Report on the investigation of

the failure of a warp block

on board the UK registered fishing vessel

Ocean Star

north of the Shetland Islands

resulting in one fatality

on 26 November 2001

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Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

The fundamental purpose of investigating an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 1999 is to determine its circumstances and the causes with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

This report is not written with liability in mind and is not intended to be used in court for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in the future.

CONTENTS

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

CPR	-	Cardio-pulmonary resuscitation
HSE	-	Health and Safety Executive
m	-	metre
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MIN	-	Marine Information Note
mm	-	millimetre
MRSC	-	Maritime Rescue Sub-Centre
SFIA	-	Sea Fish Industry Authority
TWI	-	The Welding Institute
UTC	-	Universal time co-ordinated

SYNOPSIS

At about 1839 (UTC) on 26 November 2001, a fatal accident occurred on board the twin-rig trawler *Ocean Star*, while she was recovering her fishing gear. The coastguard at MRSC Shetland informed the MAIB of the accident at 2045 that day.

While fishing to the north of the Shetland Islands, the skipper received a coastguard weather forecast to the effect that the wind was due to increase to force 9. He decided to suspend fishing operations and heaved in the gear until there was 130m of warp still remaining.

In preparation for bringing the cod ends inboard with the gilson hook, a deckhand threw a heaving line up from the poop deck around the base of the gallows, and forward, to a second deckhand, who was on the top deck. The two deckhands were able to do this out of sight of each other. When the deckhand on the poop deck turned away, he heard a loud noise and thought that one of the main warp wires had parted. He looked up and saw that the starboard main warp block had broken and that the heaving line was trailing astern of the vessel. He retrieved the line and threw it back up to the other deckhand. The line was not caught. He called a warning to him and then to the skipper, that the block had come apart.

From the wheelhouse, the skipper saw the deckhand lying limp over the hand-rail on the top deck. The crew carried him into the wheelhouse, and started CPR. This was stopped when they realised the deckhand's ribs were broken. The skipper called the coastguard and informed them of the situation and told them the vessel would proceed to Lerwick.

Having described the symptoms, by radio, to a doctor at the Aberdeen Royal Infirmary, the skipper was told that the deckhand was dead.

An analysis of the block showed that it had failed under load because of progressive wear of a cheek plate caused by the outward movement of a bearing sleeve. A full inspection of this block by a registered body for the purpose of certifying it safe, might well have detected the use of thin sleeving and have caused the block to be withdrawn from service as a result.

Actions since, and intended to be, taken by the Maritime and Coastguard Agency (MCA) with regard to the testing, inspection and maintenance of hauling gear, will contribute to preventing similar accidents in future. Therefore, the MAIB has recommended that the intended regulations and guidance are implemented as soon as possible.

Photograph 1

Ocean Star

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *OCEAN STAR* AND ACCIDENT

Vessel details

Registered owner	:	Riverview Investments Limited
Port of registry	:	Peterhead
Flag	:	UK
Type	:	Stern twin-rig trawler
Built	:	1989 in Sweden
Construction	:	Steel
Length overall	:	26.72m
Registered Length	:	24.39m
Gross tonnage	:	231
Engine power	:	675kW

Accident details

Time and date	:	1839 (UTC) 26 November 2001
Location of accident	:	Latitude 61° 04’ N longitude 000° 55’ W, 12.5 miles north of Muckle Flugga, Shetland Islands
Persons on board	:	5
Injuries/fatalities	:	One fatality
Damage	:	Minor damage to vessel

1.2 BACKGROUND

The following is a general description of the operation which had already started at the time of the accident **(refer to diagram 1)**.

In preparation for bringing in the cod ends on deck, to land the catch on board using the gilson hook, one of the deckhands throws a heaving line from the poop deck, around the outboard side of the starboard gallows, and up to a second deckhand on the top deck, who stands in a position beneath the starboard main warp. The second deckhand catches the heaving line and makes it fast to the hand-rail. When the nets have been heaved in as far as the poop deck, the second deckhand takes both the gilson line and hook aft and connects the hook and heaving line together. The deckhands on the poop deck heave on the line to bring the gilson hook aft and then connect it to the beckets, which are close to the cod ends. The gilson line is heaved in by a winch on the fore deck, which pulls the cod ends along the starboard side and forward to the hopper on the fore deck. The cod ends are then heaved inboard so that the catch can be released into the hopper.

1.3 NARRATIVE

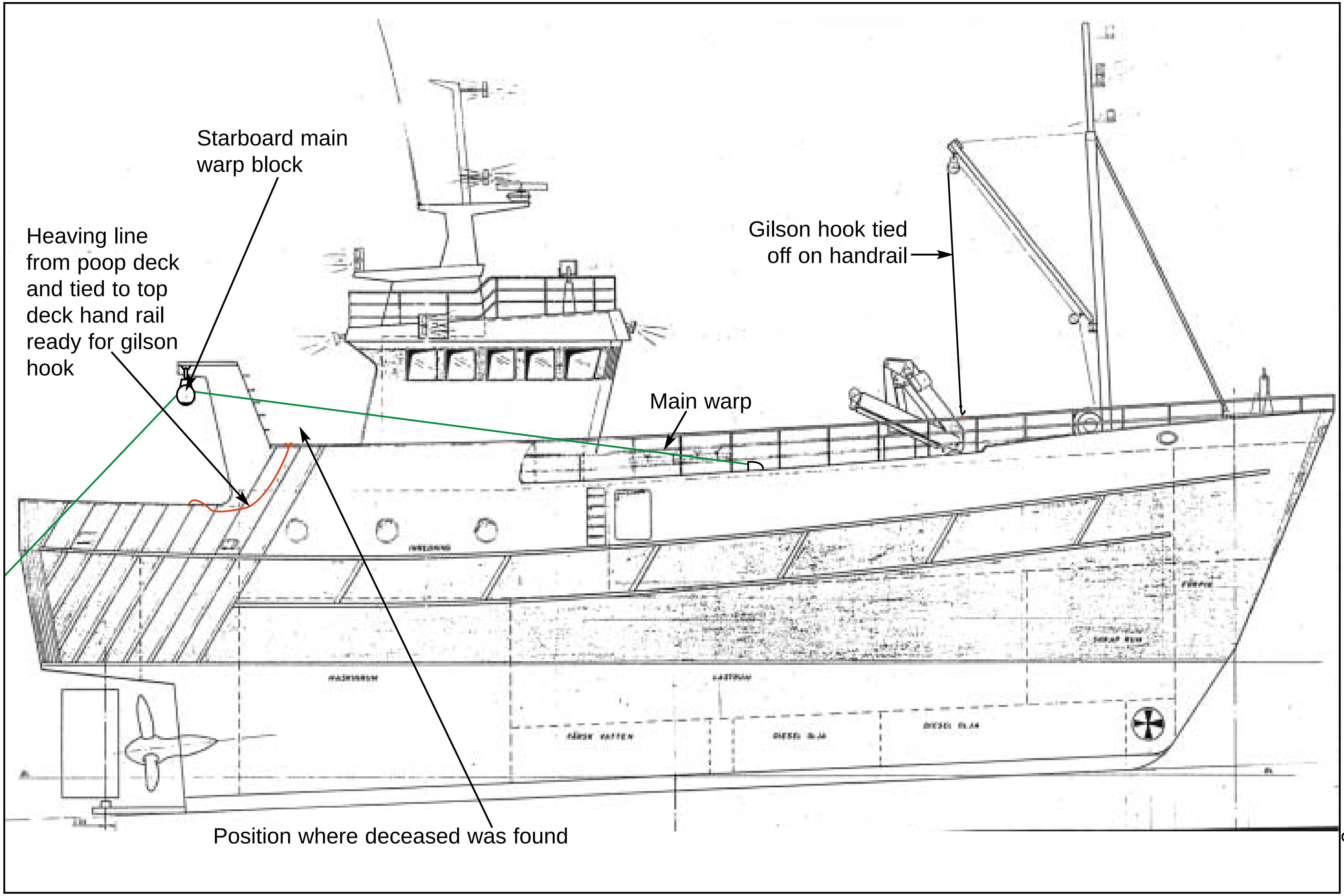
All times are UTC.

At about 0200 on 26 November 2001, *Ocean Star* left Cullivoe, where she had landed her catch. Later that morning she began fishing to the north of Muckle Flugga; the weather at this time was moderate.

During her second tow of the day, the skipper received a coastguard weather forecast, which included a severe gale warning for the area. He called Shetland coastguard for more details and was told that the wind was 35 knots in Lerwick, and was due to increase to force 9.

The skipper decided to call the crew on deck to heave in the fishing gear, and he gave them about 15 minutes to get ready. At about 1832, the skipper started the hydraulics for the winches and then heaved in the gear until there was 130m of warp still remaining, which was about equal to the depth of water.

A deckhand on the poop deck took the heaving line off the cleat and threw it up and around the base of the gallows to the second deckhand, without sighting him. As he turned away, he heard a loud noise and thought one of the main warp wires had parted. He looked up and saw that the starboard main warp block had broken **(see photograph 2)** and that the heaving line was trailing astern of the vessel. He retrieved the line and threw it back up to the other deckhand. The line was not caught. He called a warning to him and then to the skipper, that the block had come apart.


Starboard main warp block
Heaving line from poop deck and tied to top deck hand rail ready for gilson hook
Gilson hook tied off on handrail
Main warp
Position where deceased was found
Diagram 1

Photograph 2

A view of *Ocean Star* and of the broken starboard main warp block

From the wheelhouse, the skipper saw the deckhand lying limp over the hand-rail **(see photograph 3)**. He shouted for assistance from the rest of the crew, who arrived shortly afterwards.

With the block under load, the cheek plate and bearing support had collapsed. This collapse released the trawl wire from the block pulley, causing it to spring downwards, and to hit and injure the deckhand.

They carried the deckhand into the wheelhouse, where they placed him into the recovery position and checked for his pulse. They were unable to detect a pulse either on his wrist or his neck. They opened his clothing and checked for a heart beat and then started CPR. However, when he realised the deckhand's ribs were broken, the skipper immediately stopped administering CPR and placed him back into the recovery position.

The skipper called the coastguard and informed them of the situation and told them the vessel would proceed to Lerwick. Having described the symptoms, by radio, to a doctor at the Aberdeen Royal Infirmary, the skipper was told that the deckhand was dead.

The fishing gear was fully retrieved and the vessel sailed for Lerwick, where she arrived at 0430 the next morning.

1.4 ENVIRONMENTAL CONDITIONS

A deep Atlantic depression was moving north-east towards south-east Iceland, with associated fronts sweeping across the British Isles. At the time of the accident, Lerwick coastguard recorded winds of 35 knots from the south-south-west, with rough seas and moderate visibility.

Photograph 3

The skipper standing where the deceased was found

1.5 *OCEAN STAR*

1.5.1 The vessel

Ocean Star (ex *Harmony*; ex *Halland*), a twin-rig trawler, had a full shelter deck forward of her accommodation/wheelhouse superstructure with a refrigerated hold supplied by an ice-making machine. The winches for the three main warps (port, centre and starboard) were contained within the shelter deck. The warps for the port and starboard winch drums passed through openings in the top deck, about one quarter length from the wheelhouse front to the stem. From the opening, each of the warps led aft and passed through one of two blocks, which were hung from a mounting point from the outboard sides of the gallows, and then to the trawl board and sweep for its respective net.

In 1999, *Ocean Star* underwent a major refit, which included new engines, hydraulic and electrical systems, and auto-tensioning winches.

A local engineering firm refurbished **(see section 2.3)** the starboard main warp hanging block in February 2001. The firm's job description, viewed by the owner of the vessel as a routine procedure regarding worn fishing equipment, was:

> *To remove starboard hanging block. Strip, weld up grooves. Fit new bearings and seals. Repair side plates and stiffen up.*

This job was carried out by one of the engineering firm's workshop staff.

1.5.2 The crew

<u>The skipper</u>, William Geddes, was 41 years old and had been fishing since 1980 when he started as a deckhand on seine netters sailing out of Peterhead. After gaining the second hand certificate of competency in 1986, in partnership with his brother-in-law, he bought a fishing vessel and sailed as mate for about 2 years. They then started pair-trawling with another vessel and he sailed as skipper until 1997. In that year, he bought *Ocean Star* and had sailed on her as skipper ever since. In 1998 he gained the Deck Officer Certificate of Competency (Fishing Vessel) Class 2.

<u>The deceased</u>, Kenneth Ogilvie, was 58 years old and had been fishing for most of his life. He had been sailing on *Ocean Star* since February 2001. He had also sailed with the skipper on one of his other vessels for about 2 years.

<u>The deckhand</u>, Ian McLean, was 42 years old and had served on various types of fishing vessels sailing out of Peterhead for about 20 years. He had been with *Ocean Star* for nearly 2 years.

One of the other two deckhands was 52 year old Joseph Humphrey. He also served as an engineer in that he had a Deck Officer Certificate of Competency (Fishing Vessel) Class 1. The last deckhand was 36 years old and was a stand-in for a regular crew member.

1.6 POST ACCIDENT EXAMINATION OF THE BLOCK ASSEMBLY

The construction and assembly of the starboard main warp hanging block is shown in **diagram 2.**

The block had been attached to the mounting point underneath the after gantry by a hanger and a shackle **(see photograph 4)**.

This assembly was removed from the vessel and sent, via Fraserborough police, to The Test House (Cambridge) Ltd, where it was received on 25 February 2002.

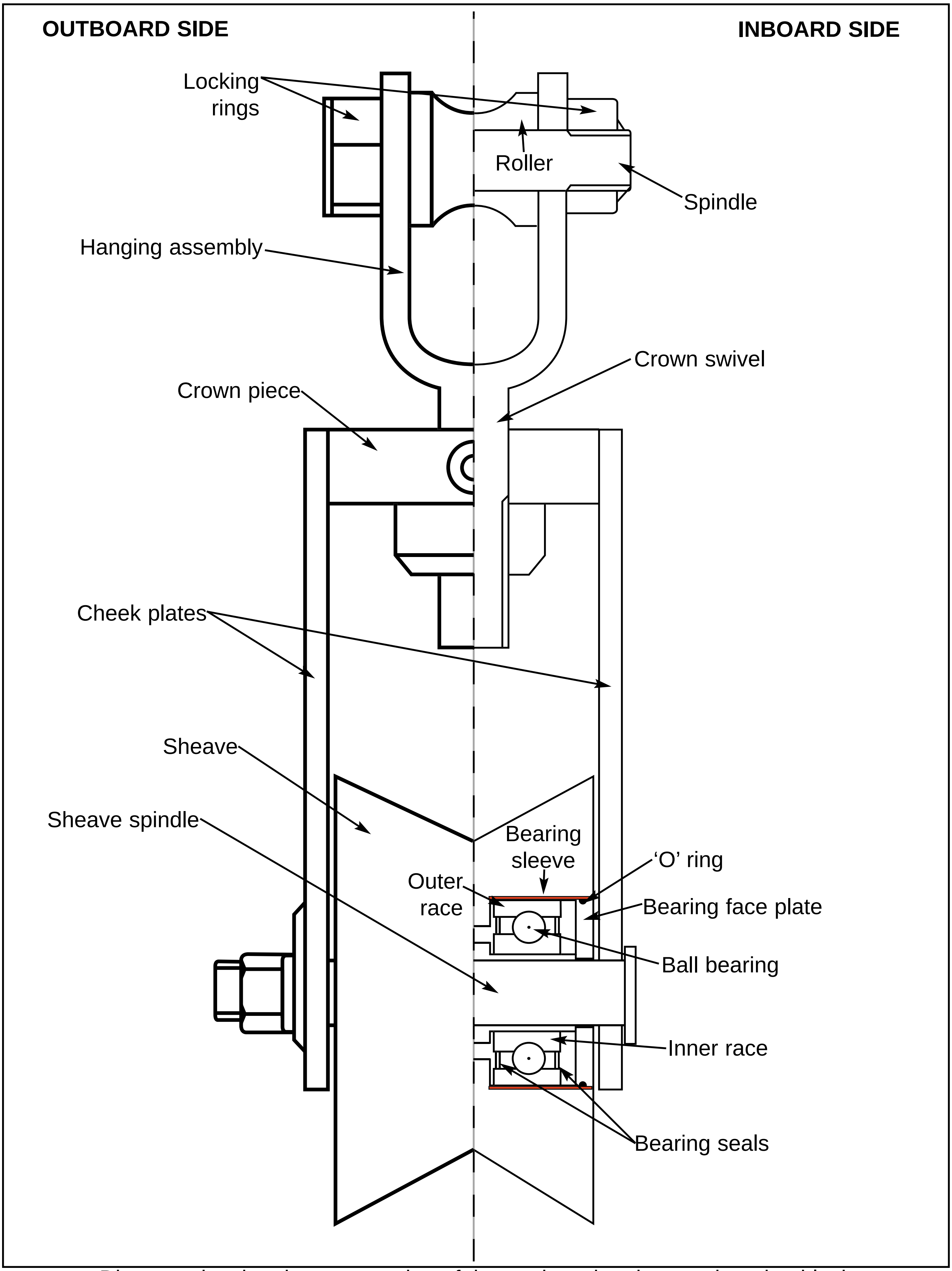
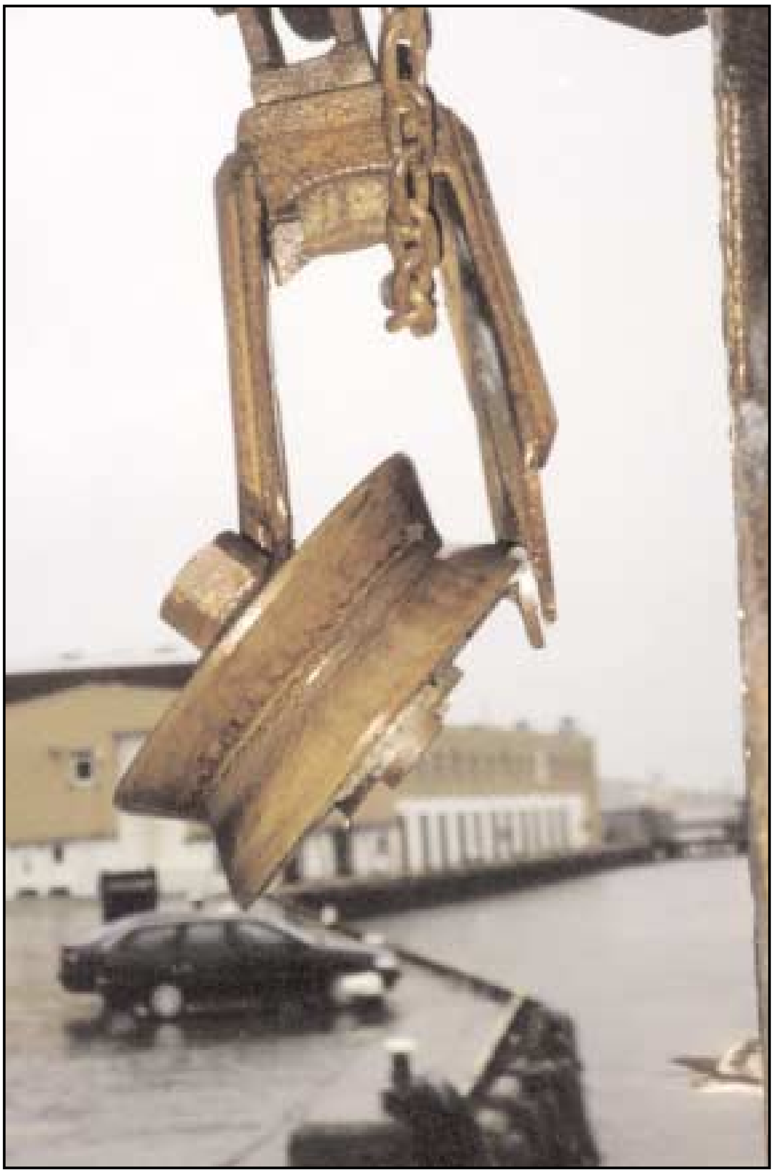


Diagram showing the construction of the starboard main warp hanging block
Note: Hanging bolt not shown

Photograph 4



The starboard main warp hanging block
in-situ onboard *Ocean Star*

The MAIB contracted The Test House (Cambridge) Ltd to disassemble, inspect and analyse the block. The company is a wholly owned subsidiary of The Welding Institute (TWI). It is accredited for mechanical, metallurgical, corrosion and non-destructive testing.

The objective of The Test House laboratory-based failure analysis was to identify the reason, or reasons, which had contributed to the failure of the block.

1.6.1 Visual examination of the block assembly

The block was disassembled at The Test House on 18 March 2002 in the presence of MAIB inspectors and other interested parties.

Diagram 2 shows the construction of the block. As can be seen, it consisted of the hanger assembly, crown, cheek plates, spindle, sheave, bearing face plates, sleeves, outboard and inboard side bearing assembly and outboard and inboard ball races. The cheek plates ranged in thickness between 12.3mm and 13.4mm, and both had been reinforced with half round bar stiffeners.

(Note: "outboard" and "inboard" refers to which side the block was hanging with respect to *Ocean Star*.)

The hanger assembly

This consisted of a hanger bolt, or "U" bolt, and a profiled steel sheave mounted on a steel spindle which had a grease nipple.

The sheave was sandwiched between two side plates and held captive by two outer locking rings on the spindle. The side plates had been welded to the upper part of the crown swivel, however, they had been cut off when the block was removed from its position on board *Ocean Star*.

Visual inspection showed that both the hanger bolt and the hanging shackle were severely worn. The locking rings of the hanging shackle had been welded in position, and the shackle roller was seized on to its spindle.

The hanger bolt was made from steel bar, which had been formed into a 180° bend **(see photograph 5)**. There was a wear zone on the inner bend which had been overlaid with a hard facing type of weld metal over a length of 65mm.

Immediately forward of this hard facing, the hanger bolt had suffered extensive rubbing wear which had reduced the bar diameter from 51.9mm to 31.4mm.

The block crown piece

The crown swivel **(see photograph 6**) consisted of an upper part, to which the hanger roller assembly was mounted. On the lower side of this, a spindle penetrated the crown piece and was secured by a nut, to form the swivel. The crown piece was equipped with a grease nipple to lubricate this swivel.

This assembly was seized.

The crown piece was marked with either HB19 or H819. No meaning for these markings was found.

The sheave block

The sheave block was made up of two cheek plates about 13mm thick, which had been reinforced with half round bar stiffeners welded to both plate edges.

The cheek plates were welded to the crown piece. The outboard side welds had both begun to tear as a result of the bending suffered by the outboard cheek plate during the failure of the block.

Photograph 5

The hanger bolt for the starboard main warp block in-situ onboard *Ocean Star*

Photograph 6

Crown swivel

The sheave was sandwiched between the cheek plates and held captive by the spindle. The spindle was fitted with a grease nipple.

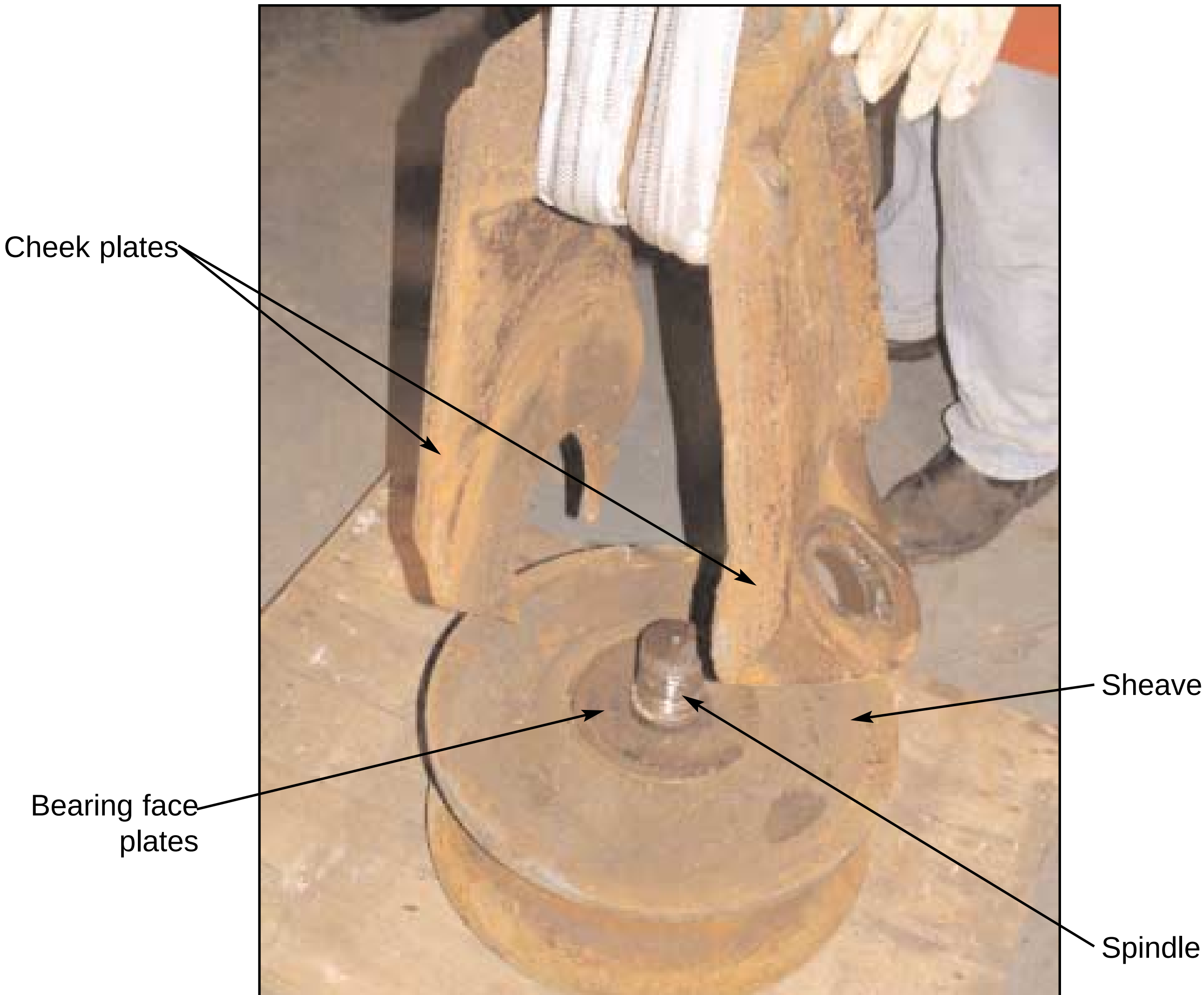
The sheave block had failed as a result of the inboard side cheek plate being severed by way of the sheave's central spindle bearing. This had led to outward bending of the outboard cheek plate, which allowed the warp to drop clear of the block.

The cheek plates showed wear, consistent with the warp running against them.

Photographs 7 and 8 show the severed cheek plate and the wear caused by the warp.

The sheave itself retained a reasonably sharp contact surface profile, and showed no signs of significant local rubbing wear.

Photograph 7



The cheek plates being removed from the roller

Photograph 8

A view of both cheek plates

1.6.2 Disassembly and analysis of the sheave block

The locking bar was cut off the outboard side cheek plate and the spindle nut removed.

The spindle was then knocked out of the block. The spindle showed evidence of fresh grease.

Once the sheave was clear of the cheek plates, it was evident that the inboard side cheek plate had been severed by the inboard side sheave bearing sleeve migrating out of the sheave and wearing through the cheek plate like a coring tool.

The outboard side cheek plate showed similar damage, again caused by outward migration of the bearing sleeve. The depth of the damage to this side varied between 2.0mm and 3.4mm.

Each side of the sheave was fitted with push-in steel face plates. Each of these had an “O” seal with the sheave. Once removed, these exposed polymeric bearing seals, and behind these there was one spherical bearing assembly on each side.

The inner and outer races of the inboard side bearing were found to be fractured.

The inner races of both bearings had been pressed on to a bush through which the spindle passed (**see photograph 9**).

The sheave had a central raised face, which had had one bearing fitted up to each side. The bearing sleeves had also been fitted up to this central face before they started migrating out of the sheave in service. The outward migration of these sleeves corresponded with the depth of damage done to each cheek plate.

Photograph 9

The outboard ball races removed from the roller

The bearing sleeves

The inboard side bearing sleeve protruded 15mm out of the sheave and was about 1.6mm thick **(see photograph 10 and diagram 3)**.

Subsequent detailed analysis of these sleeves showed that they were manufactured from a medium carbon steel which had been through hardened before fitting in the sheave. Although of the same grade of steel, the two sleeves were from different parent steel casts and the outboard side sleeve was significantly softer than the inboard one. The chemical analysis of the steels is shown in **Appendix 1**.

Photograph 10

A view of the roller, showing the extent of the outward movement of the steel sleeve from the bearing housing

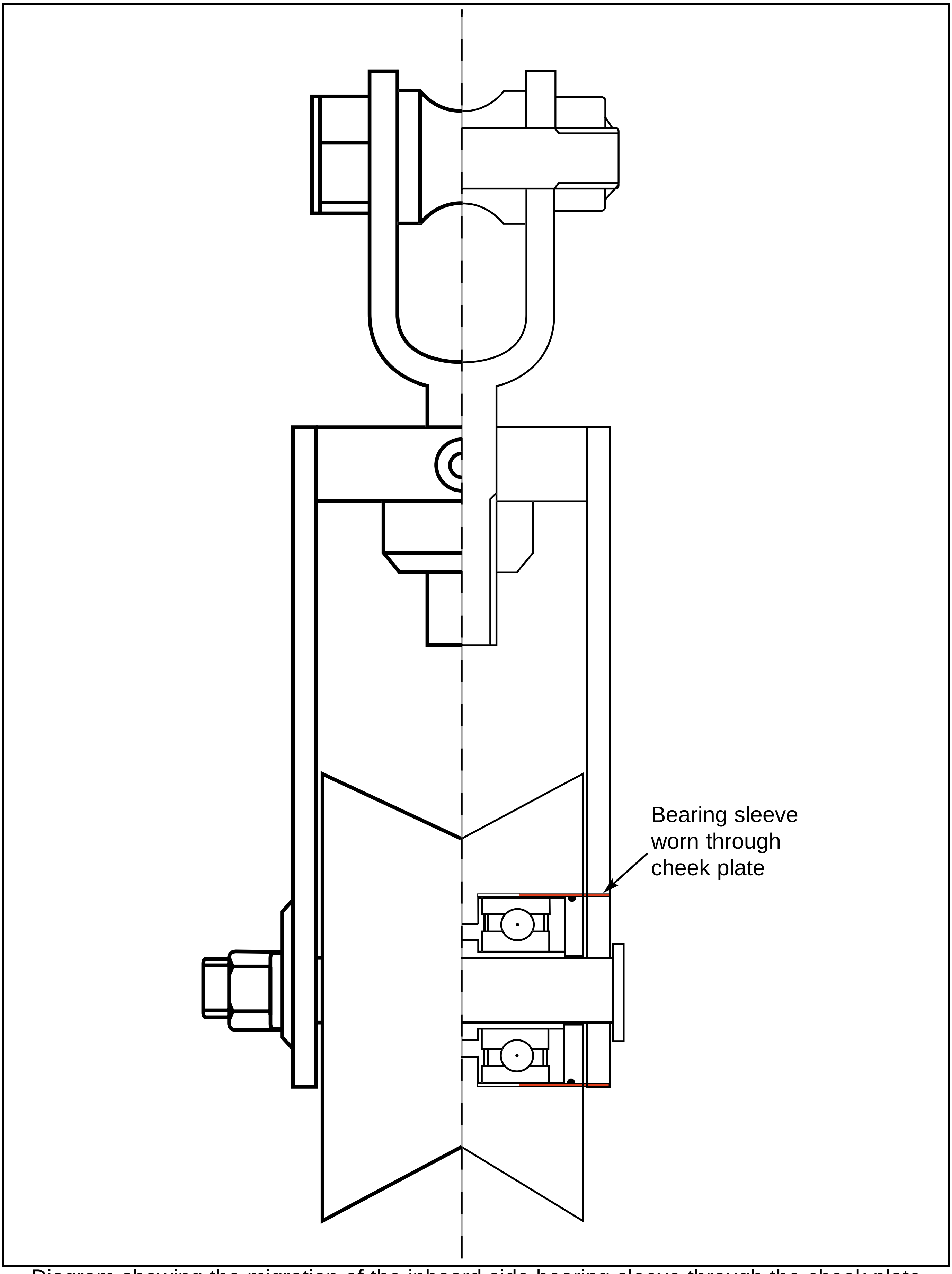


Diagram showing the migration of the inboard side bearing sleeve through the cheek plate

The bearings

Both bearing assemblies consisted of an outer cover plate sealed with an "O" ring, an outer and an inner polymeric seal, and cage retained ball bearings held between an inner and outer ball race. The bearings were marked on the outer race as follows "6315 2RS1/C3 FRANCE 07 028W".

The "6315" marking is a standard code which identifies the bearing as a single row of deep groove ball bearings of inner diameter 75mm, outer diameter 160mm, width 37mm.

The "2RS1" code identifies them as being grease-filled and sealed for life with nitrile rubber seals. This makes these bearings impossible to grease in service.

The "C3" denotes the tolerances to which the bearings were built. The rest of the markings are thought to be specific to the manufacturer.

The outboard side bearing was free running and operable. The ball bearings appeared slightly rusted, but had suffered no loss of shape or spalling[1]. The inner and outer races were also slightly rusted, but found to be crack free.

The ball bearings of the inboard side bearing were found to be in a similar condition to those of the outboard side. However, the inner and outer races of this bearing had suffered multiple fractures. Subsequent analysis showed that these fractures were of some considerable age and caused by rolling contact fatigue cracking **(see photographs 11 and 12)**.

1.7 SUMMARY OF THE CONCLUSIONS REACHED BY THE TEST HOUSE

1.7.1 Main conclusions

The Test House reached the following conclusions regarding the failure of the block assembly as a result of its laboratory-based failure analysis:

- The block failed as a result of the inboard bearing sleeve moving outward from the bearing housing and progressively wearing through the inboard cheek plate.
- The method of block sleeving represented the most contributory cause of the block failure.
- The use of thin unsecured sleeves, which had been press-fitted into the bearing housing, appeared to represent a refurbishment operation rather than an original design and construction feature.
- The relatively high hardness of the sleeves and their thinness allowed them to cut into the cheek plates like coring tools, when under load.

[1] The cracking and flaking of metal particles from a surface

Photograph 11

Closer view of inboard side of roller showing
fractures to inner and outer ball races

Photograph 12

The inboard inner and outer ball races removed from the roller

- The use of thin unsecured sleeves in the block's bearing housings appeared ill conceived and may have contributed to poor load distribution across the outer ball race faces.

- The outboard cheek plate was being worn through by the outboard bearing sleeve. This would have failed in time.

- Operational maintenance of the block had been providing grease to the bearing assemblies before the accident. This suggests that a maintenance system was in place on the vessel.

- The inner and outer ball races on the inboard side bearing had collapsed as a result of extensive radial and circumferential fatigue cracking. The apparent wear pattern at the rolling surfaces of the bearing suggested that high axial loading was not a significant contributory cause of the failure.

- The failure of the inboard side bearing may have initiated the sleeve migration or the sleeve migration may have led to the bearing failure. However the similar migration of the outboard side sleeve suggests that bearing failure was not a prerequisite to sleeve migration.

- It is most probable that the failure of the block had occurred progressively over a period of time extending beyond the vessel's last trip.

- It would not have been expected that the vessel's crew would have the necessary expertise or experience to recognise that the block was in a state of incipient failure immediately before the accident.

1.7.2 Other issues

A number of construction and maintenance issues were identified by The Test House during its investigation. These included:

- The welding on the top shackle pin, both original and retrospective, was not completed via suitably engineered and qualified procedures. This led to unsafe hardness levels in the heat affected zone of these welds.

- The hard facing welds to the shackle hanger resulted in accelerated wear of the non hard faced shackle in contact with it.

- The insufficient coverage of hard facing on the hanger also led to extreme wear beyond the area that was hard faced.

1.8 REQUIREMENTS AND GUIDANCE FOR TRAWLING EQUIPMENT

There is one reference to winches, tackles and lifting gear in *The Fishing Vessels (Safety Provisions) Rules 1975*, *Rule 54,* which states:

> *Every vessel of 12m in length and over to which these Rules apply shall be provided with winches, tackles and lifting gear properly installed having regard to the intended service of the vessel.*

Additions to Rule 54 were made in 1998 for vessels of 15m length or over:

> *(1) All equipment used in hoisting shall be tested and examined at regular intervals.*
>
> *(2) All parts of hauling gear, hoisting gear and related equipment shall be maintained in good repair and working order.*

Just before the accident, Merchant Shipping Notice M1657*, Hazards Associated with Trawling and use of Lifting Equipment* was superseded by the MCA's MGN 181 (F), *Fishing Vessels: The Hazards Associated with Trawling, Including Beam Trawling and Scallop Dredging.* M1657 included references to the maintenance of lifting gear, and MGN 181(F) gave only general advice on safety matters related to the operation of fishing vessels. There was no specific advice relating to blocks and hauling equipment in either of them.

The MCA's MIN 83 (M+F), *Lifting Equipment: Risk of Accident from Improper Repairs and Lack of Maintenance of Cargo or Pulley Blocks*, which expired on 31 October 2001, gave the following advice:

> *Lifting plant and all parts of hauling gear, hoisting gear and related equipment should be kept in good, efficient working order and should be subject to careful visual checks at regular intervals. The deterioration of equipment through general wear and tear, erosion of bearing surfaces, damage, corrosion or other similar effects would be apparent from periodical close visual inspections. The presence of undocumented repairs could be detected at this time. Worn, damaged or corroded equipment, equipment with undocumented repairs or block swivel eyes showing evidence of weld seal repairs from original manufacture, should be removed from service and either replaced or repaired, tested and examined by a specialist test house ashore.*
>
> *A block should not be supplied or accepted for service on board without a valid test certificate.*

The following tips on general visual checks and maintenance are also offered:

- *Check that the swivel head is free to rotate, at the same time ensuring that there is not too much slackness or lateral movement.*

- *Examine the side plates for distortion or buckling. This may allow the wire to jam between the plates and the sheaves.*

- *The sheaves should be free to turn when rotated by hand.*

- *Examine sheaves for cracks.*

- *Examine the sheaves for bush or bearing wear.*

- *Check eyes, pins and shackles at steel to steel contact surfaces for evidence of wear and reduction of cross sectional area.*

- *Check the grooves in the sheaves for wear. A worn groove will bring out accelerated deterioration in the steel wire rope.*

- *Check the axle pins are secure and held against rotation.*

- *Carry out regular and adequate lubrication. Grease the shank and the bearing of the swivel and the axle. Grease points are usually provided for this purpose.*

- *It is best to clean and oil or grease the outer surfaces rather than paint them. Paint may clog lubrication holes, obliterate markings and could hide defects.*

- *Check for general material defects such as cracks, distortion and corrosion that could affect the safe working load and overall strength.*

- *Do not carry out any material repairs or modifications to blocks such as welding, drilling or grinding, which is likely to affect the safe working load. If in doubt, refer to a specialist test house ashore for maintenance and testing, or replace the equipment.*

- *Keep records identifying the block, when and where it was brought into use, its safe working load and any repairs or modifications and tests carried out.*

1.9 RISK ASSESSMENT AND CONTROL MEASURES

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997, came into force on 31 March 1998 (Marine Guidance Note MGN 20 (M+F) refers):

> *Under the Regulations, it is the duty of employers to protect the health and safety of workers and others affected by their activities so far as is reasonably practicable. The principles for ensuring health and safety are:*
>
> *(a) the avoidance of risks, which among other things includes the combating of risks at source and the replacement of dangerous practices, substances or equipment;*

(b) *the evaluation of unavoidable risks and the taking of action to reduce them;*

(c) *adoption of work patterns and procedures which take account of the capacity of the individual, especially in respect of the design of the workplace and the choice of work equipment, with a view in particular to alleviating monotonous work and to reducing any consequent adverse effect on workers' health and safety.*

Duties of employers

All employers have a duty to ensure so far as is reasonably practicable the health and safety of workers and others affected by their activities in accordance with the principles set out above. The basis of all safety measures should be an assessment by the employer of any risks to workers' health and safety from their work activities.

The measures taken must not involve cost to workers and are required to include the provision of:

- *safe working places and environment;*
- *safe plant, machinery and equipment;*
- *health and safety training, instruction, supervision and information;*
- *any necessary protective clothing and equipment where risk cannot be removed by other means;*
- *a health and safety policy;*
- *information for workers about the findings of their risk assessment;*
- *health surveillance of workers as appropriate;*
- *information on the special occupational qualifications required to any employment business supplying them with temporary workers;*
- *information about their activities and staff to the Company; and*
- *consultation with their workers or elected representative on health and safety matters.*

The Appendix to MGN 20 (M+F) provides guidance on the main elements of risk assessment. With respect to determining appropriate control measures, it lists the following in order of effectiveness:

- *a)* *if possible, eliminate hazards altogether, or combat risks at source eg use a safe substance instead of a dangerous one;*
- *b)* *if elimination is not possible, try to reduce the risk eg where risk is of electrocution, by using a low voltage electrical appliance;*
- *c)* *where possible adapt work to the individual, eg to take account of individual mental and physical capabilities;*
- *d)* *take advantage of technical progress to improve controls;*
- *e)* *give precedence to measures that protect everyone;*
- *f)* *if necessary, use a combination of techinical and procedural controls;*
- *g)* *introduce or ensure the continuation of planned maintenance, for example, of machinery safeguards;*
- *h)* *ensure emergency arrangements are in place;*
- *i)* *adopt personal protective equipment only as a last resort, after all other control options have been considered.*

In May 2000, the skipper had undertaken a risk assessment, which was documented on a Standard Risk Assessment Form, produced by SFIA. In the activity or area of *winch and warp dangers*, the skipper allocated a moderate risk against a possible hazard of gear damage and serious injury arising from worn components, and stated a necessary control measure to be “all machinery maintained and checked regularly”.

The vessel’s risk assessment was discussed by all crew members, and they were content to sign their acceptance.

1.10 THE *PIETERJE* CASE

An accident occurred on 15 February 2000 on board the Jersey-registered beam trawler *Pieterje,* which was berthed alongside, when the metal eye of the block supporting the starboard derrick failed. This resulted in the derrick, chains and nets landing on three people on the quay, one of whom, the skipper of the vessel, died as a result of his injuries.

The judge in the ensuing HSE prosecution case made the following comments:

> *No inspection was carried out and there was no documentary history showing the ages of the blocks, the date of their last inspection/refurbishment or how, when or by whom they were last inspected/refurbished.*
>
> *Its defect had arisen at the manufacture stage but would have been revealed by a professional inspection of the block.*
>
> *The vessel was safe and the company operated an acceptable standard of inspection and maintenance equal to that provided by the rest of the fishing industry.*

The judge at the High Court hearing made the following comments:

> *The level of maintenance and repair of beam trawl gear and its lifting beams, was below standard.*
>
> *The defendants (owners) did not have any record relating to the blocks on board their vessels or their service history.*
>
> *If such was the standard (in the fishing industry), it was inadequate*.

The coroner at the inquest made the following recommendation to the Secretary of State:

> *Such steps are taken as soon as ever possible to prevent a recurrence of a similar accident. Had there been a proper regulatory system in force applying to all fishing vessels at the very least, it is possible that the defects in question in this case would have resulted in the block that failed being replaced.*

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 COMMENTS ON THE TEST HOUSE REPORT

The MAIB agrees with the conclusions reached by The Test House. These indicate that the unsecured inboard bearing sleeve, which had been press fitted into the bearing housing, was probably an adaptation to the block's original design and construction. Consequently, given the blocks continued use, its failure was inevitable.

The block failed because the sleeve moved outwards from the bearing housing, causing progressive wear, effectively cutting away the inboard cheek plate. With the block under load, the cheek plate and bearing support eventually collapsed. This collapse released the trawl wire from the block pulley, causing it to spring downwards, and to hit and fatally injure the deckhand.

The failure was sudden and unexpected: during its operation, there was probably no obvious indication with the block to warn the crew that it was about to collapse.

2.3 CONSTRUCTION AND MAINTENANCE OF THE BLOCK

The use of bearings instead of bushes in the sheaves of hanging blocks has been brought about by the demands placed on these blocks by auto trawl winches. The constant adjustment of the warp by these systems requires the use of ball or roller bearings, since bushes would quickly wear out. Where taper bearings are fitted, steel washers or spacers can be fitted either side of the sheave to ensure that the bearings are correctly adjusted. This was not the design of this block and there was no space for such spacers in its construction.

When the block was last overhauled, the standard practice for the engineering firm was followed. This involved replacing the old bearings with new ones of the same type and construction, cleaning and examining the various parts of the block for wear and repairing this wear as necessary.

There is no reason to suspect that at the time of the last overhaul it would be evident that the sleeves fitted to this block were likely to come loose and cause the damage and failure that subsequently occurred.

The use of sleeves is common practice in the manufacture and maintenance of blocks. The sheaves are often too hard to machine easily and are manufactured with an oversized central hole. This is then sleeved down to the size required for the bearings.

These sleeves are usually made of EN8 or similar steel, a relatively soft, resilient steel which is easily machined. They are pushed into place and held by either interference fit or glue. This has the advantage of allowing a new sleeve to be fitted at overhaul, in the event of the original one becoming worn or damaged, without requiring a new sheave.

Sleeves are normally of a much thicker construction than that found on this block, typically 5mm to 10mm thick. Additionally, they are often machined to leave a shoulder of material behind the bearings. This not only facilitates removal of the sleeves, but also ensures that they are held in the sheave by the outer bearing races.

The vessel's engineer was unaware that the sheave was fitted with sealed bearings and used to grease the block every trip. In doing so, he made an external, visual examination of it. Although he might have been expected to notice the condition of the hanger and hanger shackle, it is highly unlikely that anyone would have seen the bearing sleeves working their way into the cheek plates with the block suspended in its normal position on board. Only disassembly of the block would have revealed this.

The wear to the cheek plates in way of the warp is not unusual in this type of block. It can indicate that the block swivel has seized, as was the case here, and such a seizure could lead to increased axial loading on the sheave bearings. However, in the absence of evidence to indicate high axial loading, the seizure of the swivel is not considered by The Test House or the MAIB to be a causal factor in either the failure of the inboard side bearing or the migration of the bearing sleeves.

It might be expected that the wearing away of the cheek plates, or the operation of the block with a failed bearing, would have been heard when the block was in use. However, there was a significant amount of background noise from the engine and hydraulic gear, and this could have drowned out these sounds.

The problem was not evident to the person who overhauled the block earlier that year. It is possible, therefore, that the system of failure had not begun by then.

It is a matter of conjecture as to what could have initiated the outward movement of the thin sleeves.

2.4 TESTING AND CERTIFICATION OF BLOCKS

There is no record of the manufacture and subsequent overhauls of this block. The records of the last overhaul show no details of the work carried out, and it is not known how many times this block had been overhauled.

Without a history of overhauls, or being able to locate the original manufacturer, it is not possible to conclude for certain whether the thin sleeves found in this sheave were a feature of the original design or the result of a past overhaul. The sleeves which were fitted were probably an adaptation of the original design: inquiries have found that the design is not known to specialist repair agencies and manufacturers of similar types of blocks.

The requirements for trawling equipment **(see section 1.8)** make a differentiation between lifting and hauling gear. The latter is similar to the former, but the loads which arise in hauling gear may not always be known or be capable of ready determination, because hauling gear is subject to variable and dynamic loads. However, hauling gear is subject to more frequent use, and, therefore, more wear and tear than lifting gear. Although there has been no requirement in the past for hauling gear to be tested and examined at regular intervals, in the same manner as hoisting gear, the MCA's intended action **(see section 4)** should address this situation.

It is unlikely, in this case, that load testing would have brought to light the specific problem with this particular block. However, a written history of supply, tests, inspections and overhaul by a registered body, would allow the source of the thin plate sleeves to be easily identified and timely intervention to stop similar failure in future.

A full inspection of this block, by a registered body for the purpose of certifying it safe, might well have detected the use of thin sleeving. This examination could have caused the block to be withdrawn from service.

2.5 RISK ASSESSMENT

There is no requirement to have a written risk assessment, but many skippers use the SFIA risk assessment form as a guide and, thereby, to prove that an assessment has been made. In accepting the risk associated with worn components, the skipper was reliant on the adequacy of his stated control measure, since the procedure required the deckhand who received the heaving line to stand under the trawl warp when the block was under load. Although the machinery was maintained and checked regularly, in accordance with the stated control measure, the level of maintenance and inspection was insufficient to prevent the accident.

In accordance with the advice provided in MGN 20 (M+F), skippers and owners should, through the risk assessment process, seek to find a safe method of working away from fishing gear under load, thereby eliminating the hazard altogether. Ideally, this should be done during the design of the vessel, so as to avoid any need for procedural controls, which, as highlighted in this case, run the risk of failure.

SECTION 3 - CONCLUSIONS

3.1 CAUSAL FACTORS

The block failed because the inboard bearing sleeve moved outwards from the bearing housing, causing progressive wear and effectively cutting away the inboard cheek plate. With the block under load, the cheek plate and bearing support eventually collapsed. This collapse released the trawl wire from the block pulley, causing it to spring downwards, to hit and fatally injure the deckhand. [2.2]

3.2 OTHER FINDINGS

1. The failure was sudden and unexpected: during its operation, there was probably no obvious indication with the block to warn the crew that it was about to collapse. [2.2]

2. The Test House found that the welding on the block was substandard and unsafe. [1.7.2]

3. There is no reason to suspect that at the time of the last overhaul it would be evident that the sleeves fitted to this block were likely to come loose, and cause the damage and failure that subsequently occurred. [2.3]

4. Without a history of overhauls or being able to locate the original manufacturer, it is not possible to conclude whether the thin sleeves found in this sheave were a feature of the original design or the result of past overhaul. [2.4]

5. There has been no requirement in the past for hauling gear to be tested and examined at regular intervals in the same manner as hoisting gear; the MCA's intended action should address this situation. [2.4]

6. It is unlikely, in this case, that load testing would have brought to light the specific problem with this particular block. [2.4]

7. A full inspection of this block by a registered body for the purpose of certifying it safe, might well have detected the use of thin sleeving and have caused the block to be withdrawn from service as a result. [2.4]

8. A written history of supply, tests, inspections and overhaul would allow the source of the thin plate sleeves to be identified and the problem addressed to stop similar failure in future. [2.4]

9. Although the machinery was maintained and checked regularly in accordance with the stated control measure, the level of maintenance and inspection was insufficient to prevent the accident. [2.5]

10. Skippers and owners should, through the risk assessment process, seek to find a safe method of working away from fishing gear under load, thereby eliminating the hazard altogether. Ideally, this should be done during the design of the vessel, so as to avoid any need for procedural controls, which, as highlighted in this case, run the risk of failure. [2.5]

11. The MAIB considers the actions taken, and intended to be taken, by the MCA will contribute to preventing similar accidents in future. [4]

SECTION 4 - ACTION TAKEN AND INTENDED TO BE TAKEN

4.1 The MCA has taken, or is intending to take, action with regard to the testing, inspection, and maintenance of hauling gear, as noted below. This is in response to the MAIB investigation report of a fatality on board *Gemma Fidelis* (GY419), on 23 October 2001.

Instructions for the Guidance of Surveyors of Fishing Vessels are currently being developed and a first draft of the contents of these instructions, which relate to the MCA's interpretation of the relevant regulations for lifting and hauling gear, is as follows:

The following indicates a satisfactory test and inspection regime for winches, tackle and hoisting gear:

New vessels

Lifting and hoisting appliances and gear should be:

i. Designed to a suitable code for marine use and with a safe working load appropriate to the intended service.

ii. Constructed in accordance with the requirements of the design code.

iii. Provided with a foundation structure onboard the vessel that is adequate for all service loading that will arise during use.

iv. Overload tested after installation and examined by a competent person before first use.

v. Issued with a test certificate by the competent person confirming the appliance's safe working load.

Winches and hauling gear should be:

i. Designed for marine use and with a safe working load appropriate for the intended service and constructed accordingly.

ii. Provided with foundation structure onboard the vessel that is adequate for the service loading that will arise during use.

iii. Thoroughly examined and function tested after installation by a competent person before first use.

Existing vessels

All lifting and hauling gear should be examined by a competent person at intervals not exceeding one year. The purpose of the examination being to verify the structural integrity of the appliance and its foundations and that all control, brakes, safety stops, associated structures and gear etc. are in a satisfactory and functional condition.

Lifting appliances should be overload tested and thoroughly examined at intervals not exceeding five years or whenever structural repairs or significant modifications have been carried out.

Loose gear, blocks etc. should not be utilised unless documentary evidence of proof load testing and safe working load is available.

Replacement loose gear should not be accepted unless proof load test and safe working load documentation is available.

Whenever repairs are carried out on load bearing parts, gear or blocks then this gear should not be put into use until satisfactory proof of overload testing that verifies its integrity has been carried out by a competent person.

The *Instructions for the Guidance of Surveyors of Fishing Vessels* document is scheduled to be finalised and published by the end of 2003.

New legislation, initiated by EU Health and Safety Directive 1989/391/EEC, is currently being finalised and should enter force in 2003 as:

LOLER – The Lifting Operations and Lifting Equipment Regulations

PUWER – The Provision and Use of Work Equipment Regulations

These regulations place an obligation on employers to ensure that work equipment, including lifting and hauling gear, is safe for workers to use and is used safely. The Regulations introduce inspection requirements including testing as necessary for all work equipment which might be used by employees, regardless of vessel size.

It is intended that guidance in the form of an MGN will be developed to cover the implementation of the above regulations. The guidance will also cover the inspection and testing of lifting and hauling gear which is currently required by both *The Code of Safe Working Practice for the Construction and Use of 15 metre (LOA) to less than 24 metre (RL) Fishing Vessels* and the modified *Fishing Vessels (Safety Provisions) Rules 1975.*

Additionally, this guidance will incorporate ship-specific risk assessments, control measures and safe working procedures which are implicit for compliance with *The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997.* Safe operation of gear, including snatch blocks, will also be covered in this proposed MGN.

SECTION 5 - RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended to:

1. Implement, as soon as possible, its intended regulations and guidance with regard to the testing, inspection and maintenance of hauling gear on board fishing vessels.

Marine Accident Investigation Branch
May 2003

ANNEX 1

Chemical Analysis Report

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E-mail: chemanal@twi.co.uk

CHEMICAL ANALYSIS REPORT

UKAS TESTING 0088

ANALYSIS METHOD	OES
MATS DEPT QA REF NO	9B
MATERIAL SPECIFICATION	
CLIENT	Mr D Ellin The Test House Granta Park Great Abington Cambridge CB1 6AL
REF/ORDER NO	T20338
DATE RECEIVED	25.06.02
TWI REPORT NO	S/02/160
ANALYSIS DATE	25 06 02
INVOICE NO	

ELEMENT, % (m/m)

SAMPLE NUMBER	C	Si	Mn	P	S	Cr	Mo	Ni	Al	As	B	Co
MI 8344 Inboard side sleeve	0.42	0.19	1.03	0.011	0.020	1.09	0.30	0.22	0.018	0.027	0.0004	0.016
MI 8344 Outboard side sleeve	0.39	0.26	0.81	0.013	0.003	0.94	0.24	0.18	0.020	0.016	<0.0003	0.012
MI 8344 Inboard side cheek plate	0.13	0.20	0.49	0.038	0.020	0.013	0.003	0.020	0.040	0.021	<0.0003	0.010
MI 8344 Outboard side cheek plate	0.13	0.20	0.49	0.038	0.021	0.013	0.003	0.020	0.040	0.021	<0.0003	0.010

ELEMENT, % (m/m)

SAMPLE NUMBER	Cu	Nb	Pb	Sn	Ti	V	W	Zr	Ca	Ce	Sb
MI 8344 Inboard side sleeve	0.42	<0.002	<0.005	0.025	0.002	0.005	<0.01	<0.005	0.0010	<0.002	0.006
MI 8344 Outboard side sleeve	0.17	<0.002	<0.005	0.014	0.003	0.004	<0.01	<0.005	0.0003	<0.002	0.003
MI 8344 Inboard side cheek plate	0.021	<0.001	<0.005	<0.004	0.001	0.001	<0.01	<0.005	<0.0003	<0.002	<0.002
MI 8344 Outboard side cheek plate	0.021	<0.001	<0.005	<0.004	0.001	0.001	<0.01	<0.005	<0.0003	<0.002	<0.002

COMMENTS: Direct spark analysis. Side sleeve samples mounted in Bakelite.

 S E DAY SENIOR ANALYST SIGNATURE DATE ISSUED 25 06 02