corrosion of a wire rope is more difficult to detect than external corrosion, although the two will frequently accompany one another. Internal corrosion may be recognised by variations in diameter and a loss of clearance between the strands in the outer layer, frequently combined with wire breaks between or within the strands. Where a wire rope bends around a sheave a reduction in area will usually occur when internal corrosion is present.

.4 If during an examination there is any indication of possible internal corrosion the rope should be subjected to an internal examination by a competent person in accordance with ISO 4309 which provides a procedure for undertaking an internal examination of a wire rope over a limited portion **(Figure 11)**.

Figure 13. Internal examination of wire rope *(Source: Certex)*

.5 Consideration may also be given to supplementing the visual examination by carrying out a full-length inspection of a wire rope using approved non-destructive testing.

4.3 Examination of wire ropes running over sheaves

.1 The lengths of ropes running over sheaves are the most heavily worked parts of a rope as was the case with the operation of the hatch cover gantry crane. Persons undertaking inspections of wire ropes should therefore pay particular attention to this area of a wire rope.

.2 Unless otherwise indicated by the manufacturer, wire ropes should have the dressing of grease or oil applied during installation. This dressing should be cleaned and re-applied at regular intervals with particular reference to those lengths of wire that pass over sheaves. This removal and re-application of the rope dressing should be carried out in connection with a visual inspection of the rope.

.3 From examination **(Figure 5)** it was apparent that the hoist wires were not subject to cleaning to permit visual inspection as part of the maintenance procedures, with greasing likely to have been applied weekly onto existing grease. Insufficient attention with regard to lubrication would also have been paid to the less accessible locations such as in way of the sheaves.

SECTION 5 – Action Taken

.1 Gibraltar Maritime Administration issued an Improvement Notice on the DPA / Quality & Safety Manager of the managing company of the Cimbris on the 29th April 2008 relating to contravention of a number of provisions in relevant Merchant Shipping Regulations relating to lifting operations and use of work equipment.

.2 Gibraltar Maritime Administration issued a Shipping Guidance Notice to all Gibraltar Ship Owners and Operators and other relevant bodies highlighting the requirements for Lifting Equipment Inspection and Certification, **(Annex A)**.

.3 Gibraltar Maritime Administration requested in June 2008 at the meeting of the British Classification Committee that all recognised classification societies include instructions to surveyors such that at the time of the annual survey of a Gibraltar vessel the GMA is informed in those circumstances when class has not been appointed as the competent authority for the inspection and certification of lifting appliances.

SECTION 6 – Conclusion

6.1 Safety issues directly contributing to the accident which have resulted in recommendations.

1. The vessel was not maintaining a system of lifting appliance inspection and test, as such there was no procedures or instruction for the regular inspection of the hatch cover gantry crane, the hoist wire or loose gear for wear, damage or corrosion.

2. The hatch cover gantry crane had not been examined by a competent person as required by applicable merchant shipping regulations since the vessel entered into service in 2003.

3. The decision of the AB to remain on the tween deck hatch cover during the movement attested to a lack of effective planning and supervision of lifting operations onboard the vessel.

6.2 Other safety issues identified during the investigation also leading to recommendations.

1. The company and the vessel were not aware that a load test of the hatch cover gantry crane was required every 5 years and that this test would fall due on the 10th April 2008, six days following the accident.

2. The vessel was not maintaining a Register of Lifting Appliances and Loose Gear.

3. The lifting frame (I beam) that fell following the failure of the crane hoist wires was not marked with its self-weight as required by applicable merchant shipping regulations.

SECTION 7 – Recommendations

Briese Schiffahrts GmbH & Co. KG is recommended to:

1. Ensure that all lifting appliances are subject to inspection and test by a competent person as required by applicable merchant shipping regulations.

2. Implement within the company's safety management system adequate maintenance procedures for all lifting appliances and associated wire ropes. Such procedures should include guidance on wire rope maintenance, lubrication, installation, examination and testing.

3. Implement within the company's safety management system adequate inspection procedures for all lifting appliances and associated wire ropes. Such procedures should include both external and where evidence of corrosion is found internal inspection requirements for wire ropes as well as clear discard criteria based upon manufacturers' recommendations and ISO 4309.

4. Ensure that the procedures within the safety management system provide a clear statement of the anticipated maximum operational lifespan for all lifting appliance wire ropes based upon the type of lifting appliance, wire construction, lifting appliance utilisation and the crane and wire manufacturers' recommendations.

5. Ensure that maintenance and inspection procedures include reference to the importance of examination and lubrication of wire ropes in way of sheave blocks and other less accessible locations.

6. Ensure that maintenance and inspection procedures for wire ropes include guidance as to the removal and re-application of the wire rope dressing (greasing) over the whole length of the rope at regular intervals to permit inspection of the rope by a competent person.

7. Ensure that every lifting operation is properly planned, appropriately supervised and carried out in a safe manner.

8. Implement and maintain a Register of Lifting Appliances and Loose Gear in the form based upon the model recommended by the International Labour Organisation.