Report on the investigation into

the failure of the stores crane on the dredger

Sand Falcon

at West Thurrock, River Thames

on

29 January 2010

Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
United Kingdom
SO15 2JU

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Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 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(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

BS	-	British Standard
COPSULE	-	Code of Practice for the Safe Use of Lifting Equipment
COSWP	-	Code of Safe Working Practices
EU	-	European Union
HSE	-	Health and Safety Executive
IACS	-	International Association of Classification Societies
ICHCA	-	International Cargo Handling Co-ordination Association
IGP&I	-	International Group of Protection and Indemnity (Clubs)
ILO	-	International Labour Organization
IMO	-	International Maritime Organization
ISM	-	International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention, adopted November 1993.
kg	-	kilogram
LEEA	-	Lifting Equipment Engineers Association
LOLER	-	The Merchant Shipping (Lifting Operations and Lifting Equipment) Regulations 2006 (SI 2184/2006)
m	-	metres
MAIIF	-	Marine Accident Investigators' International Forum
mm	-	millimetres
MCA	-	Maritime and Coastguard Agency
MED	-	Marine Equipment Directive (96/98/EC)
MGN	-	Marine Guidance Note
MIN	-	Marine Information Note
MSC	-	(The IMO's) Maritime Safety Committee
PMS	-	Planned Maintenance System
PUWER	-	The Merchant Shipping (Provision and Use of Work Equipment) Regulations 2006 (SI 2183:2006)

SI	-	Statutory Instrument
SMS	-	Safety Management System
UTC	-	Coordinated Universal Time

Times: All times used in this report are UTC unless otherwise stated

Sand Falcon

SYNOPSIS

Sand Falcon was secured alongside a jetty when the trolley from its gantry-type stores crane detached and fell 7.5m, landing on the deck guardrails. The trolley weighed over 400kg and narrowly missed 7 people who were working nearby, either on the main deck or on the jetty ashore. The crane was being prepared to load ship's stores at the time and it was not lifting any weight.

The failure was due to a combination of design flaws, lack of maintenance and weaknesses in the methods used for inspection and testing to assess the safety of the crane.

This accident is one of three similar cases that happened in the period from January to May 2010. A total of 11 people have been injured in the 29 accidents involving the failure of non-cargo handling cranes that have been reported to MAIB since 2001.

Existing regulations in the UK and European Union (EU) for lifting equipment are extensive, and the International Safety Management (ISM) Code clearly stipulates the requirement for safe working practices. However, these regulations only apply to employers and ship operators, and there are few obligations applicable to equipment manufacturers and shipbuilders for this type of crane. The consequence of this is that poor crane design, limited access for crane maintenance, and inadequate instruction/ maintenance manuals were found to be contributory factors in this and in many other of the similar accidents reported to MAIB.

International regulations in this area are designed to protect the safety of shore workers and only apply to cargo handling equipment.

In view of the actions already taken by the vessel's operators, CEMEX, and the crane's manufacturers, ACTA, no recommendations have been made. However, the MAIB has issued a Safety Flyer to the Shipping Industry to highlight the importance of improving the design, maintenance and inspection of non-cargo lifting appliances.

SECTION 1 - FACTUAL INFORMATION

1.1 Particulars of *Sand Falcon* and accident

Vessel details

Registered owner	:	CEMEX UK Marine Ltd
Manager(s)	:	CEMEX UK Marine Ltd
Port of registry	:	Southampton
Flag	:	UK
Type	:	Trailing suction hopper dredger
Built	:	1998, IHC De Merwede, The Netherlands
IMO number	:	9151553
Classification society	:	Bureau Veritas (built to Lloyd's Register rules)
Construction	:	Steel
Length overall	:	115.94m
Gross tonnage	:	6534
Engine power and/or type	:	2 x Wartsila 6R32E driving twin controllable pitch propellers
Service speed	:	12.5 knots
Stores crane	:	ACTA gantry-type crane with 2 tonne safe working load

Accident details

Time and date	:	1205, 29 January 2010
Location of incident	:	Alongside at West Thurrock, River Thames
Persons on board	:	14
Injuries/fatalities	:	None
Damage	:	Crane severely damaged, minor damage to deck guardrails

1.2 BACKGROUND

Sand Falcon dredged sand and aggregates from grounds in the English Channel and North Sea. Owned and managed by CEMEX UK, the vessel discharged its cargoes to a variety of ports in the UK and near continent. On the day of the accident, the vessel was alongside at a lay-by berth for routine repairs to the cargo handling equipment and to load ship's stores.

Two 'F' class dredgers, *Sand Falcon* and its sister vessel *Sand Fulmar,* were ordered by the RMC group (subsequently taken over by CEMEX) from the De Merwede shipyard at Hardinxveld in the Netherlands in 1997. The new dredgers were a development of the earlier 'H' class vessels, *Sand Heron* and *Sand Harrier*, built by the same yard in 1990. All four vessels were registered on the UK flag and their construction was supervised by Lloyd's Register. They were all fitted with similar gantry-type stores cranes.

1.3 NARRATIVE

Sand Falcon arrived at the lay-by berth at West Thurrock on 29 January 2010 at 0700, and the stores crane was used to rig the ship's gangway. The crane was then put back to its stowed position. Later in the morning, the ship's stores were delivered. The tide was flooding, and by the time the stores were ready to be brought on board *Sand Falcon* the gangway was too steep to be used. The bosun prepared the stores crane and used it to recover the gangway back on board. During this operation, the crane's gantry-trolley moved with its usual, characteristic jerking motion, but neither the bosun nor any of the other crew assisting him thought that anything was untoward.

After stowing the gangway, the crew rigged a scaling ladder in its place. The bosun then slewed the crane outboard so that it was at right angles to the ship's side, and started to move the trolley along the gantry beam in preparation for lifting the stores. At about 1205 the trolley was above the ship's side guardrail and members of the crew, who were watching the trolley move, reported seeing the trolley wheels on the aft face of the gantry beam appear to climb up the beam. Very soon afterwards the wheels on the forward face of the gantry came off the beam. The trolley then hung momentarily on the aft face of the beam before it fell 7.5m, landing upside down on the guardrails. Although those watching attempted to shout a warning, the accident happened too quickly for anyone in the immediate vicinity of the crane to take any evasive action.

Six members of the crew and the delivery driver were all standing close by, either on the deck of the ship or on the jetty **(Figure 1)**. Fortunately, none of them was standing directly beneath the crane and no-one was injured, but the crane trolley was severely damaged.

Following the accident, the chief engineer isolated electrical power to the motors on the crane trolley. The crew then rigged chain blocks to prevent the trolley falling any further and subsequently recovered it onto the deck.

Figure 1

Main deck and jetty shortly after the accident

1.4 GANTRY CRANE

1.4.1 General purpose

The De Merwede shipyard ordered all four gantry stores cranes fitted to the 'F' and 'H' class vessels from ACTA, a long-established Danish company which specialised in the provision of marine deck equipment, cranes, and davits.

The cranes were intended for general purpose use and were used only a few times each week to rig the gangway, load stores or lift components out of the engine room.

Sand Falcon's stores crane slewed relatively slowly and there was no evidence of it being slewed or stowed violently such that the trolley could be made to 'rock' on its wheels. There was no evidence to suggest it had been used to drag or lift loads that were not located directly beneath the trolley.

1.4.2 Specification

A basic specification for the stores cranes was included in the build contract for the 'H' Class vessels which was agreed between the RMC group and the De Merwede shipyard. The cranes were intended for use in sheltered waters and

the load handling capacity, minimum and maximum reach, hoisting height and speed were included in the specification. The general conditions of the contract required *'instruction books and maintenance manuals as supplied by the respective makers'* to be provided.

There was no requirement for the cranes to be designed and built under flag state or classification society supervision. The RMC group did not choose to gain the optional classification society notation for lifting equipment.

1.4.3 Design and construction

The stores cranes supplied for the 'H' class vessels were the only ones of this particular type produced by ACTA. Having received no adverse feedback from the cranes already in service on the 'H' class vessels, the same design was accepted for use on the 'F' class.

The design of the stores crane was similar to the equipment more commonly used in engine rooms for moving machinery components. An I-beam was attached to a slewing mechanism mounted on the starboard-forward corner of the accommodation structure **(Figure 2)**. The trolley was fitted with four flanged wheels which bore on the top side of the lower flange of the I-beam to allow it to traverse along the gantry. Both the lifting and traversing motors were fitted onto the trolley. Neither motor was braked as the friction of the worm reduction gearing maintained the equipment in position when the motor was stopped. A single pinion at one corner of the trolley engaged in a rack on the beam to drive the trolley along. The trolley was located on the beam by the flanges on the wheels; there were no secondary restraints to attach the trolley to the beam.

Figure 2

Stores crane

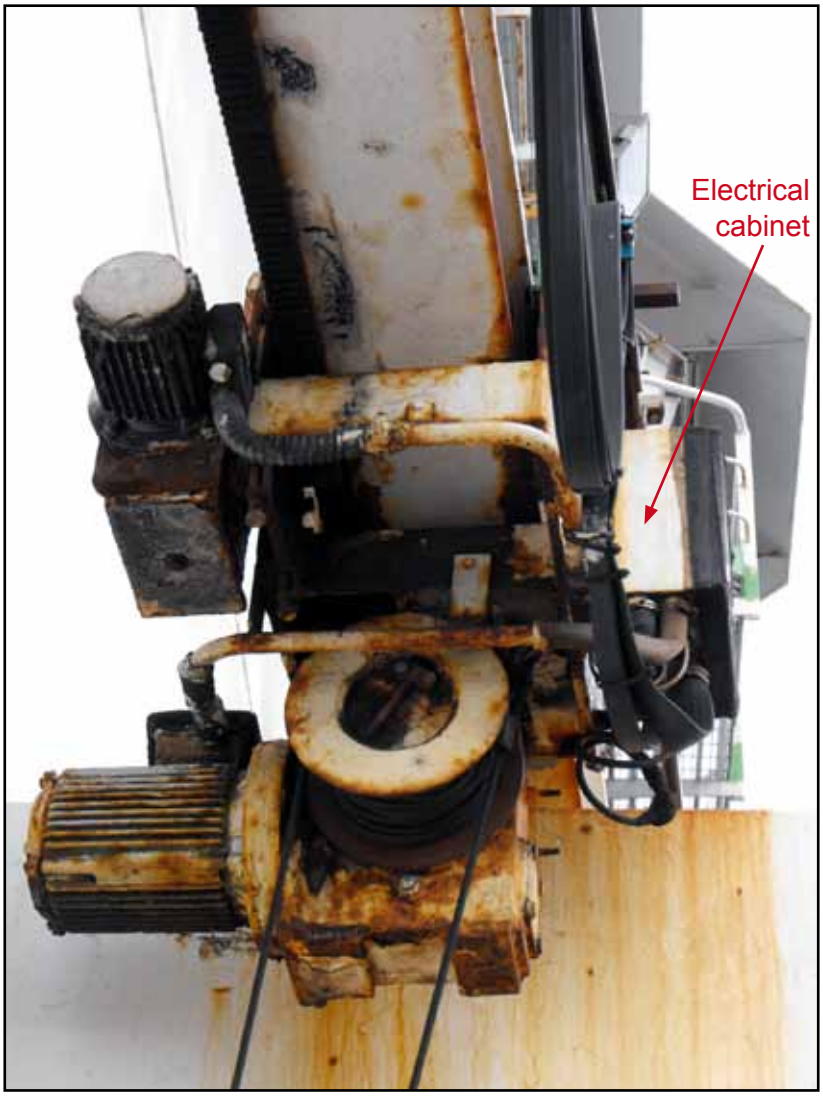
The gearbox for the double fall lifting wire was offset from the centreline **(Figures 3a & 3b)**, but the standing end of the wire was secured on the opposite side of the trolley so that the weight of any load would be shared equally by all four wheels. Both the motors and gearboxes were offset to the same side of the trolley, and it is unlikely that their weight would have been completely counter-balanced by the electrical cabinet on the other side **(Figure 4)**.

Figure 3a

Figure 3b

Gantry-trolley and offset lifting wire gearbox

Figure 4



Gantry-trolley

The cranes were designed independently from the rest of the ship and there was no requirement in the vessel's building specification for a permanent means of access to be provided to the crane equipment for maintenance and inspection work. Demand for deck equipment was high at the time the order was placed, and ACTA employed temporary staff to work on the 'F' class cranes. As a consequence, *Sand Falcon*'s crane was of rudimentary quality and not to the company's normal standard; for example, the gantry-trolley wheels had been intended for industrial, rather than marine use.

At the time of construction, there was nothing explicit to indicate to ACTA how harsh the working environment on the deck of the dredger was likely to be. In service, the crane was not only exposed to salt and sea spray, but also to fine sand and grit from the processing and unloading of dredged material. The electric motors for lifting and traversing the gantry were exposed and the electrical systems were found to be vulnerable in service.

1.4.4 Information supplied

At build, ACTA supplied a small package of drawings and a list of spare part numbers with the cranes for all four vessels. There was no description of the operating principles, and no instructions for commissioning, maintenance, test or inspection of the crane equipment.

In October 2007, the International Maritime Organization (IMO) published a marine safety circular which highlighted concern about the general standard of technical manuals supplied with marine equipment, and emphasised the importance of operating and maintenance manuals (MSC.1/Circ 1253). The circular quoted guidance on the development of manuals which had been produced by the International Association of Classification Societies (IACS).

1.4.5 Crane examination

Sand Falcon's gantry and crane trolley were inspected shortly after the accident, and the trolley was examined in more detail while it was being repaired.

The I-beam was found to be in good condition, but with some deterioration of the paint from the effects of corrosion. The lower flange was the correct width throughout **(Figure 5)**, and a plate was fitted to prevent the trolley from running off the end of the beam.

Figure 5

Gantry I-beam

ACTA calculated that the trolley weighed about 416 kg. It was corroded but was not deformed and, specifically, the chassis plates holding the wheels in position had not been splayed apart. The trolley wheels were severely corroded **(Figure 6)**. The wheel bearing covers were missing and a combination of corrosion and the products of the dredging processes had built up in the bearing races so that the wheels would not turn. Flat spots had been worn on the wheels where they had been dragged across the I-beam **(Figure 7)**.

The distance between the flanges of the wheels on opposite sides of the trolley was 300mm to suit the I-beam. The distance between the inner face of the wheel and the chassis plate on the opposite side of the trolley was also 300mm **(Figures 8a & 8b)**.

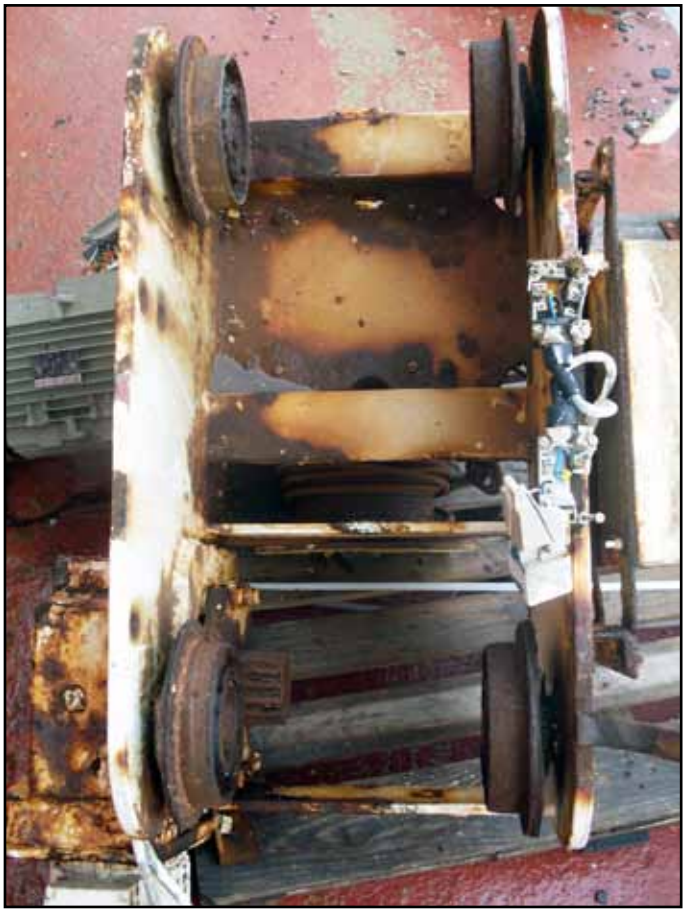
The casing of the lifting motor had been cracked and the electrical cabinet damaged during the trolley's impact with the guardrail. The lifting wire, block and sheave assembly were greased and in good condition.

1.4.6 'H' class vessels

Sand Falcon and *Sand Fulmar* incorporated the same design features as the smaller 'H' class vessels; however some of the equipment fitted on deck was different. In particular, 'H' class vessels had a substantial platform around part of the cargo handling equipment. The platform was inside the arc of the stores crane and, by coincidence, could also be used to gain access to the stores crane for maintenance **(Figure 9)**. The extra length of the 'F' class vessels meant that the platforms around the cargo equipment were in different positions. One of these platforms was nearby, but it was too low to be useful for close inspection or work on the stores crane **(Figure 10)**. The significance of this change and its consequent effect on access to the stores cranes on the 'F' class vessels had been identified, but no modifications to improve access had been made before the accident.

Following the accident on *Sand Falcon,* an inspection of the stores crane on *Sand Heron* found it to be in a generally similar condition. The trolley wheels were corroded, but the bearing covers were still in position and the wheels were free to turn. With the trolley in its normal position on the beam, it was seen that the pinion to drive the traversing function was only just meshed with the rack **(Figure 11)**. The meshing clearances had increased as the wheels became worn in the harsh operating conditions. A sliding adjustment on the trolleys fitted to all four vessels allowed the mesh of the rack and pinion to be corrected as required. Not part of the original ACTA design, but fitted to *Sand Heron*'s trolley, were angle brackets attached to the chassis side plates to provide a means of preventing the trolley from falling if the wheels failed.

Figure 6



Gantry-trolley chassis and wheels

Figure 7

Flat spots worn on wheels

Figure 8a

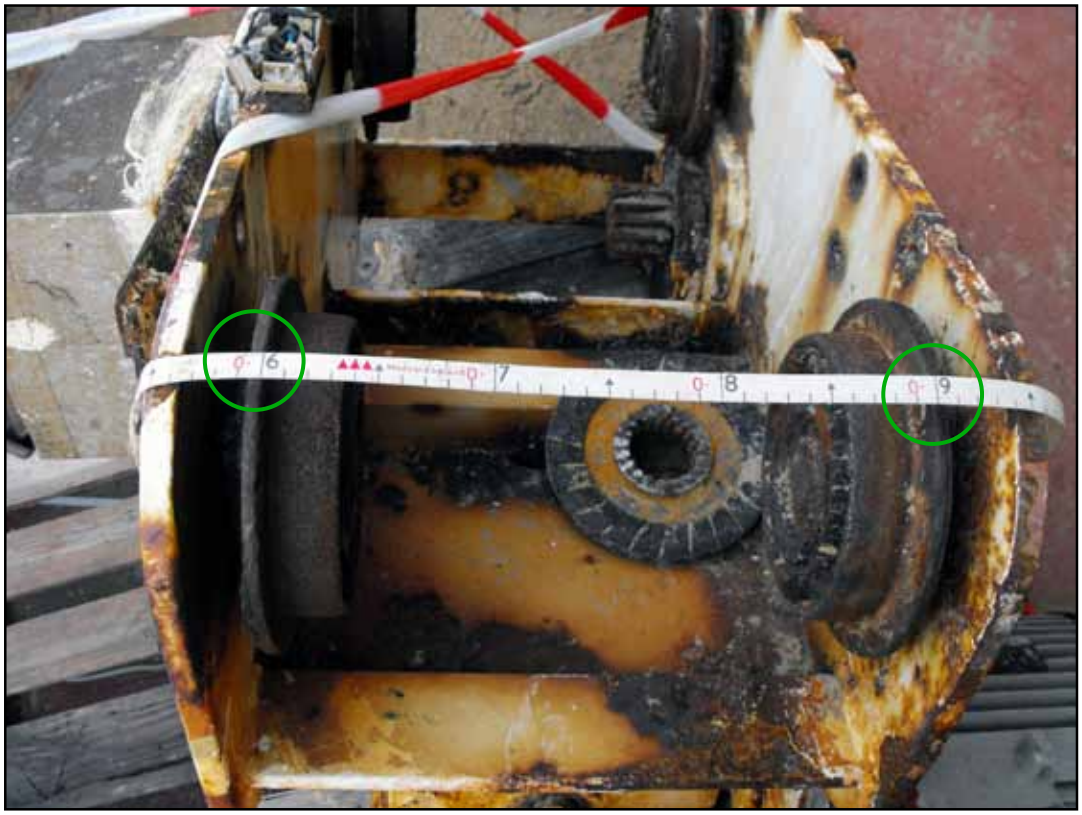
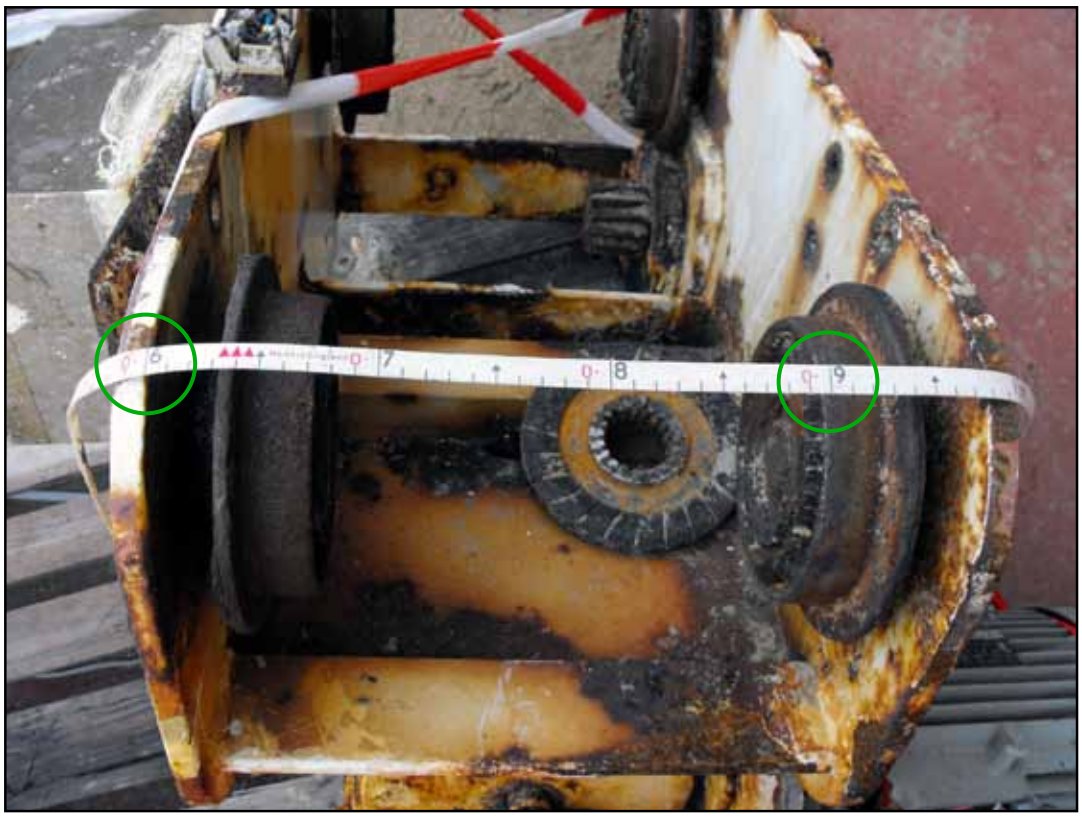
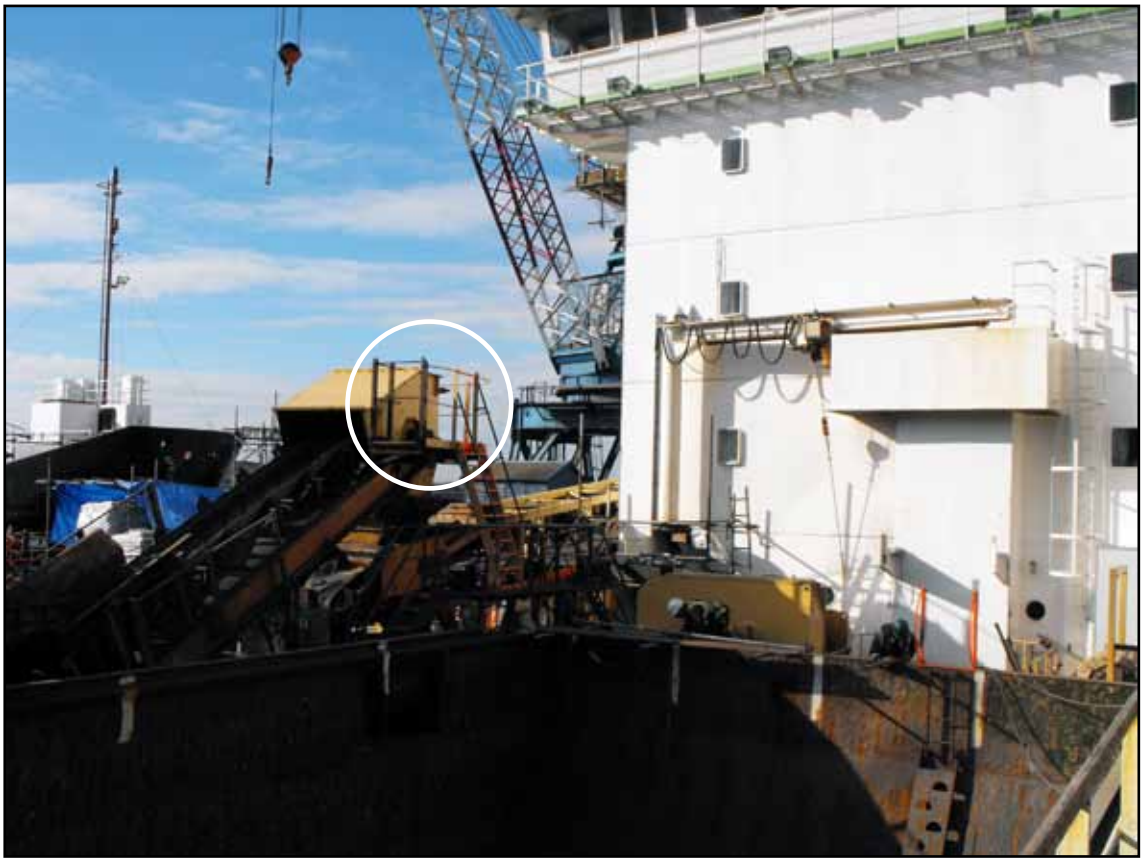


Figure 8b



Distance between trolley wheels and chassis side plates

Figure 9



Access arrangements on *Sand Heron* (‘H’ class)

Figure 10

Access arrangements on *Sand Falcon* (‘F’ class)

Figure 11

Traversing rack and pinion mesh (*Sand Heron*)

1.5 REGULATIONS FOR LIFTING EQUIPMENT

A number of international and national regulations derived from European directives apply to lifting equipment in the UK. Some of these regulations apply to lifting equipment fitted on ships.

1.5.1 International

The International Labour Organization (ILO) adopted the Occupational Safety and Health (Dock Work) Convention in 1979, known by its sequential number 'ILO 152'. Entering into force in 1981, ILO 152 applied to *"…all and any part of the work of loading or unloading a ship…"*. Embodied into UK Merchant Shipping legislation and widely referred to by classification societies in their optional notations, the most relevant aspects of ILO 152 are Articles 21 to 25. These are summarised as:

- Equipment used for lifting operations is to be of good design and construction, of adequate strength, properly installed and maintained.
- Lifting appliances are to be tested and thoroughly examined by a competent person before being put into use, after any substantial alteration or repair and, thereafter, every 5 years.

- Lifting appliances are to be thoroughly examined and certified by a competent person every 12 months.
- Lifting appliances are to be inspected regularly before use.
- Records of tests and inspections are to be kept in a lifting gear register to provide evidence of the safe condition of lifting appliances.

Although widely accepted as the principal international requirement for lifting equipment in the shipping industry, ILO 152 was intended to protect shore-based dock workers, and it only applies to cargo handling equipment.

1.5.2 European

The European Union (EU) has issued a number of directives setting minimum health and safety standards for workers, and latterly has included requirements for work equipment. The most relevant of these directives, (89/391EEC, 89/655EEC and 95/63/EC[1]), have introduced obligations on employers to provide training and written instructions on work equipment and, specifically, equipment used for lifting loads. The annex to directive 89/655/EEC defines the minimum requirements associated with the use of work equipment, and includes the following key points:

- *2.5 Work equipment presenting risk due to falling objects must be fitted with appropriate safety devices corresponding to the risk.*
- *2.13 It must be possible to carry out maintenance operations when the equipment is shut down. If this is not possible, it must be possible to take appropriate protection measures.*
- *2.16 Workers must have safe means of access to, and be able to remain safely in, all the areas necessary for production, adjustment and maintenance operations.*

More recently, the supply of machinery directive (2006/42/EC) has updated the requirements on manufacturers to ensure that their products, when supplied, are safe. Similar in concept to the EU Marine Equipment Directive (MED) (96/98/EC), the supply of machinery directive applies to a much broader range of equipment and includes requirements: that machinery is designed and built to minimise hazards; that access is provided for maintenance; and instructions

[1] Measures to encourage improvement in the safety and health of workers at work (89/391/EEC)
Minimum safety and health requirements for the use of work equipment by workers at work (89/655/EEC)
Minimum safety and health requirements for the use of work equipment by workers at work (95/63/EC), containing amendments to 89/655/EC

for operation, maintenance and repair are supplied. Although the scope of the directive does not include seagoing vessels, it does include machinery mounted on '*means of transport by water*'. EU guidance on the application of the directive gives examples, such as floating cranes, drills, excavators and dredgers.

1.5.3 National

United Kingdom Merchant Shipping Regulations enact EU directives for the minimum health and safety standards for workers. Relevant to this accident are the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations (SI 2006:2184), known as LOLER, and the Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations (SI 2006:2183), known as PUWER. Both of these regulations place duties on the employer. Practical guidance on the implementation of these regulations is provided in the Maritime and Coastguard Agency's (MCA) Marine Guidance Notes (MGN) and Code of Safe Working Practices (COSWP).

The LOLER requirements are a progression from previous UK regulations and ILO 152, but with the same general intervals for testing and thorough examination. However, LOLER applies to all types of lifting equipment and includes more comprehensive definitions for thorough examination and inspection of lifting equipment. Significantly, LOLER requires employers to *'ensure that equipment that is exposed to conditions causing deterioration liable to result in dangerous situations, is thoroughly examined to ensure that any deterioration is detected and remedied'*.

Both LOLER and its accompanying guidance in MGN 332 make it clear that tests and thorough examinations should be done by '*competent persons possessing the knowledge or experience necessary to perform the duties under the regulations*'. The level of competence required by a 'competent person' is not defined in LOLER, but is related to the complexity of the task or equipment. MGN 332 refers to British Standard (BS) 7121, the code of practice for the safe use of cranes, which gives detailed information on what should be included in tests, thorough examinations and inspections.

MGN 332 and COSWP state that records of all lifting equipment are to be kept in a lifting gear register complying with the format given in ILO 152. However, ILO 152 only applies to cargo handling equipment, and the MCA is now planning to change this guidance to make it clear that only cargo handling equipment will need to be recorded using the ILO 152 format, provided that records of other lifting equipment are kept in accordance with LOLER.

PUWER legislation reproduces most of the wording of EU directive 89/665/EEC and requires employers to provide work equipment that is appropriate for the task and to maintain it in an efficient condition. However, section 2.16 in the annex to the EU directive, requiring safe access to machines for maintenance

purposes, has not been transposed into the UK's Merchant Shipping legislation for PUWER. The Merchant Shipping (Safe Movement on Board Ship) Regulations (SI 1998:1641) include the general requirement that, '*safe means of access is provided and maintained to any place on the ship to which a person may be expected to go*'. This could be interpreted as already meeting the aims of the EU Directive for access to machinery.

The supply of machinery directive (2006/42/EC) was enacted into UK legislation in SI 2008:1597. It is cited in the Merchant Shipping legislation for PUWER as one of several regulations that describe the '*essential requirements'* of work equipment. However, the lead authorities for implementation of the supply of machinery directive in the UK, the Department for Business, Innovation and Skills, the Health and Safety Executive (HSE) and the MCA have interpreted the directive to exclude cranes permanently mounted on ships, and the regulation is not included in the Merchant Shipping Act. The rationale for its exclusion is that ships' equipment is already adequately covered by international regulations. In contrast, cranes that are permanently mounted in buildings are included in the scope of the directive.

The stores crane on *Sand Falcon* was manufactured in the EU under the predecessor to the supply of machinery directive (2006/42/EC). However the manufacturer now complies with the current supply of machinery directive, and its senior staff regarded this as an important influence that changed their approach to producing maintenance manuals.

The Danish Maritime Administration publishes its national requirements for all lifting appliances on Danish registered ships in Technical Regulation 12 **(Annex A)**. Technical Regulation 12 shares many similarities with ILO 152 and LOLER, but it also includes the need for handbooks to be provided with lifting equipment, and that such handbooks must include detailed instructions for the inspection and maintenance of the equipment. ACTA did not comply with this regulation because *Sand Falcon* was not a Danish registered vessel.

1.5.4 Industrial associations

The most widely recognised body in the lifting equipment industry is the Lifting Equipment Engineers' Association (LEEA), whose members represent all sectors of the industry, including manufacturers and testing organisations.

In conjunction with the UK HSE, LEEA has developed comprehensive guidelines on the examination and testing of lifting equipment that are published in the Code of Practice for the Safe Use of Lifting Equipment (COPSULE). LEEA also provides formal training and accreditation schemes designed to give greater assurance about the abilities of the 'competent' person.

1.6 SAFETY MANAGEMENT SYSTEM

1.6.1 Application

The International Safety Management[2] (ISM) Code requires ship operators to have plans for shipboard operations and systems for the planned maintenance of equipment. The code applied to *Sand Falcon* from 1 July 2002.

1.6.2 Lifting operations

Some months before the accident, CEMEX had begun a process of integrating all its management systems into a single computer-based system. The existing paper based Safety Management System (SMS) did not contain instructions for lifting operations using the stores crane. Generic risk assessments had been prepared and these included a control measure which required lifting equipment to be inspected and certified as being safe to use. In December 2009, a month before the accident, company managers issued a detailed circular covering lifting equipment, lifting operations and hiring of shore-based cranes. This described the relevant legislation and the MCA's guidance in MGN 331, MGN 332 and COSWP. The company also introduced procedures for training its crane operators and identified those inspections the crew were authorised to carry out. However, there was no record that the bosun on *Sand Falcon,* who was operating the crane at the time of the accident, had received the training required to operate the equipment. The circular also noted that the MCA required that the lifting gear register and associated records were to be maintained in ILO 152 format. Although the circular had been received on board *Sand Falcon*, the crew were not fully aware of its content or significance at the time of the accident.

1.6.3 Planned maintenance system

To comply with the ISM Code, CEMEX had instructed the crews of each of its vessels to develop, independently, a paper-based Planned Maintenance System (PMS). These had recently been converted to a computerised system.

In the absence of any information from the manufacturer, the crew developed a maintenance schedule for the stores crane. Maintenance work on *Sand Falcon*'s stores crane had been divided between the deck and engineering departments, and included the following tasks:

- Every 3 weeks – lubricate sheaves (deck department)
- Every 4 weeks - inspection and lubrication (deck department)
    - Including: check rack drive for damage; inspect wire, block and hook; test emergency stop
- Every 4 weeks – check gear box oil levels (engineering department)
- Every 26 weeks – test limit switches (engineering department)

[2] International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code, adopted November 1993)

- Every 52 weeks – examine lifting equipment, eg. shackles, wire strops and web slings (deck department)
- Every 5 years - load test (deck department).

There was nothing in *Sand Falcon*'s maintenance schedule to prompt the crew to arrange access to the trolley. No checks were required on the lifting wire attachments, the condition of the trolley, wheels and bearings, or meshing of the traversing pinion.

Sand Falcon's maintenance schedule was compared with the schedules on the sister ship and the two 'H' class vessels. All four schedules were different. *Sand Heron*'s schedule was the most detailed and included checks of all the controls and the traversing of the trolley. Despite the improved accessibility of the crane trolley on the 'H' class vessels, none of their maintenance schedules included the need to examine the lifting wire attachments, condition of the trolley, wheel bearings or check that the traversing pinion was properly meshed with its rack.

CEMEX had arranged for a sub-contractor (a member of LEEA) to conduct annual inspections of loose lifting equipment, fixed lifting pad eyes and lifting points. The sub-contractor used a system of colour coded tags to show which equipment had been tested. All loose gear was seen to be well organised on board, including a quarantine store for items damaged in use **(Figures 12a & 12b)**.

The lifting arrangement for the main dredge pipe had been identified by CEMEX as presenting a substantial hazard if any part failed. Weekly inspections were conducted, during which the complete length of the lifting wire was checked for damage. The wire diameter was checked at intervals to warn of elongation, and the whole wire was replaced annually regardless of its condition.

Sand Falcon's PMS had been reviewed during the most recent internal and external ISM audits. The internal audit identified that a number of emergency stop controls needed to be added to the maintenance routines. The external audit report noted that the computerised PMS was being used well and that no maintenance items were outstanding.

1.6.4 Inspection and maintenance history

Sand Falcon's stores crane was last load tested on 19 November 2008 by Pier Rigging Ltd, which was a specialist rigging and splicing company, but not a member of LEEA or any other industry associations. Pier Rigging Ltd had been sub-contracted by A&P Shipcare Ltd at Chatham Docks as part of a larger repair contract. The test certificate issued by Pier Rigging Ltd stated that the stores crane had been tested and examined in accordance with LOLER and PUWER

Figure 12a

Figure 12b

Loose gear stowage and quarantine arrangements

and that a proof load of 2.5 tonnes had been successfully applied. Although the certificate stated that the crane had been '*thoroughly examined*,' no access equipment had been provided during the test and it is therefore unlikely that either the close-up evaluation of the trolley's condition or the more detailed examinations described in LOLER had been completed.

Early in January 2009, *Sand Falcon*'s chief mate sent a defect report to the vessel's managers requesting that a new lifting motor be provided and fitted to the stores crane. Company managers received a quotation for a replacement motor from ACTA, but neither the cost nor delivery forecast was acceptable. An alternative supplier was identified, and a motor with the same electrical characteristics, but with the added feature of an electromagnetic brake, was purchased. The electromagnetically braked motor was heavier, but was selected as the brake provided an extra safety barrier to prevent loads from being lowered uncontrollably. There was nothing in the manufacturer's manual to indicate that the extra weight, added by fitting the electromagnetic brake would adversely affect the crane's operating characteristics.

The lifting motor was fitted during the next scheduled repair period between 11 and 29 April 2009, when scaffolding could be erected to give proper access. The work specification was for replacement of the lifting motor only, and the condition of the trolley was not checked by contractors or noted by ship's staff. The crane was put back into use, but was not load tested or thoroughly examined.

Sand Falcon's PMS recorded that the annual examination of the vessel's lifting equipment was conducted on 24 October 2009. The description in the maintenance schedule of the work required for this examination only referred to portable equipment, and an annual inspection of the stores crane, as intended by the regulations, was not included.

Sand Falcon's crane was last checked 23 days before the accident on 6 January 2010, when the 4-weekly inspection was done. The maintenance schedule for this work specified that the rack drive for traversing the trolley should be checked; wire, block and hook inspected; and the emergency stop operated. There were no instructions to check any part of the trolley or the lifting wire attachments.

1.7 OTHER ACCIDENTS INVOLVING NON-CARGO HANDLING CRANES

1.7.1 Accidents reported to MAIB

Records of accidents reported to MAIB show a significant number of cases involving the failure of non-cargo handling cranes. Since 2001, 29 cases have been reported, of which the vast majority had the potential to cause fatal injuries. None of the accidents reported were fatal, although a total of 11 people were injured. By comparison, only six cases involving the failure of cargo handling cranes were reported to MAIB in the same period.

Year	Summary	Injuries
2001	Hydraulic lifting ram failed in way of a weld repair	None
2002	Fitter struck by a manual winding handle causing broken ribs during maintenance procedure	1
2003	Lifting wire parted after becoming trapped in a sheave	None
2003	Motor failed, allowing crane boom to fall. Two stevedores injured by falling wire	2
2003	Crewman riding on a gantry crane was crushed between the crane and ship's structure	1
2003	Gangway davit came away from mountings when a securing pin worked loose	None
2003	Lifting wire parted due to chafing damage	None
2004	Electrical fault caused loss of luffing control, leading to structural damage	None
2004	Crane operator injured his arm when it became trapped between the crane and ship's structure while slewing	1
2005	Lifting wire parted – found to be corroded and crushed in way of a bulldog clip	None
2005	Crane luffed uncontrollably due to mechanical control defect	None
2005	Lifting wire parted – overloaded	None
2006	Unexpected release of a 'riding turn' in the luffing wire caused the jib to lower rapidly, injuring a crewman on the head	1
2006	Lifting wire parted due to corrosion. Corroded area hidden by ball weight	None
2007	Lifting wire parted on a 1 tonne SWL stores crane while it was lifting 350kg. Wire found to be in poor condition due to lack of maintenance	None
2007	Crewman crushed by hydraulic crane when the controls were activated inadvertently. Crewman's leg subsequently amputated	1
2007	Crane lowered uncontrollably due to leak on hydraulic system	None
2007	Lifting wire parted – found to be in poor condition	1
2007	Crane jib collapsed – overloaded	None
2008	Bosun seriously injured when the provisions crane he was operating detached from its mountings and fell onto a stores barge secured alongside the vessel	1
2008	Hydraulic hose burst while the crane was in use	None
2008	Hydraulic hose burst while the crane was in use	None
2008	Hydraulic cylinder failed while in use, causing crane jib to fall	None
2008	Lifting wire parted – overloaded	None
2009	Error while using crane controls led to wrong function to be used, causing crane to be driven into ship's structure	None
2009	Structure deformed due to misuse	None
2009	Lifting wire parted – found to be in poor condition	None
2009	Lifting hook detached from wire – not fitted correctly	None
2009	Lifting wire parted while lowering a workboat with two crew on board. Both crew injured. Wire found to be in poor condition and not maintained	2
Total injured		**11**

Table 1 – Summary of accidents involving the failure of non-cargo cranes reported to MAIB since 2001

Table 2 summarises the main failure modes in the accidents involving non-cargo handling cranes.

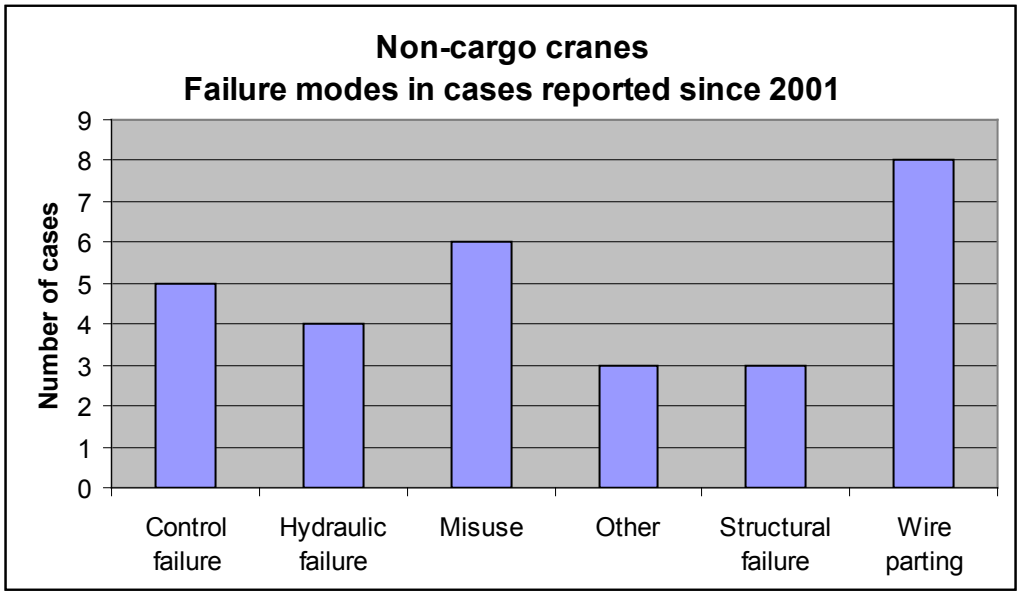


Table 2 – Summary of the failure modes of non-cargo cranes

MAIB conducted preliminary examinations into two of these cases where crew were seriously injured. The first, in 2008, on a non-EU registered vessel, involved the stores crane detaching from its mounting and falling onto a port services barge below. The second, in 2009, occurred when the lifting wire of a stores crane parted while it was being used to lower a workboat, causing the boat to fall into the sea and injuring the two occupants. In both cases, maintenance and inspection routines had missed out key components, which subsequently failed and contributed to the accidents. Similarly, the safety management systems on both vessels lacked procedures and risk assessments for lifting operations.

During the course of this investigation, MAIB inspectors have attended vessels following two more accidents involving cranes and lifting operations. The first of these, the collapse of the 'A' frame on the heavy lifting self-propelled sheerleg vessel '*Cormorant*'[3] has also been fully investigated. The other accident caused the death of one worker and serious injuries to another when a lifting cradle fell while loading wind turbine blades onto a barge. Responsibility for investigating this accident was passed to the HSE.

[3] MAIB report 15/2010 Report on the investigation of a lifting equipment failure on board the floating sheer-leg *Cormorant*, at 102 berth, Southampton on 7 March 2010

1.7.2 *Sand Fulmar*

Sand Fulmar's gantry crane suffered electrical problems and the trolley was removed in December 2009 during a dry docking and repair period. The ship repairers submitted a quote to refurbish the crane, but this was not taken up by CEMEX and the components were put aside for later repair. The trolley was examined by MAIB inspectors as refurbishment began in March 2010. It was in a very similar condition to the trolley which failed on *Sand Falcon*. It was corroded, the wheels were partially seized and would only turn a very small amount.

1.7.3 Initiatives from other organisations

The International Cargo Handling Co-ordination Association (ICHCA) has become increasingly concerned about the potential consequences resulting from the failure of non-cargo handling cranes on board ships. The case investigated by MAIB involving a stores crane falling onto a port services barge is an example that highlights the potential hazards to shore-based personnel. Because UK and other EU countries' domestic regulations are not applied to all seagoing vessels, and ILO 152, which is applicable worldwide, only includes cargo cranes, ICHCA is investigating proposals for international regulation to improve the standards of non-cargo handling cranes on all ships.

The International Group of Protection and Indemnity Clubs (IGP&I) has commenced a study into the methods used to examine the slewing rings of cargo handling cranes. This work has been prompted by several accidents, and aims to identify and share best practices among ship operators and crane manufacturers.

SECTION 2 - ANALYSIS

2.1 AIM

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.

2.2 FAILURE MODE

A combination of several factors led to *Sand Falcon'*s stores crane trolley falling from the gantry beam.

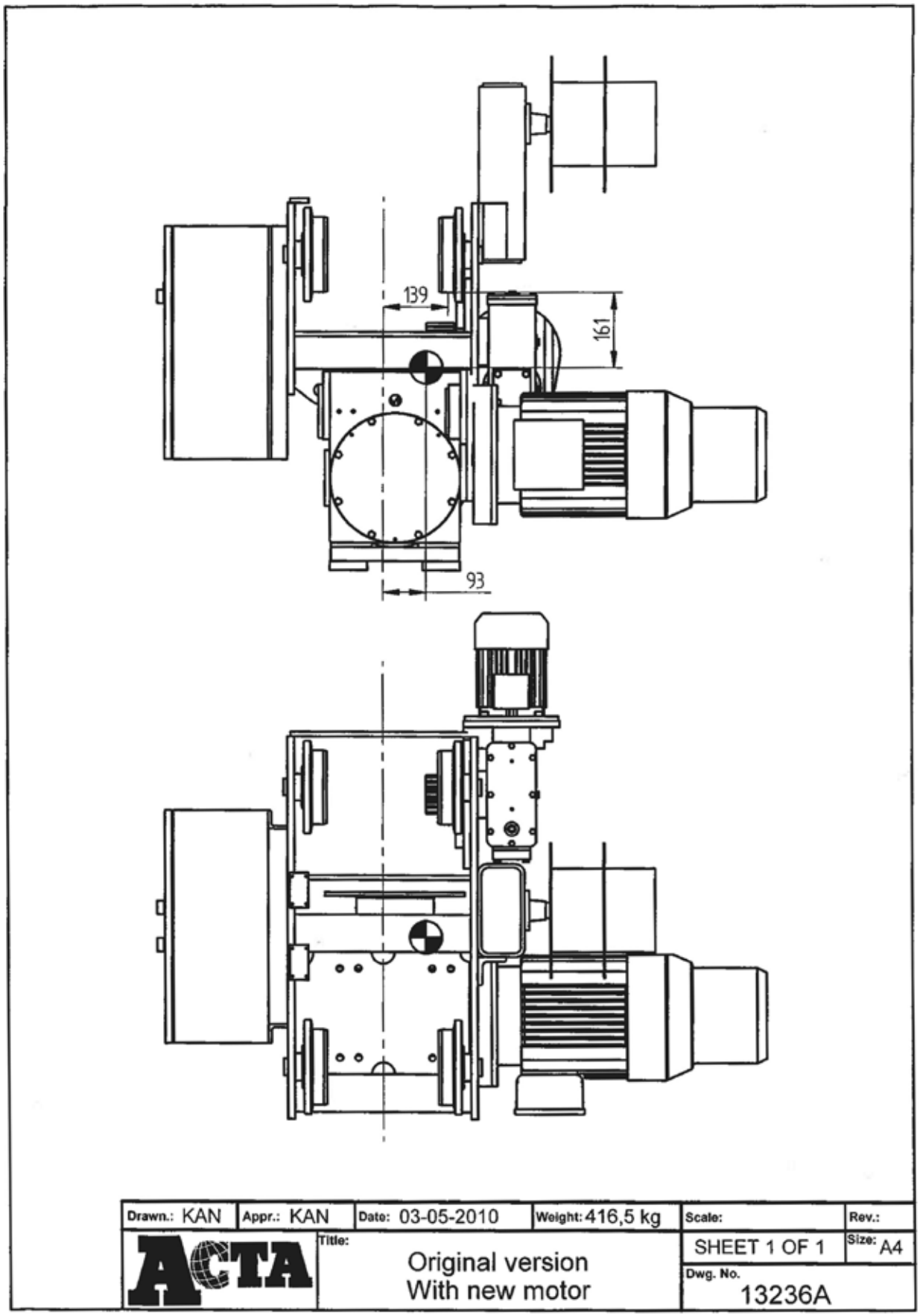
The crane trolley was, by design, not balanced unless it was carrying a load, and ACTA has calculated that the extra weight of the replacement lifting motor would have further offset the trolley's centre of gravity **(Figure 13)**. This meant that while the crane was not carrying any load, the wheels on the side furthest away from the motors would have been lightly loaded. These were the wheels that witnesses saw 'climbing' up onto the beam.

Railway accidents have shown that flanged wheels can climb onto rails (in this case the lower flange of the I-beam) if the weight pushing them into contact with the rail reduces and they are subject to a sideways force **(Figure 14)**. The trolley was known to traverse the gantry beam in jerky movements, and the crew thought this was its normal motion. However, it is more likely that the erratic motion was caused by the combined effect of the seized trolley wheels being dragged across the beam and the pinion driving at only one corner of the trolley. This offset drive would have set up twisting forces in the trolley, generating the sideways force needed for the more lightly loaded wheel flanges to climb on to the beam.

It is also possible that the flat spots that had been worn on the wheels might have caused the meshing clearances between the traversing rack and pinion to increase, as was evident on the similar, but older, crane fitted to *Sand Heron*. Had this been the case on *Sand Falcon*'s crane, the increased meshing distances could have led to the pinion slipping or striking the teeth of the rack, producing yet more uneven force on the trolley.

Once the wheels on one side of the trolley had climbed onto the lower flange of the I-beam, the dimensions of the trolley were such that the opposite wheels could drop off the other side of the beam **(Figure 15)**. Thereafter, with no other means of restraint, the trolley became detached from the beam and fell.

Figure 13



Effect of replacement motor on the gantry trolley's centre of gravity

Figure 14

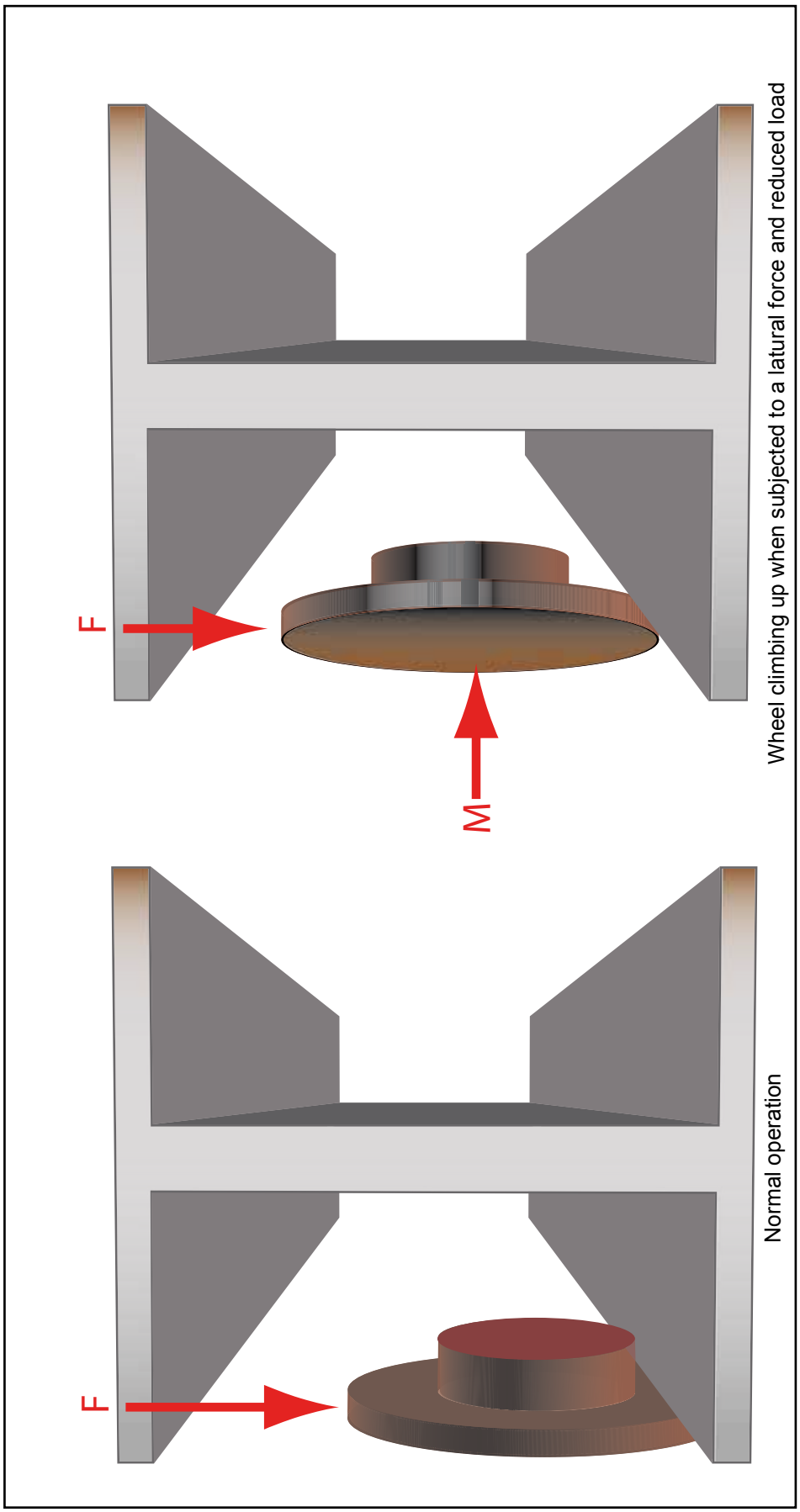
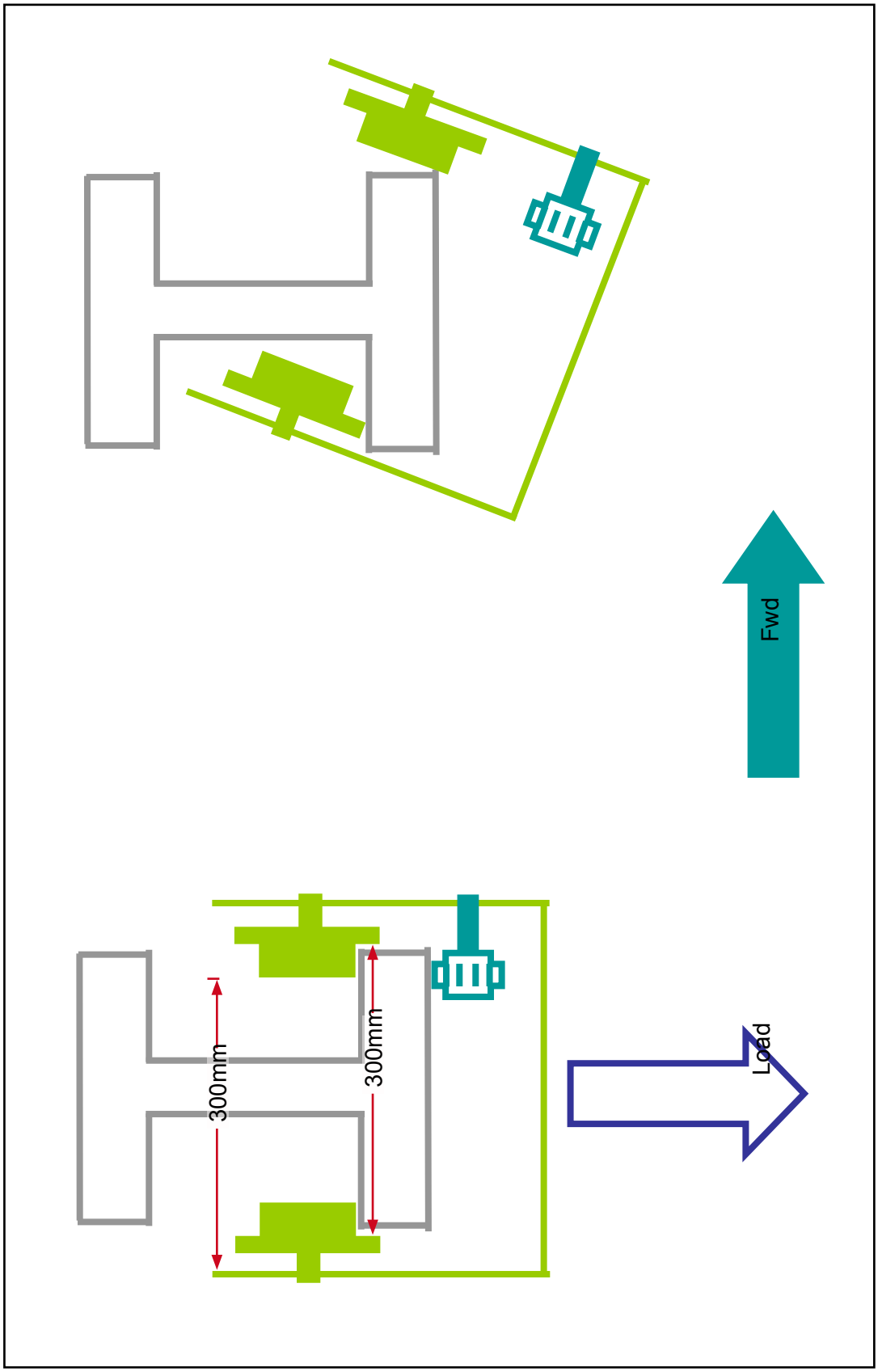

F
M
Wheel climbing up when subjected to a latural force and reduced load
F
Normal operation
Wheel derailment forces

Figure 15



Trolley detachment

2.3 DESIGN AND MANUFACTURE

The working environment on *Sand Falcon* was particularly harsh, and the crane had many features which made it vulnerable to corrosion and hard to inspect or maintain. Several aspects of the design contributed to the accident:

- The wheels were not intended for use in a marine environment and had seized.
- There was no method for cleaning or greasing the wheel bearings.
- The drive pinion to traverse the trolley caused the trolley to twist when in motion.
- The dimensions of the wheels, trolley chassis and I-beam meant that the trolley could fall off.
- The trolley relied on its own weight and the weight of a load to hold it onto the gantry beam. There were no other mechanisms to positively hold it in place, or prevent it from falling if a component failed.
- The trolley was unbalanced when the crane was not carrying a load. The imbalance was exacerbated when the lifting motor was replaced by a heavier one with an electromagnetic brake attached.

The above issues had not been recognised by the manufacturer during the design and manufacturing processes. With only a proof load test required before the crane entered service, there was no formal assurance process to check that the equipment would be suitable for use in a marine environment. During design and manufacture, no means had been provided to prevent *Sand Falcon*'s trolley from falling (as required by PUWER: protection against specified hazards). Subsequently, despite *Sand Heron*'s trolley having been modified in-service to fit fall-prevention bars, similar measures had not been applied to the crane trolleys on the company's other vessels.

2.4 MANUFACTURER'S INSTRUCTIONS

At the time *Sand Falcon* was built, ACTA did not routinely provide any instructions for commissioning, maintenance, test or inspection of the stores cranes it supplied. UK legislation places the onus on employers to maintain lifting equipment, drawing on the advice of competent people. However, meeting this responsibility is made much more difficult when manufacturers have not provided adequate information on how the equipment operates and should be maintained.

There are no international or domestic regulatory requirements that specifically require manufacturers to provide instruction manuals for cranes on ships. The IMO has recognised the importance of instruction manuals in MSC.1/Circ. 1253. However, currently the only regulation that could be interpreted as requiring manuals to be held on board ships is the ISM Code, but the obligation lies with the vessel's owners and does not extend to a general requirement for manufacturers to supply such manuals.

The EU's MED and supply of machinery directive adopt a different approach. Both directives state the information that manufacturers must include in their instruction and maintenance manuals, and further guidance is available from IACS. Further, manuals must have been assessed as part of the type approval process for equipment covered by the MED. However, the MED requirements do not apply to shipboard cranes, and the UK does not apply the supply of machinery directive to ships despite citing it in the Merchant Shipping legislation for PUWER.

Unlike the MCA, the Danish Maritime Administration (enacting the same EU directives) specifically states in its national regulations for lifting equipment that maintenance manuals must be provided, and describes what information must be included. While this regulation still only applies to ship operators, it is a useful reference for ship operators to use when agreeing equipment specifications with manufacturers.

Sand Falcon's owners could have chosen the optional classification society notation for lifting equipment and had the cranes built, commissioned and maintained in class. While this might have provided greater assurance, classification societies only check maintenance manuals from manufacturers in special circumstances, and would have been unlikely to do so in this case.

Although ACTA does now provide manuals for its cranes, manufacturers of all marine equipment should be obliged to provide adequate instructions on the operation and maintenance of the equipment that they supply.

2.5 OWNERS' RESPONSIBILITIES

2.5.1 Building specification

The specification for the crane provided by the original owners of the vessel was very basic. It did not describe the full extent of the operating conditions, nor sufficiently stipulate the requirement for operating or maintenance manuals. No consideration was given as to how the crane would be inspected or maintained, nor what access might be needed to conduct inspections in situ. Equipment cannot be expected to function as desired unless all aspects of its operation and maintenance have been considered, and the necessary requirements to enable this have been properly specified.

2.5.2 Lifting operations

At the time of the accident, on board *Sand Falcon*:

- Control measures in the risk assessments could not be achieved due to difficulties in gaining access to test and examine the stores crane.
- The opportunity for crew to inspect the stores crane before use was extremely limited because of lack of access.
- The training and qualification of the crane operator was not in accordance with the company's instructions.

While these shortcomings might not have directly contributed to the accident, they illustrate the lack of priority given to the operation and maintenance of the stores crane. This was in direct contrast to the very comprehensive control measures that were applied to ensure the main dredge pipe and loose gear were fit for purpose. This contrast had not been discovered by either the internal or external ISM audits. If the control measures that were in place for the cargo handling gear on *Sand Falcon* had been equally applied to all lifting operations on board the vessel, it is likely that the condition of the vessel's stores crane would have been more closely monitored, and any defects and/or design weaknesses rectified.

2.5.3 Planned maintenance

The ISM code and national legislation for LOLER and PUWER make it clear that the ship owner or employer is responsible for maintaining lifting equipment. However, the manufacturer had not provided any guidance on the maintenance that needed to be carried out on the stores crane. On first inspection, CEMEX had developed a PMS which appeared to be sufficient, but it omitted any reference to maintenance of the trolley itself. This omission only became apparent when each of the stores crane's components was considered against the work specified in the maintenance schedule. The maintenance schedules on CEMEX's other dredgers were all different, yet none contained schedules for maintenance on the stores crane trolley (other than to check that it moved).

Despite the obvious physical presence of a trolley on each of the four dredgers' stores cranes, and trolley defects on both *Sand Falcon* and *Sand Fulmar*, none of the crew, managers and contractors carrying out tests and examinations of the cranes had identified that the trolleys were in a potentially dangerous condition. It is highly unlikely that the sampling processes used for either internal or external ISM audits would have detected a problem in the PMS at this level of detail. With no feedback from the crew carrying out the maintenance, a detailed technical audit of the PMS for lifting equipment would have been needed to identify that maintenance routines for the trolley were insufficient.

It was impractical for CEMEX's technical managers to compare maintenance schedules for equipment common to each of their fleet's vessels because of the limitations of the original paper based PMS. However, the transfer of its PMS from a manual to a computerised system has provided CEMEX with an opportunity to unify common maintenance schedules which it intends to take.

2.5.4 Replacement lifting motor

When the stores crane's lifting motor failed, crew and managers thought they had improved safety by purchasing a replacement with an electromagnetic brake. It is common practice to use alternative suppliers for generic equipment such as electric motors, and at face value the replacement would have seemed a sensible choice. There was nothing in the ACTA crane manual to highlight the significance of balancing the trolley, and the potential for introducing a new failure mode by fitting a heavier motor was not obvious or appreciated.

There was actually no need for the crane's lifting motor to have its own brake. The motor was connected to the lifting wire through a worm and wheel reduction gearbox that made it impossible for a load on the crane hook to make the motor freewheel. This feature could have been determined from the ACTA drawings held on *Sand Falcon*, but the manual was considered to be of limited value and it was not referred to.

2.5.5 Access

Sand Falcon did not have a means of access to allow maintenance or inspection work to be conducted on the gantry crane trolley. The trolley was a significant component that could only be reached by rigging scaffolding on board or by using an aerial work platform from ashore. Consequently there was little opportunity to inspect the trolley.

EU directive 89/655/EEC on the minimum health and safety standards for workers makes it clear that access must be provided for maintenance purposes. From this accident alone, it is difficult to measure the effect of this clause not being included in the Merchant Shipping legislation on PUWER, particularly as a similar requirement exists in the Merchant Shipping (Safe Movement on Board Ship) Regulations. *Sand Heron*'s stores crane did have suitable access yet its trolley was not included in the maintenance schedule either, and it was in a similar condition to the one on *Sand Falcon*. However, the section of the Safe Movement on Board Ship Regulations regarding access is so broad that it is unlikely to prompt operators to focus on a specific issue, such as access to cranes. It would be more logical to include the 'access for maintenance' clause from the EU directive with the other requirements for machinery in the PUWER regulations.

2.5.6 Application of LOLER

LOLER requires that equipment operating in a harsh environment should be thoroughly examined at least every 12 months. *Sand Falcon*'s schedule of 4-weekly PMS routines covered only part of this requirement, and the annual examination of lifting equipment was limited to portable equipment. The significance of the trolley was missed, and the requirement of LOLER for an annual thorough examination to detect and remedy any deterioration was not met.

A 5-yearly load test was carried out in November 2008, but the 'thorough examination' that followed was extremely limited. Because there was no access to the gantry beam or trolley, a number of defects, including problems with the trolley or even the condition of the welds attaching the crane to the vessel, would have gone unnoticed or unchecked. The November 2008 5-yearly test fell far short of the standards described in BS7121 and did not fully meet the requirements of LOLER.

The replacement of the lifting motor had the potential to '*affect the strength or stability of the equipment'* and could also be considered as a modification of the original design as defined in the LOLER requirements for the testing of lifting equipment[4]. Consequently, a load test and thorough examination should have been completed before the stores crane was put back into service.

There was no register of lifting equipment in the ILO 152 format on board *Sand Falcon* as required by the current guidance from the MCA[5]. However, the combination of the PMS records and test certificates provided the same function and met the requirements of LOLER for record keeping.

It was evident from other parts of the PMS, and particularly the routines for inspecting the main dredge wire and portable equipment, that managers and crew had made significant efforts to achieve the aims of LOLER in other areas. However there were gaps in the system, which contributed to both the poor condition of the stores crane and the failure to detect how much it had deteriorated. It was also clear that the most recent test and thorough examination conducted by the 'competent person' was not comprehensive. Employing contractors who meet a recognised industry standard, such as members of LEEA, or those who work to the specifications in BS7121 should provide greater quality assurance.

2.6 SIMILAR ACCIDENTS

The reports received by MAIB indicate a significant number of accidents and injuries occurring that involve the failure of non-cargo handling cranes.

Where MAIB conducted preliminary examinations and examined the accidents in more detail, common factors of weak inspection and maintenance regimes were evident. The accident on *Sand Falcon* also illustrates another aspect found in many cases; the lack of significance attached by crew and managers to the condition of equipment peripheral to the vessels' main function, such as stores cranes. On *Sand Falcon*, there was a considerable difference between the level of attention paid to the condition of the main dredging wire and the condition of the stores crane. Failure of either had the potential to cause serious or fatal injuries, but the loss of a dredging wire would have had a far greater impact on the operation of the vessel. A broken stores crane has much less operational impact on any ship and is more easily overlooked when compiling maintenance requirements and conducting inspections.

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[4] The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006 (SI 2184/2006) section 11 (1)(b) –Testing

> 11. — (1) The employer shall ensure that no lifting equipment, accessory for lifting or loose gear is used—
> (a) after manufacture or installation, or
> (b) after any repair or modification which is likely to alter the safe working load or affect the strength or stability of the equipment,
> without being first suitably tested by a competent person.

[5] The MCA intends to clarify its guidance so that only records of cargo handling equipment need to be kept in the ILO 152 format.

Almost all the accidents that were reported had the potential to cause fatal injuries. Other organisations have similar concerns; both ICHCA and IGP&I have identified similar trends in accident rates involving both cargo and non-cargo handling cranes. Greater emphasis is needed throughout the shipping industry on the manufacture, maintenance and inspection of lifting equipment, and particularly more minor equipment, to prevent what will otherwise be an inevitable fatality.

2.7 EFFECTIVENESS OF REGULATIONS FOR NON-CARGO CRANES

This and the other accidents investigated by MAIB show that while both the ISM Code and national legislation in EU countries are extensive, neither is being fully effective in ensuring the safety of lifting equipment. Specifically, these regulations apply to vessel owners and operators, and do not address the role that equipment manufacturers and shipbuilders have in ensuring that equipment is safe and fit for purpose. Consequently, poor design, limited access for maintenance, and weak instruction manuals are regularly found as contributory factors in accidents. Both the MED and the supply of machinery directive address this problem and, if applied, would provide templates for improving the quality of regulations for cranes and other deck equipment within the EU.

In contrast to most other aspects of ship construction and operation, there are no international regulations for non-cargo cranes. Regulations in the UK are confused by the overlap between ILO 152 and LOLER, and in the longer term, a single, harmonised international regulation that covered all lifting equipment on ships would be simpler to administer.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED

1. A combination of three factors, the unbalanced trolley, seized wheels and offset drive are considered to have caused the wheels on the after face of the I-beam to climb onto the lower flange. [2.2]

2. The design of the trolley was such that once the wheels had climbed onto the lower flange of the I-beam, the opposing wheels could come clear of the beam and allow the trolley to fall. [2.2]

3. There were a number of shortcomings with the design and construction of the crane which contributed to its failure. These were not detected either before the crane was put into use or during service. [2.3]

4. There was no secondary means to prevent the trolley from falling from the beam once the wheels had come off the lower flange. [2.3]

5. There is no regulatory requirement for crane manufacturers to provide instruction manuals, and none had been provided for the commissioning, maintenance, test or inspection of the stores crane. [2.4]

6. The building specification had only a basic requirement for instruction manuals, and there was no consideration in the design for how the crane would be inspected or maintained. [2.5.1]

7. A more uniformly robust approach to all lifting operations would have led to a greater likelihood of the stores crane's shortcomings and defects being corrected. [2.5.2]

8. The planned maintenance system did not include any detailed work on the crane trolley. This shortcoming had not been identified during any other maintenance work or during tests and inspections. [2.5.3]

9. Including an electromagnetic brake in the replacement lifting motor was an unnecessary addition that increased its weight and further upset the balance of the crane trolley. [2.5.4]

10. There was no permanent means of access to the crane, consequently there was little opportunity to inspect or maintain the crane trolley. [2.5.5]

11. Inspections, tests and thorough examinations of the crane under LOLER and PUWER did not detect the deterioration of the trolley in sufficient time to rectify it. [2.5.6]

12. Employing contractors who meet a recognised industry standard, such as members of LEEA, or those who work to the specifications in BS7121 should provide greater quality assurance that maintenance and inspections are being comprehensively conducted. [2.5.6]

13. Weak maintenance and inspection routines have been identified as common factors in a substantial number of accidents involving non-cargo cranes. [2.6]

14. The majority of the accidents involving non-cargo cranes that have been reported to MAIB had the potential to cause fatal injuries. Greater emphasis is needed on the manufacture, maintenance and inspection of lifting equipment to prevent what will otherwise be an inevitable fatality. [2.6]

15. Existing regulations for non-cargo cranes on ships place little responsibility on the manufacturer. Consequently poor design, limited access for maintenance and weak instruction manuals are regularly found as contributory factors in accidents.

16. In the longer term, a single harmonised international regulation that covered all lifting equipment on ships would be less confusing and simpler to administer. [2.7]

3.2 OTHER SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS

1. The clause in EU directive 89/655/EEC regarding ‘access for maintenance’ should be included in the UK’s PUWER legislation in order to prompt operators to consider the problem. [2.5.5]

SECTION 4 - ACTION TAKEN

4.1 ACTA

ACTA assisted the MAIB investigation by conducting a review of the trolley design and calculations on the effect of changing the lifting motor. The company has subsequently proposed modifications to:

- mitigate the effects of any off-centre loading **(Figures 16a, 16b & 16c)**
- provide secondary restraints to prevent the trolley from falling in the event of failure.

4.2 CEMEX UK MARINE LTD

Immediately after the accident, CEMEX issued safety bulletins to all vessels in its fleet explaining the circumstances of the accident and suspending use of the affected stores cranes. CEMEX engaged a specialist engineering contractor to overhaul the stores cranes on the 'H' class vessels and make modifications to:

- mitigate the effects of any off-centre loading
- add greasing points for the trolley wheel bearings
- fit better quality trolley wheels
- provide secondary restraints to prevent the trolley from falling in the event of failure
- provide access platforms for future maintenance and inspection work on the trolleys.

CEMEX has continued with its programme of amalgamating its SMS and PMS into a single computer based system, and has included improvements to:

- risk assessments for lifting operations
- work instructions and guidance for lifting operations
- records of lifting gear test and inspections in ILO 152 format
- PMS instructions to include maintenance on the trolley

The new system is expected to be completed by the end of 2010 and CEMEX has developed a training package involving staff sailing with each vessel to explain the system to crew and train them in its use.

CEMEX has also arranged a single support contract for the testing and thorough examination to BS7121 for all fixed and portable lifting equipment on all its vessels.

Figure 16a

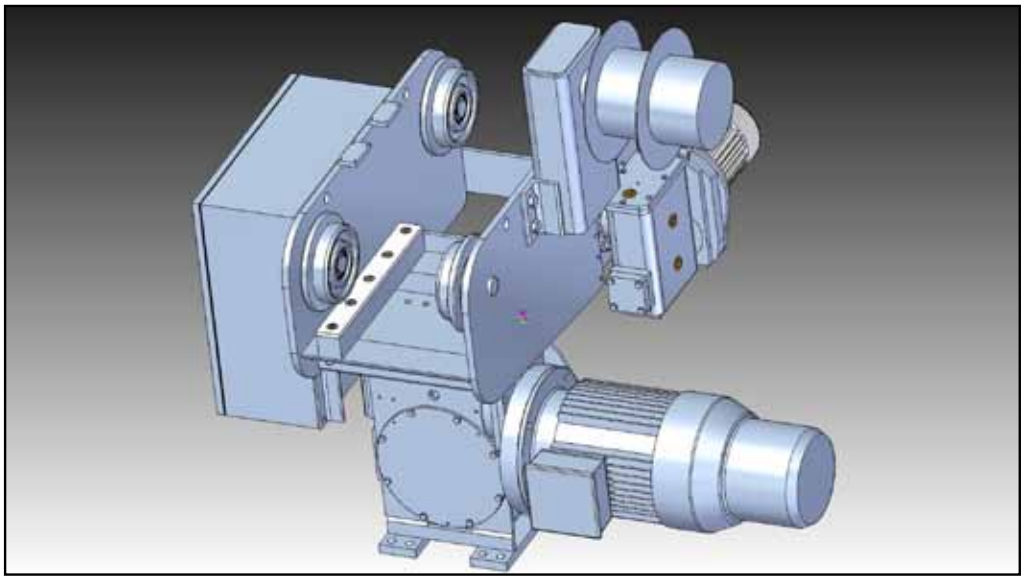


Figure 16b

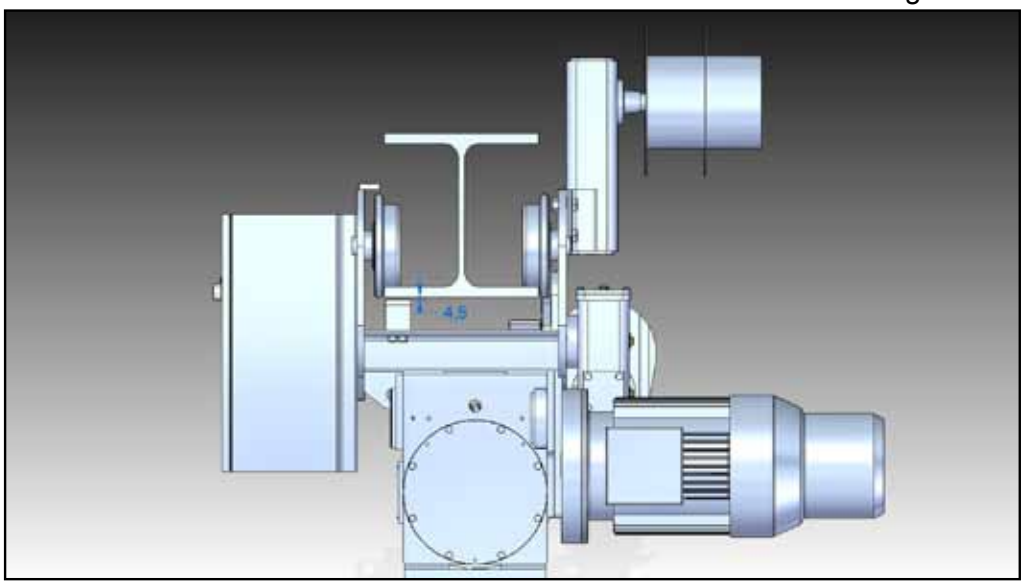
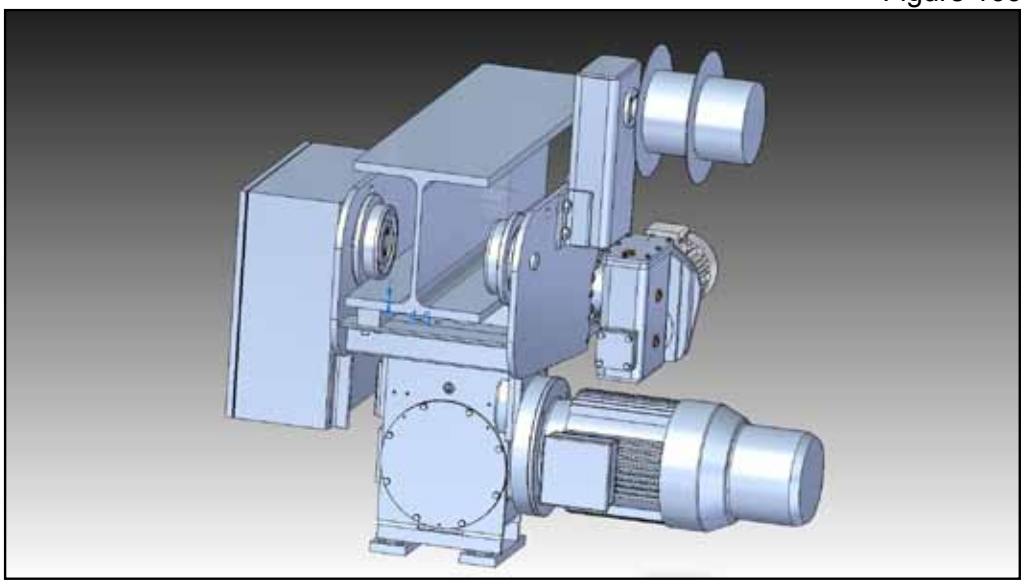


Figure 16c



Modifications proposed by ACTA

4.3 MARINE ACCIDENT INVESTIGATION BRANCH

MAIB has published a Safety Flyer **(Annex B)** on this subject to be widely distributed around the shipping industry.

The Chief Inspector of Marine Accidents has placed the issue of accidents involving non-cargo lifting appliances on the agenda for the next meeting of the Marine Accident Investigators' International Forum (MAIIF) in order to establish the incidence of similar accidents reported to other administrations, and to investigate the potential benefits of international regulation in this area.

SECTION 5 - RECOMMENDATIONS

In view of the actions taken by ACTA and CEMEX, no recommendations have been made.

Marine Accident Investigation Branch
November 2010