ACCIDENT REPORT

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

Report on the investigation of

the fatal injury to a deckhand following a chain failure

on the scallop dredger

Honeybourne III (PD905)

16 nautical miles south of Newhaven, England

on 6 October 2023

VERY SERIOUS MARINE CASUALTY REPORT NO 1/2026 JANUARY 2026

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 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 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, 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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For all enquiries:

Marine Accident Investigation Branch
First Floor, Spring Place
105 Commercial Road
Southampton
SO15 1GH
United Kingdom

Email: maib@dft.gov.uk
Telephone: +44 (0)23 8039 5500

Press enquiries during office hours: +44 (0)19 3244 0015
Press enquiries out of hours: +44 (0)30 0777 7878

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

°	-	angular degrees
°C	-	degrees Celsius
BS	-	British Standard
CoC	-	Certificate of Competency
EN	-	European Norm
EN 397	-	BS EN 397:2012+A1:2012 – Industrial safety helmets
EN 818-2	-	BS EN 818-2:1996+A1:2008 – Short link chain for lifting purposes. Safety – Part 2: Medium tolerance chain for chain slings. Grade 8
EN 818-6	-	BS EN 818-6:2000+A1:2008 – Short link chain for lifting purposes. Safety – Part 6: Chain slings. Specification for information for use and maintenance to be provided by the manufacturer
CCTV	-	closed-circuit television
DPA	-	Designated Person Ashore
FIC	-	focused inspection campaign
HE	-	hydrogen embrittlement
HMCG	-	His Majesty's Coastguard
HRC	-	Hardness Rockwell C scale, a measure of resistance to indentation using a diamond cone to indent the material
HSE	-	Health and Safety Executive
Hv10	-	Vickers Hardness scale value, using a 10kg force
IMO	-	International Maritime Organization
kg	-	kilogram
kN	-	kilonewton
LEEA	-	Lifting Equipment Engineers Association
LEEA COPSULE	-	The LEEA Code of Practice for Safe Use of Lifting Equipment, Edition 9
LOLER	-	Statutory Instrument 2006 No. 2184, The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006
m	-	metres
Macduff	-	Macduff Shellfish (Scotland) Limited
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note

mm	-	millimetres
MPa	-	megapascals
MSC.1/Circ.1663	-	IMO Circular MSC.1/Circ.1663 – Guidelines for Lifting Appliances
MSIS	-	Marine Survey Instructions for the Guidance of Surveyors
MSN	-	Merchant Shipping Notice
nm	-	nautical miles
PFD	-	personal flotation device
PPE	-	personal protective equipment
PUWER	-	Statutory Instrument 2006 No. 2183, The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006
SMS	-	safety management system
SOLAS	-	International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended
t	-	tonnes
UK	-	United Kingdom
UTC	-	universal time coordinated
WLL	-	working load limit, the maximum operating load that a piece of equipment is designed to handle

TIMES: all times used in this report are British Summer Time (UTC+1) unless otherwise stated.

Honeybourne III

SYNOPSIS

At 2345 on 6 October 2023 Denver Teleron, a deckhand on the scallop dredger *Honeybourne III* (PD905) was fatally injured when he was struck by a towing block that had fallen from the head of the port derrick.

The crew of *Honeybourne III* were recovering its gear in a position about 16 nautical miles south of Newhaven, England. The port scallop dredges were recovered and the dredge beam was tensioned against chains connected at each end. A section of chain supporting the fishing gear at the derrick head failed, releasing the suspended gear that fell to the deck below, striking and fatally injuring the deckhand who was working beneath it.

The chain that failed formed part of a quick-release assembly designed to enable the crew to release the towing point from the derrick head should the dredging gear snag on the seabed and endanger the stability of the vessel. The chain failed where it passed over a static steel pin at the top of the derrick.

The investigation established that the complex bending moments applied to the chain links at the derrick head reduced their ability to withstand the load applied, likely contributed to by the material hardness of the chain link material.

Despite a previous incident in its fleet of vessels where a similar quick-release chain had failed, the safety regime within the company and had not recognised the design flaw in operating loaded chains over static pins. The lifting gear inspection regime on board had not identified the deterioration of the chain and the company was operating under the impression that the quick-release assembly as fitted was a mandatory requirement.

In June 2025, the MAIB published a report into the fatal accident on board the beam trawler *Cornishman* that had similar circumstances to the accident on *Honeybourne III*. That report made recommendations to the Maritime and Coastguard Agency to update its guidance to state training and accreditation requirements for competent persons carrying out lifting gear inspections, and the training and guidance provided to its surveyors. These recommendations were relevant to the safety issues identified on *Honeybourne III*.

Honeybourne III's owner, Macduff Shellfish (Scotland) Limited, reviewed and amended its procedure for the management of lifting equipment inspections on board.

As a result of this investigation, the Maritime and Coastguard Agency has been recommended to use its powers to reduce the substantial risk presented by the use of a chain led over a static pin as the sole means of supporting a suspended load and to incorporate verification of actions from its safety bulletin on safety concerns over lifting equipment inspections into its instructions to surveyors.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF *HONEYBOURNE III* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Honeybourne III*
Flag	UK
Classification society	Not applicable
IMO number/fishing numbers	8211796/PD905
Type	Scallop dredger
Registered owner	Macduff Shellfish (Scotland) Limited
Manager(s)	Macduff Shellfish (Scotland) Limited
Construction	1983
Year of build	Steel
Length overall	29.16m
Registered length	25.84m
Gross tonnage	215
Minimum safe manning	7
Authorised cargo	Scallops

VOYAGE PARTICULARS	
Port of departure	Shoreham, England
Port of arrival	Shoreham, England
Type of voyage	Scallop dredging
Cargo information	Scallops
Manning	7

MARINE CASUALTY INFORMATION	
Date and time	6 October 2023 at 2347
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	16nm south of Newhaven, England
Place on board	Deck
Injuries/fatalities	1 fatality
Damage/environmental impact	None
Ship operation	Dredging operations
Voyage segment	Mid-water
External & internal environment	South-westerly, force 3 to 4; 2m swell; air temperature 17°C
Persons on board	7

1.2 NARRATIVE

On 1 October 2023, the scallop dredger *Honeybourne III* departed from Shoreham, England to dredge for scallops in the English Channel. On 4 October, following a period operating in the Baie de Seine, France, *Honeybourne III* repositioned to the western end of the southbound lane of the Dover Strait traffic separation scheme and resumed dredging operations.

At 1800 on 6 October, Denver Teleron (deckhand 1) and deckhand 2 started their second watch of the day. The skipper was on duty in the wheelhouse.

At 2305, the crew on duty deployed *Honeybourne III*'s dredging gear. At 2330, the mate relieved the skipper, who then left the wheelhouse and went to their cabin to rest. The vessel was about 16 nautical miles (nm) south of Newhaven, England, on a northerly heading.

At 2345, deckhand 1 and deckhand 2 were resting in the mess room when the mate called them on the internal call system to retrieve the dredging gear. The two deckhands left the messroom, donned their oilskin jackets and made their way along the open working deck to the whaleback, where they each collected a personal flotation device (PFD) and safety helmet.

The mate recovered the dredge beams to the top of the tipping doors using the winch controls in the wheelhouse. The derrick arm was raised against the buffer on its gantry. Deckhand 1 climbed onto the port conveyor belt and attached a rope from the port tugger winch to the centre of the beam. Deckhand 1 then moved to the aft end of the conveyor and connected a safety chain to that end of the beam, while deckhand 2 did the same at the forward end. Deckhand 2 signalled to the mate that the safety chains were attached. Deckhand 1 walked forward along the conveyor belt towards the steps leading down to the amidships working deck.

At 2347, the mate used the winch to tension the dredge beam against the safety chains. As they did so, a chain link in the quick-release assembly at the head of the port derrick parted. The dredging gear towing blocks and wires fell to the deck, striking a top corner of the wheelhouse on the way. One block struck deckhand 1, who was still on the conveyor, and he fell to the side of the deckhouse. His safety helmet came off. The beam, with the laden scallop dredges attached, fell outboard of the tipping door but remained attached to the vessel by the safety chains and tugger rope.

The skipper heard the sound of the gear failure and went to the wheelhouse. After a quick assessment of the situation, they sent the mate to help provide first aid to the injured deckhand.

The mate and deckhand 2 cleared the warps and blocks that were lying over their unconscious colleague and moved him to the centre of the deck.

At 2353, the skipper sent a “Mayday” call on the very high frequency radio, requesting assistance. His Majesty’s Coastguard (HMCG) responded and tasked a lifeboat from Newhaven and a rescue helicopter to assist.

A nearby fishing vessel heard the broadcast from *Honeybourne III*'s skipper and closed on its position to transfer additional medical supplies. HMCG contacted the UK's designated telemedical advice service to provide direct medical advice to *Honeybourne III*'s skipper. The vessel's crew continued administering first aid to the deckhand, including the use of a defibrillator, until the lifeboat and rescue helicopter arrived at 0105.

Despite the best efforts of all involved, the deckhand could not be resuscitated and, at 0125, he was declared deceased by the rescue helicopter paramedic. *Honeybourne III* returned to Shoreham, where the deckhand's body was landed into the care of the local authorities.

1.3 ENVIRONMENT

The weather at the time of the accident was calm with a fresh breeze from the south-west, force 3 to 5. The air temperature was 17°C. *Honeybourne III* was rolling easily in a 1.5m to 2m swell.

1.4 *HONEYBOURNE III*

1.4.1 Overview

Honeybourne III was built as a trawler in 1983 in the Netherlands. It had been registered in the UK since 1992 and was converted to a scallop dredger in 1996. The vessel held an International Fishing Vessel Certificate, issued in May 2023 by the Maritime and Coastguard Agency (MCA), that was valid until 12 March 2026.

Honeybourne III was owned and managed by Macduff Shellfish (Scotland) Limited (Macduff). The vessel operated out of Shoreham and Plymouth and ran to a weekly schedule, with 6 days at sea in the English Channel followed by a day in port to unload the catch, conduct storing and maintenance, and provide a rest period for the crew.

The wheelhouse of *Honeybourne III* was one deck above and aft of the main working deck **(Figure 1)**. The winches for the towing warps were housed in a winch room directly below the wheelhouse. Aft of the winch room was the galley, crew mess, and locker room with the sleeping accommodation situated below. Two tugger winches, used to haul the dredge beams inboard when retrieving the fishing gear, were mounted to the bulkhead at the working deck's aft end.

Image courtesy of [Herman Jansen B.V.]()

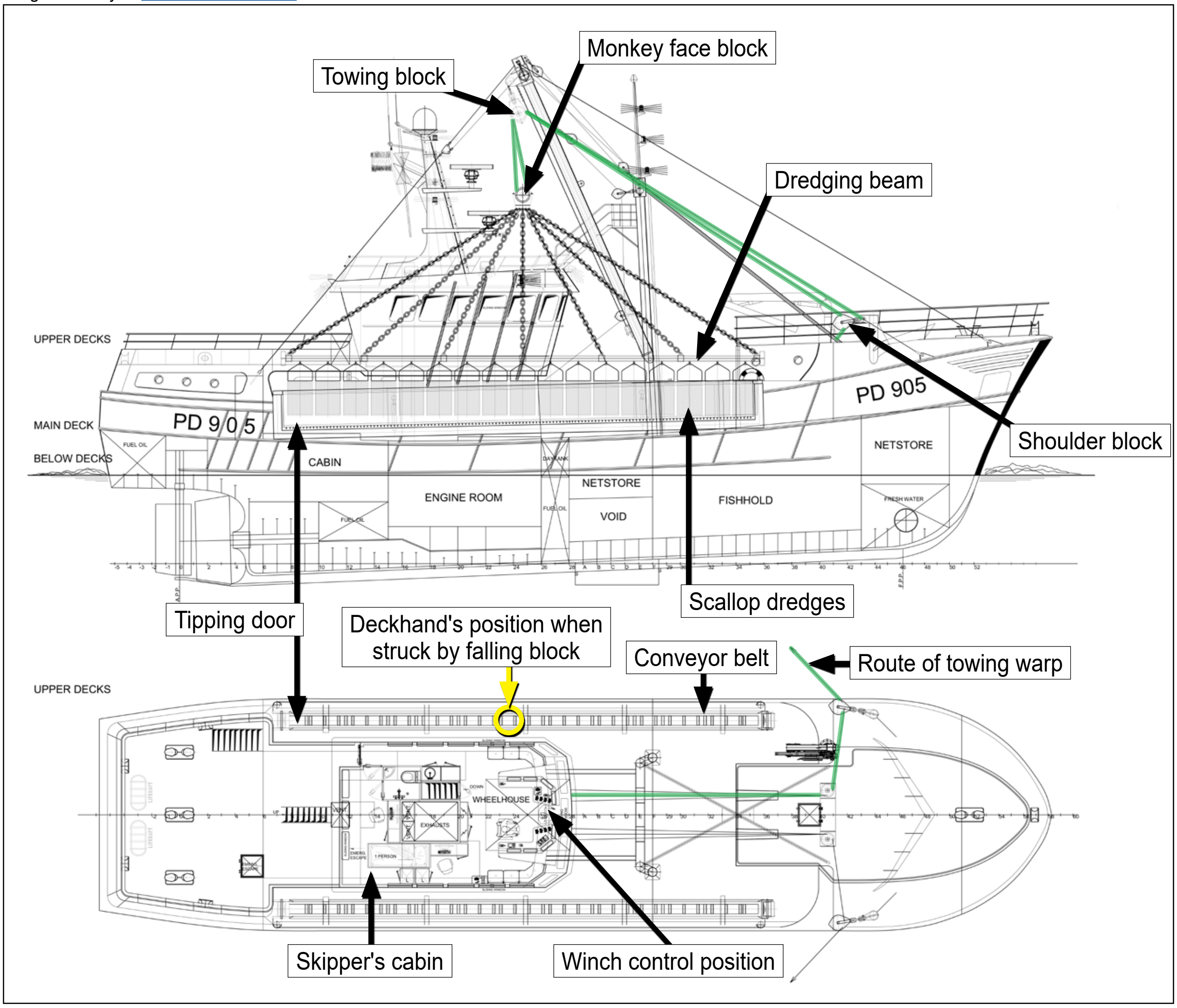

Figure 1: *Honeybourne III* general arrangement

1.4.2 Crew

The crew of *Honeybourne III* comprised a skipper, mate and five deckhands. The skipper held a Deck Officer (Fishing Vessel) Class 1 Certificate of Competency (CoC) issued by the MCA; the mate held a Second Hand (Full) Certificate of Equivalent Competency issued by the MCA that recognised their CoC issued by the Republic of Ireland. The skipper and mate each worked four weeks on board followed by two weeks' leave. The crew contracts were for a 10-month period. *Honeybourne III*'s crew all had between 3 years' and 5 years' experience working on board the vessel.

Four of the five deckhands worked a split watch schedule of 6 hours on and 6 hours off, with two deckhands on each watch. The fifth deckhand worked an offset schedule that overlapped the changeover of the other deck watches. The skipper and mate stood alternate watches in the wheelhouse.

The five deckhands worked on deck for shooting and hauling the dredging gear and completed other tasks as required when not working the gear.

The crew had no formal training in the inspection of lifting equipment and there was no evidence that the company had completed any assessment of the skipper's capability to assess the condition of the vessel's lifting equipment.

1.4.3 Deckhand 1

Denver Teleron was a 35-year-old Filipino national who had joined *Honeybourne III* on 3 April 2023. He had worked on vessels operated by Macduff for the previous 7 years.

Deckhand 1 was certified as medically fit and had undertaken the required safety training courses for his role on board. At the time of the accident he had been working on deck since 1800 and was approaching the end of his 6-hour watch.

The postmortem recorded the cause of death as traumatic head injury, principally due to a lateral blow to the left side of the head. A later toxicology report did not indicate the presence of alcohol or drugs.

1.4.4 Personal protective equipment

At the time of the accident deckhand 1 was wearing waterproof coveralls, safety boots, gloves, a safety helmet and an inflatable PFD.

Five safety helmets that complied with European standard BS EN 397:2012+A1:2012 – Industrial safety helmets (EN 397), along with the crew PFDs, were stowed in the whaleback. The stowage arrangements for the safety helmets and PFDs necessitated the crew passing along the open working deck to access them.

When the accident happened, deckhand 1 was wearing a helmet of a different type to those stored in the whaleback. It was reported that he had purchased this helmet himself. The helmet was fitted with a chinstrap and ear pads. The chinstrap was intended to be fastened with two plastic connectors, one of which was missing.

A label attached to the helmet stated it was constructed to the CE EN 1077 standard[1] and was suitable for *snow sport use only*. The helmet showed signs of use; it had scuff marks and paint flecks over its external surfaces and rusted steel connections. There was no evident damage to the shell of the helmet and its internal padding was in place.

1.5 MACDUFF SHELLFISH (SCOTLAND) LIMITED

1.5.1 Organisation

Macduff operated a fleet of eight scallopers from facilities in Mintlaw, Aberdeenshire, Scotland. The company's fleet management included operational, technical and managerial support.

1.5.2 Safety management

Macduff had implemented a safety management system (SMS) in 2020. The SMS contained risk assessments for activities carried out on board *Honeybourne III*, one of which dealt with the risk of *failure of lifting equipment leading to suspended objects being dropped from height*. The control measures to mitigate this risk included the use of hard hats; checking and maintenance of lifting equipment;

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[1] European Standard BS EN 1077:2007 – Helmets for alpine skiers and snowboarders.

and excluding crew members from the area below or near any load being lifted. With these measures in place, the risk was assessed as being medium and suitably controlled.

A lifting plan formed part of the operational instructions in the SMS. On deck safety, the lifting plan stated that:

> *operators and supervisors are to take particular care when shooting/ hauling the fishing gear that crew are in 'safe positions' and any 'blind spots' are adequately covered by CCTV. No one should stand under a suspended load.*

The lifting plan defined the 'safe zone' between the port and starboard conveyors by overlaying a photograph of the open working deck, taken from the wheelhouse roof, with an illustrated box filled in with diagonal lines **(Figure 2)**.

Macduff's SMS stated that a competent person for the inspection of lifting equipment *could be the skipper, crew member or shore-based individual with the appropriate knowledge or experience*.

Image courtesy of Macduff Shellfish (Scotland) Ltd

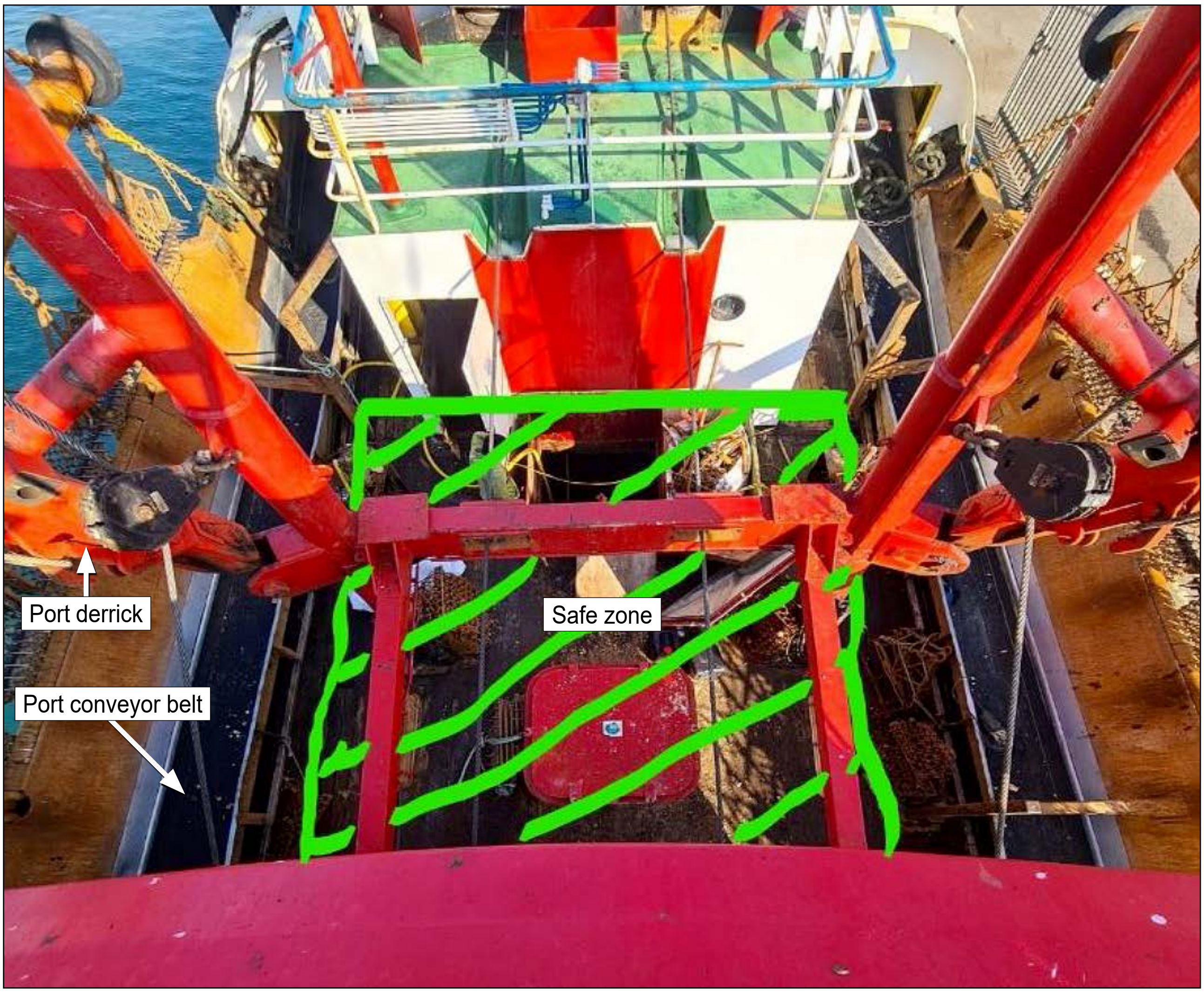

Figure 2: *Honeybourne III* lifting plan 'safe zone'

A personal protective equipment (PPE) policy defined the company requirements for the provision and use of PPE. The policy stated that PPE would be provided free of charge and would meet European or UK certifying authority standards.

A company assigned Designated Person Ashore (DPA) acted as the point of receipt for reports submitted by the fleet, including monthly inspections. The DPA would pass the reports on to departmental managers to address findings as necessary.

1.5.3 Technical oversight

A fleet engineer and fleet superintendent had oversight of the maintenance of the Macduff fleet and managed the planning and conduct of refits to the vessels. They were responsible to a chief superintendent, who reported to the head of fleet operations.

The lifting plan identified superintendents as competent persons for the conduct of lifting gear inspections. They did not undertake this role and relied on reports from the skippers to identify and report faults on their vessels.

When replacement lifting gear was requested, the superintendents would arrange the supply of certified equipment to the vessels. Records indicated there was a regular flow of components for lifting equipment to the vessels. Macduff maintained a stock of spare gear at its transport and logistics headquarters near Glasgow, Scotland.

1.6 *HONEYBOURNE III* FISHING OPERATIONS

1.6.1 General

Honeybourne III had two derricks that supported the vessel's dredging gear positioned on the port and starboard sides of the main working deck forward of the wheelhouse. The derrick arms were 10.45m long and extended out from the base of a gantry on the working deck.

At the head of each derrick a 155kg towing block was suspended from a quick-release assembly by a hammerlock shackle[2]. The towing warps passed from shoulder blocks on each side of the vessel's bow up through the suspended towing blocks to 168kg monkey face blocks, from which the dredge beams were suspended **(**see **Figure 1)**.

When dredging, both derricks were lowered to just above sea level. The tops of the derricks would occasionally dip into the water as the vessel rolled.

A pad eye at the centre of each dredge beam allowed the rope from one of two tugger winches to be connected. At each end of the dredge beam were two further pad eyes to allow for the connection of two 16mm safety chains that secured the beams at the correct height for the tipping door pins to engage with rings at the base of each scallop dredge **(Figure 3)**.

[2] A coupling link designed to connect chain to other fittings.

Figure 3: *Honeybourne III* dredging equipment (starboard side shown)

With the dredge beam resting against a buffer, the tipping doors would be raised, emptying the contents of the scallop dredges onto the longitudinal conveyor belts that transferred the catch forward to be sorted by the crew. The processed catch would be stowed in the fish hold directly below the main deck for later landing.

When the port derrick was fully raised against the buffer on the gantry, with the safety chains attached, its head was approximately 11m above the deck. The towing block was 0.5m below this and would sit above the port forward corner of the wheelhouse. The conveyors were about 1m above the deck.

The winches were controlled from levers positioned at the front of the wheelhouse. The aft end of the dredge beams were not directly visible from the winch control position, but were covered by the closed-circuit television (CCTV) system displayed above the winch control position. There was no means provided to monitor the load on the winches.

Each dredge would take about 40 minutes and the vessel would complete 20 to 24 dredges per day.

1.6.2 Quick-release and derrick head arrangement

The quick-release arrangement on each derrick allowed the crew to release the towing block and all the gear suspended from it. This would reduce the heeling moment on the vessel if the gear were to snag on the seabed when dredging, as the weight on the towing warps would act on the shoulder blocks instead of the end of the derricks. The company believed this arrangement to be mandatory.

The quick-release arrangement consisted of a steel pelican hook assembly at the base of each derrick arm. A 36mm soft eye in one end of the steel release wire was placed over the hook and the release wire extended up the length of the underside of the derrick arm. At the derrick head[3], seven links of 32mm chain were connected into another soft eye at the other end of the release wire. This chain passed over a steel static pin mounted between two cheek plates on the derrick head's rotating collar **(Figure 4)**. The rotating collar was designed to allow the derrick head to rotate to follow the direction of the load applied by the dredging gear. The static pin was hollow with an outer diameter of 168mm and a wall thickness of 32mm.

When the derrick arms were extended, the section of quick-release chain lying over the static pin would curve over an angle of 90°. On retrieval, with the derrick arms raised to their stowed position, this angle would increase to 180°.

Knocking out the pin holding the pelican hook closed would allow it to open and release the eye of the release wire. Once released, the chain and release wire would move freely over the static pin in the derrick head, allowing the towing block to fall **(Figure 5)**. The gear would remain connected to the winch and would hang from the shoulder block alongside the vessel.

[3] Also known as a horse's head.

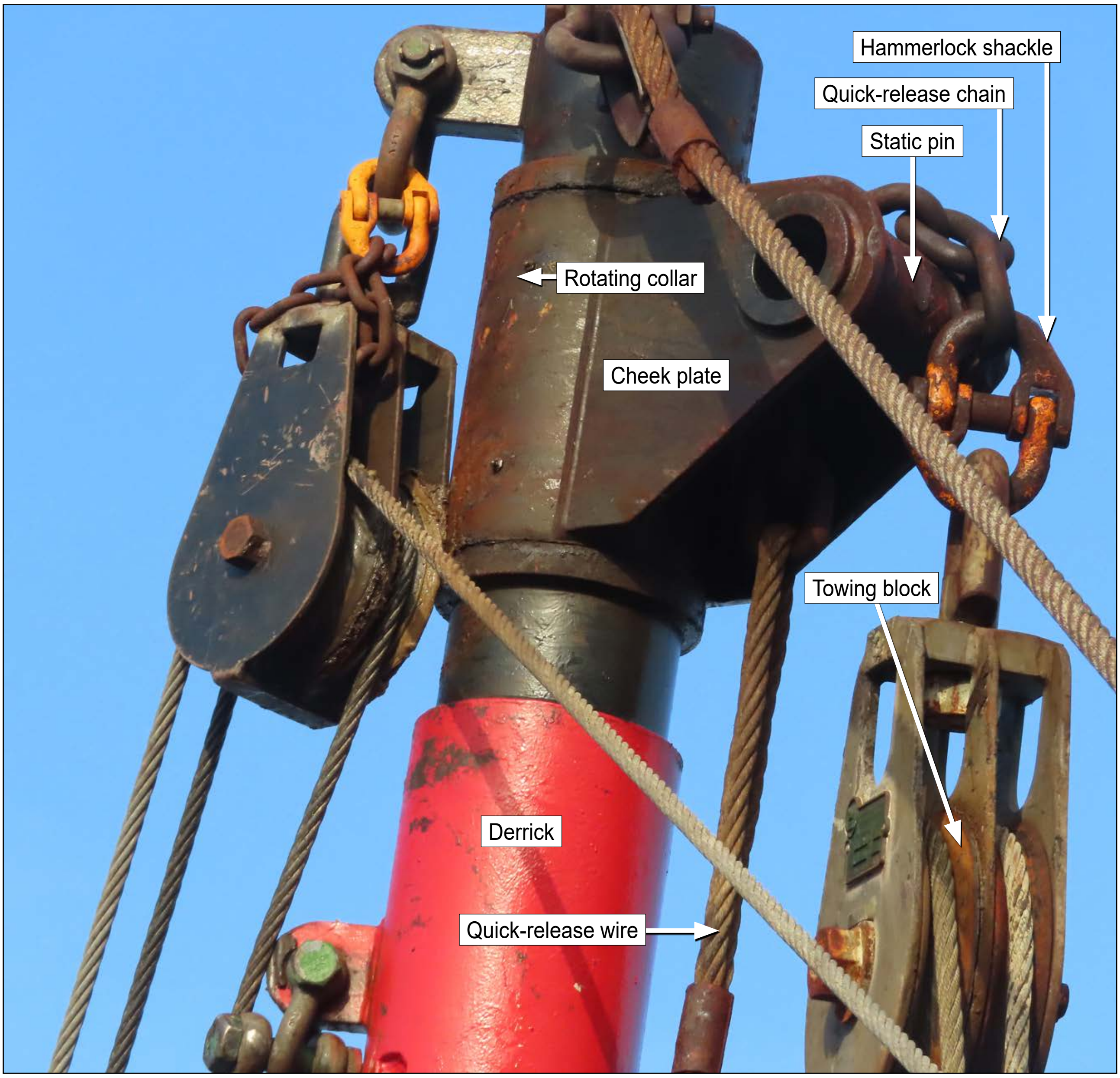

Figure 4: Derrick head arrangement (starboard side shown)

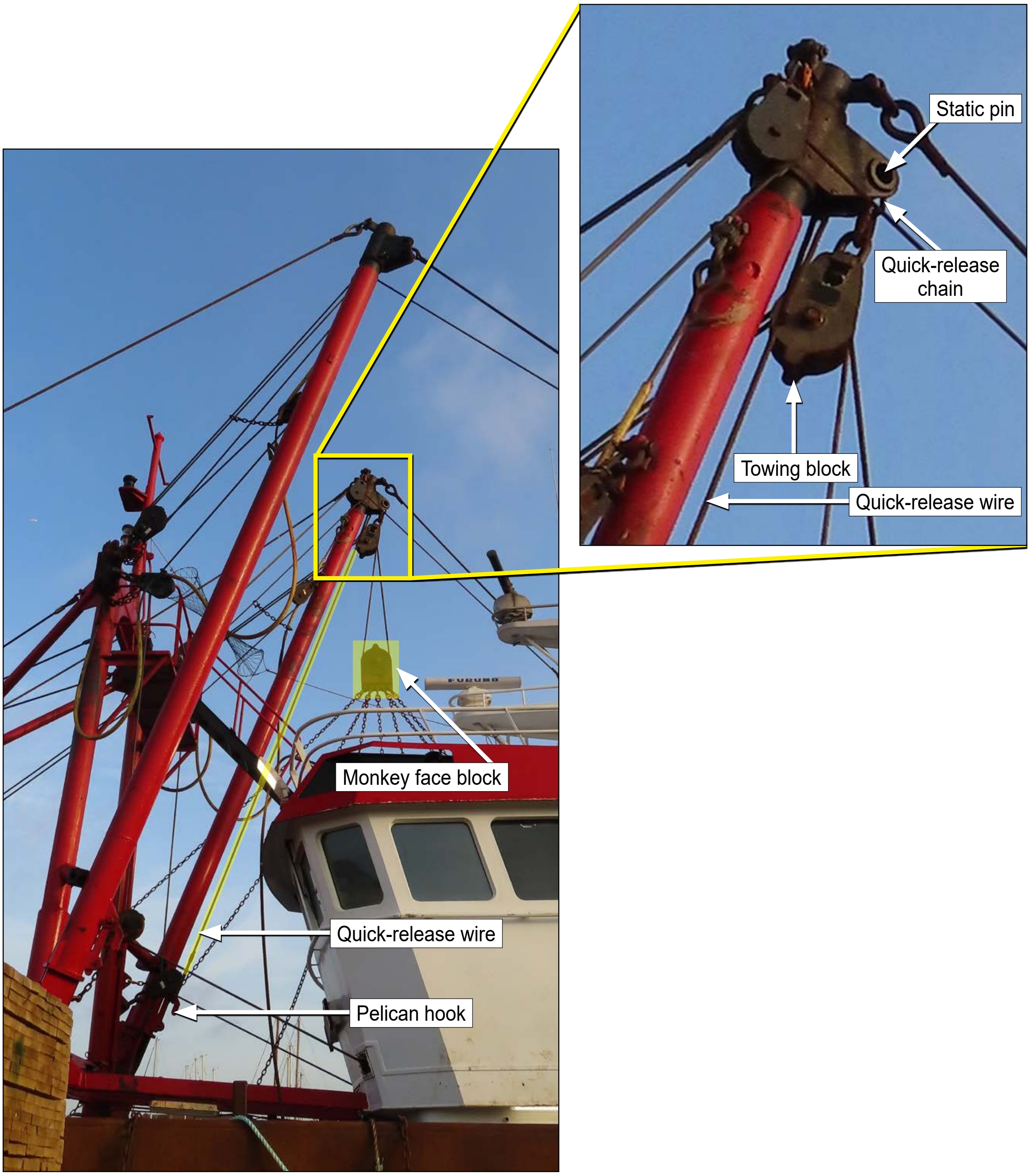

Figure 5: Dredging gear quick-release assembly (starboard side highlighted)

1.6.3 Operational loads on quick-release assemblies

No working load limit[4] (WLL) was defined for *Honeybourne III*'s derricks.

The vessel's lifting plan stated that:

> *the maximum loading of the fishing gear and operation is of the order of 20 - 25 tonnes. The loading is most when the gear becomes snagged on the seabed/ in a wreck.* [sic]

The maximum pull the winch was capable of producing reduced as more wire was wound onto the drum. The maximum pull was 35.9 tonnes (t) at the innermost layer, reducing to 14.4t when all of the towing warp was wound onto the drum.

The arrangement of the gear on *Honeybourne III* had a double purchase arrangement, increasing the load by a factor of two.

1.6.4 Component history

The wire and chain components of the quick-release assemblies for both derricks on *Honeybourne III* were renewed on 28 September 2022. They were supplied to Macduff by a fishing gear supplier in Peterhead, Scotland in June of that year. The chain elements of the assemblies were taken from a stock of chain owned by Macduff but held by the fishing gear supplier.

The chain used was part of a 200m batch manufactured in Poland and delivered to a supplier in Sweden in November 2020. The chain arrived at a UK wholesaler on 6 June 2021 and was delivered to the fishing gear supplier at the end of that month.

1.6.5 Chain standards

The chain supplied for use in the quick-release assemblies on *Honeybourne III* was specified as 32mm Grade 8 short link chain. It was contained in the manufacturer's catalogue for *lifting chains, chains used for hoists*. No specific guidance on the use of this chain was provided by the manufacturer.

The chain was supplied with an inspection certificate from the manufacturer. The certificate indicated that the chain supplied matched that which had been ordered.

The chain was manufactured and tested to the technical standard *European Norm (EN) 818-2:1996+A1:2008 – Short link chain for lifting purposes. Safety – Part 2: Medium tolerance chain for chain slings. Grade 8*[5] (EN 818-2).

Section 4 of EN 818-2 identified that:

> *Accidental release of a load, or release of a load due to failure of lifting accessories such as slings or their component parts puts at risk either directly or indirectly the safety or health…of those persons within the danger zone of lifting equipment.*

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[4] The force that an item of equipment is rated to withstand routinely, for extended periods. The minimum breaking load divided by the WLL determines the equipment's factor of safety.

[5] Implemented in the UK in the British Standard (BS) EN 818-2.

The EN 818-2 standard set out:

- chain dimensions
- chemical composition
- WLL
- manufacturing proof force
- minimum breaking force
- marking
- elongation at breaking force

For a 32mm chain, the standard set the load requirements given in **Table 1**. The chain was required to be hardened then tempered to a minimum of 400°C but tests for the hardness of the chain material were not required. The certificate provided did not indicate a hardness value for the chain when manufactured.

Section 5 of EN 818-2 stated that:

> *The steel shall contain alloying elements in sufficient quantities so that the finished chain, when heat treated in accordance with 5.3.2, complies not only with the mechanical properties specified in this Part of EN 818 but also possesses adequate low temperature ductility and toughness to provide resistance to impact loading.* [sic]

The certification provided with the batch of chain indicated that, when manufactured, the chain met the requirements of the standard in terms of dimensions, chemical composition, minimum breaking load and elongation.

Nominal size (mm)	WLL (t)	Manufacturing proof force (kN)	Minimum breaking load (kN)	Minimum bend deflection (mm)
32	31.5	804	1290	26

Table 1: EN 818-2 working load and test requirements for 32mm chain

1.7 POST-ACCIDENT EXAMINATION AND TESTS

1.7.1 General

Following the accident on board *Honeybourne III*, one end of the steel release wire and six chain links from the port quick-release assembly were found on top of the wheelhouse. The other end of the release wire had detached from the quick-release hook mechanism at the base of the derrick arm and was lying on the deck. One half of a failed 32mm chain link was found on the deck by the crew. The lower edge of the port navigation light alcove on the top corner of the wheelhouse showed evidence of contact damage. The port derrick head was found to freely rotate.

The static pin and cheek plate assembly from the port derrick head, the quick-release chains from both the port and starboard derricks, and the recovered partial link of 32mm chain were removed from the vessel for examination.

There was significant wear to the load-bearing components supporting the dredging gear **(Figure 6)**, specifically:

- the static pins and edges of the cheek plates in the derrick heads;
- the chain links of the quick-release assemblies; and
- the crown of the port hammerlock shackle connecting the port quick-release chain to the towing block.

Figure 6: Wear and damage to load-bearing components on port derrick

The weight of *Honeybourne III*'s fishing gear was measured after the accident. The free weight of the gear without catch measured at the upper block was 8.5t. A test of the operation of the gear against the safety chains as it would be conducted in operation raised the load to 11t. The loads generated during operation would vary depending on catch, speed of vessel and the condition of the seabed.

1.7.2 Analysis by the Health and Safety Executive

The investigation engaged the science division of the Health and Safety Executive (HSE) to test the recovered items. The HSE's findings **(Annex A)** included:

- Material composition – the material of the partial chain link from the port quick-release assembly met the EN 818-2 material composition standard and included 1.2% manganese. The static pin was manufactured from a low carbon steel.

- Material hardness – the average bulk and near-surface hardness values of the partial chain link were 398 Hv10[6] and 392 Hv10, respectively. The static pin had a resultant bulk hardness value of 145 Hv10.

- Fracture mechanism – the partial chain link had two different fracture types on each face of the link. One face showed a faceted cleavage fracture consistent with a brittle fracture; the other fracture surface showed evidence typical of a ductile failure.

- Tensile testing – the two intact chain lengths from *Honeybourne III* were tested to destruction to assess the breaking loads. The port section of chain achieved a load of 1,166kN and the starboard achieved a load of 1,055kN. The elongation of both sections of chain when tested did not attain the elongation required by EN 818-2.

The fracture surfaces of the tested chain sections indicated that they failed in a ductile shear manner at the crown of the link where it was in contact with the adjacent link.

The analysis report concluded that the chain was *not intrinsically unsound and was capable of performing as designed*.

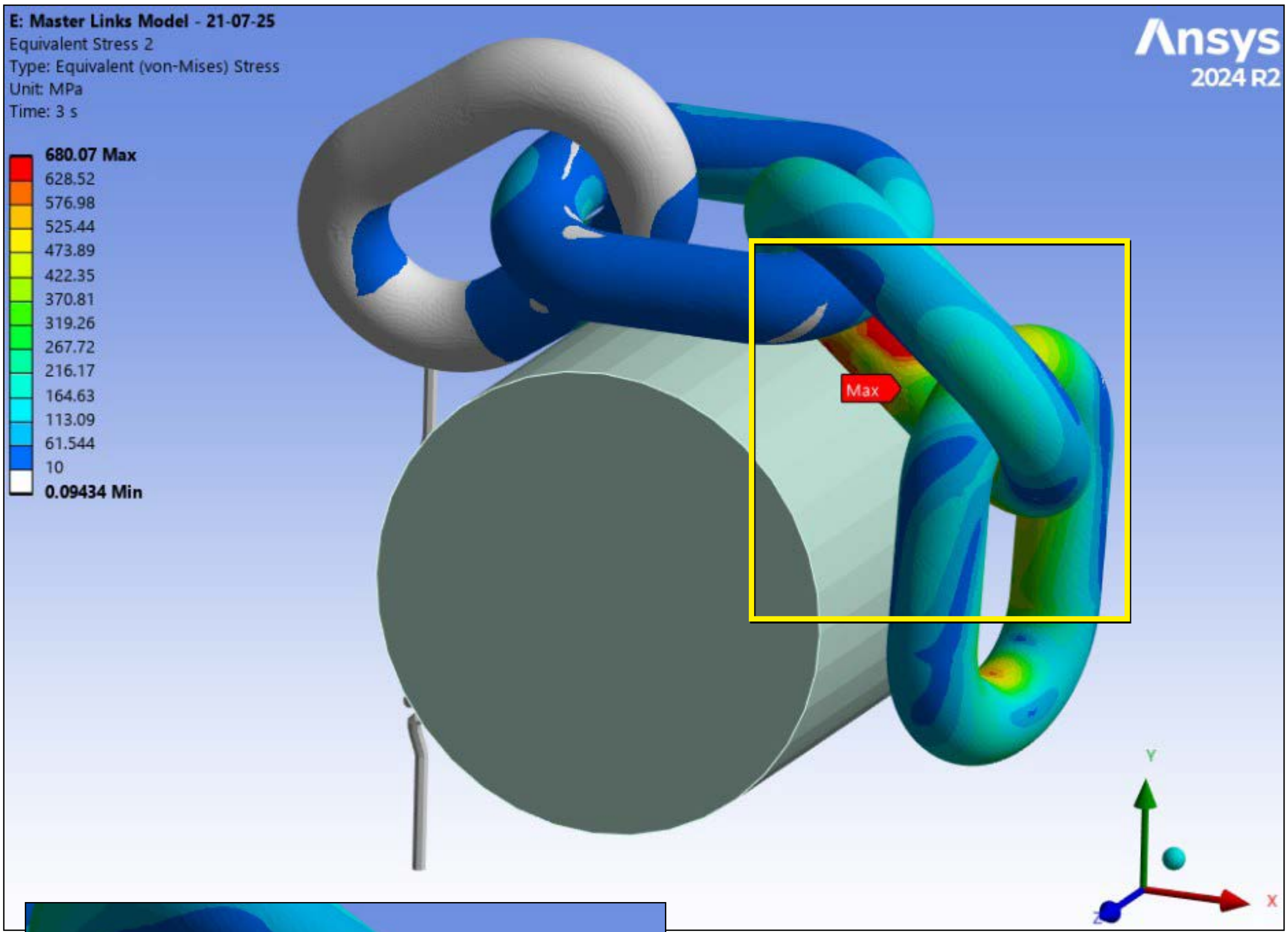
1.7.3 Analysis by Mechanika Ltd

The investigation commissioned Mechanika Ltd to conduct a finite element analysis of the chain arrangement as found at the derrick head of *Honeybourne III*. The study examined the stresses in the chain links over the static pin while subjected to the maximum load that could be applied by the winch **(Figure 7)**. The report **(Annex B)** found that:

> *…high stresses and plastic strains are induced from two point bending… due to non-coincident location of the links around the static pin.*

[6] Vickers Hardness scale value, using a 10kg force.

Image courtesy of [Mechanika Ltd]



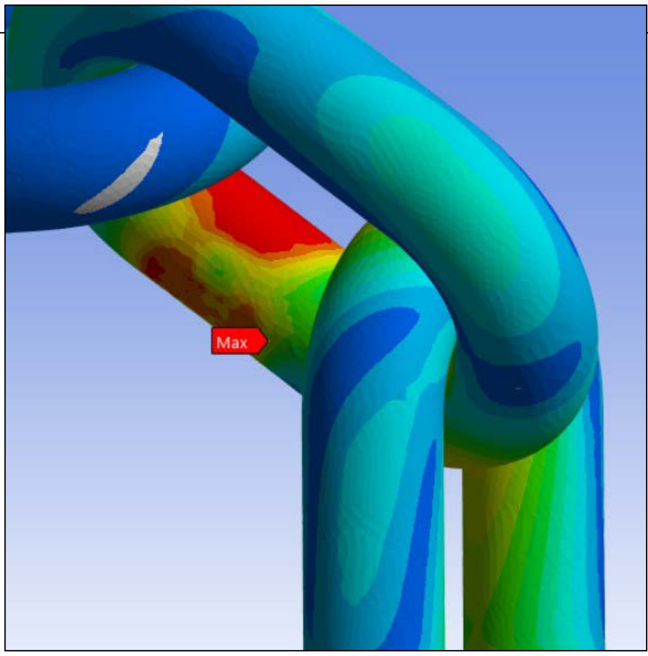


Figure 7: Finite element modelling of stress in quick-release chain passing over a static pin, taken from the Mechanika Report **(Annex B)**

Further, that the chain links:

> *…will always experience two point bending which will induce high local stresses and plastic strains. This is unavoidable given the current design of the static pin and chain links, since it is impossible for the links to remain fully coincident to the surface around the diameter of the pin. Therefore there will always be unsupported regions on the links experiencing bending.*

Ultimately, that:

The static pin design is unsafe and promotes secondary bending in the links…

Mechanika Ltd's report was based on a defined orientation. It noted the complexity of the forces applied to chain elements when bent around a static pin. The report highlighted that:

The bending of the links around the static pin, has a more damaging effect on fatigue life when compared to pure axial tension. Load is transferred through curved surfaces - causing contact stress and bending at the interlink bearing points. Link deformation under tension is not purely axial: the straight portions of a link see axial tension, while the curved ends experience bending and contact pressure, especially at the crown. Misalignment (common in real-world use) can lead to secondary bending…

1.8 QUICK-RELEASE ALTERNATIVE ARRANGEMENTS

Other methods of preventing the capsize of beam and scallop dredgers by releasing fouled fishing gear from the derrick head have been developed. These include: the use of wire and sheave arrangements; the replacement of the derrick head arrangement with a swinging arm mechanism; and the provision of warp tension monitoring and release systems.

Secondary means of retaining the gear in the event of a chain failure, which prevents the gear from falling to the deck while still allowing the release of the gear in an emergency, have also been installed. Examples of the alternative arrangements were provided in MAIB Safety Bulletin SB1/2024 **(Annex C)** that was published following the accident.

There were no recorded reports to the MAIB of failures of quick-release assemblies where alternative arrangements were in use.

1.9 LIFTING EQUIPMENT INSPECTION AND MAINTENANCE

1.9.1 Lifting plan responsibilities

Honeybourne III carried a lifting plan detailing Macduff's requirements for the operation, maintenance and inspection of lifting gear.

The company was responsible for:

ensuring that equipment on the vessel is fit for purpose and safe to use.

having a maintenance and inspection regime to ensure that equipment remains in a safe condition.

having a system to ensure that the maintenance inspection regime is being followed.

The skipper was responsible for:

ensuring that the maintenance and inspection regime is carried out and safe procedures for use of equipment are followed.

The crew were responsible for:

> *complying with onboard procedures, following the orders of the skipper and reporting any defect that they notice.*

The lifting plan identified the *gantry, derricks, bridles, tow bars, dredges, the wires/ connecting shackles/blocks and the main fishing winch* as key components of the hauling arrangement.

1.9.2 Lifting plan inspection requirements

The lifting plan required two inspections of the lifting equipment: one each time it was used, to identify early indications of wear; and a thorough monthly examination.

A weekly inspection of lifting gear was carried out at the end of each trip, providing an opportunity to take any necessary corrective action while in port. The weekly inspection was carried out by the deckhands predominantly, and the findings were not formally recorded.

The monthly inspection was defined as:

> *A purposeful inspection conducted by a competent person (the Skipper or companies Superintendent)…This monthly inspection should be recorded in the vessel's LOLER register.* [sic]

The lifting plan provided guidance on the inspection of chains, stating that these should *be checked for twists and bends, nicks, cuts and gouges, stretch and elongation*, noting that:

> *Wear can occur in any portion of a link that is subject to rubbing contact with another surface* and that;
>
> *If in doubt the chain should be changed.*

The quick-release gear on board *Honeybourne III* was required to be removed from the derrick head monthly and *carefully inspected for wear, especially abrasion*.

The company provided no guidance on the conduct of inspections or assessment criteria, including wear limits.

1.9.3 Monthly inspection records

On *Honeybourne III*, the monthly inspection and thorough examination of lifting appliances required by the LOLER[7] lifting regulations were conducted by the skipper.

A paper-based record of inspections was used to record the inspection activities. The records matched the template provided by the MCA in Annex 3 (2) to Marine Guidance Note (MGN) 619 (F) Amendment 1 – *The application of the lifting operations 2006 (LOLER) and provision and use of work equipment regulations 2006 (PUWER*[8]*) to fishing vessels*. The records were contained in a file on board,

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[7] Statutory Instrument 2006 No. 2184, The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006.

[8] The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006.

the preamble for which stated that the skipper was required *to make up and keep complete records of the inspection, repair, maintenance and replacement of any hauling and lifting equipment*.

The skipper completed the records of inspection on a monthly basis. The records for 2023 indicated without comment that all of the gear passed each inspection.

A monthly report to the company included a checklist reporting the condition of all the lifting equipment on board. The checklist contained a specific reference to the condition of the *pin and horses head* and confirmation that the *block register (LOLER and PUWER)* was up-to-date. The checklist included a grading for the lifting equipment of *satisfactory*, *needs attention*, or *fail*. A statement on the checklist required the skipper to *advise fleet operations of any issues ASAP*.

In the 3 months before the accident the checklists recorded that an inspection of the items had been completed, and that the block register was up-to-date. The condition of the equipment in all cases was graded as *satisfactory*.

A month before the accident an inspection of the port derrick head was undertaken, during which the rotating collar was found seized and required freeing. The condition of the quick-release chain and static pin were described as being good at that time.

1.10 USE OF LIFTING APPLIANCES

1.10.1 The Lifting Equipment Engineers Association

The Lifting Equipment Engineers Association (LEEA) was an industry association for organisations involved in the lifting industry. It provided technical standards, training and guidance on lifting equipment inspection and operation.

On the safe use of chain slings, the LEEA *Code of Practice for Safe Use of Lifting Equipment (9th edition)* (LEEA COPSULE) advised that:

- *Chain is designed to support a load in a straight line. Therefore, chain should never be loaded when twisted or worse, knotted. Where chain is tensioned across an edge or corner, adequate packing must be used.*

- *Great care should be taken to avoid shock loading as it effectively increases the weight of a load and could result in the lifting equipment being grossly overloaded.*

- *A chain sling passing around a corner may have one or more links loaded in bending, which could result in premature failure of the chain.*

- *Chain slings manufactured to Grades S, T, 8 (or 80), 10 (or 100) and 12 (or 120) should not be used either immersed in acid solutions or exposed to acid fumes, as this can cause and phenomena known as hydrogen embrittlement or hydrogen cracking, that can seriously reduce the ductility and loadbearing capacity, cause cracking and catastrophic brittle failures at stresses below the yield stress of sling material.* [sic]

The LEEA COPSULE also highlighted that *the conditions of loading, including being subject to shock loads…if the load is to be transported over areas involving high risk, e.g. work areas* needed to be taken into account in the design of lifting systems.

The LEEA COPSULE recommended that a formal system of pre-use inspection be implemented, consisting of a visual check for any obvious defects, and provided examples of defects that would require the chain sling to be removed from service and referred to a competent person:

- *Stretched chain; if the outside length of the chain links is noticeably increased or if there is any lack of free articulation between the links.*
- *Bent or twisted links; slings used in choke hitch should be inspected more frequently paying particular attention to the point of choke.*
- *Wear; most common at the interlink seats.*
- *Cuts, nicks, gouges, cracks, excessive corrosion, heat discolouration, or any other defects in chain or fittings.*

1.10.2 International Maritime Organization

On 28 June 2023, the International Maritime Organization (IMO) produced MSC.1/Circ.1663 – Guidelines for lifting appliances (MSC.1/Circ.1663) detailing requirements for the inspection and thorough examination of lifting appliances subject to the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. MSC.1/Circ.1663 highlighted that wear, corrosion and damage to equipment required particular attention. It stated that:

> *All loose gear should be considered vulnerable to marine environmental conditions which may lead to significant and accelerated deterioration and corrosion and the inspection and maintenance regime should be implemented accordingly.*

Examples of aspects of equipment requiring particular attention included *damaged, worn or corroded chains* and *physical or chemical degradation, including degradation due to the exposure to the environment*.

1.10.3 European standards for information on use and maintenance of chains

The European standard BS EN 818-6:2000+A1:2008[9] (EN 818-6) set out withdrawal criteria and precautions to be taken on the use of chain. The precautions for use, inspection requirements and examples of defects aligned with those in the LEEA COPSULE and MSC.1/Circ.1663. EN 818-6 provided guidance on acceptable wear limits, stating that:

> *Wear by contact with other objects usually occurs on the outside of the straight portions of the links where it is easily seen and measured. Wear between adjoining links is hidden. The chain should be slack and adjoining links rotated to expose the inner end of each link. Inter-link wear, as measured by taking the*

[9] Short link chain for lifting purposes. Safety – Part 6: Chain slings. Specification for information for use and maintenance to be provided by the manufacturer.

diameter indicated (d_1) and the one at right angles, (d_2) may be tolerated until the mean of these diameters has reduced to 90% of the nominal diameter (d_n) **(Figure 8)**.

$$\frac{d1 + d2}{2} > 0.9dn$$

For illustrative purposes only: not to scale

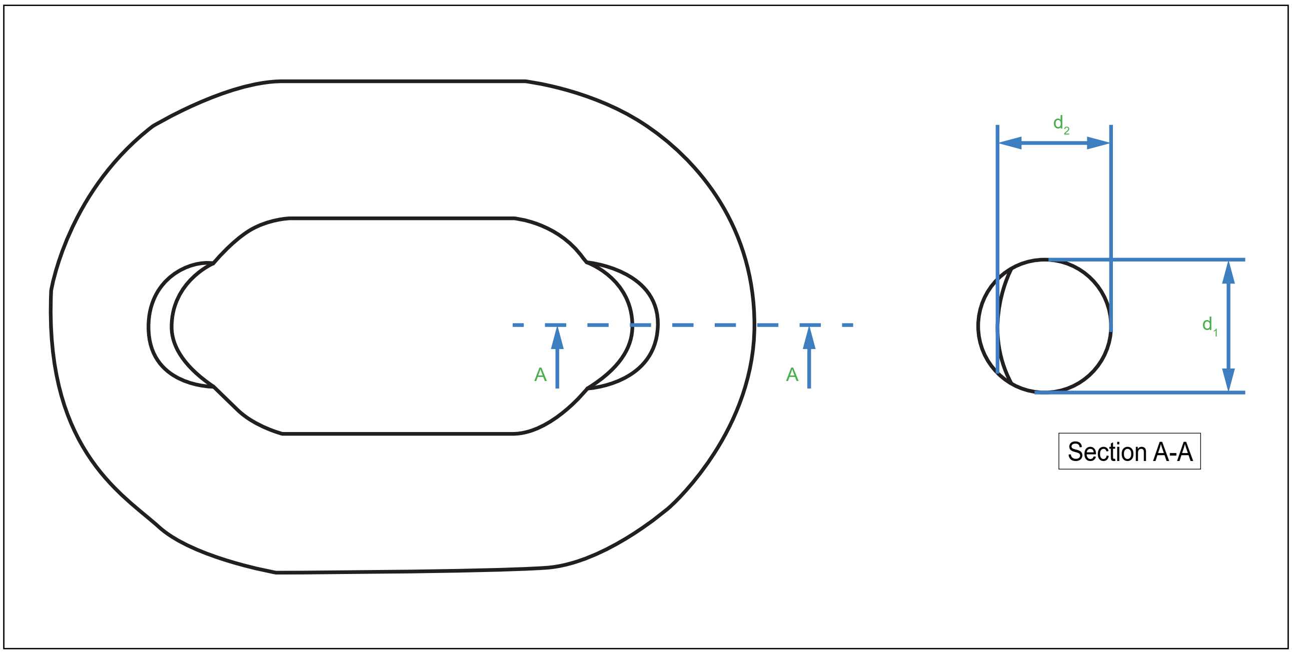

Figure 8: BS EN 818-6 guidance on acceptable wear limits

1.10.4 Chain supplier guidance

The UK supplier of the chain used on board *Honeybourne III* published guidance on the use and maintenance of alloy steel chain slings. On using chain slings in a basket configuration, where a chain was passed round a circular pin, the guidance stated that the WLL must be reduced when the ratio between the diameter around which the chain was routed and the nominal diameter of the chain was less than six.

1.10.5 Hydrogen embrittlement

Hydrogen embrittlement (HE) is a reduction in ductility and load-bearing capability due to the absorption of hydrogen by a metal. The result of hydrogen embrittlement is that components might crack and fracture at stresses less than the yield strength of the metal.

In October 2020, William Hackett Ltd issued technical guidance[10] on the effects of HE. The guidance identified the risk that HE increased as material hardness exceeded 38 HRC[11]. Section 1 of the guidelines cautioned:

> *Whilst chain and link products may be fully compliant with the relevant International Standards, the reality is that at the same time they may be unsuitable for use in the offshore environment.* [sic]

[10] Website: www.williamhackett.co.uk

[11] Hardness Rockwell C scale, using a diamond cone to indent the material. Equivalent to 348 Brinell Hardness.

Typically, when a product fails due to hydrogen embrittlement it is instantaneous and therefore the risks are severe.

Meeting the specific International standards should not therefore, be seen as a guarantee that specific equipment is fit for purpose in an offshore environment. [sic]

For chain used in marine lifting applications the guidance recommended the use of a Grade 8 chain *with a hardness of ≤38HRC*.

In 2014, the HSE published a guidance note: *Hydrogen cracking of grade T and grade 8 chain and components*[12]. The guidance stated that:

The hydrogen generated at the surface of a tensile-loaded, high-strength steel can enter the material lattice and embrittle the steel, increasing its susceptibility to failure by dynamic loading (shock loading). This is known as hydrogen embrittlement (HE).

1.11 REGULATORY OVERSIGHT OF LIFTING EQUIPMENT

1.11.1 Maritime and Coastguard Agency instructions for the guidance of surveyors

The instructions for the guidance of surveyors presented the MCA policy on the conduct of inspections and surveys. On the protection of the crew on fishing vessels, the Marine Survey Instructions for the Guidance of Surveyors (MSIS) 27.9[13] provided instructions for the assessment of winches, tackles and hoisting gear. It directly referenced the LOLER requirements, stating that:

9.3.10.7 Owners and skippers should be reminded that this is risk based legislation; there is no prescribed method or way of meeting the requirements. It is up to owners/skippers to demonstrate compliance. As with Risk Assessments, this is difficult to do unless written records of tests and inspections are maintained.

9.3.10.8 …The MCA takes the view that all lifting equipment on fishing vessels is subject to conditions causing deterioration. Therefore, lifting equipment should be load tested at least 5 yearly, and thoroughly examined at least annually by a third party and monthly by a competent person

MSIS 27.9 also stated that *if the hauling gear is controlled from the wheelhouse, the operator should also have a clear view of the crew working it, either directly or via any other suitable medium*.

Regulation 4(6) of LOLER disapplied the requirement in those regulations for a load test of lifting equipment at not more than 5-yearly intervals on fishing vessels.

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[12] Guidance Note PM39 – Hydrogen cracking of grade T and grade 8 chain and components (Third edition), 2014. http://www.hse.gov.uk/pubns/pm39.htm

[13] MSIS 27 Survey and Inspection of Fishing Vessels: Chapter 9 – Protection of the Crew.

1.11.2 Maritime and Coastguard Agency surveys

The MCA surveyors were provided with two documents to support the annual surveys of fishing vessels of 24m or over in length:

- MSIS 27 Chapter 1 Annex 17 Fishing vessel aide-memoire – 24m and over survey.
- MSIS 27 Chapter 1 Annex 17 Over 24m Fishing vessel annual-intermediate-renewal survey aide-memoire (for unclassed vessels).

Both documents contained the same single entry related to LOLER and PUWER:

> *Safety of operation of fishing gear, winches, wires, blocks, nets, lines etc (LOLER & PUWER Regs)*

The MCA published a leaflet for vessel owners/skippers titled *Fishing Vessel Surveys and Inspections: How to prepare for your next MCA visit*. On fishing and lifting gear, it stated:

> *PUWER and LOLER regulations apply. See MGN 619, MGN 331*[14] *and MGN 332*[15]*. This affects all equipment on a fishing vessel. The legislation is risk-based legislation; there is no prescriptive way of doing this. What is reasonably expected is that:*
>
> - *All work equipment and lifting gear should be maintained in good repair and working order*
> - *All work equipment and lifting gear should be tested and examined at regular intervals and a written record maintained of all tests and examinations*

The MCA did not consider its surveyors to be competent persons for the inspection or thorough examination of lifting equipment under the LOLER legislation. Surveyors relied predominantly on a vessel's on board written records for all such inspections and examinations during routine surveys. This policy was supported by a statement in MGN 619 (F) Amendment 1 that completion of the checklists with a record of any remedial measures taken would *generally be considered sufficient evidence of compliance*.

No lifting equipment deficiencies were raised during the surveys of *Honeybourne III* from 2020 until the accident, including the survey carried out in May 2023. At the post-accident inspection conducted by the MCA on 20 October 2023, a deficiency was raised stating that *numerous chain links within dredge gear on starboard side observed to have wear in the region of 50% of chain link diameter. Numerous other chain links on lifting gear throughout vessel observed to have evidence of wear*.

An intermediate survey of *Honeybourne III* on 11 March 2024 further identified that the pad eyes on the dredge beams were *wasted in access* [sic] **(Figure 9)**.

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[14] MGN 331 (M+F) Amendment 1 – The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006.

[15] MGN 332 (M+F) Amendment 2 – The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006.

Images courtesy of [Maritime & Coastguard Agency]

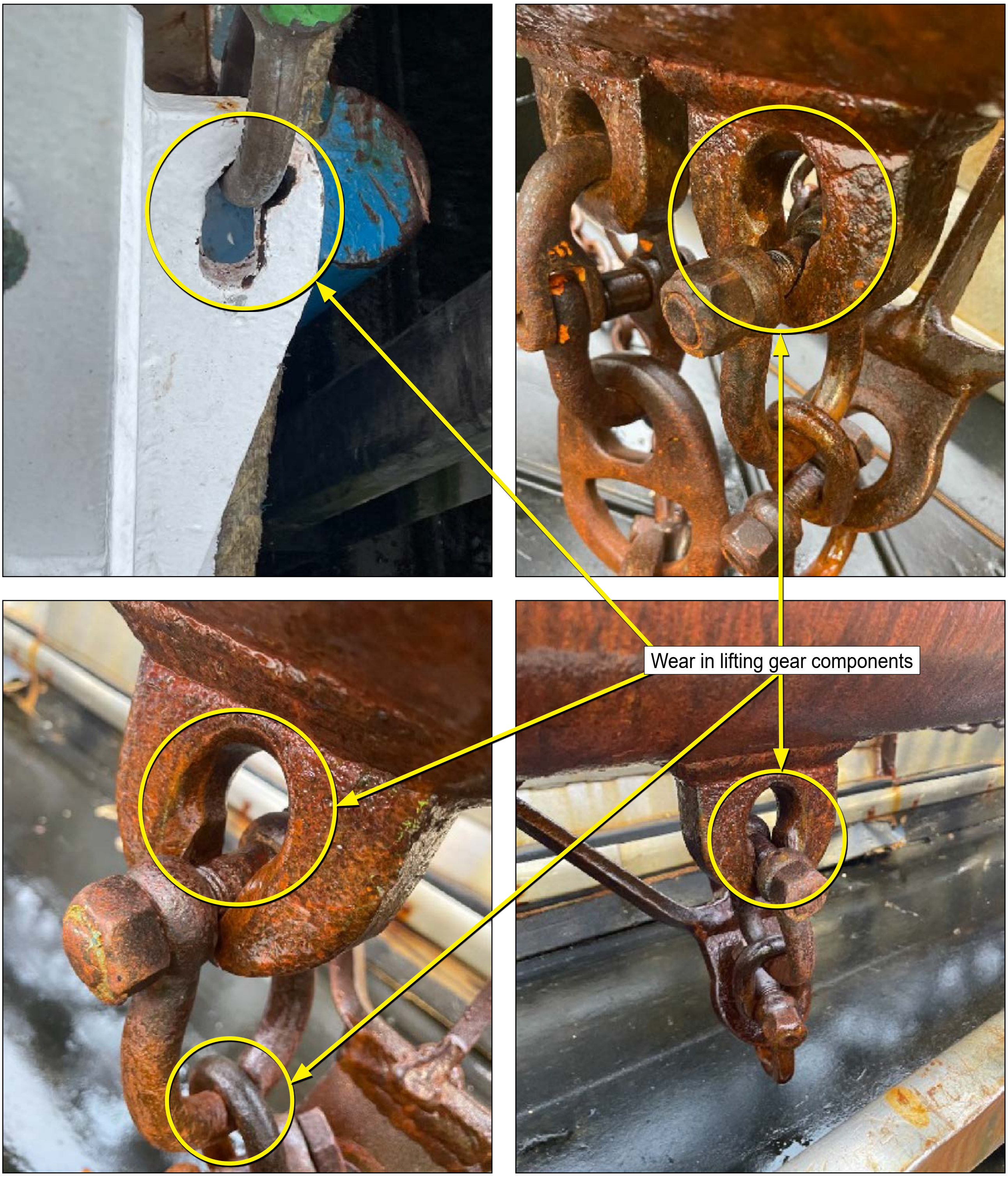


Figure 9: Post-accident lifting equipment deficiencies identified by MCA surveyors

1.11.3 Training of surveyors

The MCA did not provide dedicated training on the identification of lifting equipment defects, though a module on lifting gear was included in the internal *fishing gear technology course* that formed part of the surveyor accreditation programme. The training did not set out guidance on acceptable limits for wear of lifting equipment components.

The MCA did not set out any expectations for surveyors to assess the competence of those undertaking inspections or thorough examinations of lifting equipment.

1.11.4 Focused inspection campaign 2024

Following the accident on *Honeybourne III* the MAIB published a safety bulletin[16] **(Annex C)** highlighting concerns with derrick quick-release assembly chains. The safety bulletin made a recommendation to the MCA to conduct a focused inspection campaign (FIC) on board UK scallop dredgers and beam trawlers fitted with derrick head quick-release assemblies that incorporated chain. The FIC ended in December 2024.

Of 73 vessels initially identified with a derrick and beam arrangement, 49 were identified as having a chain over static pin arrangement at the derrick head. Inspections were carried out on 43 of these vessels; the remainder of the identified vessels were not in service. The FIC took the form of 18 inspection areas, each aligned to a LOLER lifting gear requirement and the safety issues raised in the MAIB safety bulletin.

More than one third of the vessels examined as part of the FIC had no documented risk assessment for lifting operations and a quarter had not accounted for the need for lifting equipment to be examined in exceptional circumstances.

More than 10% of vessels inspected during the FIC did not have procedures in place that ensured the competent person was appropriately trained and aware of their responsibilities. A similar proportion of vessels did not maintain records of the inspection and thorough examinations.

1.12 REGULATIONS AND GUIDANCE

1.12.1 Lifting equipment regulations

The LOLER legislation set out the responsibility of the employer to ensure that:

- Lifting equipment was *of adequate strength and stability for each load.*
- Any accessory for lifting was *of adequate strength for the purpose for which it is used and free from patent defect*.
- In selecting any accessory for lifting, that the atmospheric conditions were taken into account.
- Every lifting operation was carried out in a safe manner.
- Adequate and effective procedures and safety measures are established to secure the safety of workers during lifting operations ensuring that, *so far as is reasonably practicable, loads are not carried or suspended over areas occupied by workers, and where this is not reasonably practicable, a safe system of work is established, including adequate surveillance, to minimise the risks to workers who may need to be below the load*.

[16] Safety Bulletin SB1/2024 https://www.gov.uk/maib-reports/safety-warning-issued-following-a-chain-failure-on-scallop-dredger-honeybourne-iii-with-loss-of-1-life

Where lifting equipment or an accessory for lifting was exposed to conditions causing deterioration liable to result in dangerous situations, LOLER required it to be thoroughly examined at least every 12 months or in line with an examination scheme and, if appropriate, inspected by a competent person at suitable intervals.

The inspections and examinations of lifting equipment required by LOLER were intended to *ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time*.

1.12.2 Merchant Shipping Notice 1873 (F) Amendment 1

The Fishing Vessels (Codes of Practice) Regulations 2017 required *Honeybourne III* to comply with Merchant Shipping Notice (MSN) 1873 (F) Amendment 1 – The Code of Practice for the Construction and Safe Operation of Fishing Vessels of 24m Registered Length and Over (MSN 1873). Chapter 6 of this Code specified that:

> *All hoisting gear, hauling gear and related equipment shall satisfy the requirements of…the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006 No. 2184 as applicable, or any superseding documents.*

It also stated that:

> *The gear operator must have a clear view of the gear and any crew member working near it.*

And required that:

> *If gear is controlled from the wheelhouse, the operator must also have a clear view of the crew working near the gear, either directly or via any other suitable medium.*

1.12.3 Marine Guidance Note 619 (F) Amendment 1

In consultation with the Fishing Industry Safety Group the MCA published MGN 619 (F) to provide guidance to the fishing industry on how to comply with LOLER and PUWER.

The MGN reiterated and expanded on the guidance in MGN 332 (M+F) about the maintenance and inspection of lifting equipment, restating the general duties of the shipowner and the definition of the competent person. It included the MCA's view that *any lifting equipment fitted on a fishing vessel is subject to conditions causing deterioration, due to the effects of salt water, vibration and movement of the vessel*. The MGN stated that equipment not used for lifting people needed to be thoroughly examined by a competent person *at least every 12 months or in accordance with a scheme of examination laid down by a competent person*.

Annexed to MGN 619 (F) were checklists for fishermen to use when completing their lifting equipment inspections.

The MGN contained a caveat that an MCA surveyor may require additional examination, testing, or other remedial measures if they had grounds to consider the equipment unsafe.

1.12.4 Marine Guidance Note 332 (M+F) Amendment 2

This MGN provided guidance on the application of LOLER. It noted that serious accidents had been caused by the failure of lifting equipment or single point failures of equipment, stating that:

> *Corrosion, metal fatigue, inappropriate repairs or modifications and poor maintenance can all contribute to reduced safety margins.*

To ensure that all parts of lifting equipment were in good working order MGN 332 (M+F) advised that regular preventative maintenance should be carried out.

1.12.5 Marine Guidance Note 587 (F) Amendment 1

The guidance contained in MGN 587 (F) Amendment 1 – International Labour Organization Work in Fishing Convention (No. 188), Health and Safety: responsibilities of fishing vessel owners, managers, skippers and fishermen highlighted the general duty to avoid risks, including combatting risks at source and replacing dangerous practices or equipment. MGN 587 (F) stated that risks identified as unavoidable should be evaluated, and measures taken to reduce them to as low as reasonably practicable.

The MGN indicated that the provision and maintenance of plant, equipment, and systems of work were necessary to meet the general duties in the regulations.

1.12.6 Marine Guidance Note 415 (F)

On the need for quick-release assemblies, MGN 415 (F) – Fishing Vessels: The Hazards Associated with Trawling, including Beam Trawling and Scallop Dredging, stated that, *if snagged gear cannot be freed without hazarding the vessel, it should be released*. And, that *there should be an emergency means for the fast release of snagged gear*. It proposed that the owner should consider, among other suggested requirements:

- *bridge control or a suitable alternative method for the release or lowering of derrick head blocks. This will enable controlled lowering of the point of suspension of the load from the head of the derrick down to the shoulder block. This can prevent a dangerous list or capsize occurring if the gear picks up an abnormal load.*

- *That all of the lifting or hauling gear has been maintained and inspected and is in good order.*

1.12.7 Fishermen's Safety Guide

Published by the MCA, the Fishermen's Safety Guide provided advice on safe working practices and emergency procedures on fishing vessels. The guide advised that *to reduce the danger in a situation where the gear is fast on the seabed the derricks should be fitted with a release device to transfer the load from the end of the derrick to the side of the vessel*.

The section on *General considerations for working and lifting equipment* asked several questions, including whether the equipment on board was *inspected to ensure that it is, and continues to be, safe for use*. It advised that *inspections should be carried out by a competent person and a record kept until the next inspection*, noting the need for defective equipment to be taken out of service immediately.

The guide provided advice on the appropriate PPE to be used on board, stating that *Hard hats are to be worn if there is a risk of being struck on the head*. It also noted the risk of ropes or lifting tackle breaking under load and advised that crew should not stand underneath a suspended load.

1.12.8 Competent person

The LOLER legislation provided for different scales of activities through inspections and thorough examinations, each one being conducted by a person with the requisite competence for the task being undertaken.

The company was responsible for ensuring that the person conducting the inspections and thorough examinations met the LOLER definition of a competent person as:

> *a person possessing the knowledge or experience necessary for the performance of the duties under these Regulations*

The regulations did not dictate that formal training on the inspection or thorough examination of lifting equipment was required. A large number of training providers did deliver training on the examination of lifting equipment.

To help companies meet their responsibilities under LOLER, MGN 619 (F) Amendment 1 contained guidance on the role of the competent person stating that:

> *The Regulations require that a competent person carries out inspection, thorough examination and testing and determining the frequency of thorough examination. The level of competence required for each of these duties should be determined by risk assessment taking into account the complexity of the equipment. It should not be assumed that possession of a certificate of competency automatically means that person is a "competent person" for every duty under these regulations. The competent person in each case could be the skipper or a crew member or a shore-based person with the appropriate knowledge or experience. However, in respect of inspection and testing, the competent person should be sufficiently independent and impartial to allow objective decisions to be made.*

MGN 332 (M+F) provided guidance on the definitions contained in LOLER that mirrored that in MGN 619(F), further stating that:

> *It is for the shipowner and employer to satisfy themselves that the person carrying out an inspection, test, thorough examination or any other duty under these Regulations has such appropriate practical and theoretical knowledge and experience of the lifting equipment to be tested or thoroughly examined as will enable them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the lifting equipment.*

None of the guidance produced by the MCA in support of the fishing industry set out any expectations for the training of competent persons.

1.12.9 Maritime and Coastguard Agency safety bulletins

On 5 October 2020, the MCA published Safety Bulletin 17[17] reminding owners, employers, skippers and crew of UK fishing vessels of their responsibilities towards health and safety following a number of near misses, accidents, and a fatality during lifting operations. Although applicable to all fishing vessels, the safety bulletin highlighted scallop dredgers as being an immediate concern and identified the need to identify potential blind sectors in lifting operations.

On 20 August 2021, the MCA issued a further safety bulletin – Safety Bulletin 20[18]. This safety bulletin drew specific attention to the need for the established inspection regime for lifting equipment to be increased in areas of high load, high wear rates and high impact. The bulletin provided examples including lifting apparatus, chains, wires and pulleys – typical of that found on beam trawlers and scallopers. The safety bulletin advised that the assessment of lifting equipment should determine *the parameters within manufacturer's recommendations for continued acceptance of items of lifting equipment*.

Safety Bulletin 20 set out five actions for owners, operators, skippers, crew and safety advisors to ensure that vessels under their control:

1. *Have an inspection regime sufficient to inspect all items of lifting equipment including those likely to be subject to high load, high wear and high impact;*
2. *Have provided the competent person sufficient opportunity under appropriate conditions to be able to make an assessment for continued operation – which may require inspection techniques other than visual;*
3. *Have determined the parameters within manufacturer's recommendations for continued acceptance of items of lifting equipment;*
4. *Have determined the frequency of inspection, and where the risk indicates possibility of premature failure, to increase the frequency of inspection in accordance with the Regulations;*
5. *Have a system to record all inspections and changes to lifting equipment.*

1.12.10 Personal protective equipment

Amendment 2 of MSN 1870 (M+F) – The Merchant Shipping and Fishing Vessels (Personal Protective Equipment) Regulations 1999 set out appropriate standards for PPE to be used for different work activities on board ships.

Where there was a foreseeable risk to the head from falling objects, MSN 1870 (M+F) required the use of head protection to the BS EN 397 standard. The standard test involved a 5kg striker being dropped from a height of 1m onto the crown of the helmet.

[17] MCA Safety Bulletin 17: Safety concern over lifting operations on fishing vessels.

[18] MCA Safety Bulletin 20: Safety concern over lifting equipment inspections on fishing vessels.

1.13 PREVIOUS ACCIDENTS

1.13.1 *Cornishman* – fractured chain link

On 6 February 2021, a deckhand on board the beam trawler *Cornishman* was fatally injured when a suspended heavy steel trawl beam fell to the deck, striking and trapping him. The investigation (MAIB report 8/2025[19]) established that the deckhand was working beneath the suspended trawl beam when a chain link fractured, allowing the beam to fall.

Though fishing using a different method, the design of the quick-release assembly at the derrick head of *Cornishman* was the same as that on *Honeybourne III* with a chain leading over a static pin. The investigation highlighted that the lifting gear inspection regime did not identify the deterioration of the chain and that hydrogen embrittlement caused by operating a hard chain in a salt water environment caused cracks to form.

The report identified that the competent person did not possess the requisite knowledge to carry out effective inspections of the quick-release assemblies, which led to the defective chains remaining in service. The quick-release chains were corroded and worn, with corresponding grooving to the static pins.

The investigation report further identified that the guidance to MCA surveyors provided little detail about the survey requirements, though it did allude to checking maintenance records. The report raised the concern that MCA oversight of compliance with LOLER was not fully effective.

The report made a number of recommendations to the operator of *Cornishman* to improve the selection and maintenance of lifting equipment. Additionally, the report made recommendations to the MCA to provide guidance on training requirements for competent persons and to update its instructions for the guidance of surveyors. To assist operators in selecting the most appropriate chain for use in the marine environment, the report recommended that the chain manufacturer review its manufacturing process and offer hardness testing for the lifting chains it produced.

1.13.2 *Llanddwyn Island* – parting of hawser

On 1 March 2010, a deckhand on board the UK registered workboat *Llanddwyn Island* was fatally struck by a towing hawser when it parted during a towing operation (MAIB report 14/2010[20]). The failed element of the towing arrangement was a 13mm Grade 8 chain.

The report identified that there was a 25% reduction in strength due to the doubling up of the chain compared to a straight chain length. This had significantly reduced the chain's breaking load and ability to absorb the energy of shock loading.

[19] https://www.gov.uk/maib-reports/fatal-accident-on-the-beam-trawler-cornishman-with-loss-of-1-life

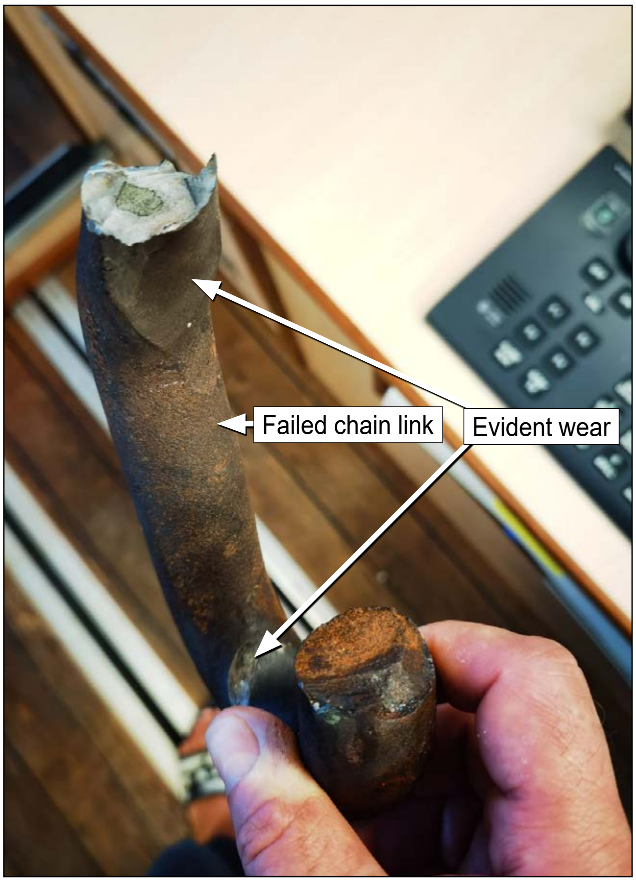
[20] https://www.gov.uk/maib-reports/parting-of-hawser-during-towing-operation-on-workboat-llanddwyn-island-at-roscoff-france-with-loss-of-1-life

1.13.3 *Isla S* – fractured chain link

On 22 September 2022, the derrick head quick-release chain parted while lifting the port dredge beam on *Isla S*, a scallop dredger operated by Macduff. The crew had hauled the gear aboard with the derricks fully raised and the forward and aft safety chains secured. The towing block fell to the deck below and the dredge beam fell outboard. There were no injuries or fatalities.

The chain link had failed in a similar manner to that on *Honeybourne III* **(Figure 10)**. An internal investigation into the failure concluded that the link failed due the presence of an unidentified hairline crack.

Images courtesy of Macduff Shellfish (Scotland) Ltd



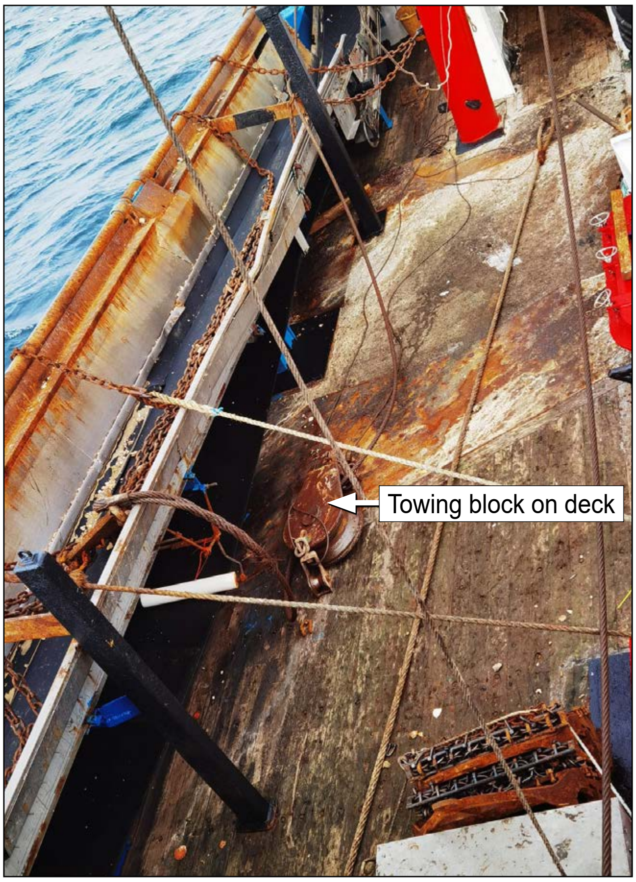


Figure 10: Failed quick-release assembly on *Isla S*

The circumstances of the accident were promulgated to the Macduff fleet, stressing the *importance of thorough weekly/monthly checks of lifting gear*. The corrective action also stated a need to discuss *the roles and responsibilities with Skippers & mates about who inspects our lifting gear onboard. Skippers & mates should be the ones doing these inspections – not just their crews*. [sic]

In response to the accident, Macduff changed its policy on the replacement schedule for the wires and chain components of the quick-release assemblies, to change them after a set period of time rather than waiting until an on board inspection found a fault with them.

The incident was not reported to the MAIB.

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 OVERVIEW

Denver Teleron was fatally injured when a 155kg dredging gear towing block fell on him as he walked along the port conveyor belt shortly after he had secured the aft safety chain to the dredge beam.

The weight of the dredging gear had been supported solely by the quick-release assembly that included a length of chain. The outermost chain link fractured where the chain passed over a static pin in the derrick head, allowing the port dredging gear, including the towing block, to fall.

The analysis considers working under suspended loads, the mechanism of the chain link failure, and the inspection and maintenance of lifting equipment on board *Honeybourne III*. It also analyses the guidance material available to support the inspection of lifting equipment and the conduct of the oversight completed by the MCA.

2.3 FATIGUE

The deckhand was approaching the end of a 6-hour watch and the mate had just relieved the skipper after a period of rest. Given the nature of the actions of the crew and the mechanism of the chain failure, it is unlikely that fatigue contributed to the accident.

2.4 ACCIDENT AND RESPONSE

When the chain on the port quick-release assembly failed, the dredging gear fell, and deckhand 1 was struck by the falling towing block. The damage on the port corner of the wheelhouse was almost certainly caused by a glancing blow from the block as it descended. The exact position of deckhand 1 when he was struck by the block and the trajectory of the block itself could not be determined. However, deckhand 1 fell to the side of the deckhouse indicating that he likely fell from the conveyor adjacent to this position. The speed of descent of the block when it released was increased by the tension on the towing warp. The force of the impact on the left-hand side of deckhand 1's head was substantial.

Deckhand 1 died when he was struck on the head by the towing block of the port dredging gear after it was released from the derrick head when the chain element of the quick-release assembly failed.

2.5 SAFETY MANAGEMENT ON BOARD *HONEYBOURNE III*

2.5.1 Working below suspended loads

Access to and from the conveyors on *Honeybourne III* was provided by the steps positioned amidships on each side of the working deck. With the derricks raised up to the buffers, it was not possible for crew to descend the steps from the conveyors without passing under the lifting blocks holding the entire load of the dredging gear.

The towing block was above the port corner of the wheelhouse when the port derrick was hauled up to the buffer and the gear tensioned against the safety chains. It is unclear whether the failure of the quick-release chain that led to the blocks falling to the deck was considered a specific hazard to be included in the risk assessment.

Macduff's implemented SMS contained risk assessments that highlighted the risks of objects falling from height. The accident on board *Isla S* the previous year had shown that this was a possibility. Had they been effectively applied, the mitigations identified in the risk assessment would have ensured that the crew were clear of the suspended loads.

The lifting plan on board *Honeybourne III* formed part of the operational procedures in the SMS. It was unclear how far aft the defined safe zone extended in the lifting plan photograph **(**see **Figure 2)**, or whether the risk of a failure of the gear had been factored into the assessment of the area considered safe. The working deck's configuration made it very unlikely that the crew were able to undertake the hauling operation without at some point working below lifting equipment bearing the entire weight of the dredging gear and under tension from the winch.

The routine operating practice of attaching the safety chains and tensioning the gear while crew remained on the conveyor undermined the lifting plan mitigation that crew should be in safe positions during shooting and hauling operations.

The safety management system did not effectively manage the risk to crew working below suspended loads.

2.5.2 Visibility of lifting operations

The winch operator was predominantly reliant on the deckhand at the forward end of the dredge beam to monitor the activities of their colleague and communicate with them.

The operation at the time of the accident followed the process routinely undertaken during retrieval of the dredging gear. It is unlikely that deckhand 1's presence on the conveyor would have influenced the conduct of the operation had his presence on the conveyor been noted by the mate operating the winch controls.

2.5.3 Personal protective equipment use and placement

With the exception of his safety helmet, deckhand 1 was wearing PPE in line with company and regulatory requirements. Deckhand 1's routine wearing of an inappropriate standard of safety helmet was not identified on board.

The left-hand side of the safety helmet, where deckhand 1 sustained the injury that led to his death, had no significant damage. It was not possible for him to have fastened the helmet he was wearing as one of the securing clips was missing from the helmet strap. It is therefore very likely that the helmet was dislodged either as deckhand 1 made an attempt to avoid the falling block, or as the block struck him. In either case, there is no evidence that the helmet absorbed any of the force imparted by the falling towing block.

The weight of the towing block, and the height it fell from, meant that the energy of the impact significantly exceeded the performance standard of both the helmet worn and those constructed to the BS EN 397 standard required by the regulations. It is unlikely that the outcome of the accident would have been different had deckhand 1 been wearing a safety helmet that met the requirements for use on the working deck.

The PFDs and safety helmets provided for the use of the crew on *Honeybourne III* were stowed in the whaleback. When called to haul the gear, the crew had to pass along the open deck without wearing head protection or a PFD.

The stowage location of the PPE on board *Honeybourne III* placed the crew at risk from the hazards the use of PPE was intended to mitigate. The inappropriate standard of PPE worn by deckhand 1 placed him at greater risk.

2.6 QUICK-RELEASE CHAIN FAILURE

2.6.1 Load experienced by quick-release chain component at failure

The free weight on the quick-release chain at the derrick head when the catch was recovered, including an estimated 25kg of catch in each of the 17 dredges, totalled approximately 9t; less than half the WLL indicated in *Honeybourne III*'s lifting plan.

When the gear was recovered and the towing warp fully wound onto the drum, the maximum load the winch could exert was 14.4t. The mechanical advantage of the gear arrangement resulted in a 28.8t maximum load able to be generated by the winch at the quick-release chain.

The WLL of the quick-release chain at the derrick head was 31.5t. It is therefore very unlikely that the force generated by the winch alone, with the warp fully wound onto the drum, would have been able to overload the chain had it been loaded in a linear orientation.

When dredging, fewer layers of warp on the winch drum meant that the increased torque available from the winch was sufficient for the load on the chain to exceed the WLL of the quick-release chain. This would have the effect of reducing the chain's factor of safety, but the load would not exceed its minimum breaking load. It is likely that the chain would have experienced shock loading during dredging operations as the dredge encountered seabed obstructions.

The port dredging gear of *Honeybourne III* was recovered to the head of the davit at the time of the accident. When brought up hard against the safety chains, it is almost certain that a shock loading was applied to the quick-release chain.

2.6.2 Effect of chain orientation on chain stress

The HSE report indicated that the chain sections were not intrinsically unsound when loaded in a linear fashion. When tested, the chain sections sustained loads well in excess of the WLL contained in the chain standard.

The chain in the port quick-release assembly passed over a static pin in the derrick head. The orientation of the chain over the static pin imparted a bending moment into the outer chain links. Those links at the inner end of the chain section were primarily loaded linearly, and were therefore subject to less bending.

The available guidance on chain orientation highlighted that chain should be loaded in a linear fashion and that when links were subject to bending the WLL should be reduced. The chain supplier's guidance highlighted that, even when new, the orientation of a 32mm chain over a static pin with a diameter of 168mm (a ratio of 5.25) would affect the WLL of the chain. Mechanika's assessment of stress in the chain links confirmed that, where a chain passed over a static pin, the links would be subject to two-point bending that imparted high stresses and plastic strain on them. It also highlighted that the level of stress on the chain links would increase with reducing pin diameter.

The wear observed in the surface of the static pin would have the effect of reducing the nominal diameter of the pin, further increasing stress as wear increased.

Mechanika's analysis supported the findings of the MAIB report on the investigation into the failure on *Llanddwyn Island* and industry guidance that indicated that the use of a chain where it was subject to bending moments effectively reduced its WLL. The Mechanika report highlighted the complex nature of the loads applied to the chain components, making it problematic to accurately assess the risk of failure.

The wear to the static pin effectively reduced the ratio between the diameter of the static pin and the chain diameter, increasing the bending moments on the chain links. The combination of high loading and the bending moments created by the passage of chain over the static pin in the port derrick head increased stress in the chain links. This reduced the ability of the chain to withstand the load applied, placing the crew working on deck at risk.

2.6.3 Wear and deformation of derrick head components

The HSE analysis of the materials of the chain in the port quick-release assembly and the static pin in the derrick head showed that the hardness of the chain material was substantially higher than that of the pin. Wear was therefore greater on the outer surface of the static pin than on the chain links.

The cheek plates of the derrick head showed evidence of the chains leading around the edge of the plates while under load. This wear supports that the derrick head was at times unable to rotate to follow the direction of the load from the gear and the rotation of the gear was taken up in the quick-release chain sections. This was further evidenced by the significant wear apparent in the chain links and hammerlock shackle.

The HSE report identified the amount of wear in the chain link crowns as being in excess of the maximum allowed by the guidance contained in the EN818-6 standard **(**see **Figure 8)**.

Relative movement between elements of the quick-release assembly due to partial seizure of the derrick head rotating collar accelerated wear. The wear reduced the strength of the components and increased the risk of failure.

2.6.4 Chain failure mode

The intact sections of the chains recovered from *Honeybourne III*'s port and starboard quick-release assemblies were tested to destruction in a linear orientation by the HSE. Despite the wear and deformation observed, the chains both withstood a load of more than 80% of the minimum breaking load required by the EN818-2 standard, and significantly more than the WLL of the chain.

Comparison of the fracture surfaces of the chain sections tested by the HSE and those of the partial chain link recovered from *Honeybourne III* showed that the modes of failure were different. The chains tested failed by the crown of one link being pulled through the crown of the adjacent one, shearing the material of the link, while the initial failure of the chain link at the port derrick head on *Honeybourne III* was a brittle fracture of one shank followed by a ductile failure of the other. There was no evidence of a developing defect or fatigue on the failure surface of the partial chain link.

The HSE report noted that the hardness of the material of the partial chain link was slightly below 400 Hv10, equating to approximately 43 HRC. Without a hardness test being recorded at manufacture, it was not possible to determine whether the hardness of the chain had increased through the period the chain was in use. However, this value was higher than the industry recommended maximum values to prevent HE. The lower elongation of the chain sections when the chain sections were tested indicated a lower ductility than recorded on the test certificates at manufacture, suggesting that the chain material had become less ductile over time.

The elongation test conducted by the HSE on the material samples extracted from the recovered partial chain link were not comparable to the EN 818-2 standard test procedure, which tested the elongation of a chain assembly.

The instantaneous failure of the chain was aligned with the risk of failure of an HE affected steel highlighted in the industry guidance. In the report of its investigation into the chain failure on board *Cornishman* the MAIB recommended to the chain manufacturer that it offers its customers a hardness test certificate for the lifting chain it manufactures to inform decisions on its use.

The failed link photographed as part of the internal investigation into the chain failure on *Isla S* appeared almost identical to that from *Honeybourne III*. Although not subject to detailed analysis, it is likely that the failure mode of the chain on *Isla S* was the same as that experienced on *Honeybourne III*.

It is most likely that the chain link failed as the result of a single high load event when the dredging gear was hauled to the derrick head against the tension of the safety chains. The configuration of the chain over a static pin at the head of the port derrick imparted a bending moment into the links of the chain. The shock loading applied by the winch, combined with this bending moment, likely caused an area of high stress in the outermost chain link.

It is likely that the chain link strength on the port quick-release assembly was reduced by its material hardness, making it susceptible to instantaneous failure under a single high load event.

2.7 EXAMINATION OF LIFTING EQUIPMENT

2.7.1 On board inspections

The wear evident in the quick-release gear at the derrick head was substantial. *Honeybourne*'s on board records of inspections carried out before the accident indicated that the skipper, designated by Macduff as being the competent person for the inspection of lifting equipment, considered this satisfactory.

The condition of the gear observed was difficult to reconcile with inspections carried out to the expected standard described in *Honeybourne III*'s lifting plan, MGN 619 (F), MGN 332 (M+F) and IMO circular MSC.1/Circ.1663.

Wear limits were available from a number of sources, including EN 818-6 and the LEEA COPSULE. The MCA's Safety Bulletin 20 highlighted the need for parameters to be set against which the condition of lifting equipment could be assessed. The *Honeybourne III* lifting plan set out a requirement to check for *excessive wear*, but did not define what 'excessive' meant.

With no supporting guidance on board, the inspections on *Honeybourne III* were wholly reliant on the judgement of the person completing them to determine the safety of the equipment being inspected. In its internal investigation into the equipment failure on board *Isla S*, Macduff had acknowledged that it was aware on board inspections might have been further delegated to other crew members.

The failure on board *Isla S* also provided an opportunity for the company to review the arrangement against the risk that a quick-release assembly was intended to mitigate and recognise the inherent risk of operating chains over static pins in the Macduff fleet. However, believing the arrangement to be a mandatory requirement, a more detailed assessment of the suitability of the arrangement was not conducted.

The assignment of the role of competent person to the skipper was based solely on their position and the expectation that their maritime experience would be sufficient to enable them to undertake effective inspections. No account was taken of the guidance in MGN 619 (F) concerning the independence and impartiality of the competent person, nor the need for the selection of the competent person for specific tasks to be based on a risk assessment.

There is no evidence that Macduff placed any pressure on skippers around the conduct of examinations, or restrictions on the ordering of replacement equipment; however, it is probably unrealistic to expect any crew member to be truly impartial.

The ongoing assessment of the condition of *Honeybourne III*'s quick-release assemblies required an understanding of chain loading, the effects of the environment, corrosion and applicable wear limits, which none of the crew possessed. The programme of on board inspections failed to detect substandard gear.

The remedial action following the *Isla S* accident was insufficient to prevent a failure occurring on *Honeybourne III*. The inspection programme on board *Honeybourne III* did not identify the underlying risk of a chain under load leading over a static pin, nor excessive wear in the quick-release assembly components. These factors reduced the strength of the arrangement and risked failures occurring in service, endangering the crew.

Without a capable competent person undertaking inspections and thorough examinations of lifting equipment, defects were not identified and the crew were placed at risk of equipment failing in service.

2.7.2 The competent person

The regulations placed a responsibility on the employer to ensure that inspections and thorough examinations were carried out by someone with the appropriate competence. The necessary attributes necessary for someone to act as a competent person were ill-defined in LOLER.

The guidance in MGN 619 (F) offered little additional detail beyond the existing regulatory requirements. It primarily restated the employer's responsibilities and suggested that the designation of a competent person should be determined through a risk assessment. The guidance in MGN 332 (M+F) Amendment 2 also left the selection of the competent person and their training needs to the company.

The report on the investigation into the failure of lifting equipment on board *Cornishman* concluded that *the industry guidance lacked clarity in the knowledge and competency requirements needed to carry out effective monthly and yearly inspections and examinations of lifting equipment*. The results from the MCA FIC and the ineffective inspection regime on board *Honeybourne III* further support the findings of the investigation into the fatal accident on board *Cornishman*.

The MCA published Safety Bulletin 20 after the accident on board *Cornishman*. This safety bulletin introduced guidance on the need for a competent person to be *appropriately trained*, implying that reliance on professional certification and experience alone might be insufficient to undertake the role and specific training may therefore be necessary. The safety bulletin did not expand with guidance on what training might be appropriate.

The accidents on board *Cornishman* and other vessels suggest that the training of competent persons across the fishing sector is ineffective and industry guidance lacks clarity as to the level of knowledge and competency required to carry out effective inspections and examinations of lifting equipment.

2.7.3 Maritime and Coastguard Agency oversight of lifting equipment

Annual surveys of *Honeybourne III* were carried out by MCA surveyors. The aide-memoire used during these surveys included a single entry associated with lifting equipment.

The guidance to surveyors in MSIS 27.9 on lifting gear provided little detail about survey requirements and the MCA was clear in its policy that surveyors were not considered to be competent persons under the terms of LOLER. With limited training provided to MCA surveyors, the scope and conduct of any inspections of lifting equipment was based almost entirely on the professional judgement of the individual surveyors undertaking the surveys and the examination of on board records.

The MCA's post-accident inspections of both *Honeybourne III* and *Cornishman* identified defects in lifting equipment, some of which almost certainly existed at the time of earlier surveys. The surveyors undertaking inspections during the FIC in 2024 also identified noncompliances with LOLER.

The MCA Safety Bulletin 20 contained a set of actions to be taken by owners, operators, skippers, crew and safety advisors to improve the effectiveness of lifting equipment inspections but the verification of these actions did not form part of the inspections carried out by MCA surveyors.

The procedures for the routine survey and inspection of vessels did not effectively verify that lifting equipment was free from patent defects. The MCA surveyors did not examine the capability of competent persons to undertake effective inspections and thorough examinations. They therefore did not actively verify that such inspections had been conducted to an appropriate standard.

The framework of oversight of inspections by the MCA surveyors was ineffective in assuring the safety of lifting equipment.

2.8 COMPARISON WITH ALTERNATIVE ARRANGEMENTS

The use of a chain over a static pin at the derrick head introduces stresses and promotes wear in the chain links. The use of such arrangements on fishing vessels is historic and many remain in use.

In the two and a half years before the accident on *Honeybourne III* the failure of a loaded chain as it passed over a static pin resulted in the deaths of two people, and injury to others. It is not clear how many unreported failures, such as that on *Isla S*, occurred in the same timeframe. The MAIB did not receive any reports of failure of an alternative system at the derrick head in the same period.

Of the 73 vessels considered for the MCA's FIC inspection, 24 were fitted with alternative arrangements. The stresses induced into the links of a chain under load led over a static pin are uncertain. Where such an arrangement in a quick-release assembly is the sole means of supporting a load, the use of an alternative system at the head of a derrick would reduce the risks from a single component failure.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. Deckhand 1 died when he was struck on the head by the towing block of the port dredging gear after it was released from the derrick head when the chain element of the quick-release assembly failed. [2.4]

2. The company's SMS did not effectively manage the risk to crew working below suspended loads. [2.5.1]

3. The company had not recognised the inherent risk in operating chains over static pins on *Honeybourne III*. [2.7.1]

4. The combination of high loading and bending moments in the outer chain links of the quick-release assembly led over a static pin increased stress in the chain links. This reduced the ability of the chain to withstand the load applied and placed crew working on deck at risk. [2.6.3]

5. The wear to the static pin effectively reduced its diameter, increasing the bending moments on the chain links. This reduced the ability of the chain to withstand the load applied and placed crew working on deck at risk. [2.6.2]

6. It is likely that the chain link strength on the port quick-release assembly was reduced by its material hardness, making it susceptible to instantaneous failure under a single high load event. [2.6.4]

7. The programme of on board inspection of lifting equipment did not identify patent defects in *Honeybourne III*'s lifting equipment to ensure it remained fit for purpose. [2.7.1]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The stowage location of the PPE on board Honeybourne III placed the crew at risk from the hazards the use of PPE was intended to mitigate. [2.5.3]

2. The inappropriate standard of PPE worn by deckhand 1 placed him at greater risk of injury from falling objects. [2.5.3]

3. It is unlikely that deckhand 1's presence on the conveyor would have influenced the conduct of the operation had his presence on the conveyor been noted by the mate operating the winch controls. [2.5.2]

4. Relative movement between elements of the quick-release assembly due to partial seizure of the derrick head rotating collar accelerated wear, reducing the strength of the components and increasing the risk of failure. [2.6.3]

5. Recent accidents indicate that the training of competent persons across the fishing sector is ineffective and industry guidance lacks clarity as to the level of knowledge

and competency required to carry out effective inspections and examinations of lifting equipment. [2.7.2]

6. The regulator did not examine the capability of competent persons to undertake effective inspections and thorough examinations. It did not, therefore, actively verify that such inspections had been conducted to an appropriate standard, leading to the risk that inspections were ineffective in assuring the safety of lifting equipment. [2.7.3]

7. The framework of oversight of inspections by the MCA surveyors was ineffective in assuring the safety of lifting equipment. [2.7.3]

8. The stresses induced into the links of a chain under load led over a static pin are uncertain. Where such an arrangement in a quick-release assembly is the sole means of supporting a load, the use of an alternative system at the derrick head would reduce the risks from a single component failure. [2.8]

SECTION 4 – ACTION TAKEN

4.1 MAIB ACTIONS

The **MAIB** has:

- Issued a safety bulletin **(Annex C)** urging owners and operators of beam and scallop trawlers to inspect their vessels' quick-release arrangements and to make any necessary changes to the equipment or its operation to ensure the safety of crew working on deck.

- Issued a safety flyer to the fishing industry **(Annex D)**.

- Made recommendations in its report on the investigation of the fatal accident to a deckhand on board the beam trawler *Cornishman* (PZ 512) that the Maritime and Coastguard Agency:

2025/114 *Update The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006 guidance to state the training requirements and accreditation of competent persons carrying out lifting equipment inspections, including:*

- *monthly and yearly company inspections*
- *annual third party inspections*
- *5-yearly load testing*

2025/115 *Update its training and guidance to surveyors to improve their ability to check compliance with The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006 during surveys.*

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

Macduff Shellfish (Scotland) Limited has:

- Started a programme for replacing the chain over static pin configuration at the derrick head on all of its vessels.

- Initiated a programme of quarterly lifting equipment inspections by the company superintendents.

- Updated its SMS to require that crew members should not walk or stand under a suspended load unless absolutely necessary, and if undertaken that all winch operations should cease until the crew member has returned to a designated safe zone on deck.

- Engaged the services of a training company to develop a course for the pre-use inspection of lifting equipment and accessories in the maritime and fishing environment, and initiated a training programme for its crew members.

- Issued instructions to its fleet personnel on the positioning of PPE such that it may be donned before exiting onto the working deck.

- Issued instructions that only safety helmets meeting the appropriate standard are to be used on its vessels.

- Reminded the skippers of its vessels of the need to thoroughly inspect all lifting equipment each time the vessel is in port and to replace any item showing signs of wear.

- Reviewed and amended its procedure for the conduct of lifting equipment inspections and the training requirements for crew undertaking such inspections.

The **Maritime and Coastguard Agency** has:

Undertaken a focused inspection campaign in line with MAIB recommendation S2024/101 to:

- Raise awareness among skippers and crews of the significant hazards associated with the use of chain links passing over a static pin as part of the derrick head quick-release assembly;

- Confirm that the risk of a failure of the derrick head quick-release assembly has been assessed, mitigated and documented by the owner, operator and/or skipper of the vessel; and

- Verify that the crew has been informed of the findings of the risk assessment and the measures taken for their protection in the event of a failure of the derrick head quick-release assembly.

SECTION 5 – RECOMMENDATIONS

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

2026/101 Take steps, using the relevant powers provided by sections 261 (improvement notices) and 262 (prohibition notices) of the Merchant Shipping Act 1995, to reduce the substantial risk presented by the use of a chain led over a static pin as the sole means of supporting a suspended load.

2026/102 Update its instructions for the guidance of surveyors to incorporate a verification that the actions contained in its Safety Bulletin 20 have been completed.

Safety recommendations shall in no case create a presumption of blame or liability

Annex A

Health and Safety Executive Science Division report EM/24/36:
Analysis of the chain failure on board scallop dredger *Honeybourne III*

Commercial in Confidence

BESPOKE RESEARCH AND CONSULTANCY FROM HSE

Analysis of the chain failure on board scallop dredger *Honeybourne III*

Author(s): [redacted]

Report number: EM/24/36

ANALYSIS OF THE CHAIN FAILURE ON BOARD SCALLOP DREDGER *HONEYBOURNE III*

Report approved by:	[redacted]
Date of Issue:	20 Dec 2024
Lead Author:	[redacted]
Customer:	Marine Accident Investigation Board (MAIB)
Technical Reviewer(s):	[redacted]
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Disclaimer:
This report and the work it describes were undertaken by the Health and Safety Executive (HSE) under contract to the MAIB. Its contents, including any opinions and/or conclusions expressed or recommendations made, do not supersede current HSE policy or guidance.

ABBREVIATIONS

AIS	Advanced Imaging Solutions
AISI	American Iron & Steel Institute
BS	British Standards
EN	European Norm
HSE SD	Health and Safety Executive Science Division
ISO	International Standards Organisation
MAIB	Marine Accident Investigation Branch
MBL	Minimum Breaking Load
MPI	Magnetic Particle Inspection
MVC	Micro Void Coalescence
NDT	Non-Destructive Testing
OES	Optical Emission Spectroscopy
PMI	Positive Material Identification
RofA	Reduction of Area
SEM	Scanning Electron Microscope
TTI	TTI Testing Limited
UTS	Ultimate Tensile Strength
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

Background

The Health and Safety Executive Science Division (HSE-SD) was engaged by the Marine Accident Investigation Branch (MAIB) to provide technical support to the investigation into the death of a fisherman. The deceased person was struck when fishing gear fell on him as a result of a failure of a chain that formed part of the towing block quick release system at the port derrick head on board the UK registered fishing vessel *Honeybourne III* on 6 October 2023.

According to the MAIB the chain failed at the point it passed over the static pin allowing the gear to fall striking and fatally injuring a fisherman.

Objectives

The purpose of this research is to examine and test the components of the quick release mechanism to determine why it failed and identify any contributory factors that led to the failure.

The following scope of works was agreed with the MAIB with dimensional, chemical and mechanical test results to be compared to the requirements of BS EN 818-2 1996+A1:2008 [1].

- detailed visual examination of the partial chain link, port and starboard quick release chains and the port derrick head and static pin
- 3D laser scan of partial chain link, port and starboard quick release chains and the port derrick head and static pin
- characterisation of the fracture surfaces of the partial chain link
- chemical analysis to determine the composition of the chain material and static pin
- perform magnetic particle inspection (MPI) on the partial chain link and the port and starboard quick release chains to identify any cracks or crack precursors
- metallography of the partial chain link and the static pin to determine the heat treatment condition of the components and identify any evidence of manufacturing defects
- perform hardness testing on the partial chain link and the static pin
- perform tensile test on the partial chain link
- perform minimum breaking load assessment on port and starboard quick release chains and a 7-link section of new chain

Conclusions

The metallurgical examination of the partial chain link showed no evidence of manufacturing defects which could have contributed to a premature failure. Also no evidence of any pre-existing cracks or progressive failures such as fatigue, stress corrosion cracking or excessive corrosion, was found.

The overall condition of the chains and the static pin showed evidence of corrosion, deformation and wear consistent with the conditions to which they are subject during service. The port and starboard chains were acceptable to the 90% of nominal minimum mean diameter requirement in BS EN 818-6 [2], with the exception of links 6 and 7 of the starboard quick release chain 23310.

Links 6 and 7 of the starboard quick release chain were measured as 87% of nominal mean diameter and therefore outside of the tolerated wear, as defined by the standard.

Magnetic particle inspection showed no evidence of any significant surface breaking cracks indicating that the chains contained no features that were likely to lead to a premature failure.

The minimum break load testing showed that, despite the wear in excess of that tolerated by the standard, the chains were capable of performing at above the working load limit. They achieved a load of up to 90% of the MBL as defined in BS EN 818-2 [1] for chains of this type. It can therefore be shown that the chain was not intrinsically unsound and was capable of performing as designed.

Metallurgical assessment of the links shows a microstructure consistent with a hardened and tempered steel this is as expected for a Grade 8 short-link chain.

The fracture surface of the partial link was predominantly flat with a faceted appearance and a shear lip around the full circumference. This indicates that the failure of the chain link was most likely as a result of a single high load event that caused a brittle fracture on one shank of the chain link followed by a ductile failure on the other shank of the link.

The nature of these fracture surfaces, when compared to the failure mode of the chains subject to MBL, show that the loading of the fractured chain link was not along the axis of the chain. It was likely loaded in bending during the incident, overloading the link and causing it to fracture.

The static pin had a lower hardness than the chain and showed significant wear and deformation with the wall thickness reduced in places to 21 mm from 32 mm. The grooves in the pin could restrict lateral movement of the chain which in turn could have contributed to the failure.

CONTENTS

1 INTRODUCTION

The Health and Safety Executive Science Division (HSE-SD) was engaged by the Marine Accident Investigation Branch (MAIB) to provide technical support to the investigation into the death of a fisherman. The deceased person was struck when fishing gear fell on him due to the failure of a chain. The chain formed part of the towing block quick release system at the port derrick head on board the UK registered fishing vessel *Honeybourne III* on 6 October 2023.

According to the MAIB, the chain failed at the point it passed over the static pin allowing the gear to fall, striking and fatally injuring a fisherman.

The purpose of this research is to examine and test the components of the quick release mechanism to determine why it failed and identify any contributory factors that led to the failure.

The following scope of works was agreed with the MAIB with dimensional, chemical and mechanical test results to be compared to the requirements of BS EN 818-2 1996+A1:2008 [1].

- Detailed visual examination of the partial chain link, port and starboard quick release chains and the port derrick head and static pin,
- 3D laser scan of partial chain link, port and starboard quick release chains and the port derrick head and static pin,
- characterisation of the fracture surfaces of the partial chain link,
- chemical analysis to determine the composition of the chain material and static pin,
- perform magnetic particle inspection (MPI) on the partial chain link and the port and starboard quick release chains to identify any cracks or crack precursors,
- metallography of the partial chain link and the static pin to determine the heat treatment condition of the components and identify any evidence of manufacturing defects,
- perform hardness testing on the partial chain link and the static pin,
- perform tensile test on the partial chain link,
- perform minimum breaking load assessment on port and starboard quick release chains and a 7-link section of new chain.

Visual and metallurgical examination, measurements, hardness testing, X-ray fluorescence and fractography were conducted by [redacted] Materials Scientist with the Engineering Materials Team at HSE-SD.

3D scanning was conducted by [redacted] Technical Team Lead for the Advanced Imaging Solutions (AIS) team at HSE SD.

Magnetic Particle Inspection was conducted at Morgan Ward NDT Limited with Mr [redacted] and Mr [redacted], Principal Materials Scientist with the Engineering Materials Team at HSE-SRC, in attendance.

Tensile testing and Spark Optical Emission spectroscopy was conducted at Element Materials Technology Limited.

Minimum Breaking Load (MBL) testing was conducted at TTI Testing Limited (TTI) with [redacted] and [redacted] in attendance.

All sections of this report, including assessment and conclusions, were written by Mr Fox.

Unless otherwise noted all photographs in this report were taken by [redacted] Any annotations were added by [redacted].

The measurements given in this report are for information only unless otherwise stated.

2 ITEMS RECEIVED

2.1 Items received

Items were recovered from the incident site by the MAIB and were delivered to HSE-Science Research Centre, Buxton, by representatives from the MAIB on 14 May 2024.

The items received for this part of the investigation are given in Table 1. Each individual item was assigned an HSE sample number on reception at HSE-SRC Buxton site. The samples comprised a failed chain link, short lengths of chain with steel cable attached and a section of the derrick.

Table 1: Items received, original identification numbers and assigned HSE sample numbers

MAIB Evidence bag/number	HSE SD Sample number	Description
M2002760 (EV2152)	23307	Partial Chain Link – 32mm Chain
EV2150	23308	Honeybourne III Port Derrick Head
EV2149	23309	Honeybourne III Port Quick Release Chain
EV2135	23310	Honeybourne III Starboard Quick Release Chain

2.2 Items created

Samples were created from parent samples for the purpose of the metallurgical investigation or as a result of mechanical testing. Each sample created was assigned an HSE-SD sample number. The samples created for this part of the investigation are summarised in Table 2.

Table 2: Samples created

Parent sample number	Child sample number	Description
23307	23420	Section of broken link – Brittle fracture
	23421	Section of broken link – Ductile fracture
	23422	Section of broken link – Metallographic sample
	23424	Section of partial Chain link – subcontract testing Mech/Chem
	23428	Section of 23420 for additional microscopy
23308	23425	Port Derrick Head – Metallographic sample
	23426	Port Derrick Head – Chemistry sample
	23427	Port Derrick Head – Spare sample
23309	23544	Fractured chain link 1 (link 6 from 23309)
	23545	Fractured chain link 2 (link 6 from 23309)
	23550	Fractography sample cut from 23544 (post TTI Test)
	23551	Fractography sample cut from 23545 (post TTI Test)
	23672	Hardness sample cut from 23545(post TTI Test)
23310	23546	Link 7 from 23310
23384	23547	Links 6 & 7 from sample 23384
23385	23548	Links 5, 6 & 7 from sample 23385
	23549	Fragment of fractured chain link

2.3 Purchased items

Additional items were purchased as part of the project for the Minimum Break Load testing. These are given in Table 3.

Table 3: Bought in items

Sample number	Description
23384	Grade 8 32mm Chain 1
23385	Grade 8 32mm Chain 2
23386	Grade 8 32mm Chain 3
23387	Grade 8 32mm Chain 4

3 METALLURGICAL EXAMINATION

3.1 In situ arrangement

The operation of the equipment in question was explained by the MAIB. The dredge gear used on board Honeybourne III to fish for scallops was suspended by a warp running through a snatch block at the head of the port derrick arm. A similar set of gear was installed on the starboard side of the vessel. The block, known as the towing block, was suspended from a length of chain comprising seven links of 32 mm short-link chain that passed over a static pin mounted between two cheek plates attached to a rotating collar at the derrick head. The other end of the chain was attached to a soft eye in a length of 32 mm steel wire leading to a release linkage positioned at the base of the derrick arm.

The principle of the quick release system was to release the towing block from the head of the derrick arm in an emergency. Releasing the gear from this point would significantly reduce the heeling moment caused by an excessive load at the end of the extended derrick arm and reduce its negative effect on the stability of the vessel.

The loading caused by towing the dredges along the seabed and lifting the gear clear of the water is transmitted fully through the chain forming part of the quick release system. The rotation of the derrick head allowed the lead of the chain to align with the load from the dredge gear when being towed.

A photograph was provided of the Starboard equipment showing the general layout of the assembly Figure 1.

Nomenclature used to describe a chain link within this report is defined in Figure 2.

3.2 Visual examination

3.2.1 Partial chain link

The partial chain link was given the sample number 23307. All measurements were taken using a Mitutoyo digital vernier calliper serial number B20166657, calibrated 29 Jan 2024. The nominal diameter of the chain as defined by BS EN 818-2 [1] is 32 mm and was measured to be an average of 33.2 mm on an unworn section. The overall length of the link from crown to fracture was approximately 160 mm as shown in Figure 3.

There was evidence of wear in the inside of the crown consistent with adhesive wear between two links in a chain. The minimum thickness of material was measured at 25mm across the area of wear.

The two fracture surfaces were distinctly different in appearance. Figure 3 Fracture 1 had a flat, faceted fracture face with a raised ridge around most of the circumference. This was consistent with a brittle fracture and its associated shear lip. In addition, there were small areas of discolouration on the fracture face which were investigated as part of the fractography examination (see Figure 4).

Figure 3 Fracture 2 was jagged in appearance with evidence of wear on the inside of the chain link, notable due to the local flattening of the surface adjacent to the fracture. The area of the fracture next to this local flattening has two parallel fissures which may be associated with the wear in this area.

There was also a distinct region of necking which is associated with a ductile fracture as the material yielded before fracture. The fracture face showed areas of corrosion as well as areas of “clean” fracture face (see Figure 5).

3.2.2 Port quick release chain

The port quick release chain was given the sample number 23309. Comprising 6 links of 32mm short-link chain (Figure 6). For the purposes of the examination the links were numbered 1 to 6, starting at the link attached to the soft eye steel cable.

The wear as defined by BS EN 818-6 A 2.2 [2] was measured using a Mitutoyo digital vernier calliper serial number B20166657, calibrated 29 Jan 2024. This was achieved by measuring the narrowest part of the link and taking a second measurement at 90°. The mean diameter was then calculated from these two measurements, compared to the nominal diameter and expressed as a percentage.

Overall, the chain appeared to be in broadly sound condition with a layer of corrosion covering most of the surface and is consistent with the conditions that the chain was exposed to during use. There was little to no wear on links 1 and 2 with the exception of some markings which identified the end of link one which was attached to the soft eye.

Links 3, 4, 5 and 6 exhibit patches of wear on the shanks. Based on their relative positions, this would be consistent with the chain rubbing against the pin (sample number 23308) while under load.

Link 4 exhibited an area of slight wear on the inside of the crown of the link where in contact with link 5. This can be seen in Figure 7.

Link 5 exhibited wear on the inside of both crowns where in contact with links 4 and 6. These were at approximately 45° from the axis of the chain indicating that the primary loading of this link was not along the axis thereby imparting bending moment to the chain link. This can be seen in Figure 8.

Link 6 also exhibited wear on the inside of both crowns where in contact with link 5 and the fractured link. These were also at approximately 45° from the axis of the chain indicating that the primary loading of this link was not along the axis thereby imparting bending moment to the chain link. This can be seen in Figure 9.

Detailed results of the visual examination and wear measurements are tabulated in Appendix A.

3.2.3 Starboard quick release chain

The starboard quick release chain was given the sample number 23310. Comprising 7 links of 32 mm short-link chain Figure 10. For the purposes of the examination the links were numbered 1 to 7 starting at the link attached to the soft eye steel cable.

The wear as defined by BS EN 818-6 A 2.2 [2] was measured using a Mitutoyo digital vernier calliper serial number B20166657, calibrated 29 Jan 2024. This was achieved by measuring the narrowest part of the link and taking a second measurement at 90°. The mean diameter was then calculated from these two measurements, compared to the nominal diameter and expressed as a percentage.

Overall, the chain appeared to be in broadly sound condition with a layer of corrosion covering most of the surface and is consistent with the conditions that the chain was exposed to during use. There was little to no wear on link 1 with the exception of some markings which identified the end of link one which was attached to the soft eye.

Link 2 showed no wear, however there appeared to be some slight deformation at the crown on one end taking the link out of ovality. This can be seen in Figure 11. This may be as a result of a manufacturing issue or deformed through use.

Links 3, 4, 5 and 6 exhibited patches of wear on the shanks of which, based on their relative positions, would be consistent with the chain rubbing against the pin (sample number 23308) while under load. These do not appear as severe as those on the port chain (Sample 23309) but are present in more locations.

Link 5 exhibited wear on the inside of both crowns where in contact with links 4 and 6. These were at approximately 45° from the axis of the chain indicating that the primary loading of this link was not along the axis thereby imparting bending moment to the chain link. This wear does not appear as severe as the wear on the corresponding link on the port chain and can be seen in Figure 12.

Link 6 also exhibited wear on the inside of the crown where in contact with link 7. This can be seen in Figure 13.

Link 7 exhibits wear in both crowns where it is in contact with Link 6 and the load. This can be seen in Figure 14 and Figure 15. There is no evidence of wear on the shanks of the link.

Detailed results of the visual examination and wear measurements are tabulated in Appendix A.

3.2.4 Port derrick head

The port derrick head was given the sample number 23308. Comprising a welded steel assembly of a cylindrical pin and two “cheek plates”. The pin is a cylindrical steel tube of diameter 170 mm and wall thickness of approximately 32 mm. The cheek plates are steel plate of thickness 21mm. The fabrication appears to have been painted during manufacture.

Initial visual inspection of the pin and cheek plates which show several large areas where the paint coating has been worn away or flaked off exposing the metal substrate. There was a layer of surface corrosion on all areas of exposed metal.

There are a number of grooves in the pin on the top where the quick release chain passed over the pin in service, these can be seen in Figure 16 and Figure 17. The grooves are on the upper half of the pin with the deepest towards the left. The location and shape of the grooves would be consistent with supporting a chain which is under load. Subsequent 3D scans of the pin show that the narrowest section of wall thickness is 21.3 mm.

The lefthand cheek plate also show signs of wear which would be consistent with a chain rubbing against it during service and indicating that the direction of loading on the chain is not perpendicular to the supporting pin. This can most clearly be seen in Figure 16.

3.3 Magnetic particle inspection

Specialist non-destructive testing company, Morgan Ward (NDT) Limited in New Mills Derbyshire, were engaged by HSE to conduct the magnetic particle inspection (MPI). The inspection was carried out on 15 July 2024 by [redacted] NDT Level II, under the supervision of [redacted] and [redacted]

Both lengths of chain, 23309 and 23310, were inspected per BS EN ISO 9934-1 [3] using a fluorescent inspection medium and the inspection took place under black light to identify any defects or crack precursors.

During inspection linear indications parallel to the length of the chain were noted at the weld on all links of both chains. These were determined to be surface scoring in the weld area as a result of the removal of the welding flash and caused during manufacture. These indications would have no impact on the integrity of the chain.

The remaining features identified were in the inside of the crown and associated with the plastic deformation at the wear location where the links contacted each other.

No indications of manufacturing defects or crack precursors were identified during the inspection.

The full technique and report produced by Morgan Ward is in Appendix B Third party test certificates: Report No. 158645.

3.4 Chemical analysis

3.4.1 Methods used

To determine the composition of the sample materials, a Niton XL3 X-ray fluorescence (XRF) instrument was used. XRF is a technique used for positive material identification (PMI) of metals based on the relative levels of heavy elements present in the metal. It is based on the X-ray signature of each element. It cannot be used for lighter elements such as carbon and sulphur.

To determine the level of carbon, sulphur and other light elements, samples of the fractured chain link and the derrick head static pin were sent for chemical analysis at Element Materials Technology using a Spark Optical Emission Spectrometry (OES) technique.

3.4.2 Partial chain link

The chemical composition requirements of BS EN 818-2 [1] define minimum and maximum mass content percentage of certain alloying elements as defined in Table 4, which is presented along with the results of the two analysis techniques.

Table 4: Chemical composition (mass percent) of partial chain link sample 23428

Element	Requirement per BS EN 818 - 2 (%)	Niton XRF Analysis (%)	OES Analysis at Element Testing (%)
Aluminium (Al)	0.025 Min	<LOD	0.04
Boron (B)		Not able to detect	<0.003
Carbon (C)		Not able to detect	0.22
Chromium (Cr)	0.40 Min*	0.47	0.51
Copper (Cu)		0.11	0.10
Manganese (Mn)		1.30	1.32
Molybdenum (Mo)	0.15 Min*	0.28	0.28
Nickel (Ni)	0.40 Min	0.53	0.54
Phosphorus (P)	0.030 Max	<LOD	0.012
Sulphur (S)	0.030 Max	<LOD	<0.005
Silicon (Si)		0.12	0.17
Titanium (Ti)		<LOD	<0.01
Vanadium (V)		0.05	0.06

* Either/Or or both

The Niton analysis performed at HSE and the OES analysis performed by Element Materials Technology show that the material was acceptable to the compositional requirements of BS EN 818-2 [1].

Test certificates are presented in Appendix B Third party test certificates: Element Lab Job#: 766654.

3.4.3 Derrick head static pin

There was no standard specified for the static pin material so there are no minimum or maximum requirements however, results are presented in Table 5.

Table 5: Chemical composition (Mass percent) of the static pin sample 23426

Element	Niton XRF Analysis (%)	OES Analysis at Element Testing (%)
Aluminium (Al)	<LOD	0.04
Boron (B)	Not able to detect	<0.003
Carbon (C)	Not able to detect	0.17
Chromium (Cr)	0.15	0.18
Copper (Cu)	0.02	0.02
Manganese (Mn)	1.19	1.20
Molybdenum (Mo)	0.01	0.01
Nickel (Ni)	<LOD	0.05
Phosphorus (P)	<LOD	0.016
Sulphur (S)	0.17	<0.005
Silicon (Si)	0.33	0.18
Titanium (Ti)	<LOD	<0.01
Vanadium (V)	0.03	0.04

The Niton Analysis instrument identified the material as equivalent to the AISI designation 1117 with a high confidence and was confirmed by the OES analysis performed by Element Materials Technology.

Test certificates are presented in Appendix B Third party test certificates: Element Lab Job#: 766754.

3.5 Metallography

3.5.1 Partial chain link

Samples 23422 and 23424, extracted from the partial chain link 22307 (Figure 18), and prepared for metallographic assessment by grinding polishing and etching by [redacted] Images were taken using a Nikon Eclipse MA200 metallurgical microscope at a range of magnifications.

Sample 23422 was prepared as a cross section of the chain link. Sample 23424 was sectioned from sample 23420 perpendicular to the fracture including the facture face and the area of material adjacent to the weld,

The microstructure of 23422 showed a uniform hardened and tempered martensitic structure across the whole cross section of the chain link. The microstructure is shown in Figure 19 and Figure 20. This is consistent with that of a low alloy steel which has been austenitized, air cooled or oil quenched, and then tempered [4].

The microstructure of 23424 likewise showed a uniform hardened and tempered martensitic structure with no apparent heat affected zone associated with the weld indicating a fully homogenised material.

The area of interest showed slight surface corrosion when in cross section, Figure 21 and Figure 22. The lack of penetration into the sample and the presence of a shear lip indicated that this was most likely as a result of the conditions that the partial link was found in on the ship when it returned to port.

3.5.2 Derrick head static pin

Sample 23425, extracted from the derrick head static pin 23308 by [redacted] was prepared in a similar manner as samples 23422 and 23424 By [redacted] Images were taken using a Nikon metallurgical microscope at a range of magnifications.

The microstructure was uniform and showed a directional ferrite/pearlite microstructure consistent with hot rolled product with no subsequent heat treatment [4]. The microstructure is shown in Figure 23 and Figure 24.

3.6 Fractography

3.6.1 Method

Different fracture types were evident on each of the faces of the partial chain link provided for investigation. These were examined using a scanning electron microscope (SEM), model Hitachi SU3500. This technique enables higher magnification images to be taken and also provides a greater depth of field which enables three dimensional features on a surface to be studied. The technique is commonly used for identifying features on fracture faces.

3.6.2 Fracture face of 23420

Sample 23420 was extracted from the fractured chain link 22307 (Figure 18). The surface was examined using the SEM and images taken at different magnifications using the secondary electron detector and an accelerating voltage of 5kV. The images are shown together with the positions on the face in Figure 25-27. The surface showed a faceted cleavage fracture which is consistent with brittle fracture.

The images were also taken of the dark patch identified during visual examination which showed a mixed mode fracture with both micro void coalescence (MVC) and cleavage present as well as evidence of corrosion products on the surface Figure 28-29.

3.6.3 Fracture face of 23421

Sample 23421 was extracted from the fractured chain link 22307 Figure 18. The surface was examined using the SEM and images taken at different magnifications using the secondary electron detector and an accelerating voltage of 5 kV. The images are shown together with the positions on the face in Figure 30 – 34. The surface showed predominantly evidence of MVC which is typical of a ductile failure. There were also areas of mixed mode failure, wear related deformation and areas of corrosion product.

4 MECHANICAL PROPERTIES

4.1 Hardness

Hardness measurements were carried out on sample 23422 extracted from the partial chain link 22307 by [redacted] and sample 23425 extracted from the derrick head static pin 22308 by [redacted] The hardness testing was carried out in accordance with BS EN ISO 6507-1 [5] using a Vickers hardness tester (Buehler Wilson) calibrated on 11 December 2023. The measurement accuracy was ±3% for the measurements which were made using a 10 kg indenter load.

4.1.1 Partial chain link

A series of three hardness measurements were made on the sample to determine bulk hardness. A second series of measurements were made close to the surface to determine if there was any variation across the section of material. The results are presented in Table 6.

Table 6: Partial chain link hardness results Sample 23422

Bulk material hardness		Near Surface Hardness	
Point	**Hardness (Hv10)**	**Point**	**Hardness (Hv10)**
1	395	1	391
2	409	2	393
3	391	3	392
Mean	398	Mean	392

The hardness values obtained did not show any significant difference between the bulk material and the edge.

BS EN ISO 18265 [6] provides conversions between hardness values and Ultimate Tensile Strength (UTS). Using Table B2 of this standard these hardness values equate to a UTS in the range of 1,220 MPa – 1,281 MPa.

4.1.2 Derrick head static pin

Hardness measurements were carried out on sample 23425 extracted from the derrick head static pin 22308.

A series of three hardness measurements were made on the sample to determine bulk hardness results presented in Table 7.

Table 7: Static pin hardness results sample 23425

Point	Hardness (Hv10)
1	145
2	145
3	146
Mean	145

Using BS EN ISO 18265 [6] Table A1 this equates to a UTS of 465MPa

4.1.3 Port quick release chain

After completing the MBL Testing at TTI, reported in 4.3 minimum breaking load assessment, a sample was cut from the broken chain link by [redacted] and given the sample number 23672. A series of three hardness measurements were made on the sample to determine bulk hardness. A second series of measurements were made close to the surface to determine if there was any variation across the section of material. The results are presented in Table 8.

Table 8: Hardness results sample 23672

Bulk material hardness		Near Surface Hardness	
Point	Hardness (Hv10)	Point	Hardness (Hv10)
1	402	1	367
2	386	2	364
3	403	3	370
Mean	397	Mean	367

The near surface hardness was shown to be lower than the bulk material hardness but not significantly so. This could be as a result of the deformation and changes to the material structure post mechanical testing.

Using Table B2 of BS EN ISO 18265 [6] these hardness values equate to a UTS in the range of 1,128 MPa – 1,220 MPa.

4.2 Tensile test

Sample number 23428 was extracted from the partial chain link 22307 (Figure 18) and sent to Element Materials Technology Limited for tensile testing.

Element Materials Technology Limited extracted and machined 2 appropriately sized tensile samples to BS EN ISO 6892-1 [7]. The number of samples was limited by the available material from the partial chain link.

A summary of the test results are presented in Table 9 and the full certificate is presented in Appendix B Third party test certificates: Element Lab Job#: 766654.

Table 9: Summary of tensile test results sample 23428

Test ID	Temp °C	0.2% Yield MPa	UTS MPa	Elong. %	R of A %
BS EN 818-2	Room	-	-	>20	-
1041335	25	1139	1248	15.5	65
1041337	25	1301	1335	10.0	61

While there is no requirement in BS EN 818-2 [1] for an Ultimate Tensile Strength of the material this can be used to calculate a theoretical breaking load of 2161 kN and 2311 kN. This is above the minimum specified.

The elongation for both tensile tests was below the minimum requirement of 20%.

4.3 Minimum breaking load assessment

The port and starboard quick release chains (23309 and 23310) and a section of new chain (23384) were taken by [redacted] and [redacted] to TTI Testing Limited, Wallingford, Oxfordshire, and subject to Minimum Break Load (MBL) testing in accordance with BS EN 818-2 [1]. One new chain, sample number 23384, was to be used as a control.

The procedure for the test was to load the samples into the tensile machine and secure them to the fittings using clevis pins (Figure 35). The controller then applied the load at a rate of 5 kN per second up to a maximum of 1,290 kN hold for 15 seconds and then lower the load at 5 kN per second back down to 0 kN.

The new chain (Sample number 23384) achieved a maximum load of 1020.5 kN then failed. Upon inspection, it had also damaged the clevis pin so the test was halted until new clevis pins could be sourced.

Upon sourcing new clevis pins a second new chain (Sample number 23385) was tested using the same procedure. The clevis pins were extracted and inspected and found to be acceptable to continue testing.

The chain taken from the starboard derrick (sample 23310) failed at link 6 of 7. The chain taken from the port derrick (sample 23309) failed at link 6 of 6. A summary of the test results is presented in Table 10. Full details of the testing and results can be found in Appendix B Third party test certificates: Report number TTI-IMLR-2024-6113.

Table 10: Summary of MBL test results

Test Number	Sample ID	Temp °C	Breaking Load kN	Elong. %
BS EN 818-2		Room	>1290	>20
1	22384	25	1021	4.4
2	22385	25	1044	4.0
3	23310	25	1055	6.3
4	23309	25	1166	10.1

In all cases, the failure occurred in the crown of the chain link where it was in contact with the adjacent link, as shown in Figure 36 For sample 23310. Sample 23309 failed in two locations, the primary failure in the crown and the secondary failure in the shank, as shown in Figure 37.

The failing link from 23309 was sectioned by [redacted] and the fracture faces were examined using the SEM at HSE-SRC where the presence of elongated MVC indicated that the chain links failed in a ductile shear manner (Figure 38).

5 ASSESSMENT

5.1 General observations

Two lengths of chain, one partial chain link and the port derrick head were delivered to HSE Buxton by the MAIB for the investigation. Both chains showed damage due to wear particularly on the links furthest from where the chains were connected to the steel cable soft eye. Both chains also had a layer of surface corrosion covering the majority of the surface.

The partial chain link likewise showed evidence of both wear and corrosion in addition to the fractures associated with the failure.

The port derrick head showed corrosion on all areas of exposed metal where the painted finish had been worn away. The corrosion extended someway underneath the painted areas where the ingress of salt water had corroded the steel and lifted the paint away from the surface on both the static pin and the cheek plates.

The static pin had grooves where the chain passed over which were consistent with the imprint that would result from a loaded chain passing over the pin and deforming the material of the pin.

5.2 Partial chain link

Initial visual assessment of the partial link indicated that the link had failed in a predominantly brittle manner on one shank and in a predominantly ductile manner on the opposing shank. This was characterised by one fracture exhibiting a predominantly flat, faceted fracture face with a shear lip around the circumference. This is typical of a brittle failure. The other fracture surface exhibited a jagged appearance with evidence of necking as the material yielded, which is typical of a ductile failure.

The corrosion products which were present on the fracture faces when received by HSE were most likely post incident. The presence of the shear lip around the circumference of the failure, which would not have formed if there was a pre-existing fracture, supports this.

This was confirmed by detailed fractography using the SEM and there was no evidence of a fatigue fracture or other time dependant failure mode. This indicates that the failure was a result of a single high load event rather than a progressive failure leading to the final fracture.

The metallurgical analysis of the chain link material showed a uniform tempered martensitic structure. This is be consistent with a manufacturing heat treatment to harden and temper the chain to achieve the required properties.

Microstructural examination, including the cross section adjacent to the fracture, showed no abnormalities associated with manufacturing or welding defects. There was also no evidence of any post-manufacturing heat treatments which may have contributed to the failure.

The analysis of the material composition conducted both by XRF at HSE-SRC and OES at Element Materials Technology Limited, show that the sample complies with the requirements of BS EN 818-2 Grade 8 chain.

The two tensile tests completed at Element Materials Technology Limited showed ultimate tensile strengths of 1248 MPa and 1335 MPa.

Using the measured diameter of 33.2mm and the formula below this would give an approximate breaking load of 2161 kN – 2311 kN based on the cross sectional area of the chain in tension.

$$Breaking\ Load = 2(UTS \times \pi r^2)$$

This is above the minimum requirement for the MBL stated in BS EN ISO 818-2 of 1290kN.

The elongations measured by Element Materials Technology Limited was 15.5% and 10%, both of which are below the specified minimum requirement of 20% as stipulated in BS EN 818-2.

5.3 Chain sections

The two sections of chain (23308 and 23309) showed similar levels of corrosion and wear. The MAIB informed the HSE that the chains had been in service for one year and had passed their scheduled replacement date the week prior to the accident.

Both chains when measured for wear per BS EN 818-6 [2] using a vernier calliper. This was achieved by measuring the narrowest part of the link and taking a second measurement at 90°. The mean diameter was then calculated from these two measurements, compared to the nominal diameter and expressed as a percentage. With the exception of links 6 and 7 of the starboard quick release chain 23310, all chain links were acceptable to the 90% minimum mean diameter requirement. Links 6 and 7 of the starboard quick release chain were measured as 87% of nominal mean diameter and therefore outside of the tolerated wear, as defined by the standard.

The MBL tests conducted at TTI and witnessed by the interested parties showed maximum load values of 1055 kN and 1166 kN. This is a minimum of 335% of the working load limit of 315kN and a maximum of 90% of the MBL as defined in BS EN 818-2 [1] for chains of this type.

The elongation at failure for the two chain sections tested was 6.3% and 10.1% this is below the specification minimum of 20%

5.4 Derrick head static pin

There are no standards associated with the manufacture of these components and no drawings provided to HSE to specify the grade of steel to be used in its fabrication.

The metallurgical examination of the static pin showed a ferrite/pearlite microstructure consistent with a non-heat-treated low alloy steel, common in steel fabrications of this type.

This was confirmed by chemical analysis conducted both by XRF at HSE-SRC and OES at Element Materials Technology Limited, with the steel identified as a common low alloy grade.

The hardness tests conducted at HSE-SRC gave a value of 145HV for the static pin compared to a hardness value of >390HV for that of the chain passing over it.

When loaded, this would mean that any yielding or deformation would occur on the static pin and this could be a direct cause of the grooves observed in the surface of the pin.

When loaded, these grooves would likely restrict lateral movement of the chain while in use, potentially increasing the likelihood of the load not being transmitted along the axis of the link.

6 CONCLUSIONS

The metallurgical examination of the partial chain link showed no evidence of manufacturing defects which could have contributed to a premature failure. Also no evidence of any pre-existing cracks or progressive failures such as fatigue, stress corrosion cracking or excessive corrosion, was found

The overall condition of the chains and the static pin showed evidence of corrosion, deformation and wear consistent with the conditions to which they are subject during service. The port and starboard chains were acceptable to the 90% of nominal minimum mean diameter requirement in BS EN 818-6 [2], with the exception of links 6 and 7 of the starboard quick release chain 23310.

Links 6 and 7 of the starboard quick release chain were measured as 87% of nominal mean diameter and therefore outside of the tolerated wear, as defined by the standard.

Magnetic particle inspection showed no evidence of any significant surface breaking cracks indicating that the chains contained no features that were likely to lead to a premature failure.

The minimum break load testing showed that, despite the wear in excess of that tolerated by the standard, the chains were capable of performing at above the working load limit. They achieved a load of up to 90% of the MBL as defined in BS EN 818-2 [1] for chains of this type. It can therefore be shown that the chain was not intrinsically unsound and was capable of performing as designed.

Metallurgical assessment of the links shows a microstructure consistent with a hardened and tempered steel this is as expected for a Grade 8 short-link chain.

The fracture surface of the partial link was predominantly flat with a faceted appearance and a shear lip around the full circumference. This indicates that the failure of the chain link was most likely as a result of a single high load event that caused a brittle fracture on one shank of the chain link followed by a ductile failure on the other shank of the link.

The nature of these fracture surfaces, when compared to the failure mode of the chains subject to MBL, show that the loading of the fractured chain link was not along the axis of the chain. It was likely loaded in bending during the incident, overloading the link and causing it to fracture.

The static pin had a lower hardness than the chain and showed significant wear and deformation with the wall thickness reduced in places to 21 mm from 32 mm. The grooves in the pin could restrict lateral movement of the chain which in turn could have contributed to the failure.

7 REFERENCES

[1] British Standards Institute , BS EN 818-2 Short link chain for lifting purposes - safety Part 2: Medium tolerance chain for chain slings - grade 8, BSI, 1996 + A1 2008.

[2] British Standards Institute, BS EN 818-6 Short link chain for lifting purposes - safety Part 6: Chain slings - Specification for information for use and maintenance to be provided by the manufacturer, BSI, 2000 + A1:2008.

[3] British Standards Institute, BS EN ISO 9934-1:2016 Non-destructive testing - Magnetic Particle testing. Part 1: General Principles, BSI, 2016.

[4] American Society for Metals, Atlas of Microstructures of Industrial Alloys, Vol. 7, 8th edition, Ohio: ASM, 1972.

[5] British Standards Institute, BS EN ISO 6507-1:2023 Metallic materials - Vickers hardness test, BSI, 2023.

[6] British Standards Institute, BS EN ISO 18265:2013 Metallic materials - Conversion of hardness values, BSI, 2013.

[7] British Standards Institute, BS EN ISO 6892-1:2019 Metallic Materials - Tensile testing, BSI, 2019.

8 FIGURES

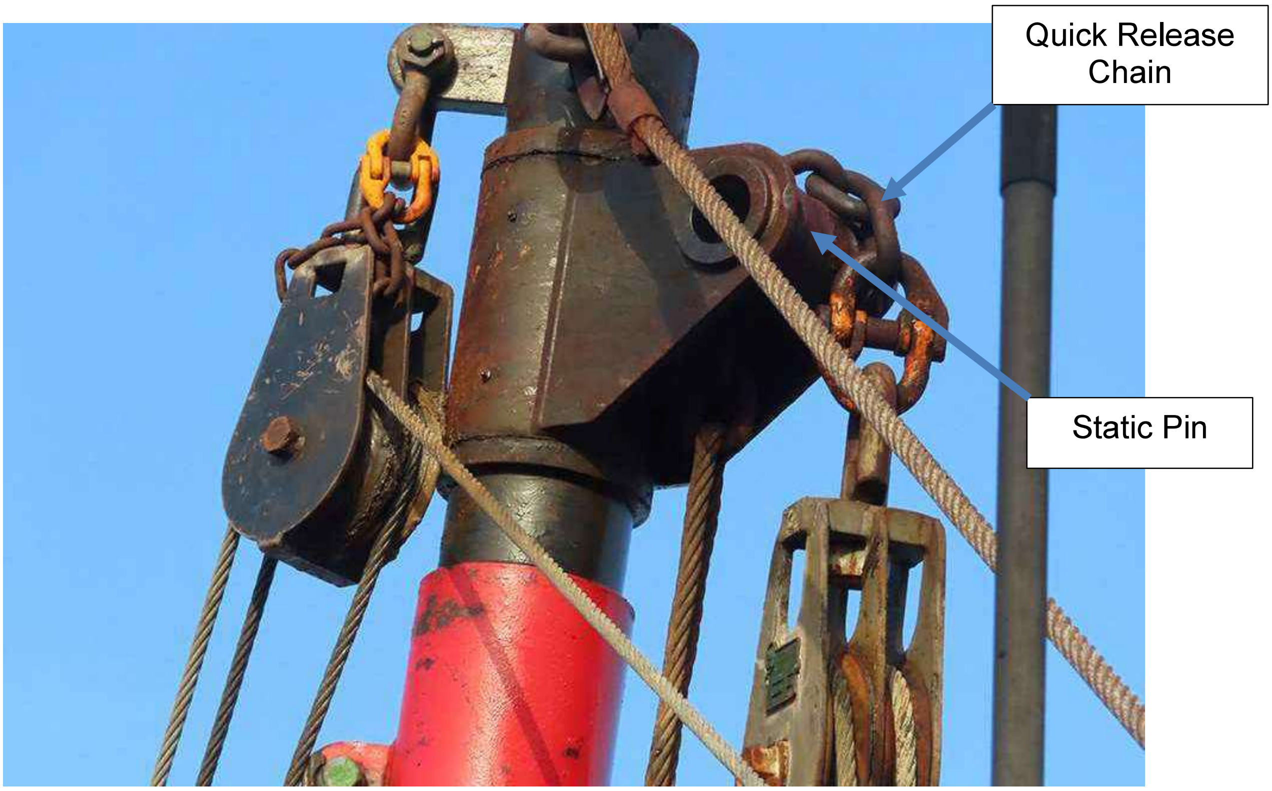


Figure 1: Starboard Derrick Head Assembly image provided by MAIB (image HoneybourneIII_WebReadyDerrickArrangementStarboardSide)

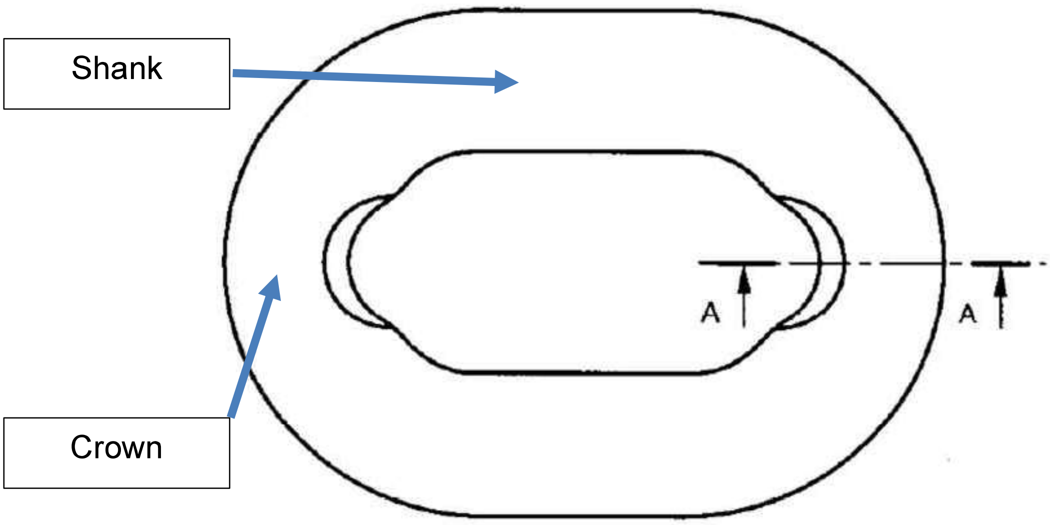


Figure 2: Diagram of chain link nomenclature, image from [2] annotated by [redacted]

Figure 3: Partial chain link, sample 23307 (image 20240625_085251957_iOS)

Figure 4: Partial Chain Link Fracture Face 1, sample 23307 (image 20240605_152035447_iOS rotated)

Figure 5: Partial Chain Link Fracture Face 2, sample 23307 (image 20240605_152047417_iOS rotated)

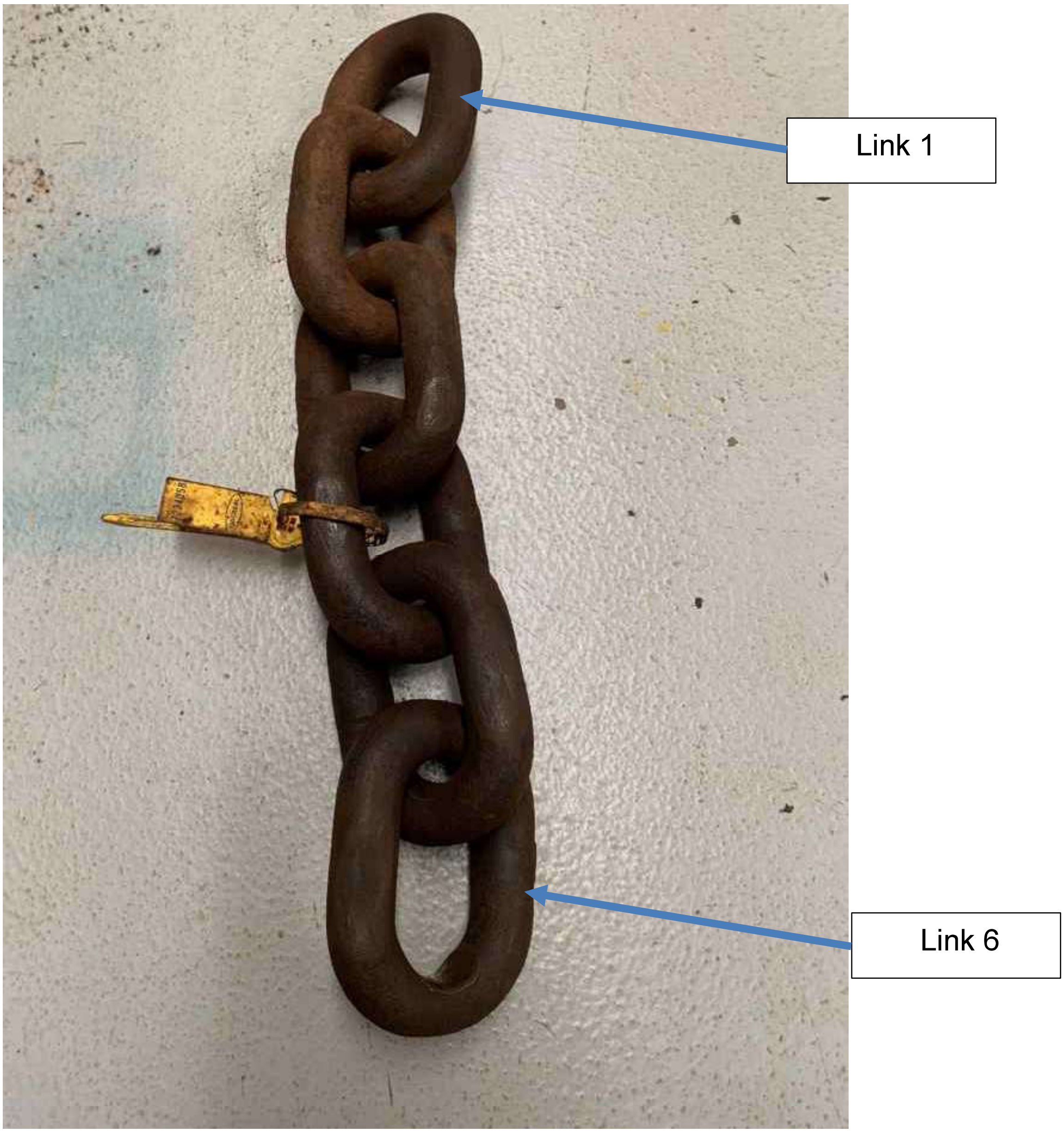


Figure 6: Port quick release chain, sample 23309 (image 20240618_132420371_iOS)

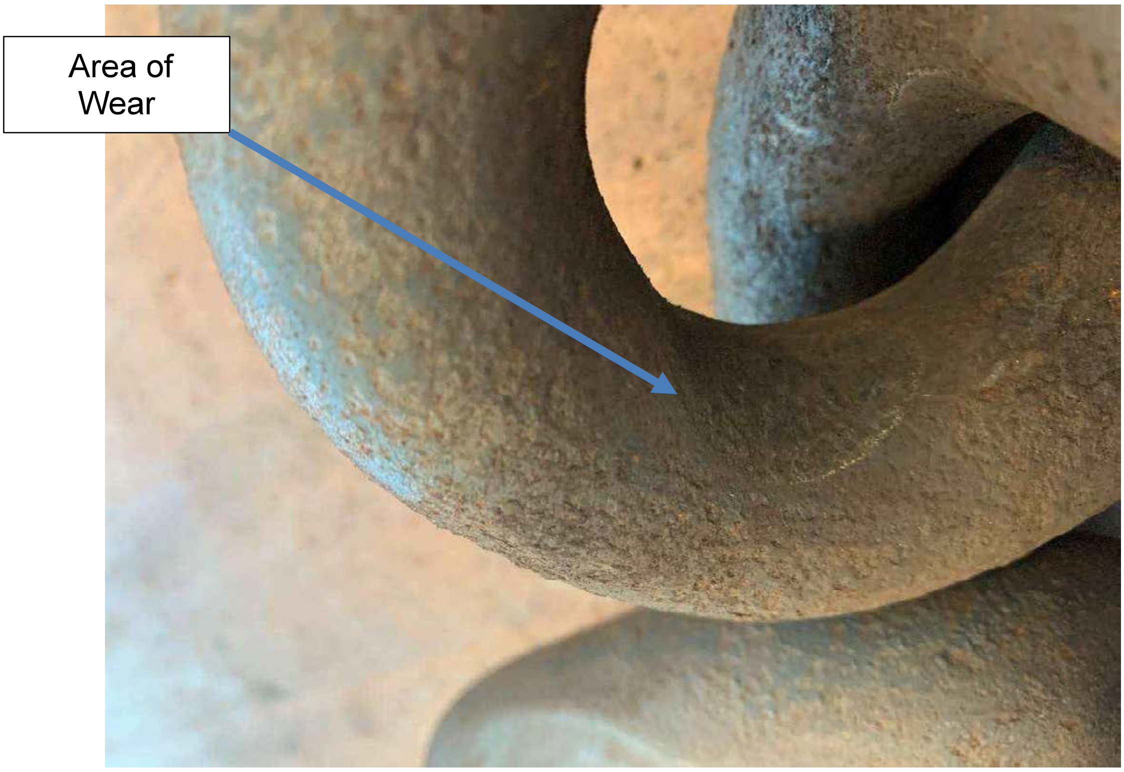


Figure 7: Wear on link 4 sample 23309 (image 20240620_103727026_iOS rotated)

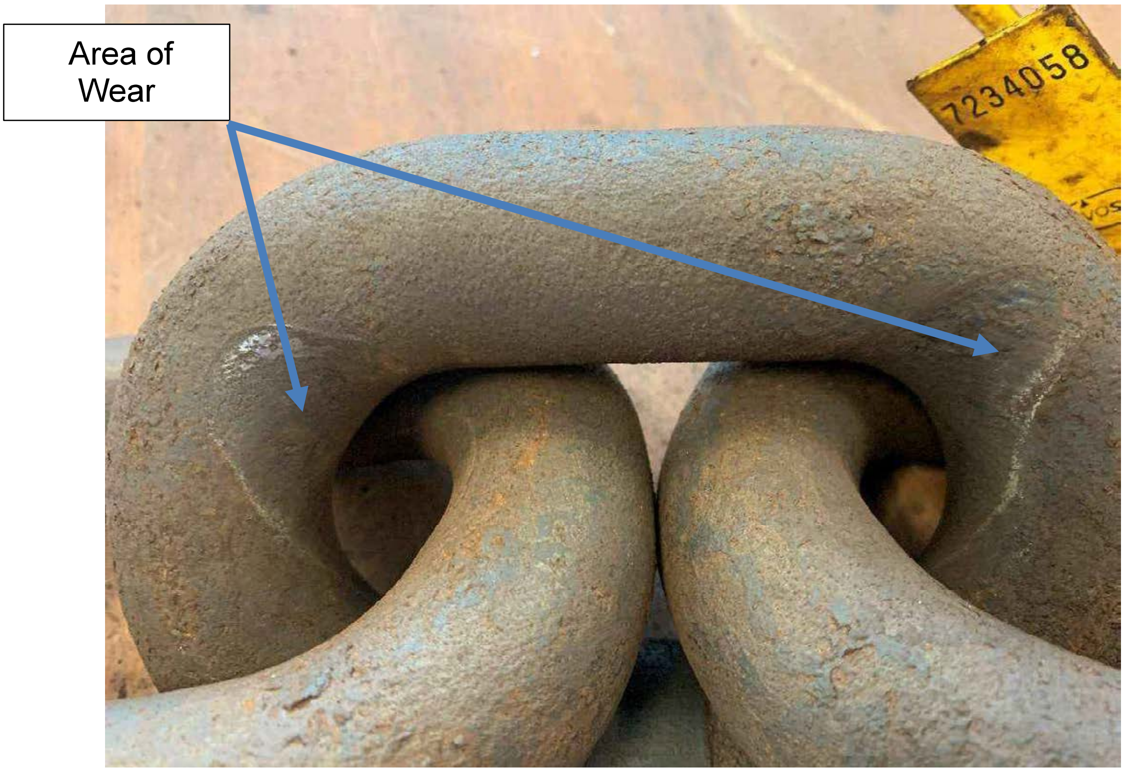


Figure 8: Wear on link 5 sample 23309 (image 20240620_104613230_iOS rotated)

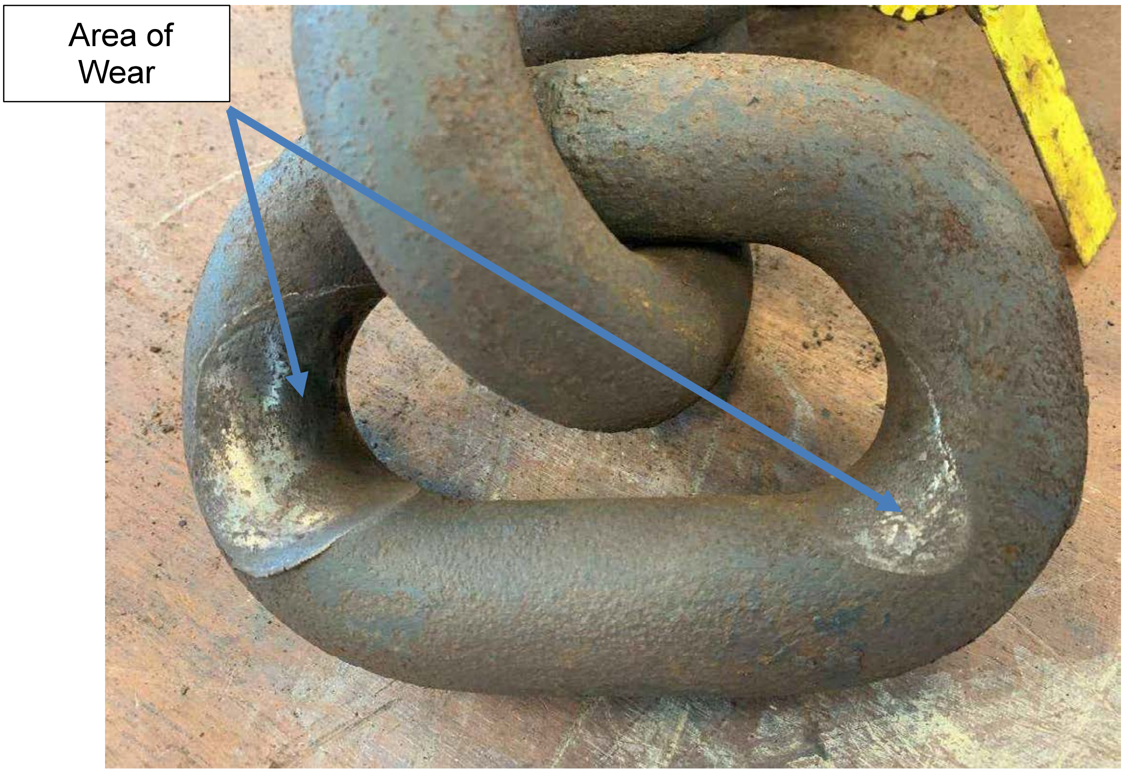


Figure 9: Wear on link 6 sample 23309 (image 20240620_105123598_iOS)

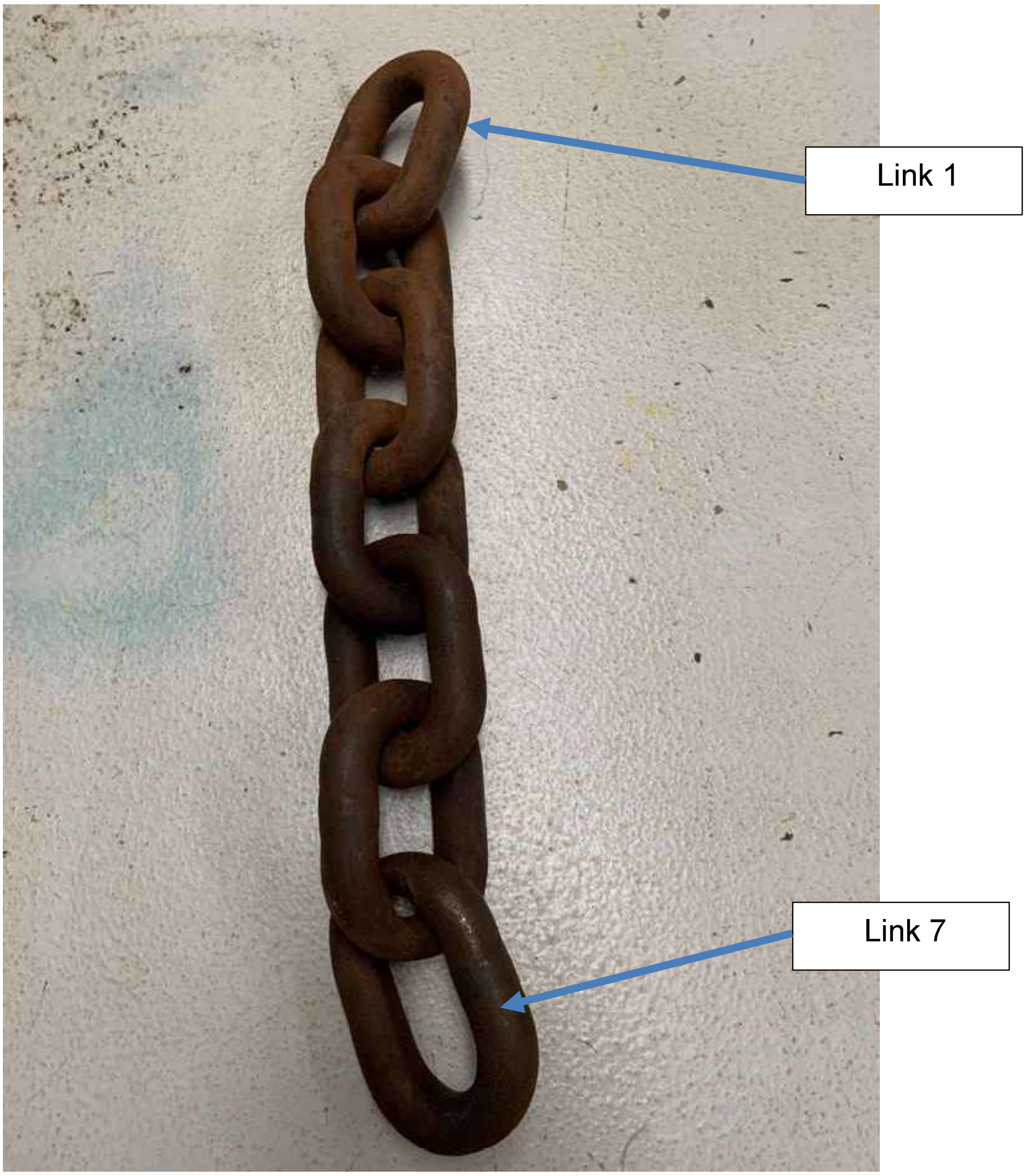


Figure 10: Starboard quick release chain, sample 23310 (image 20240618_132243103_iOS)

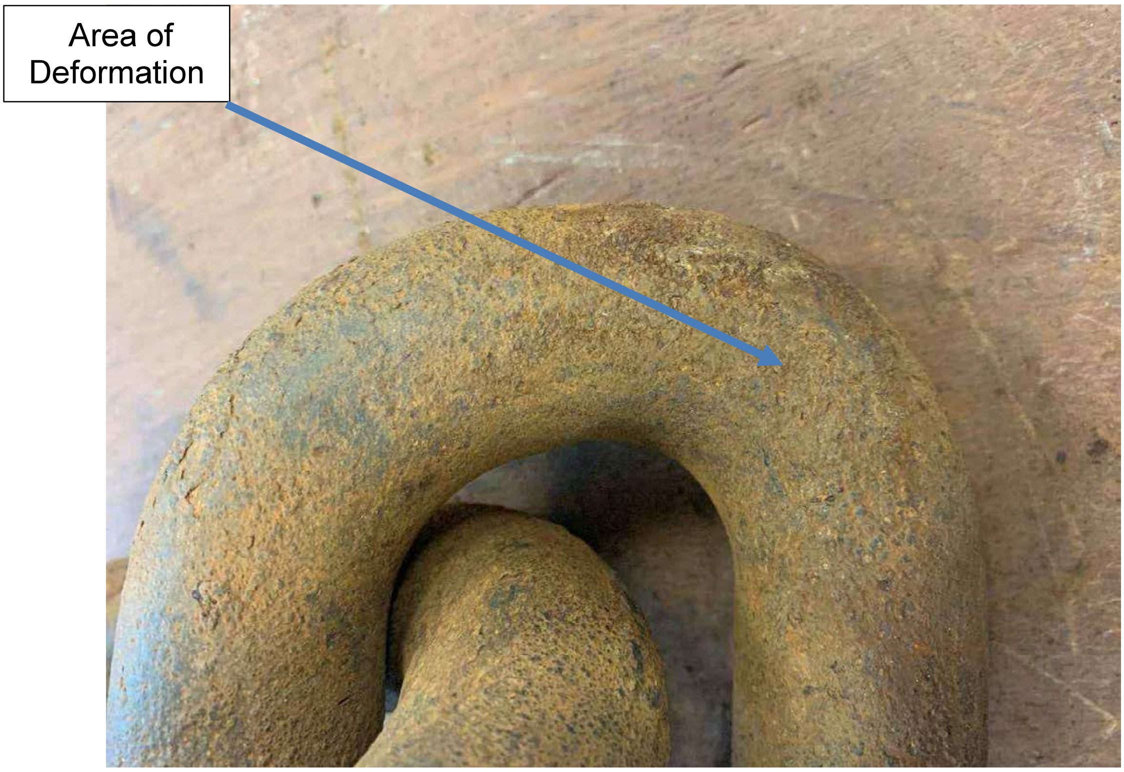


Figure 11: Deformation on link 2 sample 23310 (image 20240620_151007950_iOS rotated)

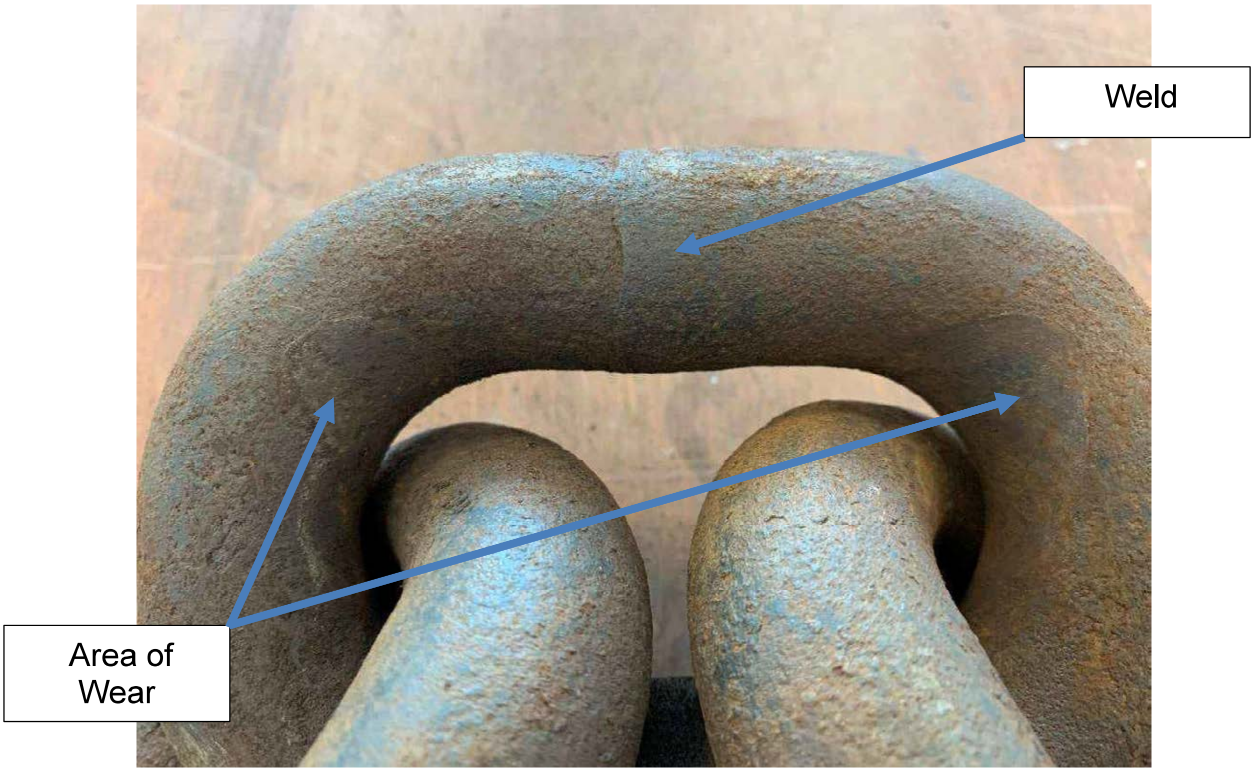


Figure 12: Wear on link 5 sample 23310 (image 20240621_102513297_iOS)

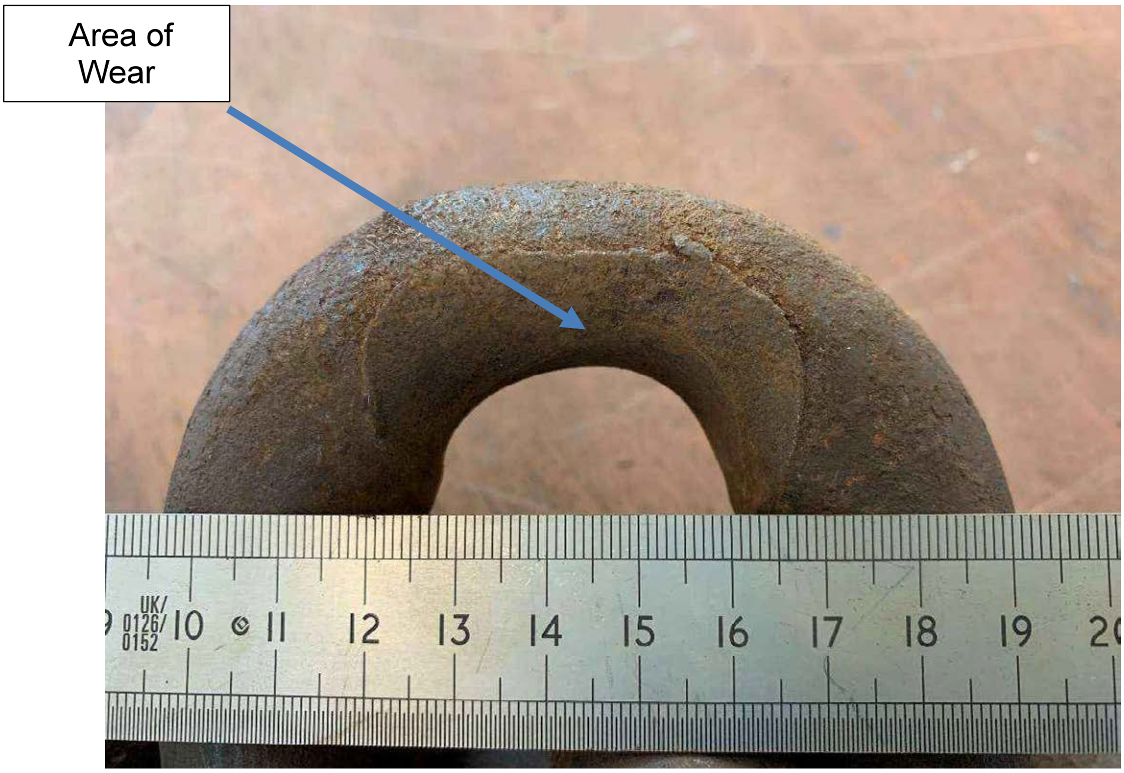


Figure 13: Wear on link 6 sample 23310 (image 20240621_103114418_iOS)

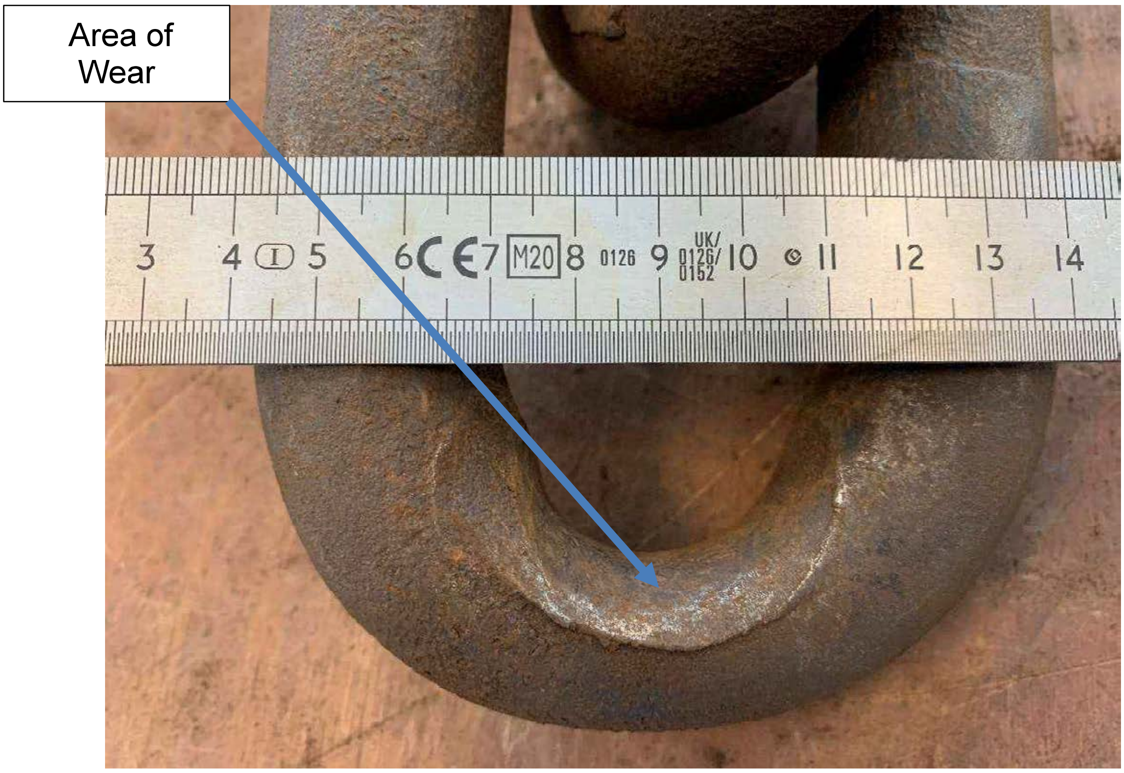


Figure 14: Wear in link 7 sample 23310 (image 20240621_103242649_iOS)

Figure 15: Wear on link 7 sample 23310 (image 20240621_103338363_iOS)

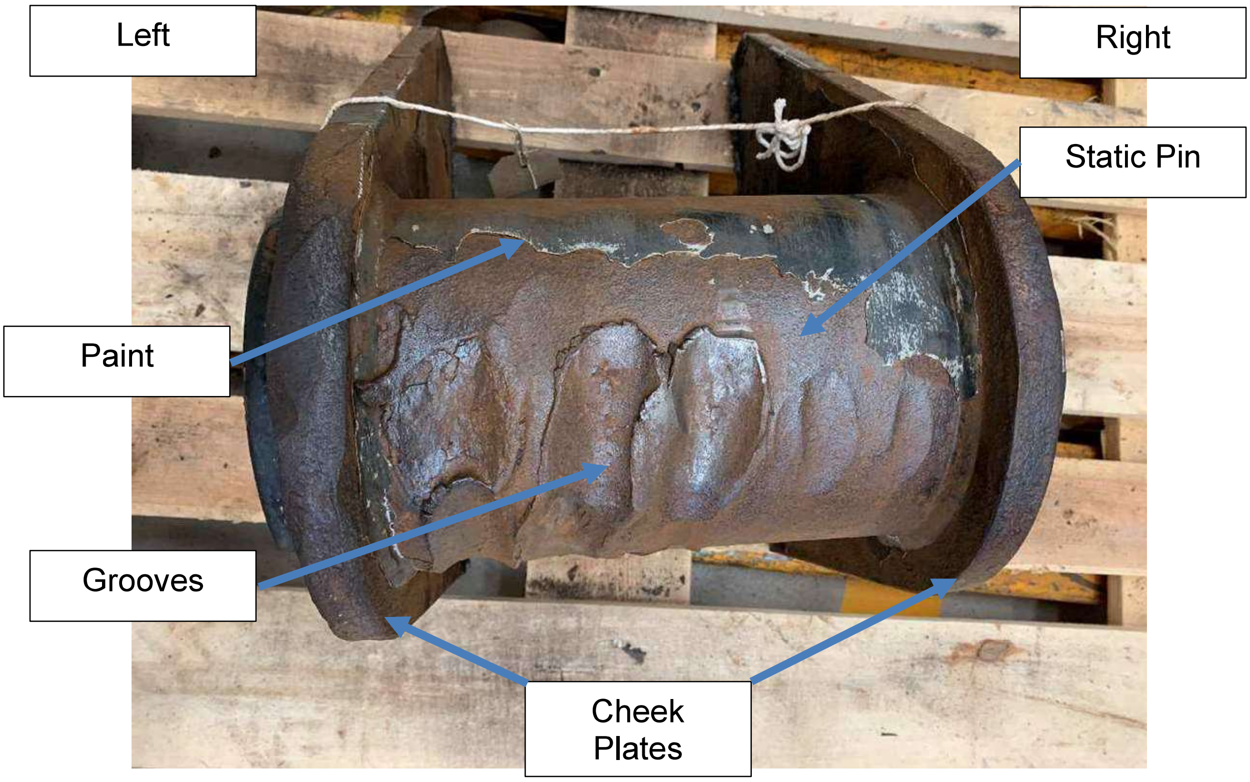


Figure 16: Port derrick head assembly, sample 23308 (image 20240605_123731286_iOS rotated)

Figure 17: Port derrick head assembly, sample 23308 (image 20240605_123907296_iOS rotated)

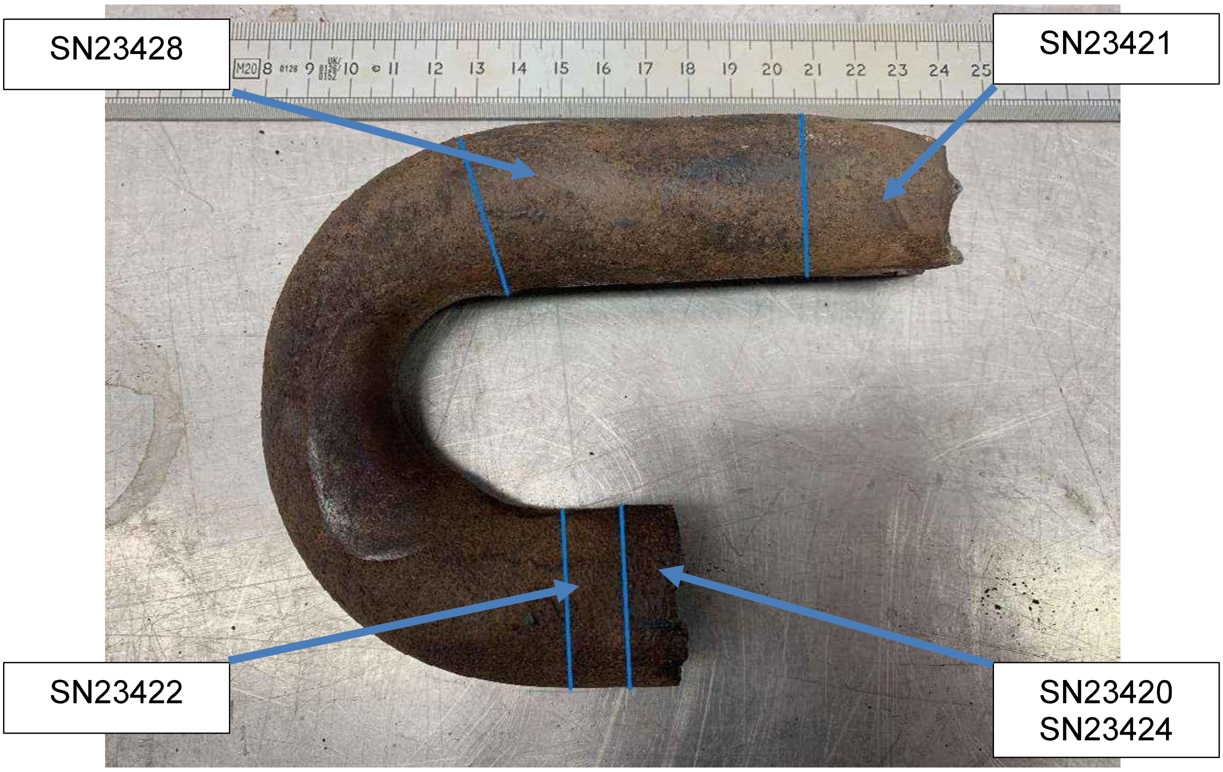


Figure 18: Partial chain link, sample 23307 (image 20240625_085251957_iOS modified to show sample loactions)

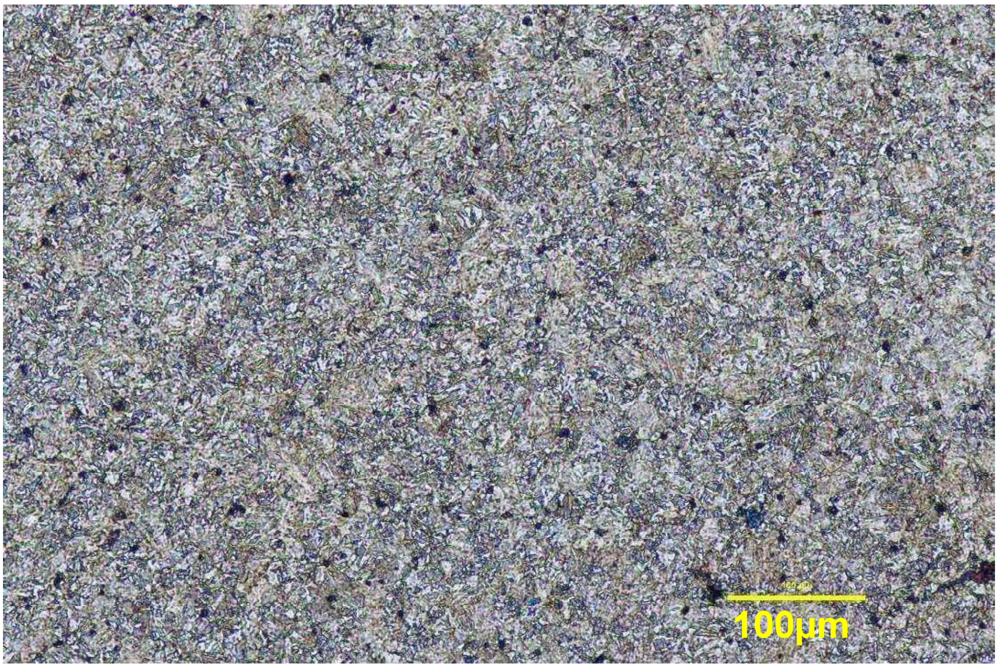


Figure 19: Sample 23422 Microstructure at X100 magnification (image 23422 X100 01)

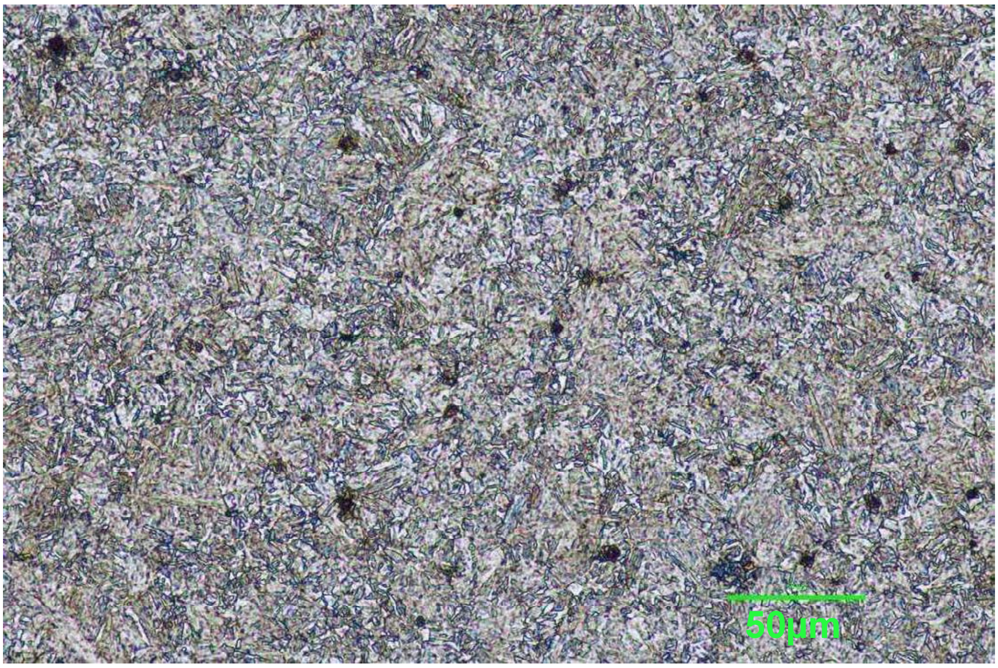


Figure 20: Sample 23422 Microstructure at X200 magnification (image 23422 X200 01)

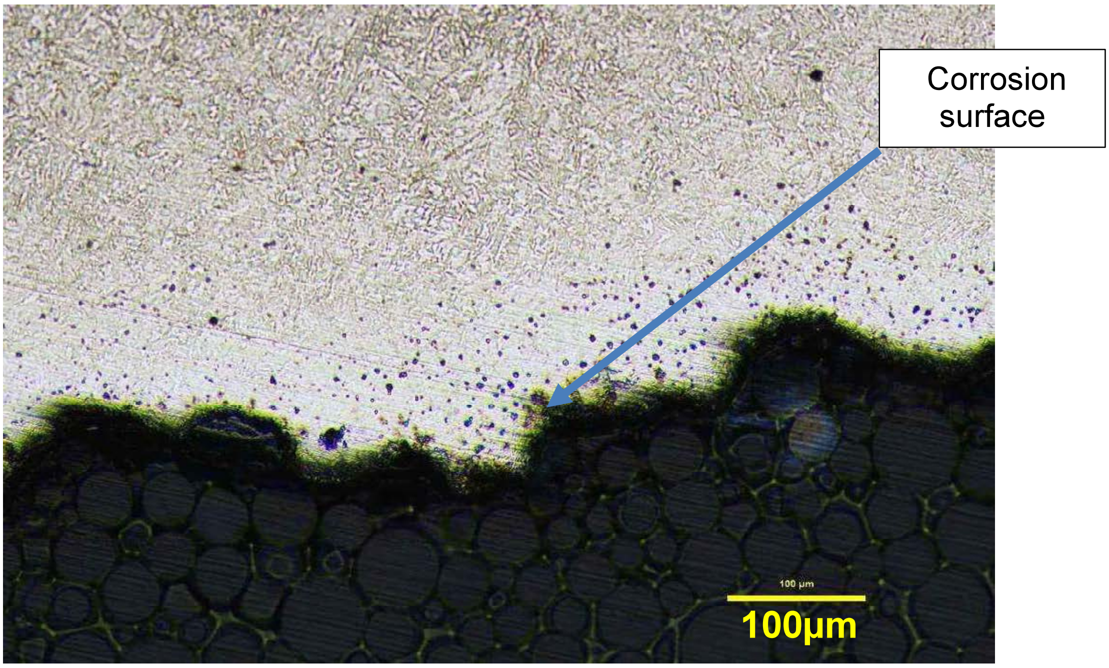


Figure 21: Sample 23424 Microstructure at X100 magnification (image 23424 X100 01)

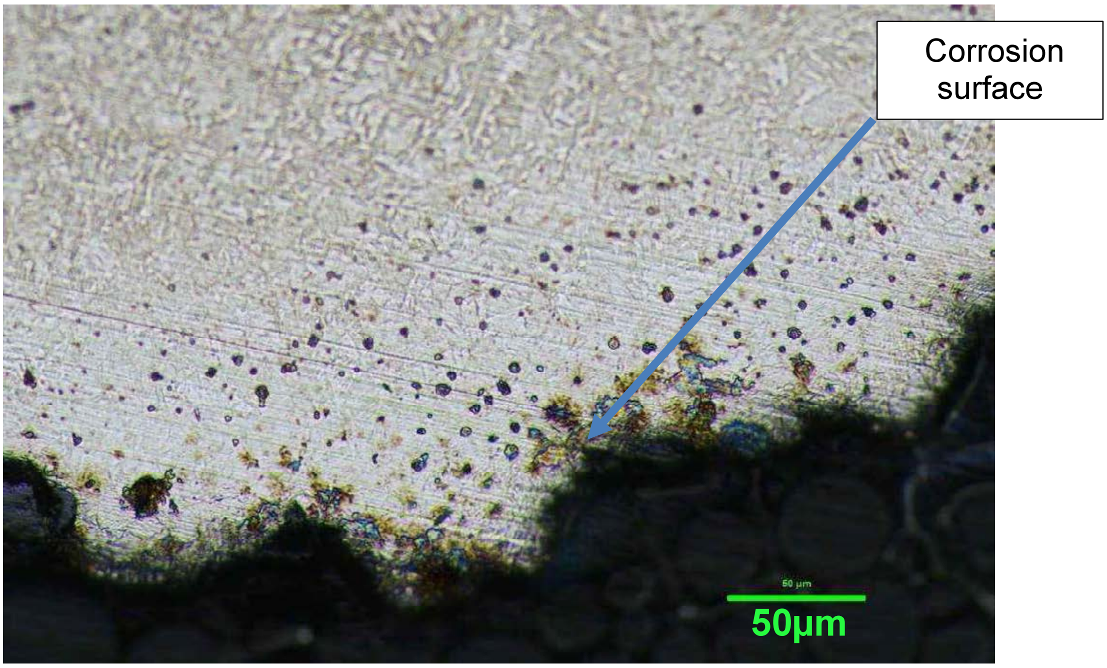


Figure 22: Sample 23424 Microstructure at X200 magnification (image 23424 X200 01)

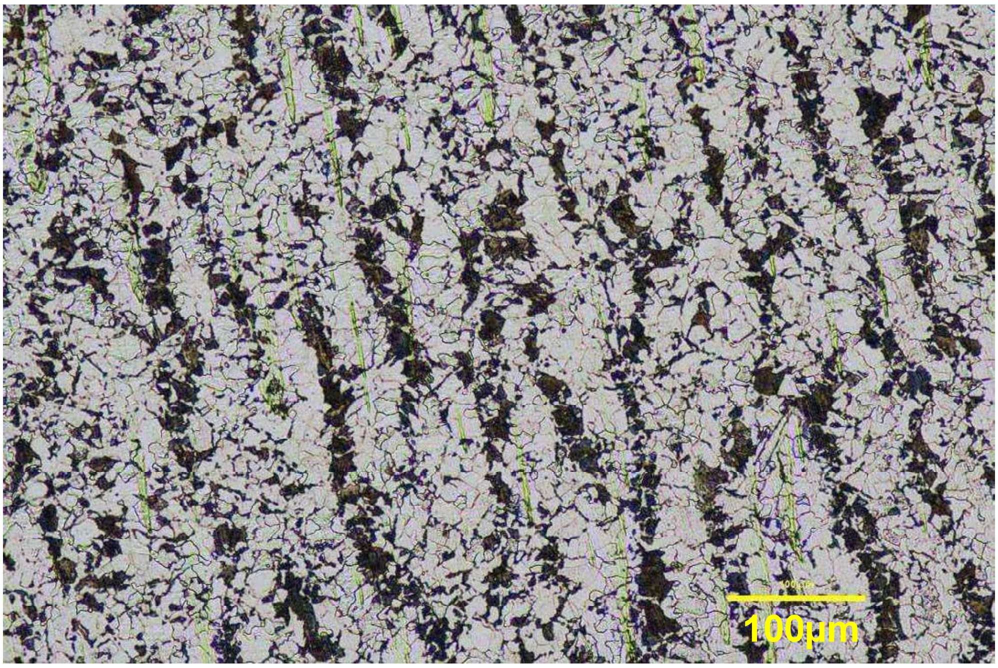


Figure 23: Sample 23425 Microstructure at X100 magnification (image 23425 X100 01)

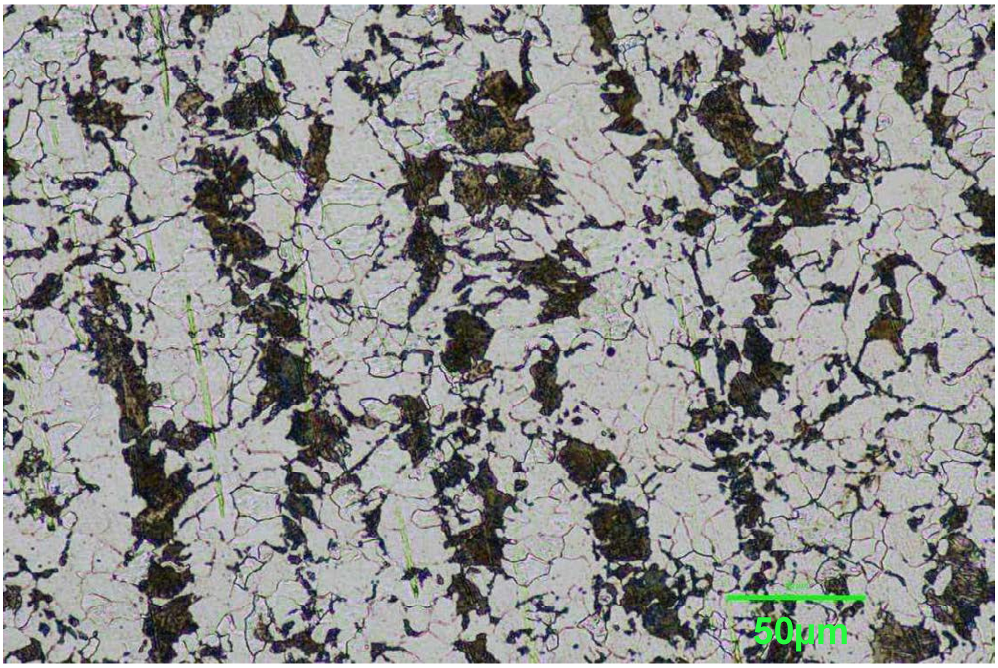


Figure 24: Sample 23425 Microstructure at X200 magnification (image 23425 X200 01)

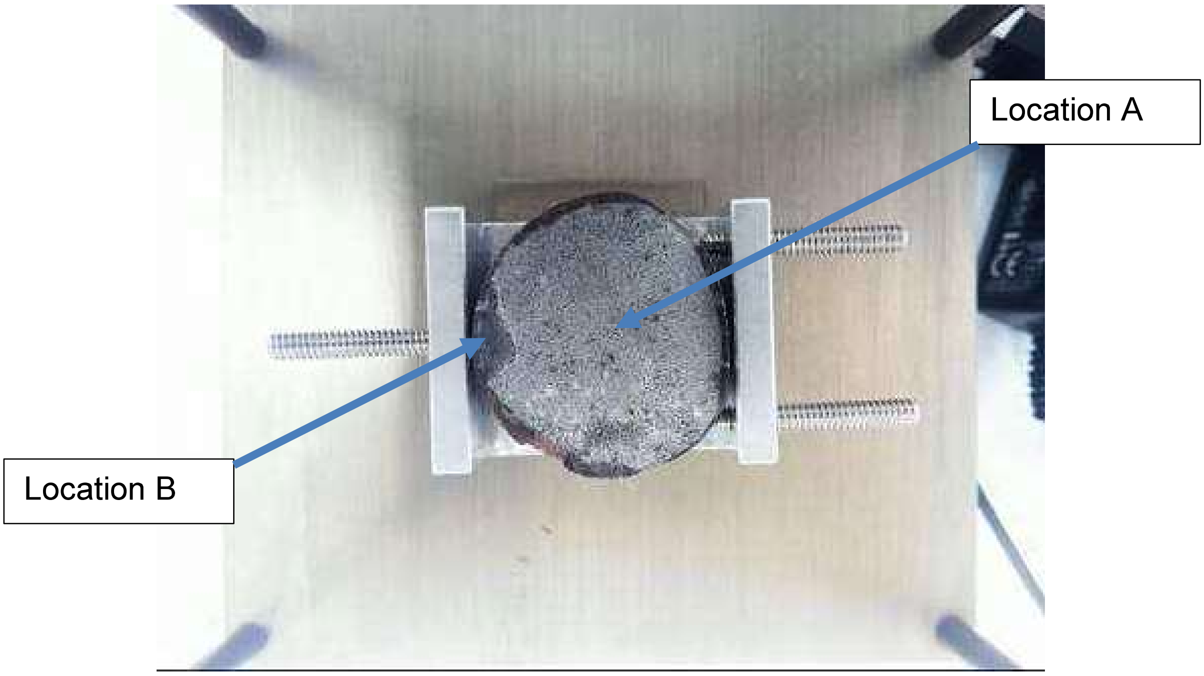


Figure 25: Sample 23420 showing image locations (image SN23420 Fracture face)

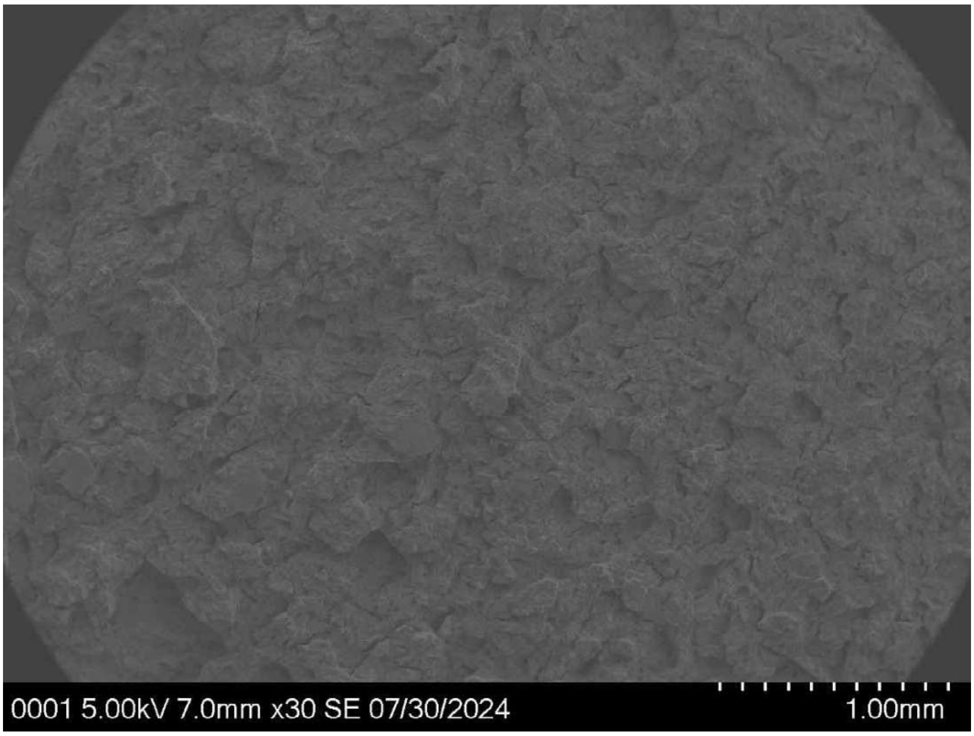


Figure 26: Sample 23420 Location A x30 magnification (image 23420 X30 Image_0001)

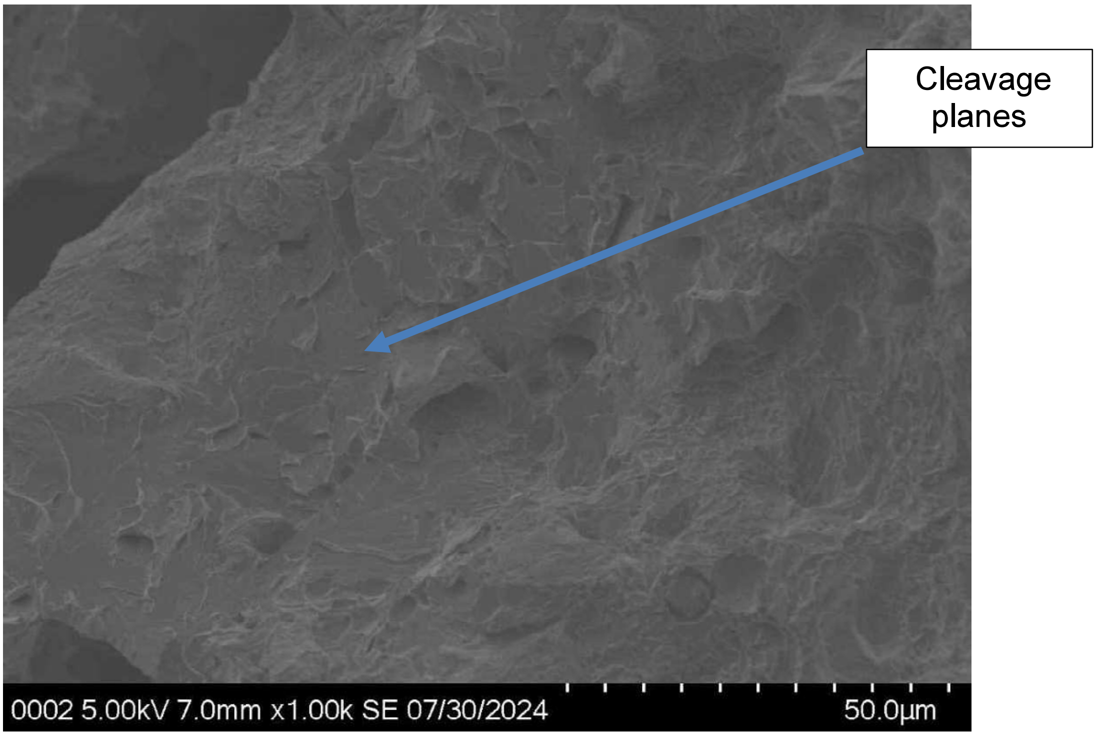


Figure 27: Sample 23420 location A x1000 magnification (image 23420 X1000 Image_0002)

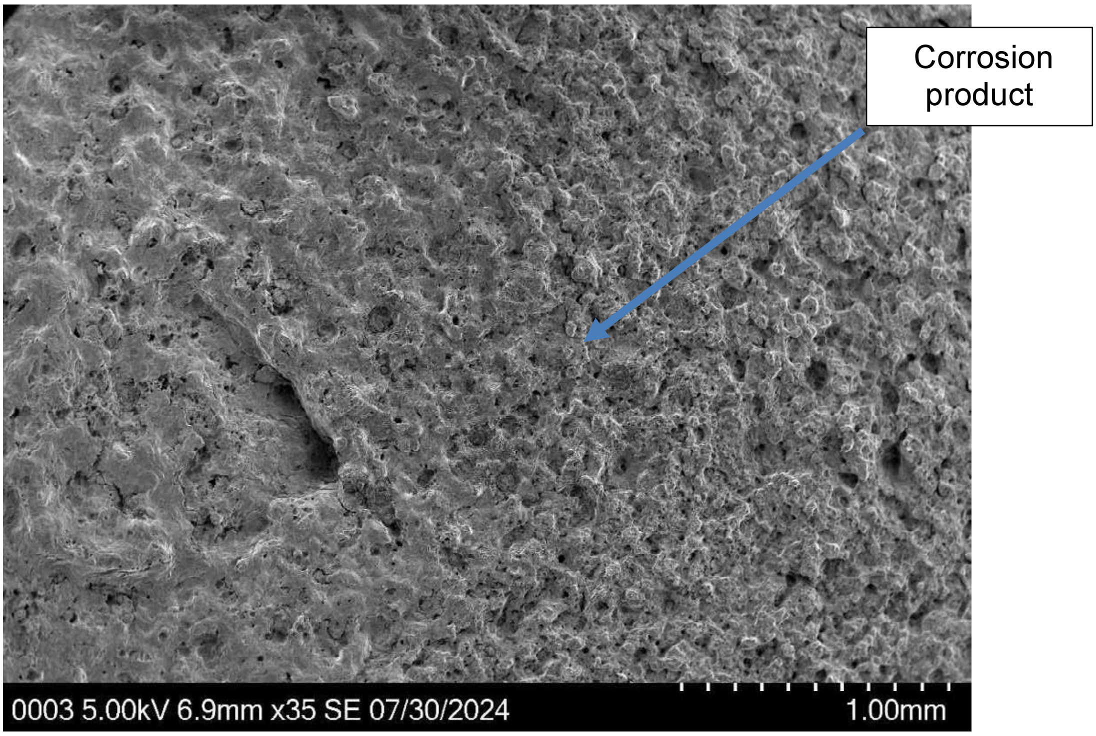


Figure 28: Sample 23420 location B x35 magnification (image 23420 X35 Image_0009 dark patch)

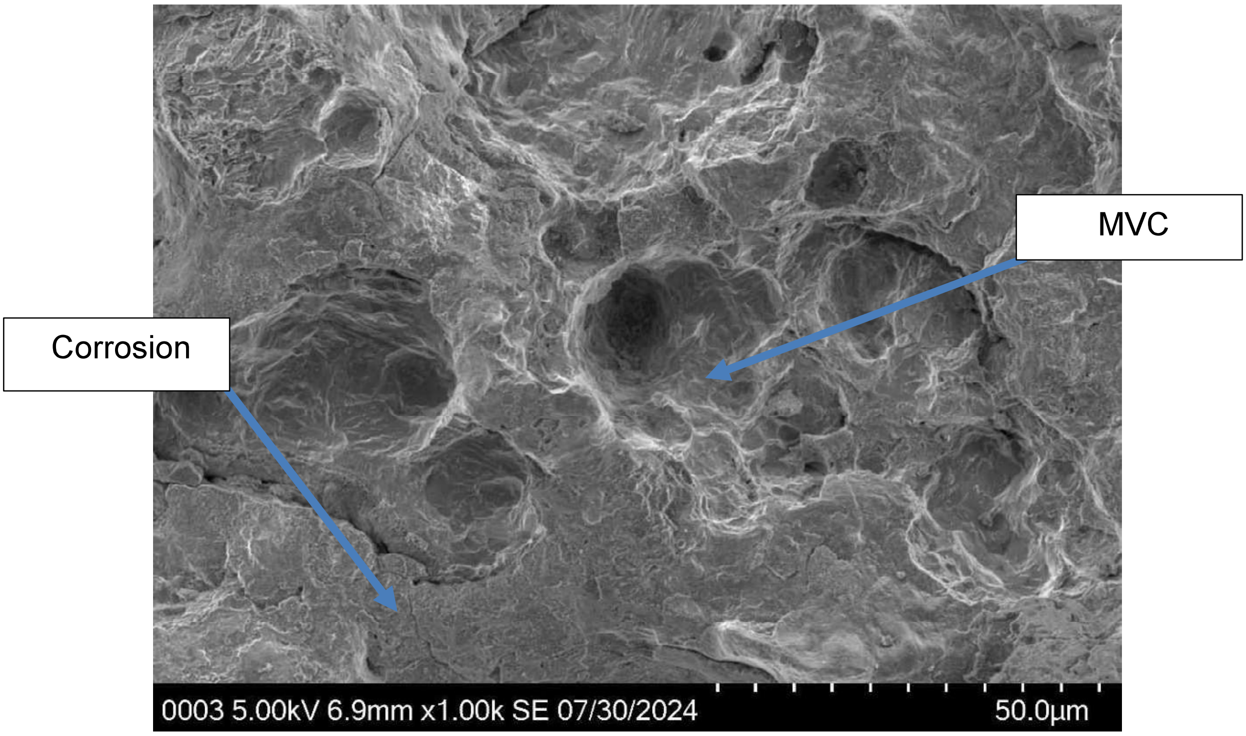


Figure 29: Sample 23420 location B x1000 magnification (image 23420 X1000 Image_0011 dark patch)

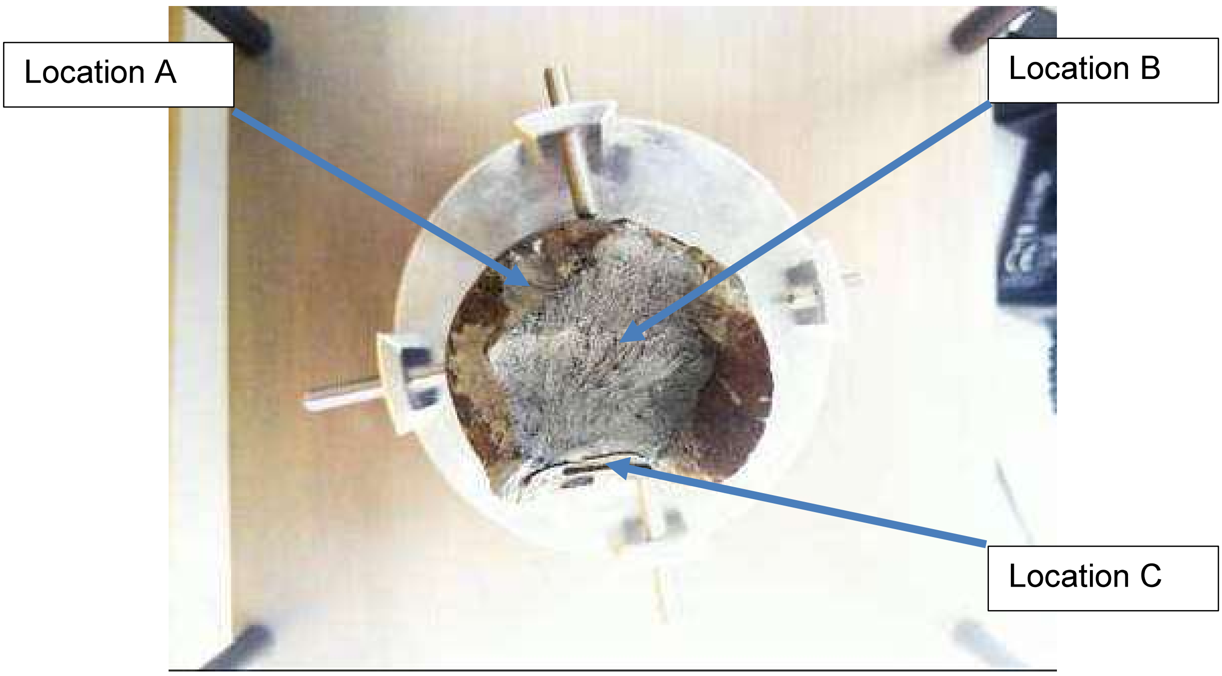


Figure 30: Sample 23421 showing image locations (image SN23421 Fracture face)

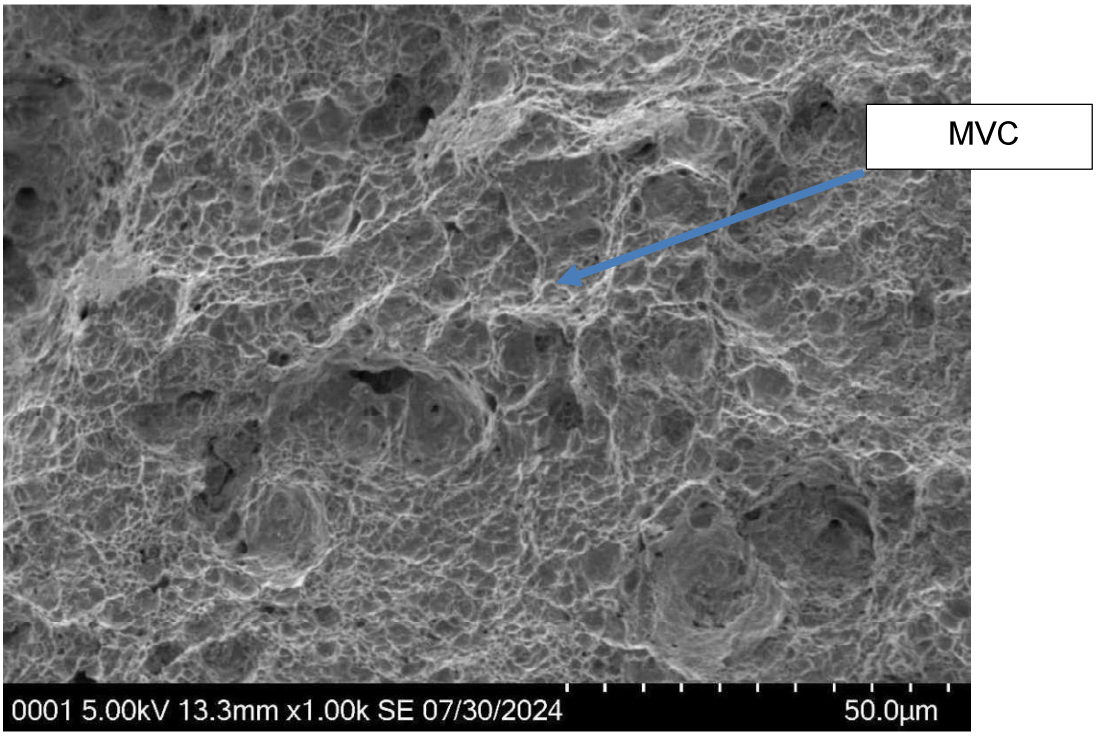


Figure 31: Sample 23421 location A x1000 magnification (image 23421 Image_0001)

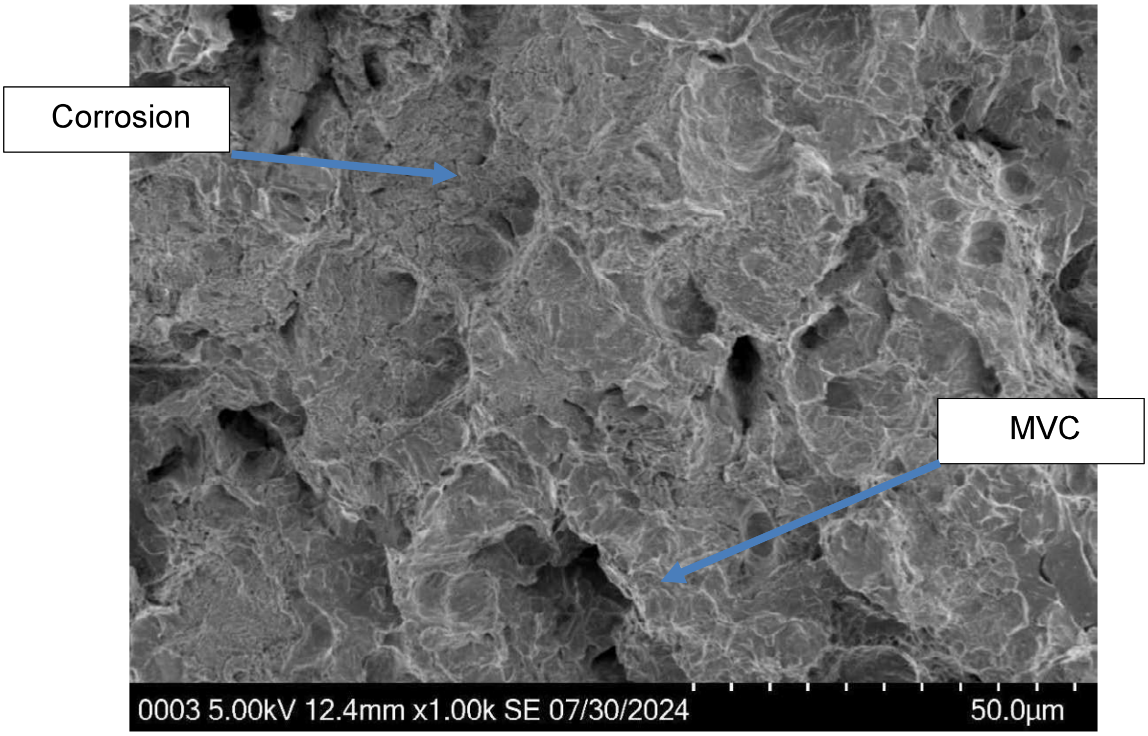


Figure 32: Sample 23421 location B x1000 magnification (image 23421 Image_0003)

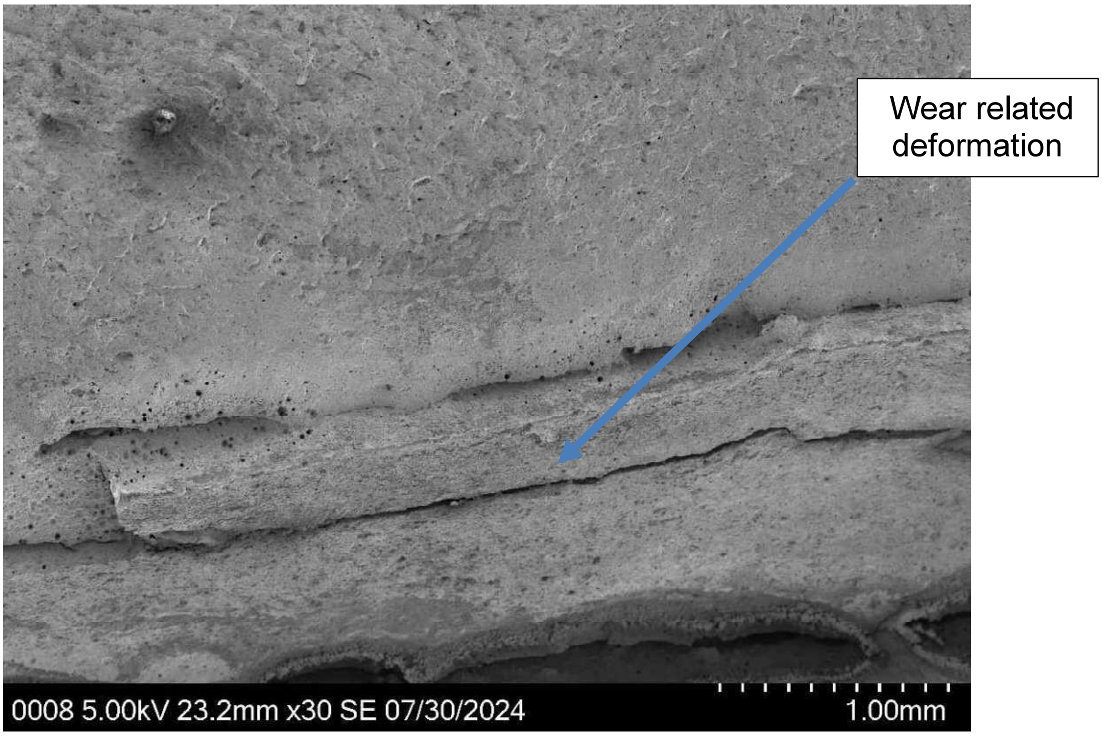


Figure 33: Sample 23421 location C x 30 magnification (image 23421 Image_0008)

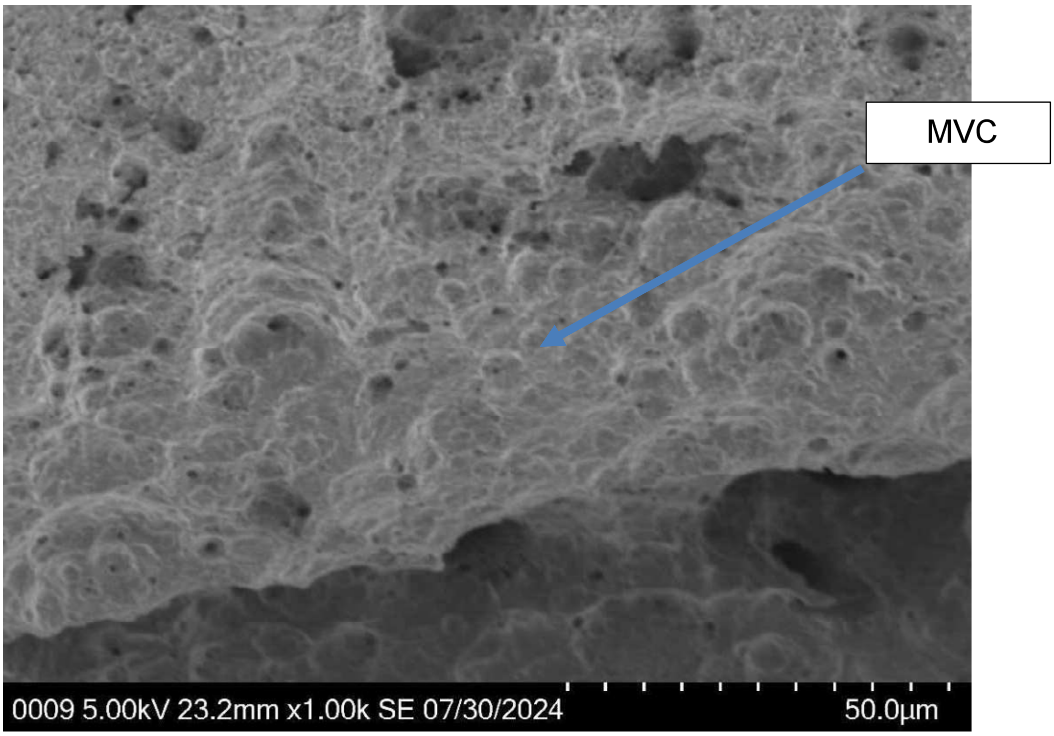


Figure 34: Sample 23421 location C x1000 magnification (image 23421 Image_0009)

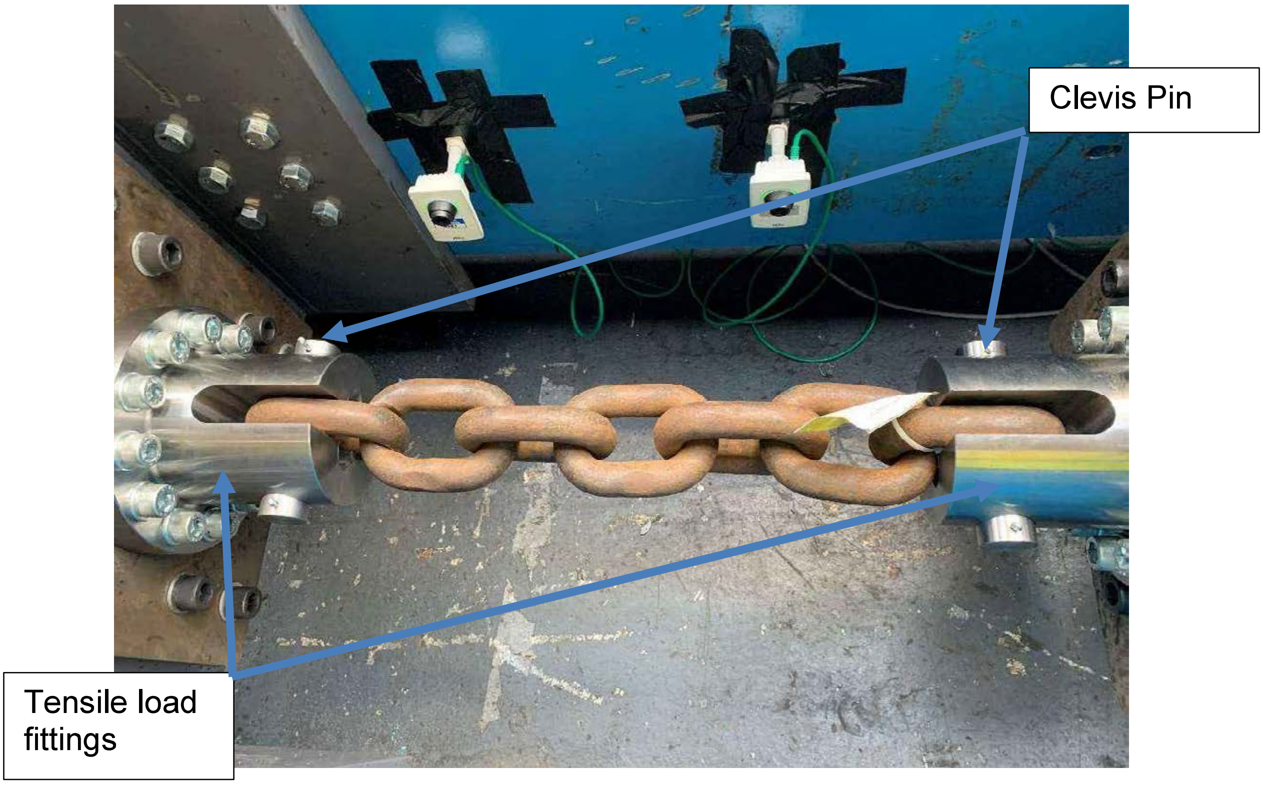


Figure 35: Sample 23310 loaded into tensile testing equipment fixtures and clevis pins identified (image 20240906_093908073_iOS)

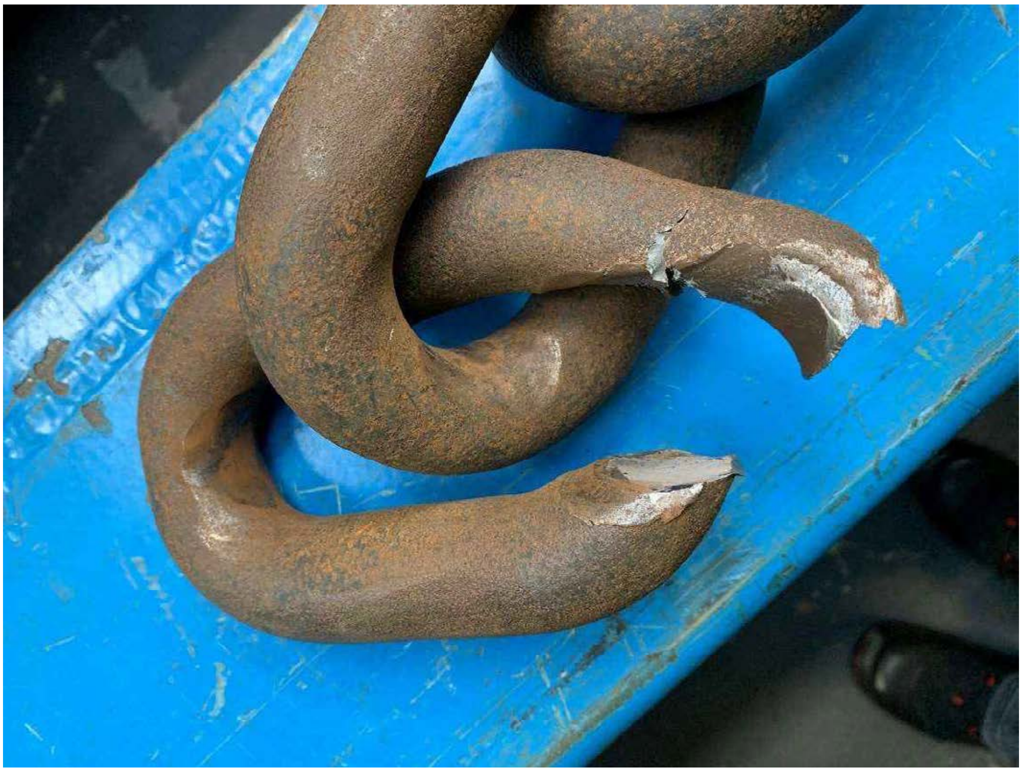


Figure 36: Sample 23310 post MBL test showing the fractured link (20241017_095314490_iOS)

Figure 37: Samples 23544 & 23545 from 23309 post MBL test showing the fractured link (20241017_104856329_iOS)

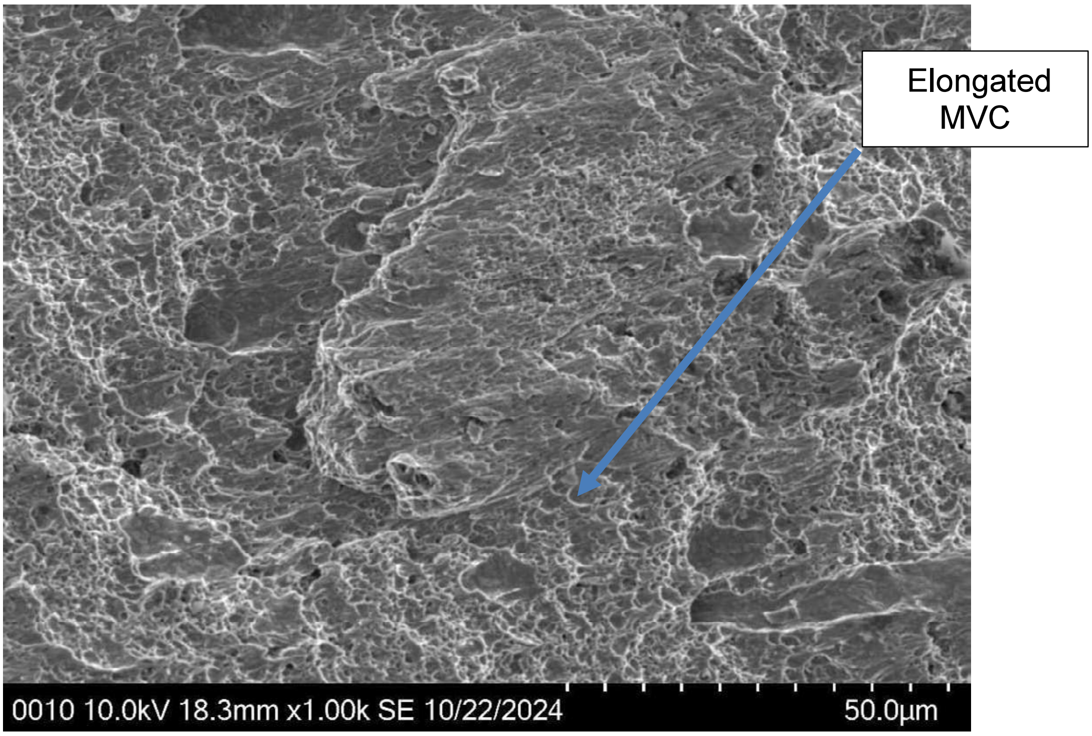


Figure 38: Sample 23550 Primary Fracture Face X1000 magnification (image number 23550_0010)

APPENDIX A VISUAL INSPECTION RESULTS

Chain ID	Link	Observations	Wear per BS EN 818-6	Photo references
23309	1	Broadly sound with surface corrosion consistent with being exposed to a marine environment. No evidence of any gross defects or damage	No wear	20240620_091404098_iOS; 20240620_092738025_iOS
	2	Broadly sound with surface corrosion consistent with being exposed to a marine environment. No evidence of any gross defects or damage	No Wear	
	3	Broadly sound with surface corrosion consistent with being exposed to a marine environment. A patch of wear approx. 30 x 20mm at the transition from the shank to the crown of the link	102% of nominal	20240620_095903528_iOS
	4	Broadly sound with surface corrosion consistent with being exposed to a marine environment. Patch of wear on the non-welded shank approx. 45 x 20mm, 2mm deep. Wear also evident on inside of the crown where contacting Link 5	102% of nominal	20240620_103400166_iOS (Figure 7); 20240620_103727026_iOS
	5	Broadly sound with surface corrosion consistent with being exposed to a marine environment. Patch of	99% of nominal	20240620_103904649_iOS; 20240620_104613230_iOS (Figure 8)

		wear on the non-welded shank approx. 55 x 30mm 3 mm deep. Wear also evident inside both crowns were contacting links 4 and 6. Wear at 45° to the axis indicating that the load was not along the axis of the link		
	6	Surface corrosion consistent with being exposed to a marine environment. Patch of wear on the non-welded shank 55 x 30mm 3mm deep and significant wear in the inside of the crowns where in contact with link 5 and the missing link 7.	92% of nominal	20240620_104834224_iOS; 20240620_105123598_iOS (Figure 9)
23310	1	Broadly sound with surface corrosion consistent with being exposed to a marine environment. No evidence of any gross defects or damage	No wear	20240620_150411077_iOS
	2	Broadly sound with surface corrosion consistent with being exposed to a marine environment. Some slight deformation at the crown on one end taking the link out of ovality.	No wear	20240620_151007950_iOS (Figure 11)
	3	Broadly sound with surface corrosion consistent with being exposed to a marine environment. Evidence of wear on the transition from shank	100% of nominal	20240620_154249674_iOS

	to crown approx. 30 x 20mm		
4	Broadly sound with surface corrosion consistent with being exposed to a marine environment. 3 patches of wear noted, on the welded shank approx. 30 x 20mm 2mm deep, on the non-welded shank 2 patches 50 x 20mm 1mm deep and 25 x 20 1mm deep	102% of nominal	20240621_091725000_iOS; 20240621_091925995_iOS; 20240621_091937595_iOS
5	Broadly sound with surface corrosion consistent with being exposed to a marine environment. Evident wear in multiple location on the shanks and in the inside of both crowns. 3 patches of wear noted, on the welded shank approx. 50 x 25mm 1mm deep, on the non-welded shank 2 patches 50 x 20mm 1mm deep and 45 x 20 1mm deep. Wear in both crowns at 45° to the axis indicating that the load was not along the axis of the link.	101% of nominal	20240621_102120541_iOS; 20240621_102144135_iOS; 20240621_102341726_iOS; 20240621_102513297_iOS (Figure 12)
6	Surface corrosion consistent with being exposed to a marine environment. Wear evident on shanks in 3 patches of wear noted, on the welded shank approx. 40 x 15mm 3mm deep, on the non-welded shank 2 patches 40 x 20mm	87% of nominal	20240621_102759382_iOS; 20240621_102925961_iOS; 20240621_103042068_iOS; 20240621_103114418_iOS (Figure 13)

		1mm deep and 55 x 20 1mm deep. Significant wear in crown where it is in contact with link 7		
	7	Surface corrosion consistent with being exposed to a marine environment. Significant wear in both crowns	87% of nominal	20240621_103242649_iOS (Figure 14); 20240621_103338363_iOS (Figure 15)

APPENDIX B THIRD PARTY TEST CERTIFICATES

Morgan Ward NDT Limited

Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.1 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Magnetising Equipment Johnson & Allen Yoke		Material Ferromagnetic Material	
Serial No. JY2-0318	Calibration Date Due: On Use	Surface Condition As Machined	
Detecting Media LUMOR J 14HF		Area Inspected 100% Accessible Areas	
Type Fluorescent	Batch No. C232818897		
Viewing Conditions		Procedure / Standard: BS EN ISO 9934-1	Issue No / Date 2016
White (Lux) 1360 <6 Background	UV Lamp Serial No. MW000371 UV-A (μW/Cm2) 1880	Acceptance Criteria: Report FIndings	Issue No / Date n/a

Test Details & Results:
Please see photos below for results.

Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

Morgan Ward NDT Limited

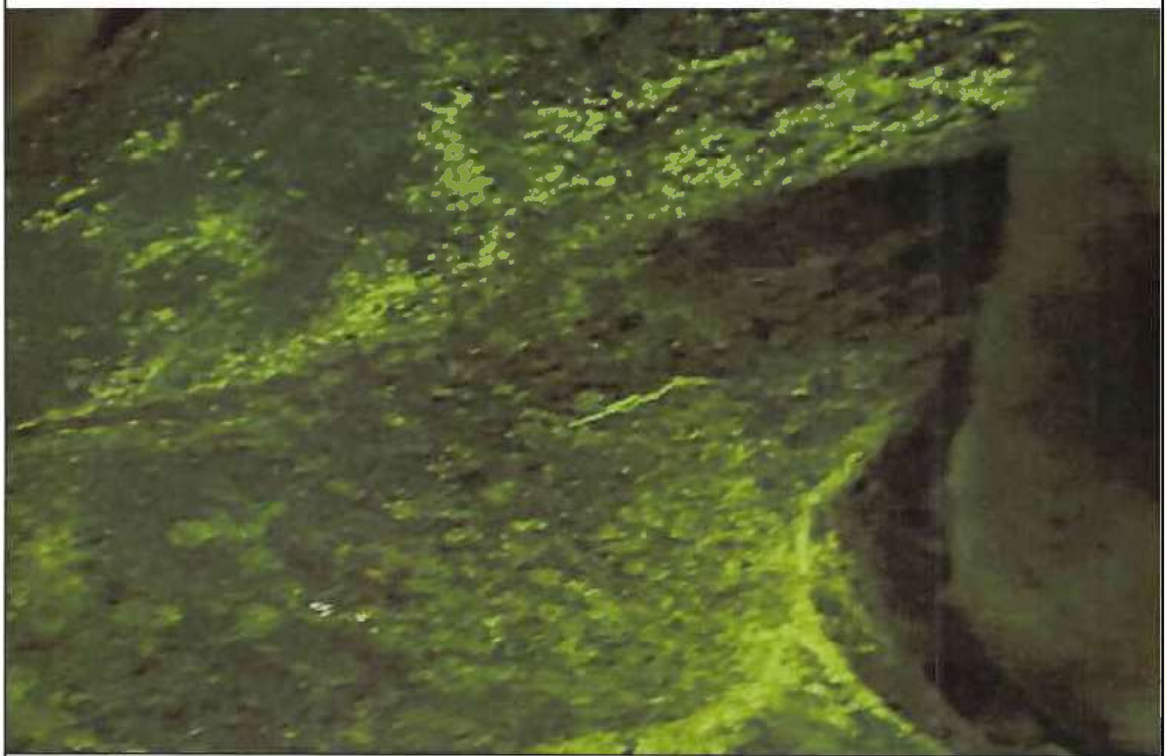
Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No:	158645.1
	Date of Test:	15.07.2024
	Job No:	-
	Order No:	43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Test Details & Results:
Chain Link, crack indication noted



Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW
Operator	[redacted]
Qualification	PCN LII
Certificate No.	316269

[redacted]

Date : **06.09.2024**
FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

Morgan Ward NDT Limited

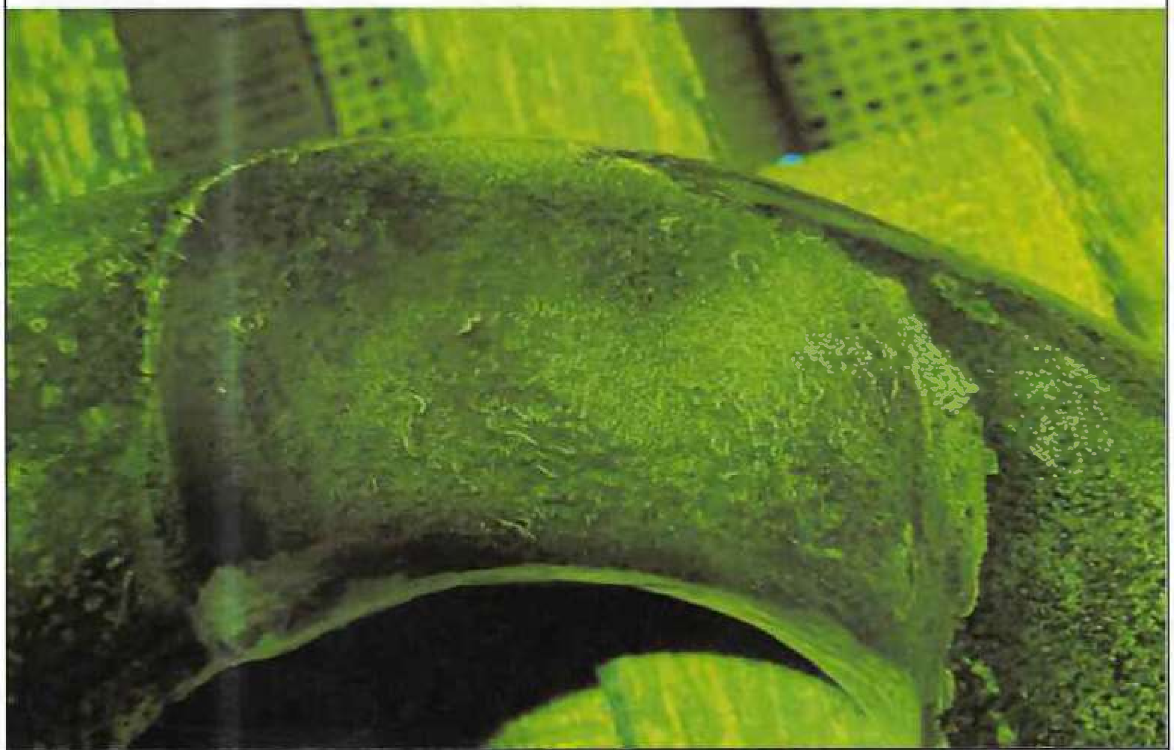
Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.1 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Test Details & Results:
Chain Link, crack indication noted, severe wear noted on the internal radius, several stress cracks noted.



Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

Morgan Ward NDT Limited

Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No:	158645.1
	Date of Test:	15.07.2024
	Job No:	-
	Order No:	43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Test Details & Results:
Chain Link, crack indication noted, wear noted on the internal radius, several stress cracks noted.

Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

Morgan Ward NDT Limited

Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.1 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Test Details & Results:
Chain Link, crack indication noted, sever wear noted on the internal radius, several stress cracks noted. Cracking noted towards the outer radius edge.

Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

Morgan Ward NDT Limited

Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.1 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Test Details & Results:
Chain Link, crack indication noted, sever wear noted on the internal radius, several stress cracks noted.

Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

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MAGNETIC PARTICLE INSPECTION **REPORT**

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.1 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
2 Sets of Chain links
32mm Grade 8 short link chains
6 Link Chain Serial No: 23309
7 Link Chain Serial No: 23310

Test Details & Results:
Chain Link, crack indication noted, sever wear noted on the internal radius, several stress cracks noted.

Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

morgan ward

Morgan Ward NDT Limited

Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN		Report No: 158645.2 Date of Test: 15.07.2024 Job No: - Order No: 43070026083	
Component / Identification. 1 Chain link with severe damage. 32mm Grade 8 short link chain			
Magnetising Equipment Johnson & Allen Yoke		Material Ferromagnetic Material	
Serial No. JY2-0318	Calibration Date Due: On Use	Surface Condition As Machined	
Detecting Media LUMOR J 14HF		Area Inspected 100% Accessible Areas	
Type Fluorescent	Batch No. C232818897		
Viewing Conditions		Procedure / Standard: BS EN ISO 9934-1	Issue No / Date 2016
White (Lux) 1360 <6 Background	UV Lamp Serial No. MW000371 UV-A (µW/Cm2) 1880	Acceptance Criteria: Report Findings	Issue No / Date n/a
Test Details & Results: Please see photos below for results.			
Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW		
Operator	[redacted]	[redacted]	
Qualification	PCN LII		
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED	

morgan ward

Morgan Ward NDT Limited

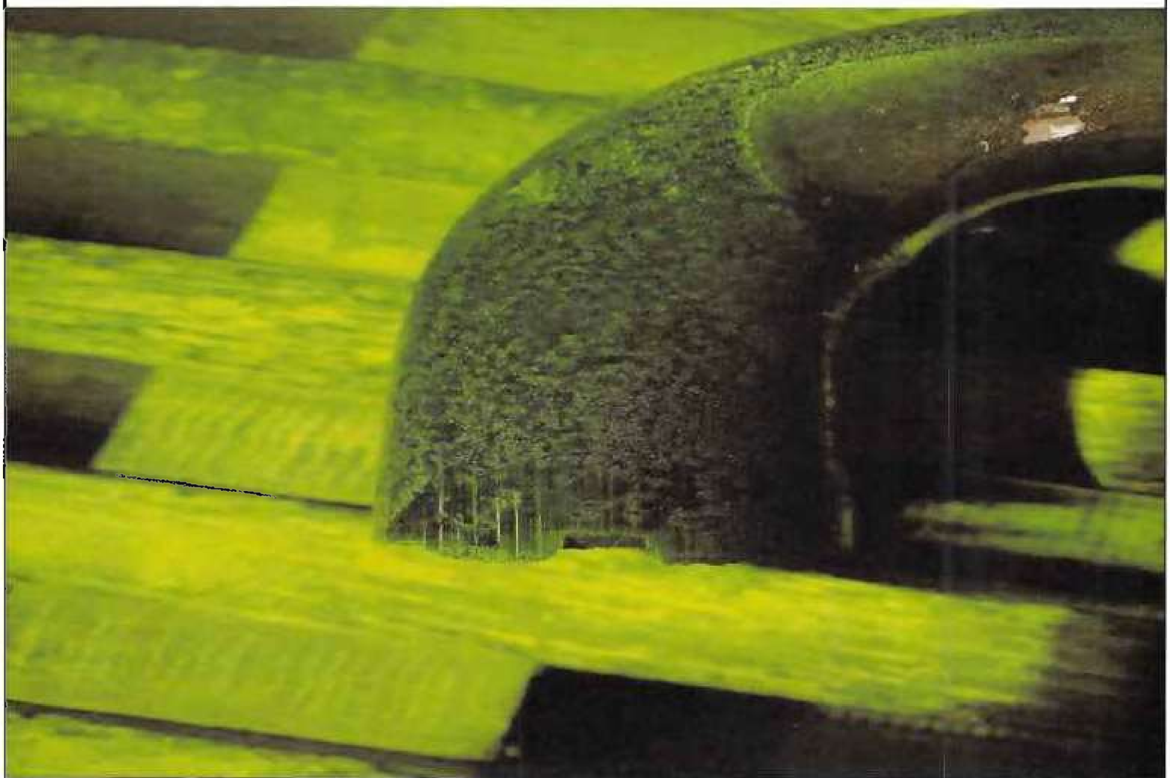
Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.2 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
1 Chain link with severe damage.
32mm Grade 8 short link chain

Test Details & Results:
Chain Link, crack indication noted, wear noted on the internal radius.
Cracking noted where chain link as failed under load.



Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

morgan ward

Morgan Ward NDT Limited

Dale Road, New Mills, High Peak,
Derbyshire. SK22 4NW, United Kingdom
Tel: +44 (0) 1663 747061
e-mail:admin@morganward.co.uk

MAGNETIC PARTICLE INSPECTION REPORT

Client: Health & Safety Executive Harpur Hill Buxton Derbyshire SK17 9JN	Report No: 158645.2 Date of Test: 15.07.2024 Job No: - Order No: 43070026083

Component / Identification.
1 Chain link with severe damage.
32mm Grade 8 short link chain

Test Details & Results:
Rounded indication noted, with presence of cracking around the edge.

Test Location	Morgan Ward (NDT) Ltd. Unit 2 Dale Road SK22 4NW	
Operator	[redacted]	[redacted]
Qualification	PCN LII	
Certificate No.	316269	Date : **06.09.2024** FOR AND ON BEHALF OF MORGAN WARD (NDT) LIMITED

element

TEST CERTIFICATE

Element Materials Technology Sheffield Ltd
3 Ignite
Magna Way
Rotherham
S60 1FD
UNITED KINGDOM

P: +44 114 272 6581
F: +44 114 272 3248
info.sheffield@element.com
www.element.com

ilac-MRA UKAS TESTING 0136

HEALTH & SAFETY LABORATORY
HARPUR HILL, BUXTON
DERBYSHIRE SK17 9JN
United Kingdom

PO / SO: 43070026413
Material: Low Alloy Steel

Specification(s): Client Requirements

Lab Job#: 766754
Certification Date: 18/10/24

Job Number: PE20767 Job Title: MAIB Incident Person Responsible: [redacted] Sample ID: 23426
Size / Description: Port Derrick Head

Chemical Analysis | Test Date: 29-08-24 | Operator: [redacted]

Test ID	Element	Description	Result	Min	Max	Unit	Test Type	Method Reference
1041339	Al	Aluminium	0.04	INFO		Wt. %	OES/AES	Accredited In House Method
	B	Boron	<0.003	INFO		Wt. %	OES/AES	
	C	Carbon	0.17	INFO		Wt. %	OES/AES	
	Cr	Chromium	0.18	INFO		Wt. %	OES/AES	
	Cu	Copper	0.02	INFO		Wt. %	OES/AES	
	Mn	Manganese	1.20	INFO		Wt. %	OES/AES	
	Mo	Molybdenum	0.01	INFO		Wt. %	OES/AES	
	Ni	Nickel	0.05	INFO		Wt. %	OES/AES	
	P	Phosphorus	0.016	INFO		Wt. %	OES/AES	
	S	Sulfur	<0.005	INFO		Wt. %	OES/AES	
	Si	Silicon	0.18	INFO		Wt. %	OES/AES	
	Ti	Titanium	<0.01	INFO		Wt. %	OES/AES	
	V	Vanadium	0.04	INFO		Wt. %	OES/AES	

This test certificate replaces and supersedes the test certificate 147871 Version 1. [reason for revision - Sample IDs changed as per request [redacted] 15/10/2024]

Disposition

For Information Only.

END OF REPORT

Any tests marked with a * are outside of the laboratory's ISO17025 scope of accreditation.

Signed for and on behalf of Element

SBell

Stephen Bell, Chemistry Supervisor

	Uncertainty of Measurement
Aluminium	±0.01%
Boron	--
Carbon	±0.03%
Chromium	±0.03%
Copper	±0.01%
Manganese	±0.09%
Molybdenum	±0.01%
Nickel	±0.02%
Phosphorus	±0.01%
Sulphur	--
Silicon	±0.01%
Titanium	--
Vanadium	±0.01%

element

Element Materials Technology Sheffield Ltd
3 Ignite
Magna Way
Rotherham
S60 1FD
UNITED KINGDOM

P: +44 114 272 6581
F: +44 114 272 3248
info.sheffield@element.com
www.element.com

ilac-MRA UKAS TESTING 0136

TEST CERTIFICATE

HEALTH & SAFETY LABORATORY
HARPUR HILL, BUXTON
DERBYSHIRE SK17 9JN
United Kingdom

PO / SO: 43070026413
Material: Low Alloy Steel

Specification(s): Client Requirements

Lab Job#: 766654
Certification Date: 18/10/24

Job Number: PE20767
Job Title: MAIB Incident
Person Responsible: [redacted]
Sample ID: 23428
Size / Description: Section of partial chain link

Chemical Analysis

Test Date: 29-08-24 | Operator: Tiffany Tran

Test ID	Element	Description	Result	Min	Max	Unit	Test Type	Method Reference
1041334	Al	Aluminium	0.04	INFO		Wt. %	OES/AES	Accredited In House Method
	B	Boron	<0.003	INFO		Wt. %	OES/AES	
	C	Carbon	0.22	INFO		Wt. %	OES/AES	
	Cr	Chromium	0.51	INFO		Wt. %	OES/AES	
	Cu	Copper	0.10	INFO		Wt. %	OES/AES	
	Mn	Manganese	1.32	INFO		Wt. %	OES/AES	
	Mo	Molybdenum	0.28	INFO		Wt. %	OES/AES	
	Ni	Nickel	0.54	INFO		Wt. %	OES/AES	
	P	Phosphorus	0.012	INFO		Wt. %	OES/AES	
	S	Sulfur	<0.005	INFO		Wt. %	OES/AES	
	Si	Silicon	0.17	INFO		Wt. %	OES/AES	
	Ti	Titanium	<0.01	INFO		Wt. %	OES/AES	
	V	Vanadium	0.06	INFO		Wt. %	OES/AES	

Tensile Test (Room Temp.)

Test Date: 29-08-24 | Operator: [redacted]

	Temp	Stressed Dimension	Area	0.2% Yield		Ultimate Load	Ultimate Strength	Elong 5D/5.65W After Fracture		R of A		Test Method
Test ID	°C	mm	mm²	kN	MPa	kN	MPa	mm	%	mm	%	
1041335	25	4.00 (d)	12.57	14.31	1139	15.68	1248	18.50	15.5	2.36	65	BS EN ISO 6892-1 - 2019
1041337	25	3.98 (d)	12.44	16.18	1301	16.61	1335	22.00	10.0	2.50	61	BS EN ISO 6892-1 - 2019

This test certificate replaces and supersedes the test certificate 147771 Version 1 [reason for revision - Sample IDs changed

Any tests marked with a * are outside of the laboratory's ISO17025 scope of accreditation.

[redacted]

Element Materials Technology Sheffield Ltd
3 Ignite
Magna Way
Rotherham
S60 1FD
UNITED KINGDOM

P: +44 114 272 6581
F: +44 114 272 3248
info.sheffield@element.com
www.element.com

0136

TEST CERTIFICATE

HEALTH & SAFETY LABORATORY
HARPUR HILL, BUXTON
DERBYSHIRE SK17 9JN
United Kingdom

PO / SO: 43070026413
Material: Low Alloy Steel
Specification(s): Client Requirements

Lab Job#: 766654
Certification Date: 18/10/24

as per request [redacted] 15/10/2024]

Disposition
For Information Only.

END OF REPORT

Any tests marked with a * are outside of the laboratory's ISO17025 scope of accreditation.

[redacted]

	Uncertainty of Measurement
Aluminium	±0.01%
Boron	--
Carbon	±0.03%
Chromium	±0.03%
Copper	±0.01%
Manganese	±0.09%
Molybdenum	±0.04%
Nickel	±0.09%
Phosphorus	±0.01%
Sulphur	--
Silicon	±0.01%
Titanium	--
Vanadium	±0.01%

TTI Testing Ltd

Unit 2, Hithercroft Road, Wallingford, Oxfordshire, OX10 9DG, UK

www.tti-testing.com

Breaking load verification of 32 mm short link chain

TTI Reference number TTI-IMLR-2024-6113

Date	Rev.	Description	Prepared by	Authorised by
21/10/24	0	for issue to client	[redacted]	[redacted]
22/10/24	1	Correction of typo.		

Distribution:

TTI Testing Ltd (author, file)

HSE Science and Research Centre

Attention:

[redacted]

Contents

1 Introduction

The Health and Safety Executive (**HSE)** has contracted **TTI Testing** to undertake tensile testing of some sections of Ø32 mm short link chain in order to compare the breaking load with the Minimum Breaking Load (MBL) specified in Table 5 of EN 818-2 [1].

This document describes the work which **TTI Testing** undertook and presents the results of measurements made in fulfilment of this requirement.

2 Samples

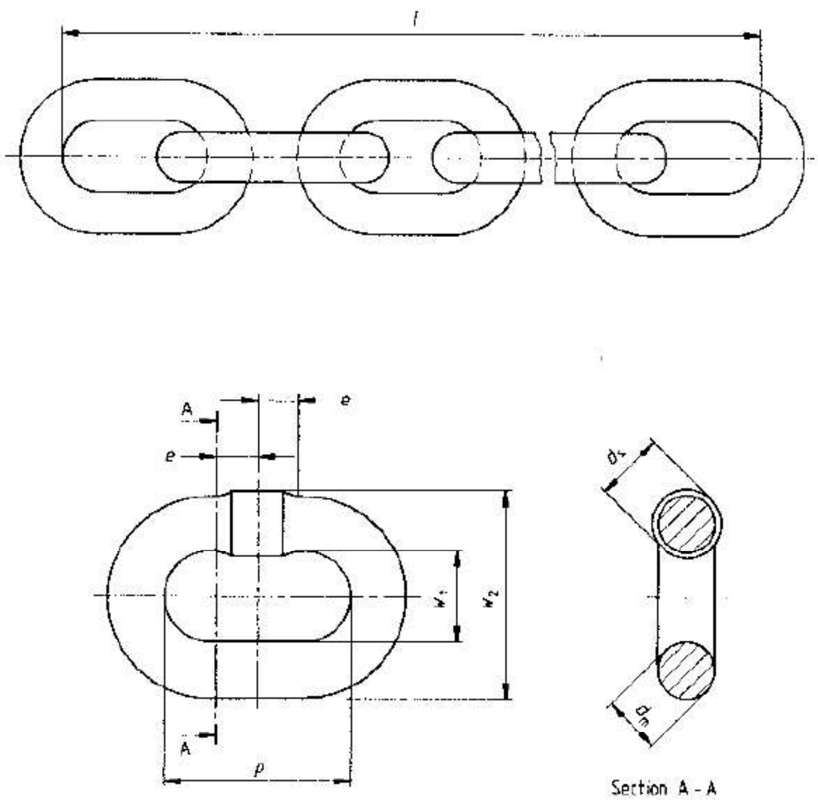
Full details of the chain samples are unknown, but they were all nominally Ø32 mm short link chain as per BS EN 818-1 [2]. Figure 2.1 shows a drawing of short link chain: the pitch length, p is typically 3 times the parent bar diameter, d_m giving an overall link length of $5d_m$ (so 160 mm for Ø32 mm chain). Typical weight is 23 kg/m.

The MBL for grade 8 Ø32 mm chain as per BS EN 818-2 [1] is 1290 kN.

The samples supplied for testing were in two groups:

- Two lengths each seven links long of new chain procured for proving of the test methodology (e.g. checking machine control settings) and providing some base line data on the behaviour of chain under tensile load; and,
- Two lengths of chain from the quick-release assembly of the dredging gear on UK registered scallop dredger *Honeybourne III*.
  - One length of chain seven links long from the starboard side; and,
  - One length of chain six links long from the port side, the seventh link having failed in service causing the dredging gear to fall.

Figure 2.2 which is taken from the MAIB safety bulletin [3] shows the general arrangement of the chain in service on the starboard side derrick before it was removed for testing.



Key:

l = multiple pitch length
p = pitch
d_m = material diameter
d_s = weld diameter
e = length dimensionally affected by welding
w_1 = internal width away from the weld
w_2 = external width over the weld

Figure 2.1: Link and chain dimensions (from [2]).

Figure 2.2: *Honeybourne III* derrick arrangement (starboard side) (from [3]).

3 Test equipment

Testing was conducted in TTI Testing's long bed 1.5 MN tensile testing machine (Figure 3.1). The movable crosshead was positioned to accommodate the relatively short sample lengths. Table 3.1 lists the main parameters of the equipment, whilst calibration certificates are presented in Appendix A.

Figure 3.1: Main actuator 1.5 MN testing machine at TTI Testing's laboratory in Wallingford, UK. The load cell is just behind the tooling plate on which is mounted one of the chain fittings.

Parameter	
Load capacity (MN / tonnes)	1.5 / 150
Actuator stroke (mm)	2,000
Adjustable cross head for slack removal	Y
Moveable 'static' crosshead	Y
Bed length (mm)	15,000
Controller	Cube SERIES
Fatigue rated	Y
Block loading	Y
Service (random) loading (waveform from .xls file)	Y
May be used in combination with a rotary motor	Y

Table 3.1: Main parameters of the 1.5 MN long bed tensile testing machine.

Figure 3.2 shows a typical fitting which was used in the first test to fix the ends of the chain sample to the test machine. Although the test was successful in that the chain sample broke clear of the fittings, the pins bruised and bent slightly meaning that they could not be removed from the clevises. Testing was suspended whilst new fittings were designed and manufactured, Figure 3.3.

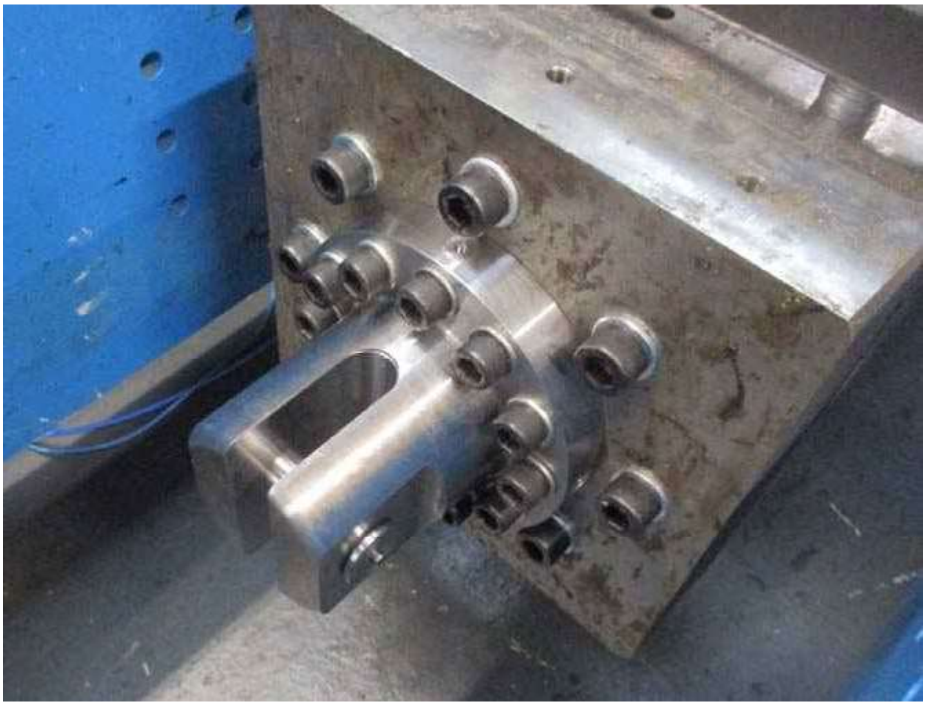


Figure 3.2: Ø32 mm chain fittings used for the first test.

Figure 3.3: Re-designed Ø32 mm chain fittings used for tests 2 - 4.

4 Testing

The purpose of the work reported here was to demonstrate whether or not each of the chain samples could support the MBL. The test was undertaken as described in §6.5 of EN 818-1 [2].

The procedure below was followed:

1. With the fittings mounted in the test machine the load cell channel was checked and if necessary zeroed. (Note for the samples with an odd number of links the clevises were both mounted with the slots in the vertical orientation. For samples with an even number of links one of these fittings was rotated by 90° (it was only necessary to rotate one) to accommodate the sample without imposing any twist.)
2. Each end of the sample was mounted in the 1.5 MN machine as shown in §4 (Fig. 3.3).
3. A small load (2 kN) was applied to the sample to remove the sample sag and the nominal internal length L_n measured by means of a steel tape measure across the backs of the fitting pins.
4. The stroke channel of the test machine was zeroed.
5. The machine data logger was started recording both load and stroke channels.
6. The sample was loaded at a rate of approx. 10 $N/mm^2/s$ (5 kN/s was employed).
7. The sample was loaded towards the MBL of the chain (1290 kN). If this load was reached, it would be held for 15 s, before unloading the sample at the same rate.
8. The sample was then removed from the machine.

5 Schedule and witness of testing

Initial witnessed testing on a new sample of chain (Test 1) was conducted on 6th September 2024. As mentioned in §3, problems were experienced with the fittings. These were re-designed and new fittings were made. A trial was made on a sample of new chain (Test 2) to confirm the new fitting performance (14th October 2024), and following successful completion of that, Tests 3 and 4 (the ex-incident samples) were conducted with witnesses present on 17th October 2024.

The table below lists the witnesses who attended at **TTI Testing** to witness the various tests:

Name	Representing	Date of attendance
[redacted]	[redacted]	6th September and 17th October 2024
[redacted]	[redacted]	6th September and 17th October 2024
[redacted]	[redacted]	6th September and 17th October 2024
[redacted]	[redacted]	6th September and 17th October 2024
[redacted]	[redacted]	6th September and 17th October 2024
[redacted]	[redacted]	6th September 2024
[redacted]	[redacted]	17th October 2024

6 Results

6.1 Test 1 – HSE Sample 22384

Test 1 was conducted on a sample of as new chain, seven links long. Under a load of 2 kN, L_n was measured at 669 mm. The sample supported a load of **1,020.50 kN**, before failure at the link-link interface of the second and third links from the main actuator end of the sample, Figure 6.1.

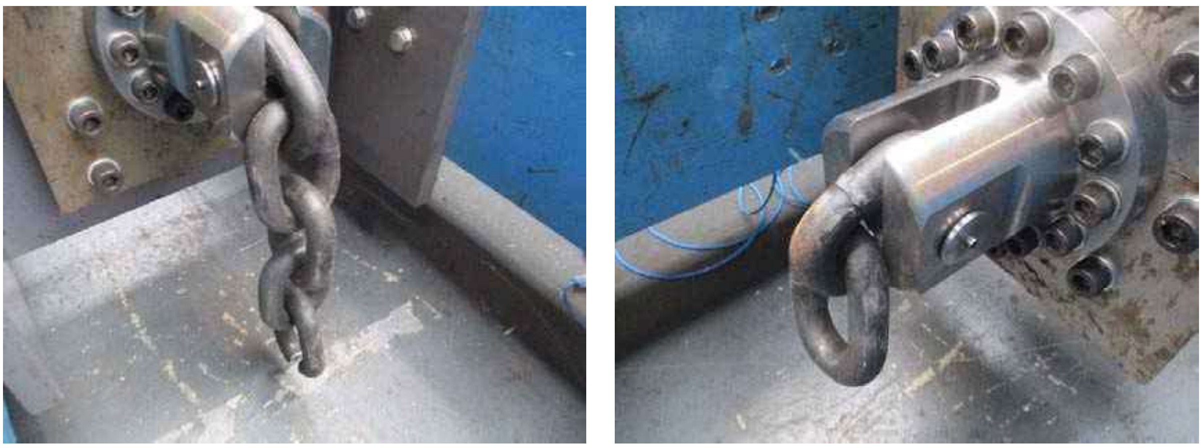
Figure 6.2 shows the load-elongation relationship which is based on the L_n measured at 2 kN and data recorded during the test. It is noted that there would be an effect on the measured stroke caused by the bending of the pins which was seen during testing. This effect has not been allowed for in the relationship presented in Figure 6.2, but may be of the order of 10%.

It is noted that the measured breaking load and elongation at failure for this sample are both well below the specification in BS EN 818 of 1290 kN [1, Table 5] and 20% [1, §5.4.2].

As mentioned earlier, the performance of the first set of chain fittings was not satisfactory. Although the chain sample failed clear of the fitting pins (giving confidence that the measured failure load was unaffected by the fittings) it was impossible to remove one of the pins to exchange samples for subsequent tests.

Testing was suspended whilst new fittings were designed and manufactured. The **HSE** left a second new chain sample with **TTI Testing** for use in the design and testing of the new fittings. After measurements of the links, it was determined that the fitting pin diameter could be increased. In addition, the pins were manufactured from a higher grade and heat treated steel.

Additionally, given the low breaking load measured in Test 1 it was decided to take the opportunity to check the calibration of the load cell (even though it had only recently been calibrated).



Static end of sample

Main actuator end of sample

Figure 6.1: Failure of the sample 22384 at 2^{nd} – 3^{rd} link-link interface.

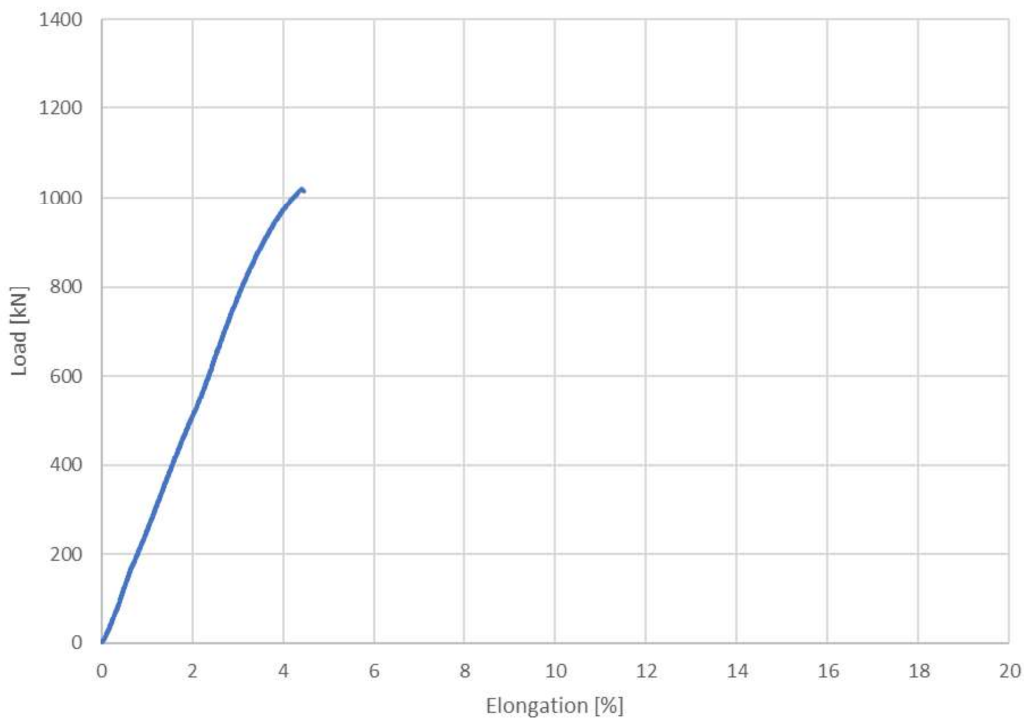


Figure 6.2: Load-elongation relationship for sample 22384 based on recorded data.

6.2 Test 2 – HSE Sample 22385

Test 2 was conducted with the new test fittings on a sample of as new chain, seven links long, Figure 6.3.

With reference to Figure 6.3 note the video cameras which were mounted on the side columns of the machine which were used to video the sample during the test. The feed from these cameras and a ceiling mounted camera were recorded along with that of the PC screen associated with the machine controller (which displayed the test machine load and stroke), see for example Figure 6.4.

Under a load of 2 kN, L_n was measured at 669 mm. The sample supported a load of **1,044.16 kN**, before failure at the link-link interface of the third and fourth links from the main actuator end of the sample, Figure 6.5.

Figure 6.6 shows the load-elongation relationship which is based on the L_n measured at 2 kN and data recorded during the test.

Figure 6.3: Test 2 sample set up in the 1.5 MN machine with new test fittings.

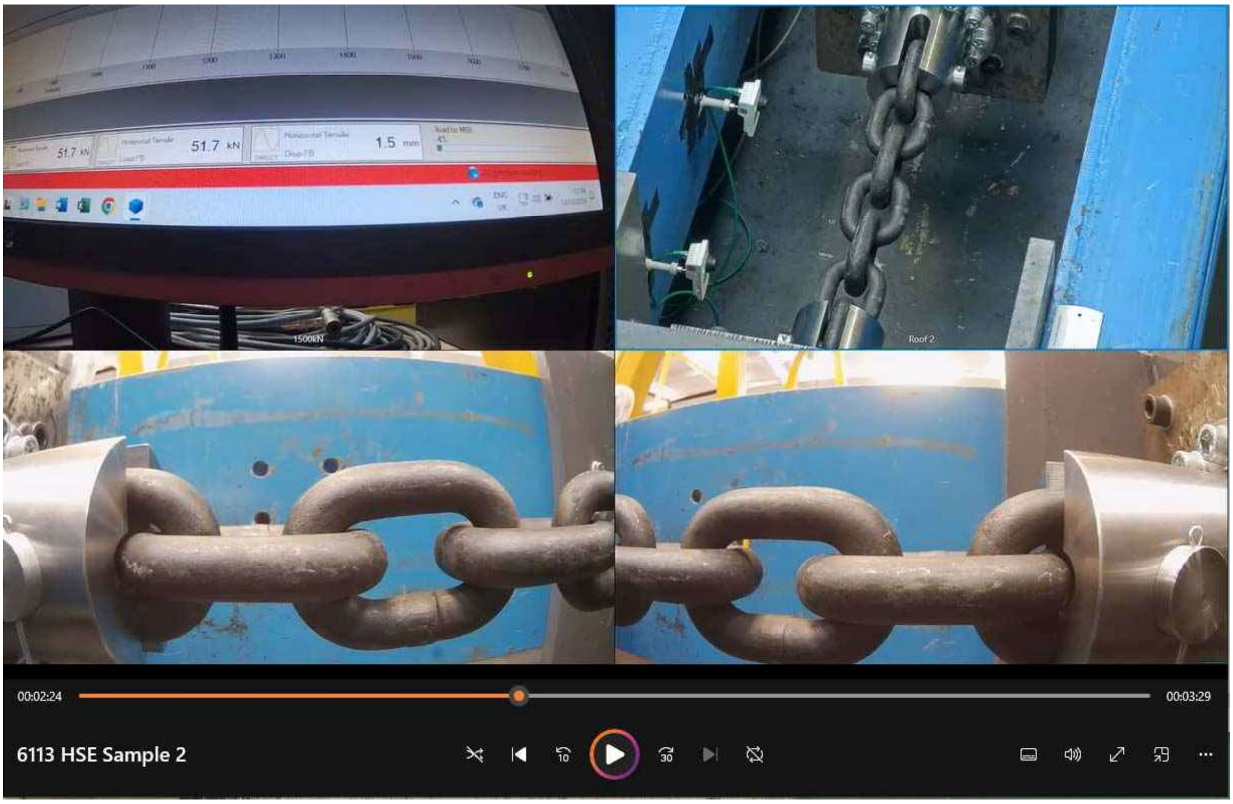


Figure 6.4: Example screenshot of the camera video capture software (Test 2).

Figure 6.5: Failure of the sample 22385 at 3rd – 4th link-link interface.

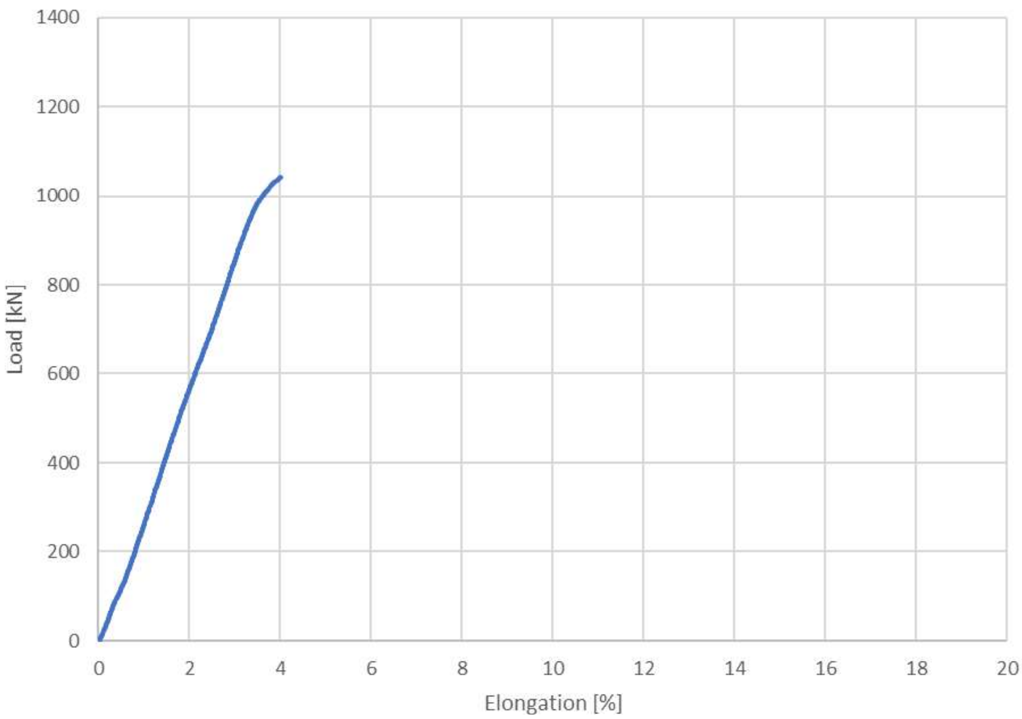


Figure 6.6: Load-elongation relationship for sample 22385 based on recorded data.

6.3 Test 3 – HSE Sample 23310 (starboard side chain)

Test 3 was conducted on the starboard side chain from the vessel *Honeybourne III*. This was the chain which was seven links long and had not failed (Figure 2.2).

Under a load of 2 kN, L_n was measured at 696 mm. The sample supported a load of **1,055.02 kN**, before failure of the second link at the link-link interface of the first and second links at the static end of the sample, Figure 6.7. Figure 6.8 shows the load-elongation relationship which is based on the L_n measured at 2 kN and data recorded during the test.

Chain sample after testing

End link in static end fitting

Detail view on failed link

Figure 6.7: Views on the failure of the sample 23310 at 1st and 2nd link-link interface from the static end of the machine.

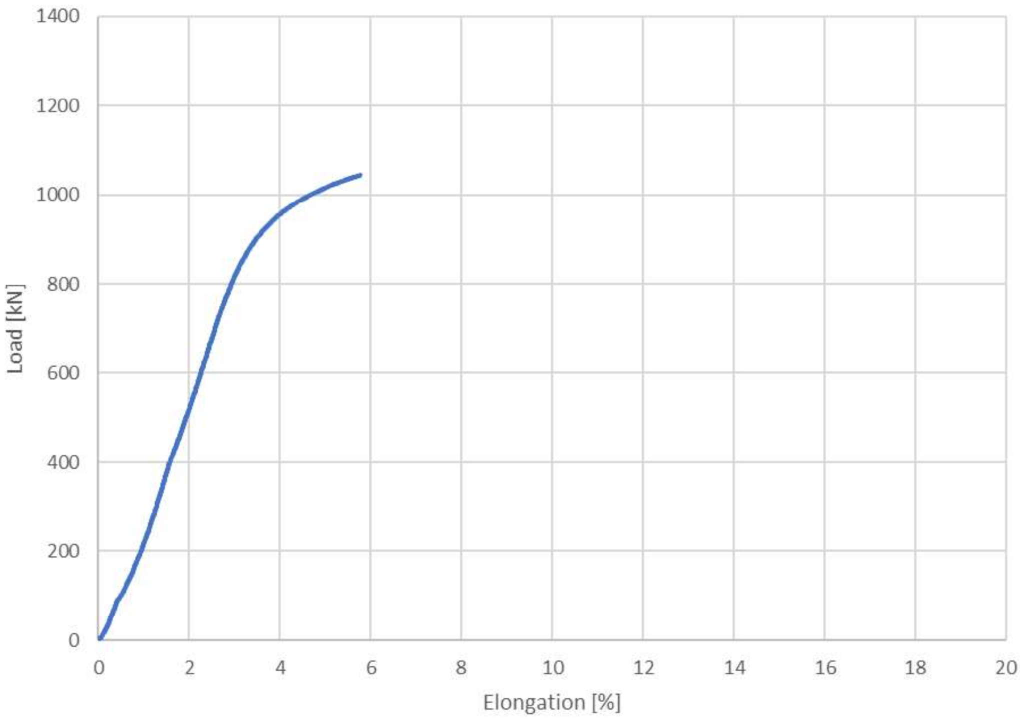


Figure 6.8: Load-elongation relationship for sample 23310 based on recorded data.

6.4 Test 4 – HSE Sample 23309 (port side chain)

Test 4 was conducted on the port side chain from the vessel *Honeybourne III*. This was the sample which was six links long, the seventh having failed during the incident.

Under a load of 2 kN, L_n was measured at 582 mm. The sample supported a load of **1,166.19 kN**, before main failure of the first link at the link-link interface of the first and second links at the static end of the sample, Figure 6.9. As the test machine pulled the sample apart a secondary failure occurred on the same link. Figure 6.10 shows the load-elongation relationship which is based on the L_n measured at 2 kN and data recorded during the test.

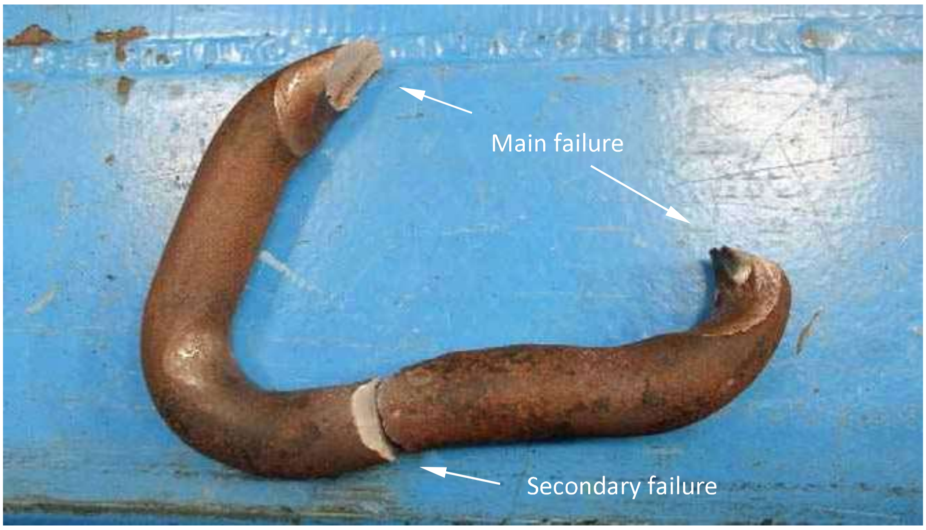


Figure 6.9: Failed link after testing of sample 23309 (Test 4).

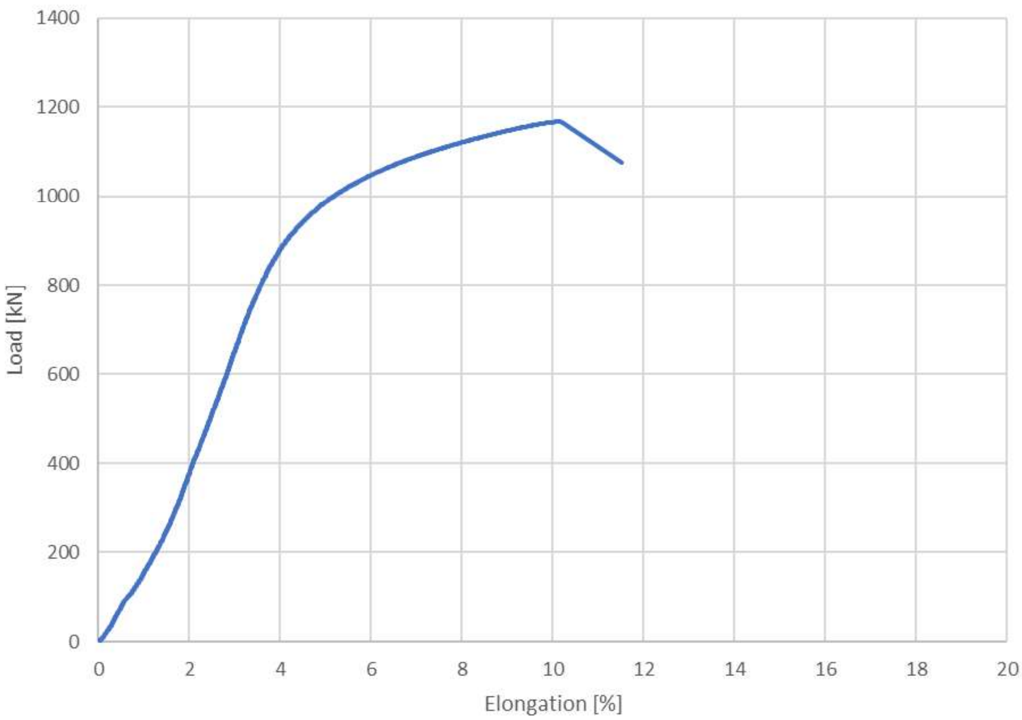


Figure 6.10: Load-elongation relationship for sample 22309 based on recorded data.

6.5 QR codes for test videos

The QR codes below provide links to videos taken during the testing.

Test 1 - 22384

Test 2 - 22385

Test 3 – 7 link 23310

Test 4 – 6 link 23309

7 Conclusions

This report has described the methodology employed to undertake breaking strength measurements on lengths of grade 8 Ø32 mm short link chain. Testing was undertaken in accordance with BS EN 818-1 [2].

All samples tested failed clear of the fittings used to mount the chain samples into the 1.5 MN test machine used for the tests. This gives confidence that the measured failure loads are representative of the samples.

Table 7.1 summarises the results from the four tests. For ease of comparison, the load-elongation relationships for the four tests are presented in Figure 7.1. As mentioned above, the elongation of sample 22384 has probably been influenced by the deflection of the pins.

Test No.	Sample ID	Number of links in sample	L_n measured at 2 kN [mm]	Failure load [kN]	Elongation at failure [%]
1	22384	7	669	1020.50	4.4
2	22385	7	669	1044.16	4.0
3	23310	7	696	1055.02	6.3
4	23309	6	582	1166.19	10.1

Table 7.1: Summary of the results of the tensile tests on the chain samples.

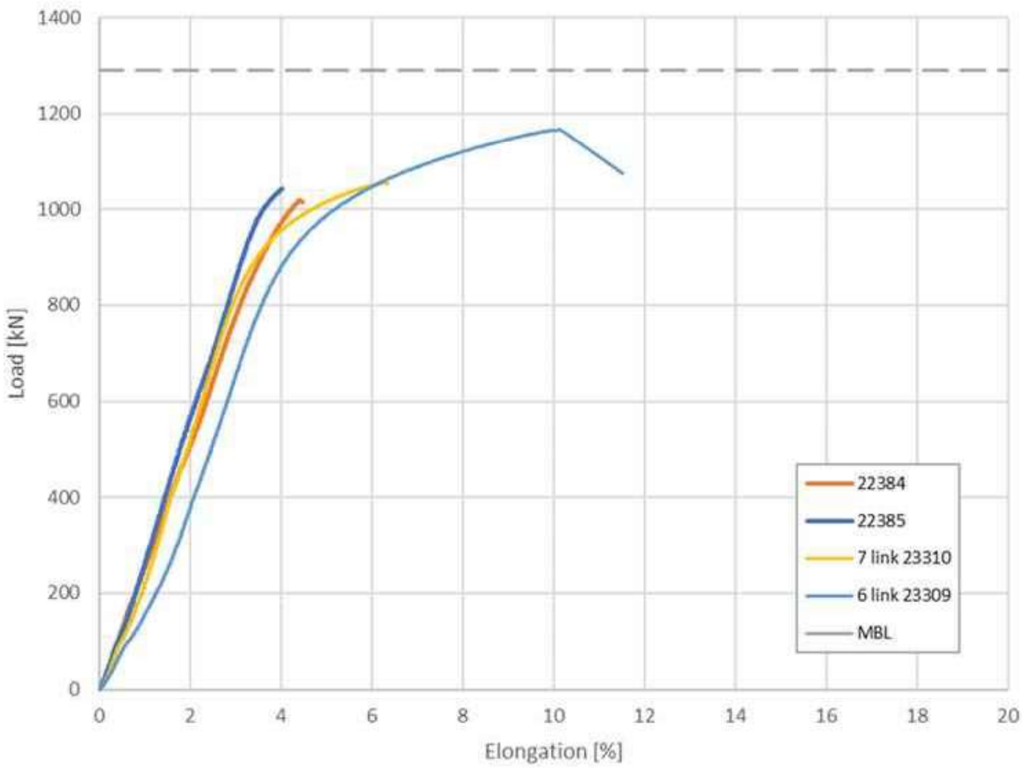


Figure 7.1: Load-elongation relationships based on measured L_n and the recorded load-stroke data from each test.

8 Disposal of materials sent to TTI Testing

Following testing all samples were taken by the HSE representatives.

9 References

[1] **BS EN 818-2:1996+A1:2008** *Short link chain for lifting purposes. Safety. Medium tolerance chain for chain slings. Grade 8*, British Standards Institute, April 1997, Amendment November 2008.

[2] **BS EN 818-1:1996+A1:2008** *Short link chain for lifting purposes. Safety. General conditions of acceptance*, British Standards Institute, November 1996, Amendment September 2008.

[3] **MAIB** *Fatal injury to a deckhand following a chain failure on the scallop dredger Honeybourne III (PD905) approximately 16 nautical miles south of Newhaven, England on 6 October 2023*, MAIB Safety Bulletin SB1/2024, February 2024.

Appendix A – Calibration certificates for the 1.5 MN machine

This appendix presents calibration certificates for the 1.5 MN load cell and actuator displacement transducer (‘stroke’).

Following the unexpectedly low breaking load measured in Test 1 on sample 22384, the opportunity was taken to check the calibration on the load cell whilst the new fittings were being manufactured. The calibration was found to be in order and no adjustment was required.

CERTIFICATE OF CALIBRATION

ISSUED BY: ZwickRoell Ltd.
UKAS ACCREDITED CALIBRATION LABORATORY
CERTIFICATE NUMBER: 2408-3356
DATE OF ISSUE: 30 August 2024

0167

ZwickRoell Ltd.
Worcester Six Business Park, Clayfield Road, Worcester
Worcestershire WR4 0AE
For Service Call: +44 (0) 1568 613516
For Email: laboratory@zwickroell.com

Internet: www.zwickroell.com

Approved Signatories
[redacted]

Issued To:	**TTI Testing Ltd**		
Address:	**Unit 2, Beadle Industrial Estate, Hithecroft Road, Wallingford, Oxfordshire, OX109DG**		
Machine Description:	Universal Testing Machine	**Serial Number:**	1
Manufacturer / Type:	Fox VPS	**Force Capacity:**	1500kN
Display System:	Single Range Computer Display	**Software:**	Cubus 2.1.92.7011
Force Transducer:	1500kN Interface Load Cell	**Serial Number:**	1098463A
Associated Equipment:	CaTs Cube Servo Controller	**Serial Number:**	10111
Associated Equipment:	XPS PC Computer	**Serial Number:**	JP504N3
Date of Calibration:	**02 August 2024**	**Ambient Temperature:**	**27.3°C**
Zwick reference numbers:	F105113		
Previous certificate number:	2308-3443R	Issued on:	28 September 2023

Method:
The testing machine identified above has been calibrated in accordance with the requirements of **BS EN ISO 7500-1:2018** over the ranges given below for increasing forces only. The calibration was performed using force proving devices and / or masses which meet the requirements of BS EN ISO 7500-1 and equipment which is calibrated in accordance with BS EN ISO 376:2011
The machine complied with the requirements of the standard for the following ranges and classifications with regard to the relative error, repeatability, resolution and zero return to which table 2 of the standard refers:

Range	Mode	Status	Classification of range(s)
1500kN	Tension	As found	1500kN Class 1 down to 10kN
1500kN	Compression	As found	1500kN Class 1 down to 10kN

Detailed tabulated results are shown on the following pages.

Calibrated by: [redacted] **Certified by:** [redacted]

CERTIFICATE OF CALIBRATION

ISSUED BY: ZwickRoell Ltd.
UKAS ACCREDITED CALIBRATION LABORATORY 0167
CERTIFICATE NUMBER: 2408-3356
DATE OF ISSUE: 30 August 2024

The following traceable force proving equipment was used for the calibration:

Description	Capacity	Class	Serial Number	Certificate Number	Date Calibrated
DC Ratio meter	N/A	N/A	3035	2023080117-1	02 November 2023
Load Cell	50kN	0.5	51522156	2304031	20 April 2023
Load Cell	600kN	0.5	600/4U	2022080289-1	07 September 2022
Load Cell	2000kN	1.0	102278	2023010370-1	15 February 2023
Load Cell	3000kN	1.0	3000/7C	2023030163-1	30 June 2023

With reference to clause 6 of BS EN ISO 7500-1 the proving equipment used have been calibrated to BS EN ISO 376 and the class of the proving device(s) was equal to or exceeded the class to which the machine has been verified.

The expiry date of the certificates of calibration for the elastic proving devices used is 26 months and for masses 5 years from the dates given above.

Where masses are used, the value for gravity (g) used to calculate the forces exerted by the masses was $9.815m/s^2$

When using elastic proving devices the constant indicated force method was used to effect the verification. When masses are used the constant true force method was used to effect the verification. Three verification runs were made on each range

The ZwickRoell Calibration Laboratory is accredited by UKAS to BS EN ISO/IEC 17025 (General requirements for the competence of testing and calibration laboratories) to perform the calibration which is reported on this certificate.

Prior to verification the machine was inspected for good working order and was found to satisfy the guidelines given in section 5 of BS EN ISO 7500-1

The calculation of the accuracy and repeatability errors and the classification of the testing machines performance was made in accordance with the method specified in BS EN ISO 7500-1:2018

Where there are adjacent results at the same force increment, these are at the overlap point from the two proving devices used.

The results only relate to the item calibrated, described above.

The decision rule of the classification does not take into account the uncertainty as described in Section 7 of BS EN ISO 7500-1

The following settings were made in accordance with the manufacturers instructions.

Range	: Bipolar, Transducer: S	Excitation: 10v	Gain: 457.9	(-ve): 0.991, Trim (+ve):	Offset: -4.53
1500kN					

Cal File: Horizontal Tensile Load - FB1 02.08.24

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.
The uncertainty stated above refer to values obtained during calibration and make no allowances for factors such as long term drift, and alignment effects, the influences of these factors should be taken into account by the user.

Results:

Range 1 1500kN Tension			Range 2 1500kN Compression		
These results are:	As found - no adjustments were made		These results are:	As found - no adjustments were made	
Nominal Force	Relative Error	Relative Uncertainty	Nominal Force	Relative Error	Relative Uncertainty
kN	%	%	kN	%	%
10.00	0.47	0.25	10.00	-0.10	0.25
10.50	0.45	0.25	10.50	-0.24	0.25
15.00	0.11	0.24	15.00	-0.27	0.25
30.00	0.30	0.24	30.00	-0.50	0.24
50.00	0.22	0.24	50.00	-0.35	0.25
50.00	0.20	0.24	50.00	-0.75	0.28
60.00	0.14	0.26	60.00	-0.30	0.28
105.00	-0.28	0.29	105.00	-0.56	0.24
150.00	-0.33	0.24	150.00	-0.11	0.45
300.00	-0.58	0.27	300.00	-0.19	0.26
300.00	-0.07	0.49	300.00	0.33	0.48
600.00	0.03	0.49	600.00	0.37	0.48
900.00	0.17	0.48	900.00	0.38	0.48
1200.00	0.11	0.54	1200.00	0.36	0.48
1500.00	0.44	0.48	1500.00	0.28	0.48

End of Certificate

In the result table(s) above a negative relative error indicates that the machine indicator lags the true applied force.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.
The uncertainty stated above refer to values obtained during calibration and make no allowances for factors such as long term drift, and alignment effects, the influences of these factors should be taken into account by the user.

CERTIFICATE OF CALIBRATION

ISSUED BY: ZwickRoell Ltd.
UKAS ACCREDITED CALIBRATION LABORATORY
CERTIFICATE NUMBER: 2410-3902R
DATE OF ISSUE: 17 October 2024
This certificate replaces 2410-3902 due to incorrect previous certificate information.

0167

Approved Signatories
[redacted]

ZwickRoell Ltd.
Worcester Six Business Park, Clayfield Road, Worcester
Worcestershire WR4 0AE
For Service Call: +44 (0) 1568 613516
For Email: laboratory@zwickroell.com

Internet:
www.zwickroell.com

Issued To:	**TTI Testing Ltd**		
Address:	**Unit 2, Beadle Industrial Estate, Hithecroft Road, Wallingford, Oxfordshire, OX109DG**		
Machine Description:	Universal Testing Machine	**Serial Number:**	1
Manufacturer / Type:	Fox VPS	**Force Capacity:**	1500kN
Display System:	Single Range Computer Display	**Software:**	Cubus 2.1.92.7011
Force Transducer:	1500kN Interface Load Cell	**Serial Number:**	1098463A
Associated Equipment:	CaTs Cube Servo Controller	**Serial Number:**	10111
Associated Equipment:	XPS PC Computer	**Serial Number:**	JP504N3
Date of Calibration:	**20 September 2024**	**Ambient Temperature:**	**27.3°C**
Zwick reference numbers:	F105113		
Previous certificate number:	2408-3356	Issued on:	02 August 2024

Method:
The testing machine identified above has been calibrated in accordance with the requirements of **BS EN ISO 7500-1:2018** over the ranges given below for increasing forces only. The calibration was performed using force proving devices and / or masses which meet the requirements of BS EN ISO 7500-1 and equipment which is calibrated in accordance with BS EN ISO 376:2011
The machine complied with the requirements of the standard for the following ranges and classifications with regard to the relative error, repeatability, resolution and zero return to which table 2 of the standard refers:

Range	**Mode**	**Display**	**Status**	**Classification of range(s)**
1500kN	Tension	Display 1	As found	1500kN Class 1 down to 10kN
1500kN	Compression	Display 1	As found	1500kN Class 1 down to 10kN

Detailed tabulated results are shown on the following pages.

Calibrated by: [redacted] **Certified by:** [redacted]

CERTIFICATE OF CALIBRATION

ISSUED BY: ZwickRoell Ltd.
UKAS ACCREDITED CALIBRATION LABORATORY 0167
CERTIFICATE NUMBER: 2410-3902R
DATE OF ISSUE: 17 October 2024

The following traceable force proving equipment was used for the calibration:

Description	Capacity	Class	Serial Number	Certificate Number	Date Calibrated
DC Ratio meter	N/A	N/A	3035	2023080117-1	02 November 2023
Load Cell	50kN	0.5	51522156	2304031	20 April 2023
Load Cell	600kN	0.5	31421	2023010131-1	22 May 2023
Load Cell	2000kN	1.0	102278	2023010370-1	15 February 2023
Load Cell	3000kN	1.0	153	2023100225-1	27 November 2023

With reference to clause 6 of BS EN ISO 7500-1 the proving equipment used have been calibrated to BS EN ISO 376 and the class of the proving device(s) was equal to or exceeded the class to which the machine has been verified.

The expiry date of the certificates of calibration for the elastic proving devices used is 26 months and for masses 5 years from the dates given above.

Where masses are used, the value for gravity (g) used to calculate the forces exerted by the masses was 9.815m/s^2

When using elastic proving devices the constant indicated force method was used to effect the verification. When masses are used the constant true force method was used to effect the verification. Three verification runs were made on each range

The ZwickRoell Calibration Laboratory is accredited by UKAS to BS EN ISO/IEC 17025 (General requirements for the competence of testing and calibration laboratories) to perform the calibration which is reported on this certificate.

Prior to verification the machine was inspected for good working order and was found to satisfy the guidelines given in section 5 of BS EN ISO 7500-1

The calculation of the accuracy and repeatability errors and the classification of the testing machines performance was made in accordance with the method specified in BS EN ISO 7500-1:2018

Where there are adjacent results at the same force increment, these are at the overlap point from the two proving devices used.

The results only relate to the item calibrated, described above.

The decision rule of the classification does not take into account the uncertainty as described in Section 7 of BS EN ISO 7500-1

The following settings were made in accordance with the manufacturers instructions.

Range	: Bipolar, Transducer: S	Excitation: 10v	Gain: 457.9	(-ve): 0.991, Trim (+ve):	Offset: -4.53
1500kN					

Cal File: Horizontal Tensile Load - FB1 02.08.24

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.
The uncertainty stated above refer to values obtained during calibration and make no allowances for factors such as long term drift, and alignment effects, the influences of these factors should be taken into account by the user.

Results:

Range 1 1500kN Tension Display 1			Range 2 1500kN Compression Display 1		
These results are:	As found - no adjustments were made		These results are:	As found - no adjustments were made	
Nominal Force	Relative Error	Relative Uncertainty	Nominal Force -ve	Relative Error	Relative Uncertainty
kN	%	%	kN	%	%
10.00	0.51	0.25	10.00	0.50	0.25
10.50	0.24	0.51	10.50	0.59	0.26
15.00	0.57	0.45	15.00	0.21	0.25
30.00	0.53	0.44	30.00	0.22	0.24
30.00	0.11	0.26	30.00	0.24	0.26
50.00	0.02	0.24	50.00	-0.20	0.33
60.00	0.08	0.25	60.00	0.44	0.26
105.00	-0.18	0.24	105.00	0.41	0.26
150.00	-0.07	0.26	150.00	0.40	0.24
300.00	-0.06	0.24	300.00	0.52	0.24
300.00	-0.08	0.48	300.00	0.44	0.48
600.00	0.00	0.48	600.00	0.44	0.48
900.00	0.14	0.48	900.00	0.47	0.48
1200.00	0.33	0.48	1200.00	0.49	0.48
1500.00	0.44	0.48	1500.00	0.46	0.48

End of Certificate

In the result table(s) above a negative relative error indicates that the machine indicator lags the true applied force.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.
The uncertainty stated above refer to values obtained during calibration and make no allowances for factors such as long term drift, and alignment effects, the influences of these factors should be taken into account by the user.

Metalitest

Certificate of Calibration

Certificate No. 24MET2104 Date of Issue 04/09/2024

Calibration Engineer [redacted]

Approved Signatory [redacted]

Displacement Calibration

To Standards:
BS EN ISO 5893 2019 A1 2020

Issued by: Metalitest Ltd
Address: Suite 2a, Blackthorn House, St Pauls Square, Birmingham, B3 1RL
t: 0121 751 2112
sales@Metalitest.com www.Metalitest.com

Manufacturer / Supplier	Fox VPS
Description/ Capacity	1500kN Horizontal Universal
Date of Calibration	12/08/2024

Machine Location	Testhouse
Machine Type	Horizontal
Machine Serial Number	1

Customer	TTI Testing Ltd
Address	Unit 2 Hithercroft Road, Wallingford, OX10 9DG
End user (if different from customer)	-

The machine above has been checked to ensure it is set up and operating in accordance with the manufacturer's instructions.
It has been verified to the Standard BS EN ISO 5893 2019 A1 2020
Preventative maintenance was done during the routine service prior to calibration after initial operation checks.

Associated Equipment: Dell Computer System S/N: JP504N3 , Cubus Software Version 2.1.92, Cats3 Servo Controller S/N: 10111
Calibration Equipment: Height Gauge 600 mm, s/n RR13017, Date 20-06-24, Certificate No. 066030-7S at Pennine

Thermometer 3, s/n 2846956, Date 30-07-24, Certificate No. H2409561 at Quasartronics

Temperature: 29.8 °C Resolution at Zero: 0.01 mm
Range Calibrated: 0 mm to 999.9 mm **Results as Found**

Setting up procedure: Height gauge set up on base. Crosshead adjusted. Displacement program used. Grips fixed.
Calibration procedure: Grips normal sample distance apart. Zero machine and zero height gauge. Tensile direction incremental

Nominal Displacement	Mean Error		Uncertainty ±
mm	mm	%	mm
0	0.000	0.00	0.000
600	-0.033	-0.01	0.302
650	-0.153	-0.02	0.302
700	-0.150	-0.02	0.301
750	-0.093	-0.01	0.307
800	-0.120	-0.02	0.331
850	-0.140	-0.02	0.375
900	-0.153	-0.02	0.358
0	0.000		0.042
900	-0.157	-0.02	0.353
950	-0.123	-0.01	0.336
999.9	-0.160	-0.02	0.331

Note
The uncertainties stated above refer to values obtained during verification and make no allowances for such factors as long term drift, temperature and alignment effects - the influences of such factors should be taken into account by the long term user of the testing machine.

Decision Rule - 'Simple Acceptance' is used. Uncertainties are given in the results as per the standard, conformity has to be within the tolerance limits given in the standard.

End of Certificate

Note: If/when the machine is moved, reinstalled or repaired, please check the standards for recalibration requirements before using. The above results apply only to the machine identified with its serial number at the top of this report. The reported expanded uncertainty is based on a standard uncertainty multiplied by a calculated coverage factor k=2, providing a level of confidence of approximately 95%. The combined standard uncertainty of measurement has been determined in accordance with UKAS requirements.

Metalitest

Certificate of Calibration

Certificate No. 24MET2105 Date of Issue 04/09/2024 Page 1 of 1

Calibration Engineer [redacted]

Approved Signatory [redacted]

Displacement Calibration

To Standards:

BS EN ISO 5893 2019 A1 2020

Issued by: Metalitest Ltd

Address: Suite 2a, Blackthorn House, St Pauls Square, Birmingham, B3 1RL

t: 0121 751 2112

sales@Metalitest.com www.Metalitest.com

Manufacturer / Supplier	Fox VPS
Description/ Capacity	1500kN Horizontal Universal
Date of Calibration	12/08/2024

Machine Location	Testhouse
Machine Type	Horizontal
Machine Serial Number	1

Customer	TTI Testing Ltd
Address	Unit 2 Hithercroft Road, Wallingford, OX10 9DG
End user (if different from customer)	-

The machine above has been checked to ensure it is set up and operating in accordance with the manufacturer's instructions.
It has been verified to the Standard BS EN ISO 5893 2019 A1 2020
Preventative maintenance was done during the routine service prior to calibration after initial operation checks.

Associated Equipment: Dell Computer System S/N: JP504N3 , Cubus Software Version 2.1.92, Cats3 Servo Controller S/N: 10111
Calibration Equipment: Height Gauge 600 mm, s/n RR13017, Date 20-06-24, Certificate No. 066030-7S at Pennine

Thermometer 3, s/n 2846956, Date 30-07-24, Certificate No. H2409561 at Quasartronics

Temperature: 29.5 °C Resolution at Zero: 0.01 mm
Range Calibrated: -600 mm to 0 mm **Results as Found**

Setting up procedure: Height gauge set up on base. Crosshead adjusted. Displacement program used. Grips fixed.
Calibration procedure: Grips normal sample distance apart. Zero machine and zero height gauge. Compression direction incremental

Nominal Displacement	Mean Error		Uncertainty ±
mm	mm	%	mm
0	0.000	0.00	0.000
-50	-0.007	0.01	0.043
-100	0.017	-0.02	0.071
-150	0.013	-0.01	0.065
-200	-0.017	0.01	0.052
-250	-0.110	0.04	0.067
-300	-0.160	0.05	0.058
0	0.000		0.042
-300	-0.160	0.05	0.058
-350	-0.303	0.09	0.052
-400	-0.340	0.08	0.054
-450	-0.440	0.10	0.058
-500	-0.513	0.10	0.074
-550	-0.607	0.11	0.184
-600	-0.650	0.11	0.058

Note

The uncertainties stated above refer to values obtained during verification and make no allowances for such factors as long term drift, temperature and alignment effects - the influences of such factors should be taken into account by the long term user of the testing machine.

Decision Rule - 'Simple Acceptance' is used. Uncertainties are given in the results as per the standard, conformity has to be within the tolerance limits given in the standard.

End of Certificate

Note: If/when the machine is moved, reinstalled or repaired, please check the standards for recalibration requirements before using. The above results apply only to the machine identified with its serial number at the top of this report. The reported expanded uncertainty is based on a standard uncertainty multiplied by a calculated coverage factor k=2, providing a level of confidence of approximately 95%. The combined standard uncertainty of measurement has been determined in accordance with UKAS requirements.

HSE, through its Science Division, is one of the world's leading providers of health and safety solutions to industry, government and professional bodies.

The main focus of our work is on understanding and reducing health and safety risks. We provide health and safety consultancy, research, specialist training and products to our customers worldwide.

Our long history developing health and safety solutions means that we're well placed to understand the changing industrial, regulatory and societal landscape, and to anticipate future issues.

We employ over 360 scientific, medical and technical specialists, drawing on their wealth of knowledge and experience to deliver evidence-based solutions to our clients. Our work is supported by accredited management systems.

HSE Science and Research Centre

Harpur Hill
Buxton
Derbyshire
SK17 9JN
UK

W: https://solutions.hse.gov.uk

T: +44 (0)203 028 2000

E: business.enquiries@hse.gov.uk

CERTIFIED ISO 9001 • OHSAS 18001 UKAS MANAGEMENT SYSTEMS 001

Mechanika Report CAL-MAIB-01-001A: Honeybourne Failure Analysis

Contract	001
Assembly Title	Honeybourne Quick Release Assembly Chain Links
Assembly No.	N/A
Calculation No.	CAL-MAIB-01-001
Issue	A
Date	23/07/25
Calculation Title	Honeybourne Failure Analysis
Calculation Type	○ Mass / C of G ○ Load case ◉ Structural ○ Mechanical ○ Other

Originator	Print Name	[redacted]
Reviewer	Print Name	

Level of Checking	○ Level 1 ○ Level 2 ◉ Level 3

Originator Signature	[redacted]	Date	23/07/2025
Reviewer Signature	[redacted]	Date	23/07/2025

AMENDMENT RECORD

Issue	Date	Originator	Reviewer	Amendments
A	23/07/25	[redacted]		First Issue

Software Used	Mathcad Prime v9.0 and ANSYS Workbench 2024 R2

INDEX

1. INTRODUCTION

At the request of the Marine Accident Investigation Branch (MAIB), Mechanika Ltd. has undertaken an engineering analysis to support the ongoing investigation into the fatal accident that occurred on board the UK-registered fishing vessel Honeybourne III on 6 October 2023. The incident involved the failure of a chain forming part of the port-side towing block quick release system, resulting in the release of fishing gear that fatally struck a deckhand.

Initial findings identified that the chain failed at the point where it passed over a static pin located at the derrick head. This failure allowed the suspended gear to fall unexpectedly. The MAIB commissioned this analysis to determine whether the design and loading conditions of the quick release assembly, particularly the stresses experienced by the chain links at the pin interface, were contributory factors to the failure.

This report presents the findings of a finite element analysis (FEA) of the chain and pin interface, with the aim of understanding the stress distribution within a new 32mm Grade 8 short-link chain conforming to BS EN 818-2:1996+A1:2008. The chain is modelled in contact with a plain, un-grooved 168mm static steel pin under both minimum and maximum service loads of 14.4 and 35.9 tonnes, respectively. The chain configuration assessed replicates its in-service orientation, with adjacent links lying at an angle across the surface of the pin, as shown in Figure 1.

The results of this analysis are intended to assist the MAIB in assessing whether the use of chain in this configuration was appropriate for the operational loads and whether it may have contributed to the failure leading to this tragic accident.

The orientation of the links are closely aligned with the positions shown in Figure 1, which are replicated in ANSYS Mechanical Workbench 2024 R2 FEA software. The exact position of the links on the static pin has infinite combinations due to the possibility for infinitesimally small rotations of the links relative to one another. The analysed position is aligned with Figure 1 and Ref 1.

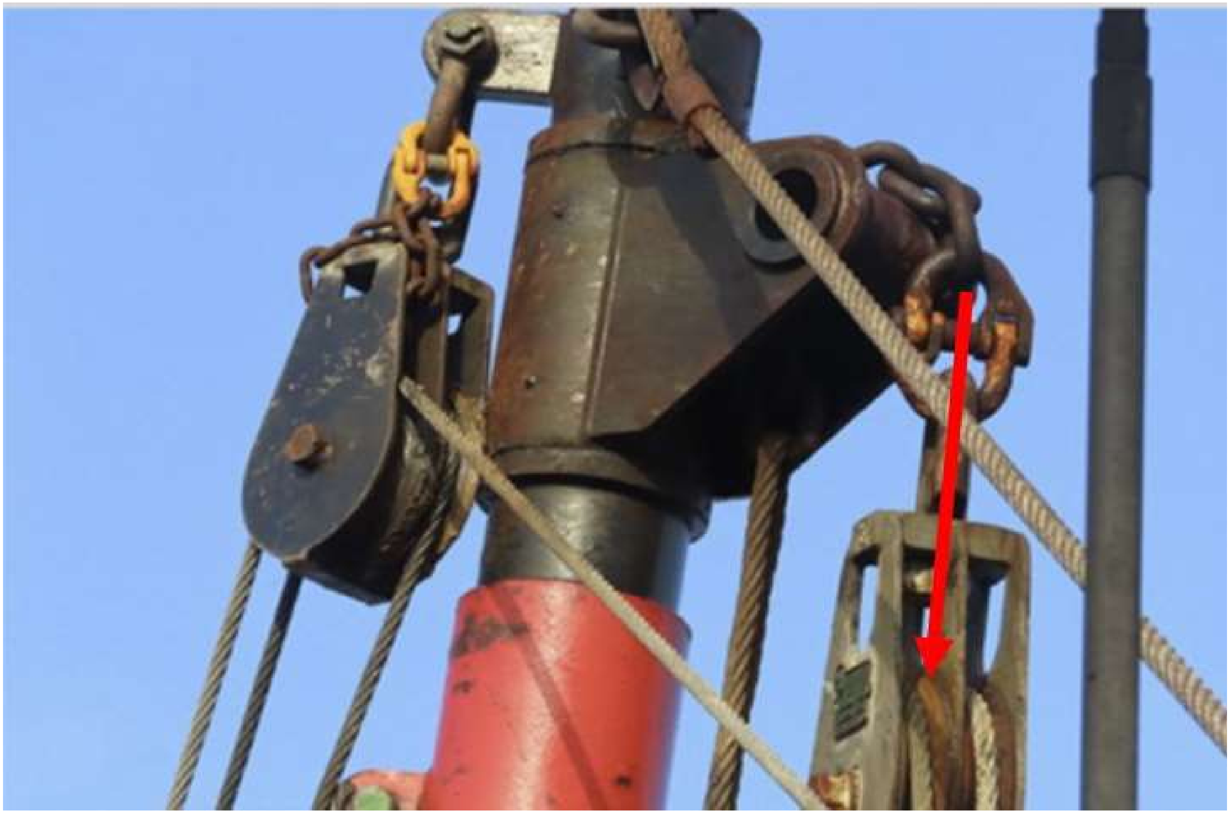


Figure 1 - Chain Links Passing Over Static Pin

2. REFERENCES

1. MAIB Specification of Works: Analysis of the chain link stress in davit head quick release mechanism of UK registered scallop dredger Honeybourne III

2. Report on the investigation of the fatal accident to a deckhand on board the beam trawler *Cornishman* (PZ 512) 44 nautical miles south-south-west of the Isles of Scilly, England on 6 February 2021

3. BS EN 818-1 : 1996: Short link chain for lifting purposes - Safety Part 1. General conditions of acceptance

4. BS EN 818-2: Short link chain for lifting purposes — Safety — Part 2: Medium tolerance chain for chain slings — Grade 8

3. LOAD CASES

The setup shown in Figure 2 is replicated in the FEA model and used for the following two load cases:

1. 14.4 tonne vertical pull load on the vertical link 1.

2. 35.9 tonne vertical pull load on the vertical link 1.

3. Verification load case consisting of two links only with a pull load of 14.4 tonnes to provide bench mark analysis for the notional stress in the links when fully aligned and not resting on the static pin. This load case is provided for information purposes only.

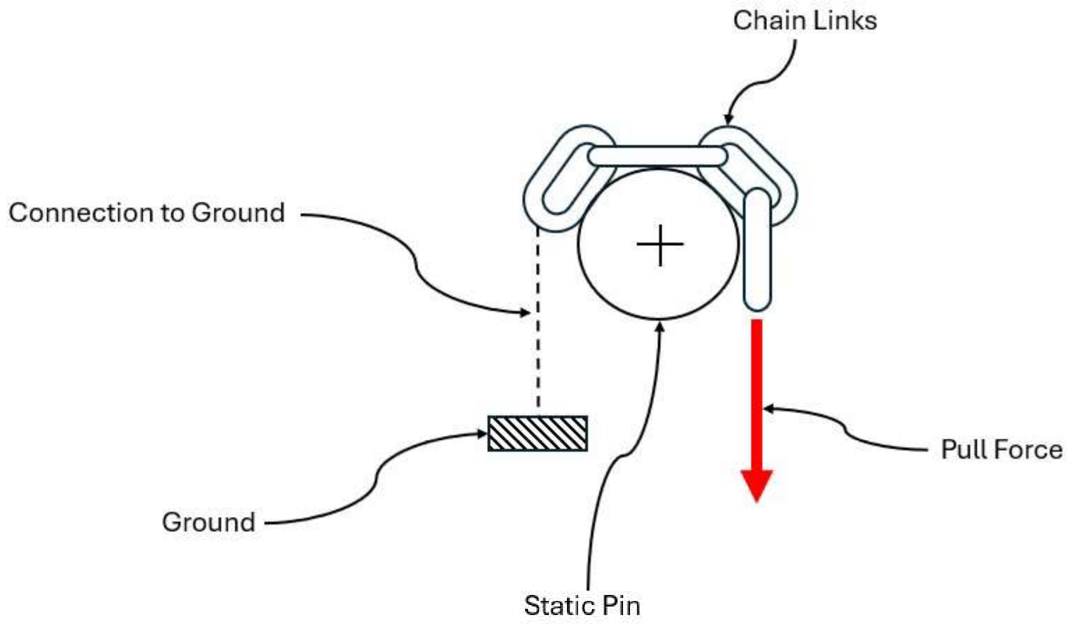


Figure 2 - Chain Links Configuration for Analysis

The chain links shown Figure 3 are orientated to reflect the position of the links shown in Ref 2 and also the images received from MAIB through email correspondence.

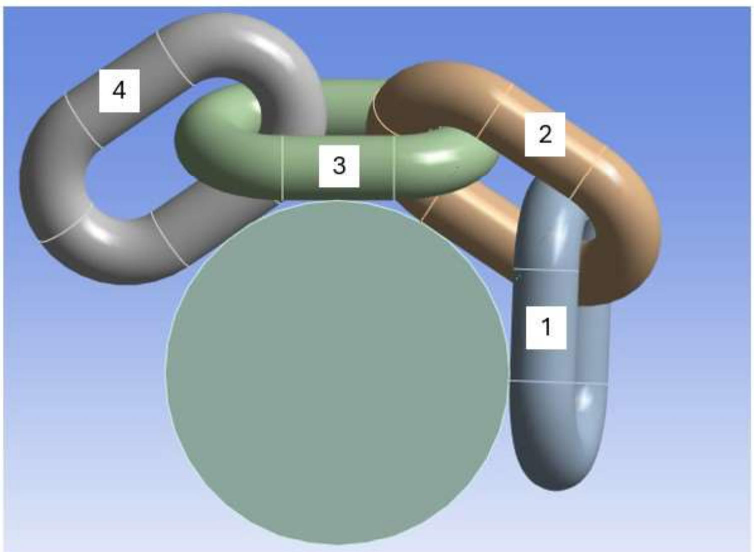


Figure 3 - Chain Links Configuration and Numbering in FEA Model

4. PERMISSIBLE STRESSES

4.1 - Grade 8 Short Link Chain

Ultimate tensile strength:
[Ref 1, Table 0]

$f_{U1} := 800\ MPa$

Yield strength:
[Ref 1, Table 0]

$f_{Y1} := 640\ MPa$

Minimum ultimate elongation:
[Ref 2, Clause 5.4.2]

$\delta_1 := 20\%$

5. FEA MODEL

The boundary conditions are summarised in the report for each model assessed. This section provides an overview of the model setup.

As mentioned in Section 3, the chain links have been orientated to reflect the position of the links shown in Ref 2 and also the images received from MAIB through email correspondence.

5.1 - Mesh Settings

A converged mesh shown in Figure 4, with the following metrics was used in the FEA.

- Static Pin outer surface: Element type "SOLID186" of size 4 mm, which is a higher order 3-D 20-node solid element that exhibits quadratic displacement behaviour. The element is defined by 20 nodes having three degrees of freedom per node: translation and rotation in the nodal x, y, and z directions.

- Chain Links: Element type "SOLID187" of size 4 mm, which is a higher order 3-D, 10-node element. SOLID187 has a quadratic displacement behaviour and is well suited to modelling irregular meshes.

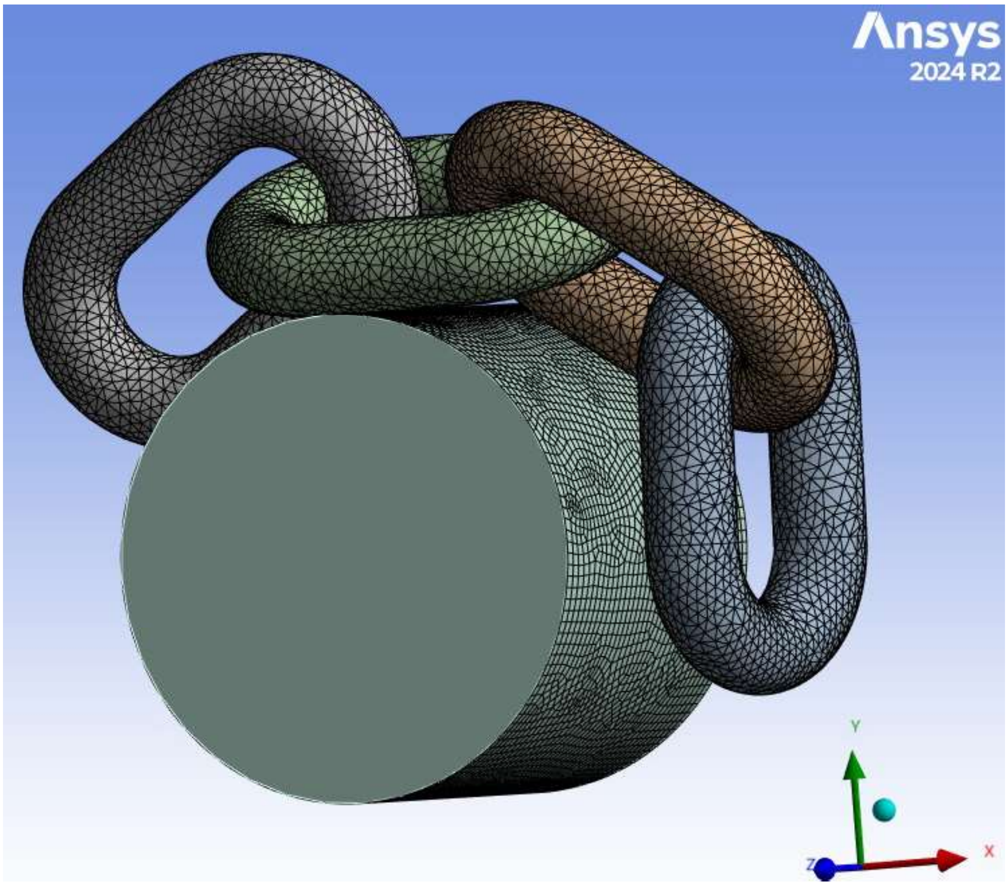


Figure 4 - FEA Mesh

Note that the static pin is treated as a rigid body and stress results are not reported on the pin. The pin is modelled to provide the correct load path for the links and to generate realistic stresses in them.

5.2 - Material Properties

All components were assigned structural steel material properties from ANSYS Mechanical Workbench 2024 R2 as shown in Figure 5.

Properties of Outline Row 3: Structural Steel

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	7850	kg m^-3
4	⊞ Isotropic Secant Coefficient of Thermal Expansion		
6	⊟ Isotropic Elasticity		
7	Derive from	Young's Modulus and Poisson's Ratio	
8	Young's Modulus	2E+11	Pa
9	Poisson's Ratio	0.3	
10	Bulk Modulus	1.6667E+11	Pa
11	Shear Modulus	7.6923E+10	Pa
12	⊟ Bilinear Isotropic Hardening		
13	Tangent Modulus Type	Plastic	
14	Yield Strength	640	MPa
15	Tangent Modulus	0	MPa

Figure 5 - Structural Steel Material Properties

5.3 - Solver Settings

Default solver settings were used in the FE model with an iterative Newton Raphson solver and Large Deformation enabled, as shown in Figure 6.

In ANSYS, large deformation analysis is used when a structure's shape changes significantly due to applied loads, and these changes affect the structural behaviour. Unlike small deformation theory, which assumes negligible changes in geometry, large deformation analysis considers these changes, introducing geometric nonlinearities like large strain, large rotation, stress stiffening, and spin softening. This approach is crucial for accurate simulations of structures where significant shape changes occur, such as in flexible components or when studying the effects of high stress level.

Three time steps are considered as described below, with further sub-steps to aid convergence:

1. Contact initiation
2. 14.4 tonne chain vertical pull load
3. 35.9 tonne chain vertical pull load

Details of "Analysis Settings"

Step Controls	
Number Of Steps	3.
Current Step Number	3.
Step End Time	3. s
Auto Time Stepping	On
Define By	Substeps
Carry Over Time Step	Off
Initial Substeps	100.
Minimum Substeps	10.
Maximum Substeps	500.
Solver Controls	
Solver Type	Program Controlled
Weak Springs	On
Spring Stiffness	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	On
Inertia Relief	Off
Quasi-Static Solution	Off

Figure 6 - Solver Settings

5.4 - Contacts

All contacts between abutting bodies were assigned frictional contact with a coefficient of friction of 0.15 (wet steel on steel) as shown in Figure 7. No contact stabilization or damping was applied to any contact in the model. The contact status is verified in the analysis to ensure that the load is correctly transferred between contacting bodies.

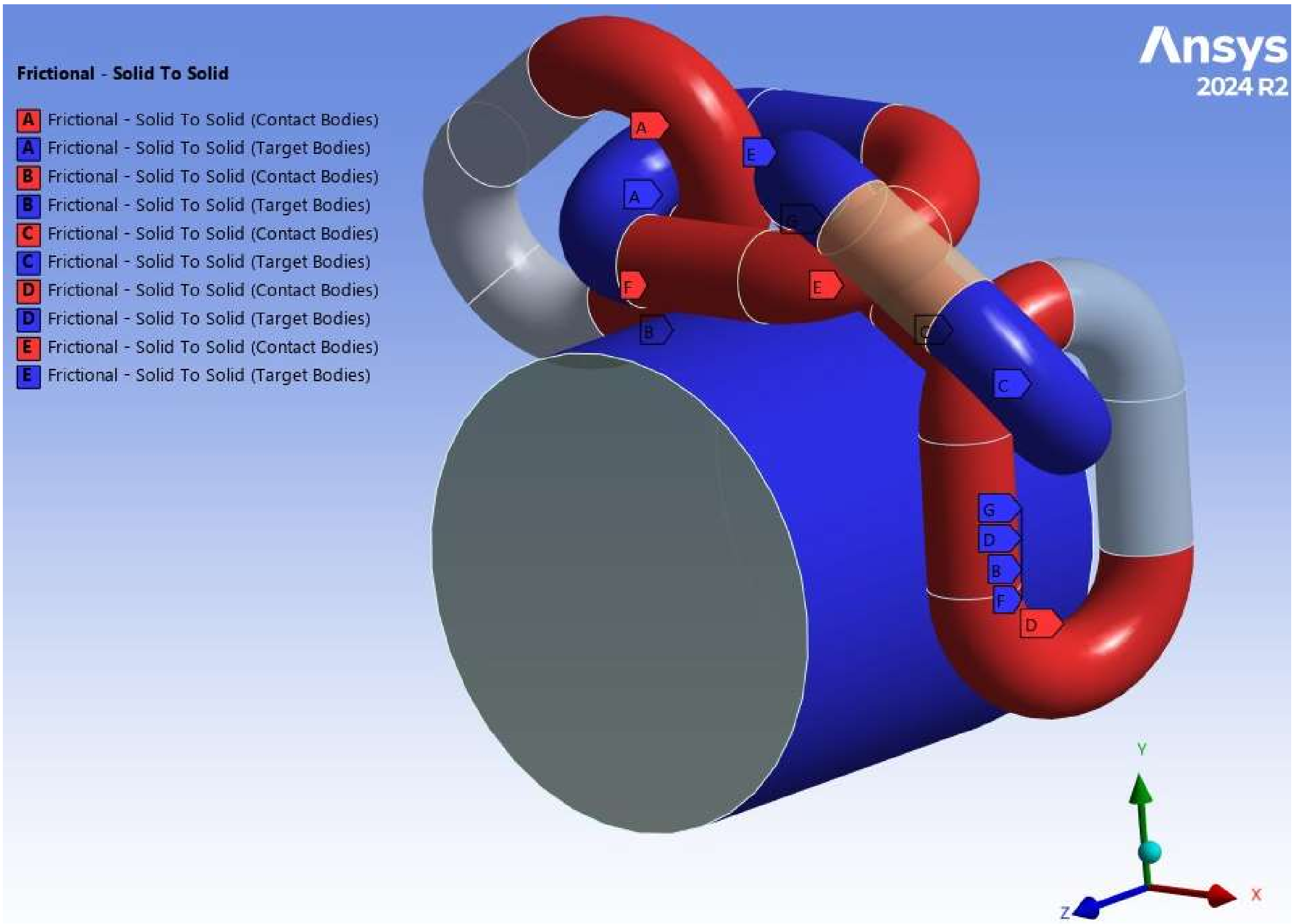


Figure 7 - Frictional Contacts

6. FEA RESULTS - Load Case 1

6.1 - Boundary Conditions

The boundary conditions at timestep 1 are shown in Figure 8. A vertical displacement of 0.001mm was applied to three of the links highlighted in yellow below, which established the contact between the links and pin. This displacement was turned off in the second time step and was only used to help contact convergence in the first instance. A remote displacement with zero degrees of freedom was applied to either side of the fixed pin and remained in place for all timesteps.

A tension only spring to ground with a stiffness of 50,000 N/mm is scoped to the lower curved region on link 4, which only restricts movement in the positive y-axis.

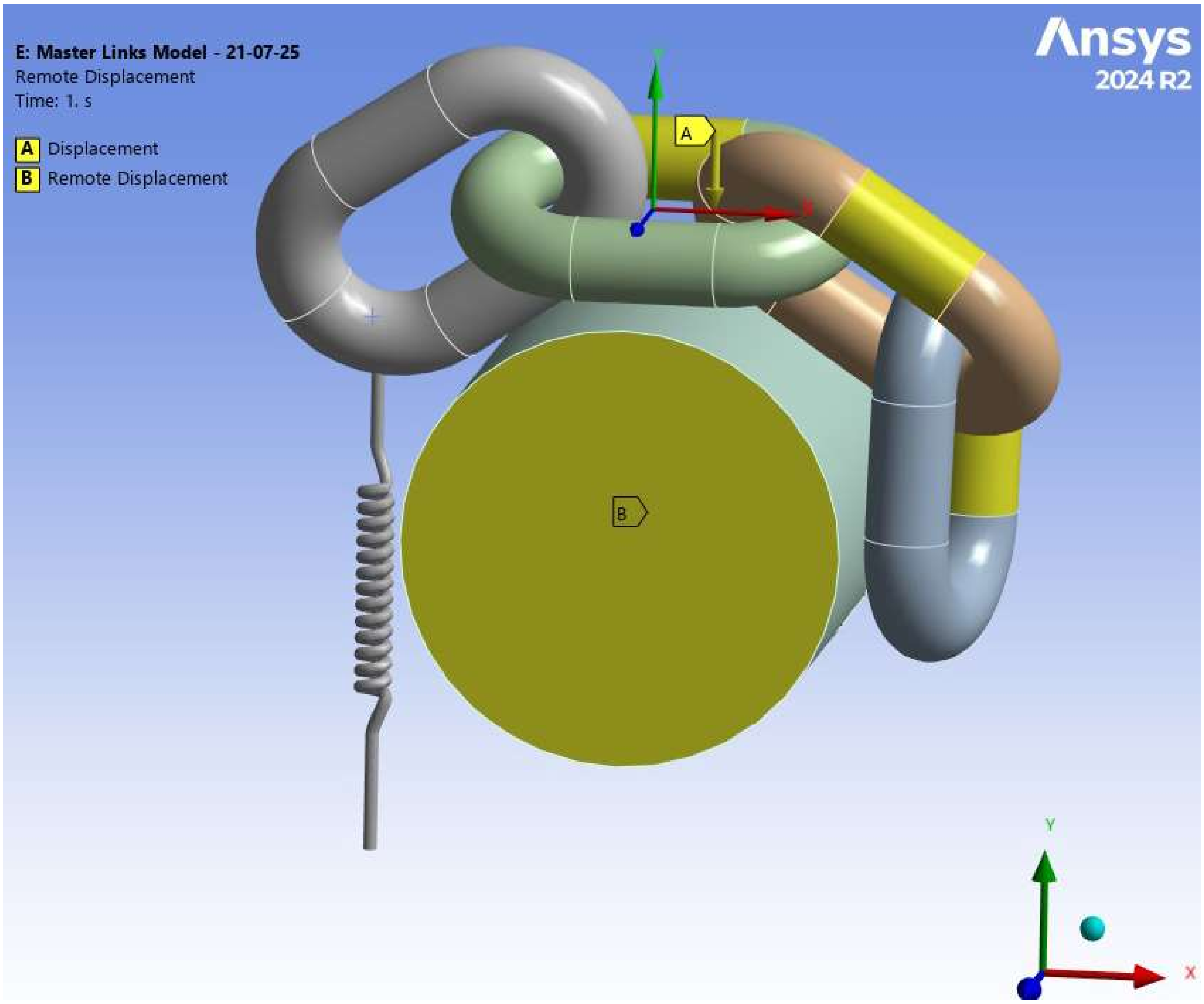


Figure 8 - Timestep 1 Boundary Conditions - LC1

At timestep 2 the vertical load of 14.4 tonne (144 kN) was applied to the distal link 1 in the negative y-axis (Figure 9). The force is applied to the curved section of the distal link 1, which is acceptable because the point of interest is at the connection of adjacent links.

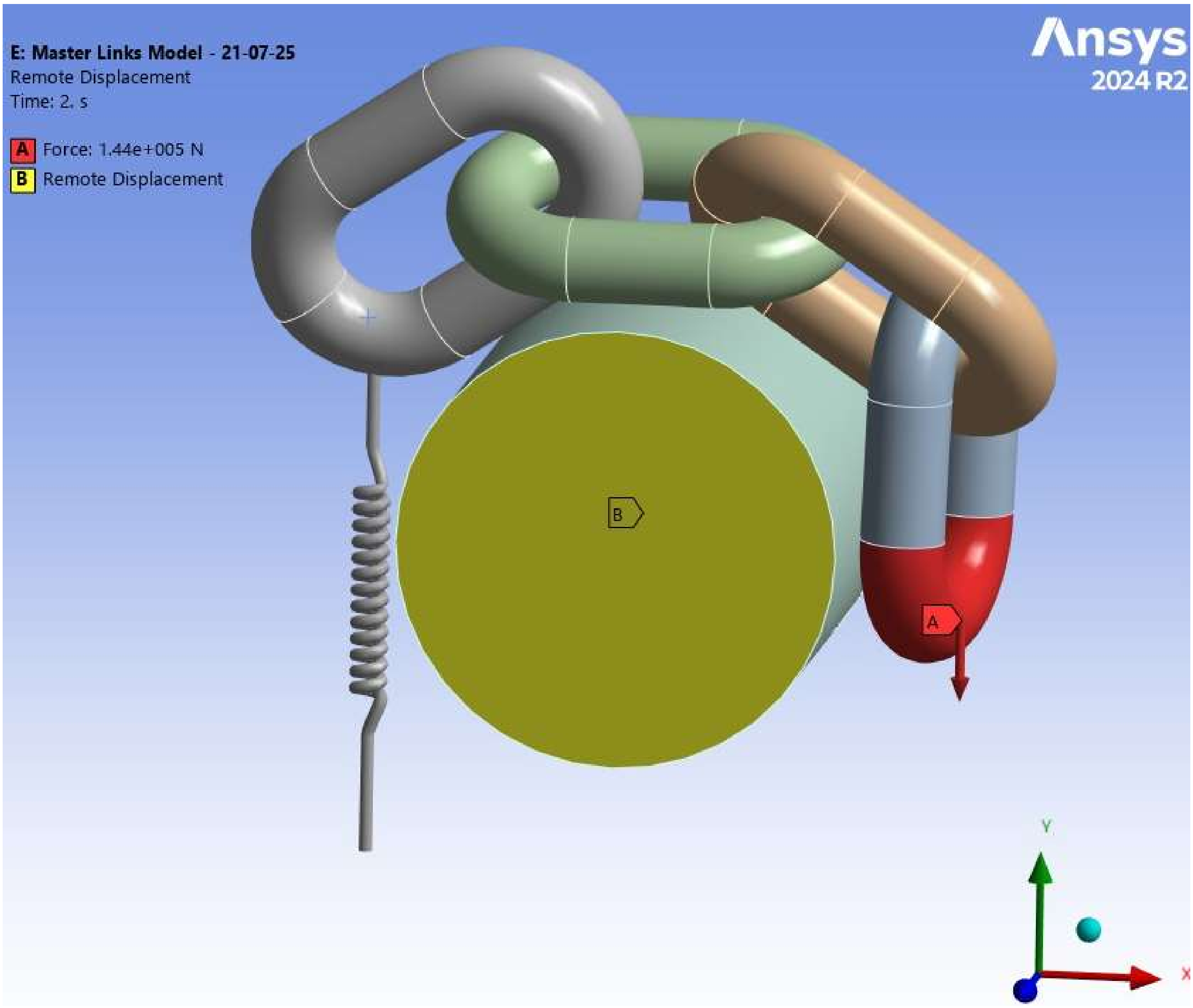


Figure 9 - Time Step 2 Boundary Conditions - LC1

6.2 - Total Deformation

The total deformation is 5.3 mm as shown in Figure 10 and is due to the rotation and adjustment of the link positions when the load is applied.

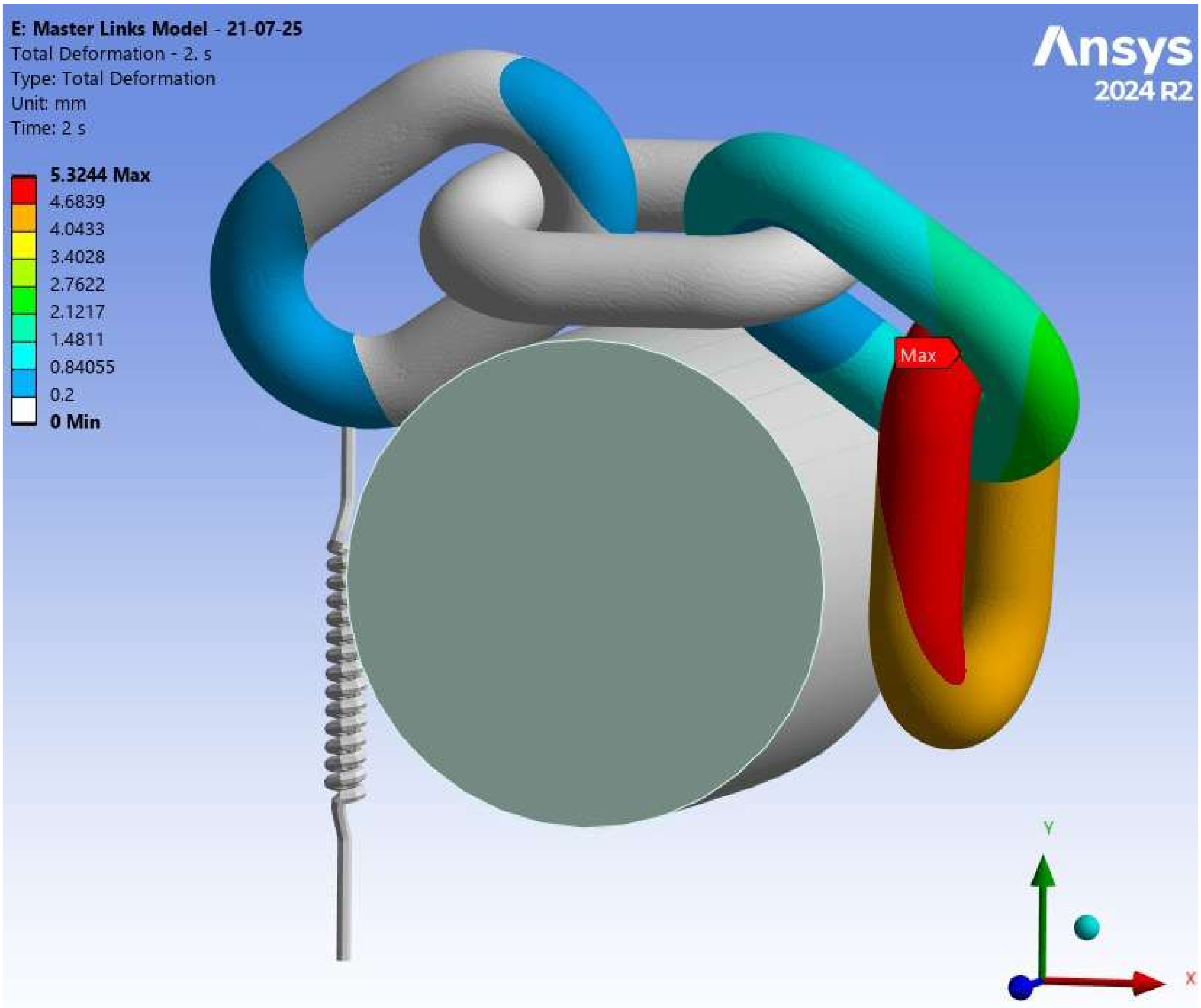


Figure 10 - Total Deformation - LC1

6.3 - Equivalent von-Mises Stress

The maximum equivalent stress is shown in Figure 11 and is 586 MPa on Link 2. Although the von-Mises stress does not exceed the material yield strength of the link, there is high compressive stress and therefore some plastic strain is also present (Figure 12). In Hertzian contact models in ANSYS, localized plastic strain can appear even if the reported equivalent von Mises stress is below the defined yield stress. ANSYS often averages stress values across nodes or elements when displaying results. As a result, a stress peak slightly above yield may be averaged down to below yield in the output, while still causing plastic strain in localized regions. This is common near contact zones where the mesh is fine and stress gradients are steep, as found in this study.

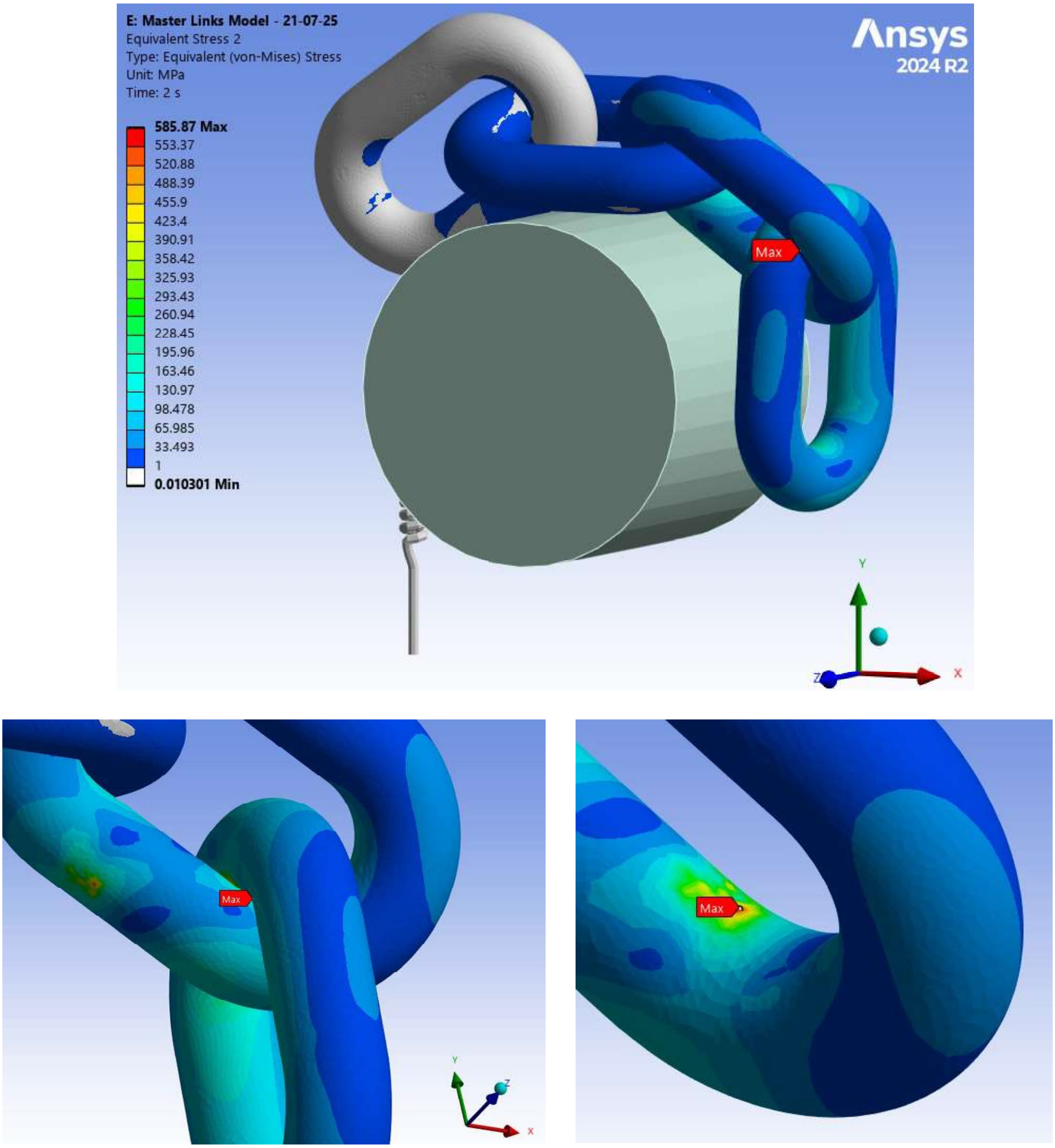


Figure 11 - Equivalent von-Mises Stress - LC1

6.4 - Equivalent Plastic Strain

The equivalent plastic strain is shown in Figure 12 on links 1 and 2, with a sectional view through the maximum strain location. The maximum plastic strain is 6.7% and the colour bar is clipped at 0.2% proof strength for visual clarity.

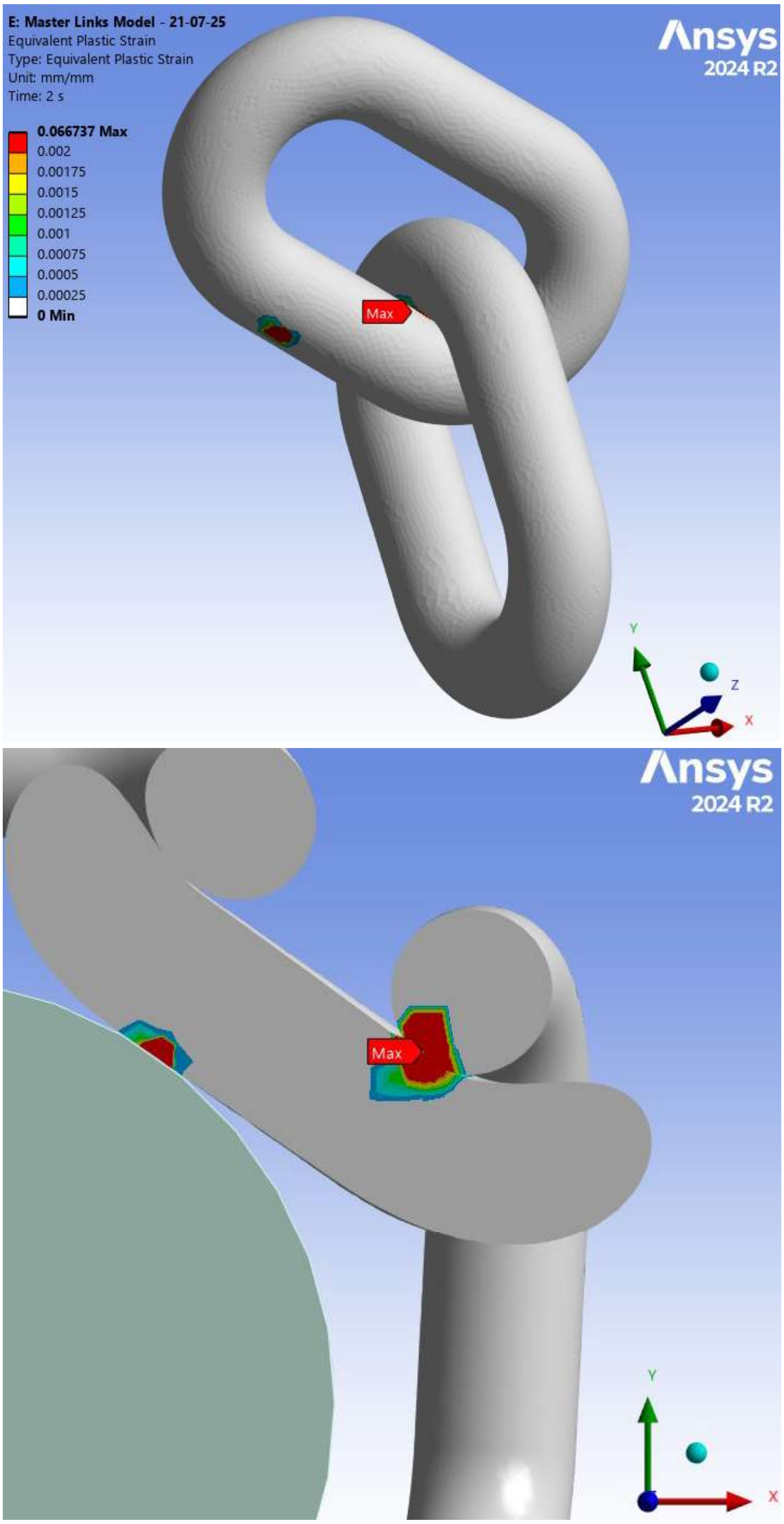


Figure 12 - Equivalent Plastic Strain on Links 1 & 2 - LC1

7. FEA RESULTS - Load Case 2

7.1 - Boundary Conditions

The boundary conditions are the same as those shown in Section 6.1, Figure 8; however, the load applied is 35.9 tonnes (359 kN) (Figure 13). The force is applied to the curved section of the distal link 1, which is acceptable because the point of interest is at the connection of adjacent links.

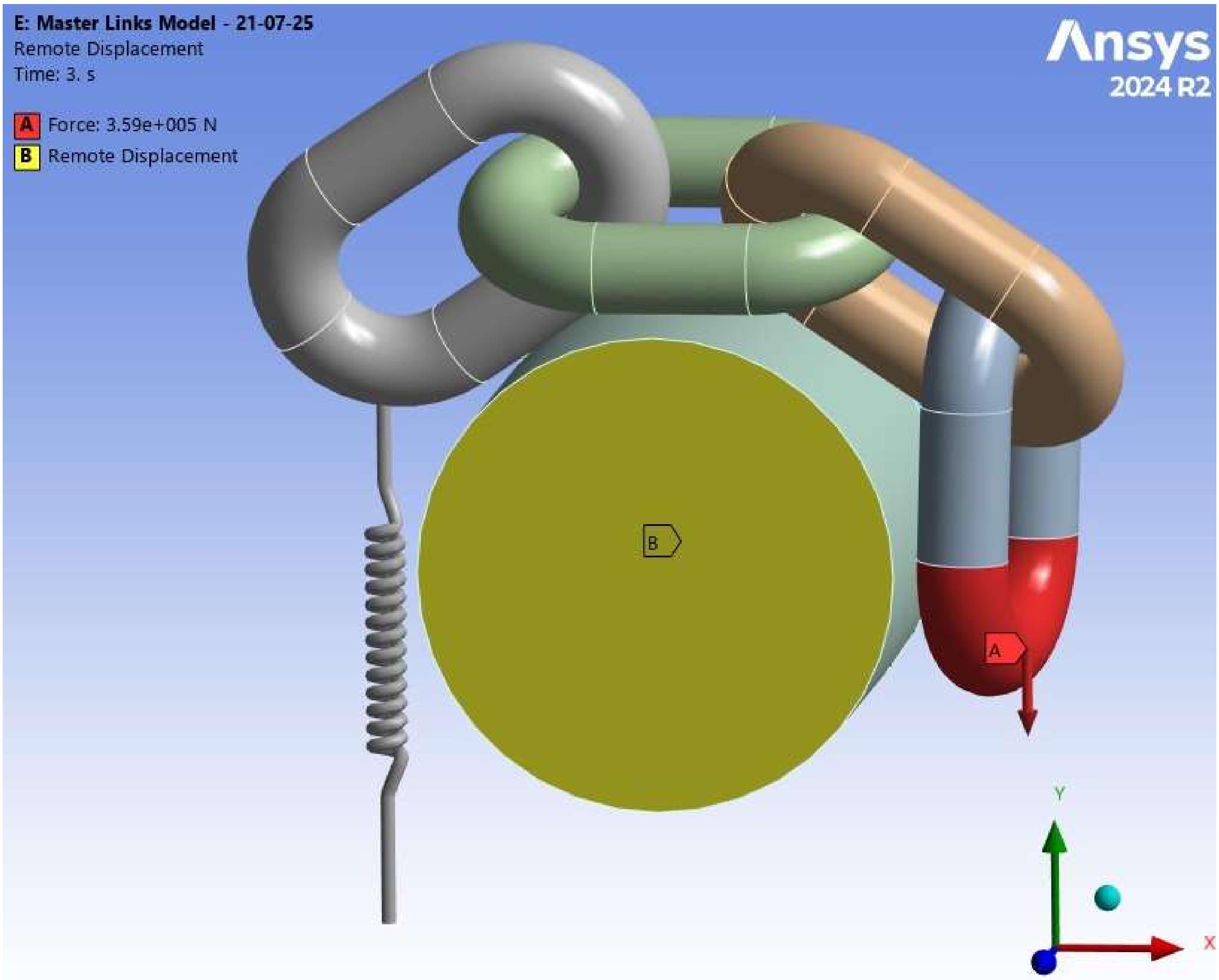


Figure 13 - Timestep 3 Boundary Conditions - LC2

7.2 - Total Deformation

The total deformation is 15.6 mm as shown in Figure 14 and is due to the rotation and adjustment of the link positions when the load is applied and also due to large plastic strains.

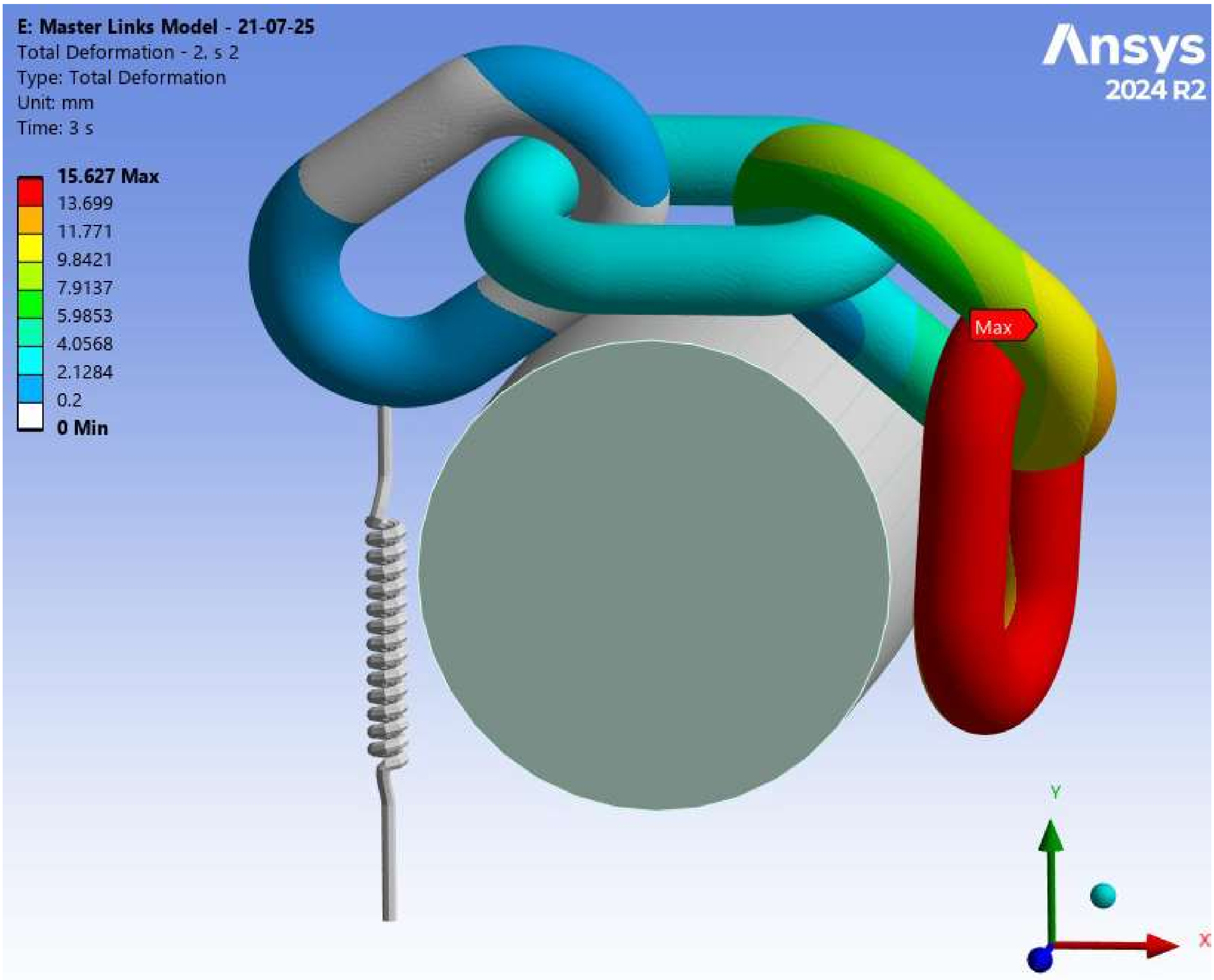


Figure 14 - Total Deformation - LC2

7.3 - Equivalent von-Mises Stress

The maximum equivalent stress is shown in Figure 15 and is 680 MPa on Link 2. This exceeds the material yield strength of the link and therefore the plastic strain is also considered in Figure 16.

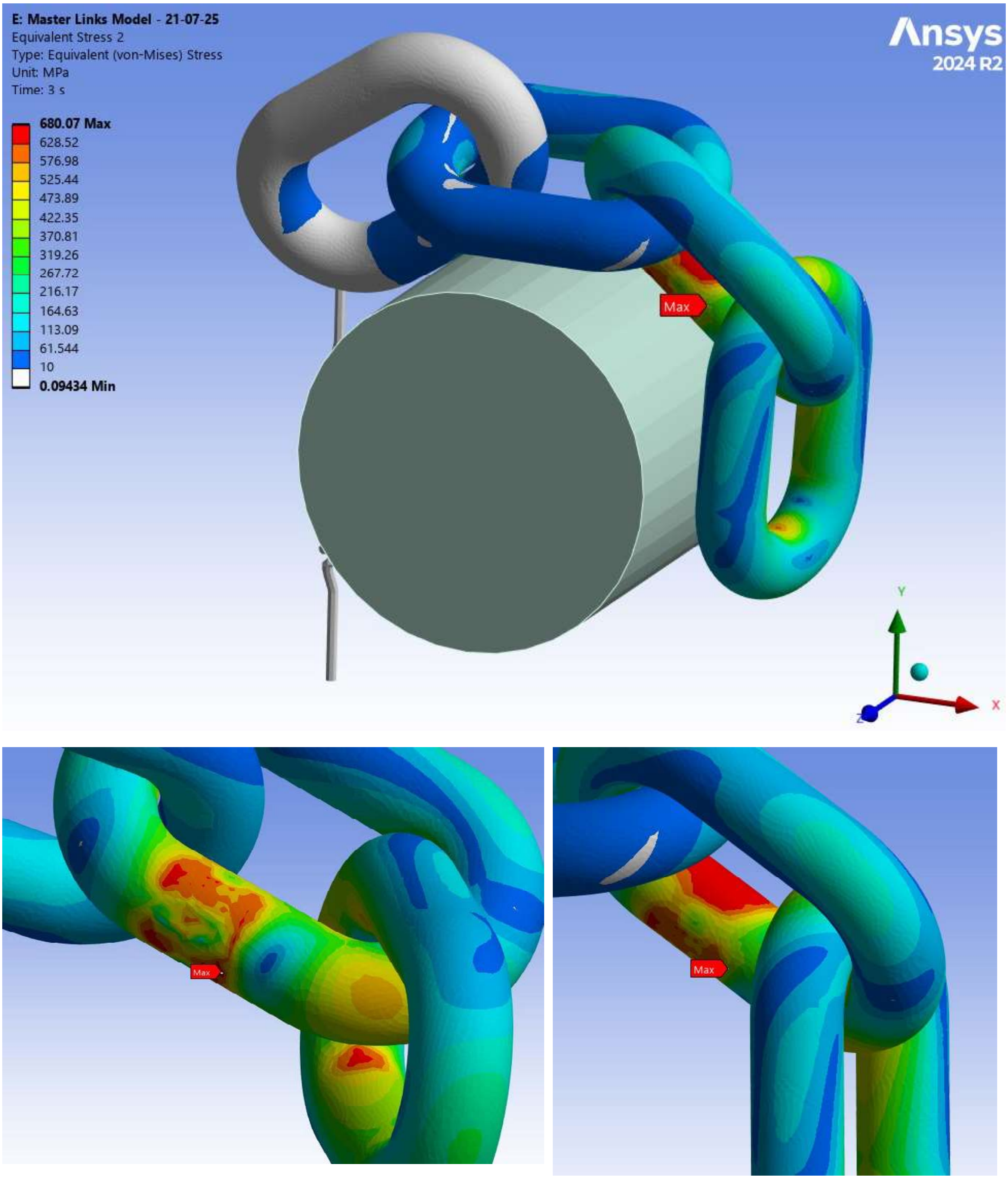


Figure 15 - Equivalent von-Mises Stress - LC2

7.4 - Equivalent Plastic Strain

The equivalent plastic strain is shown in Figure 16 on links 1 and 2, with a sectional view through the maximum strain location. The maximum plastic strain is 14.4 % and the colour bar is clipped at 0.2% proof strength for visual clarity.

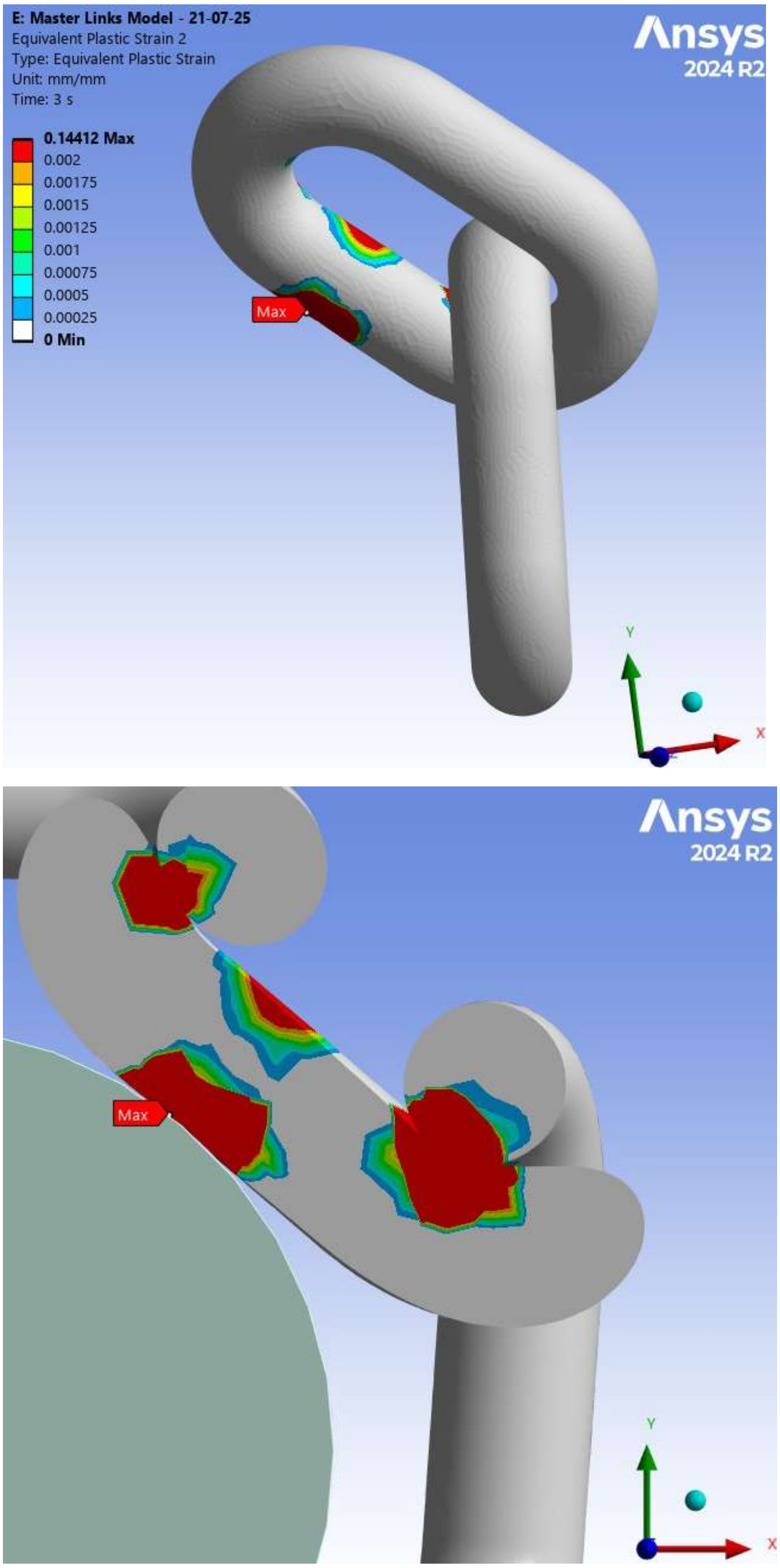


Figure 16 - Equivalent Plastic Strain on Links 1 & 2 - LC2

8. FEA RESULTS - Load Case 3

8.1 - Boundary Conditions

The boundary conditions are shown in Figure 17. One link has a fixed support at the distal rounded section and the second link has a pull force of 14.4 tonne (144 kN) applied to the opposing link. The contacts between the links are the same as those specified in Section 5.4.

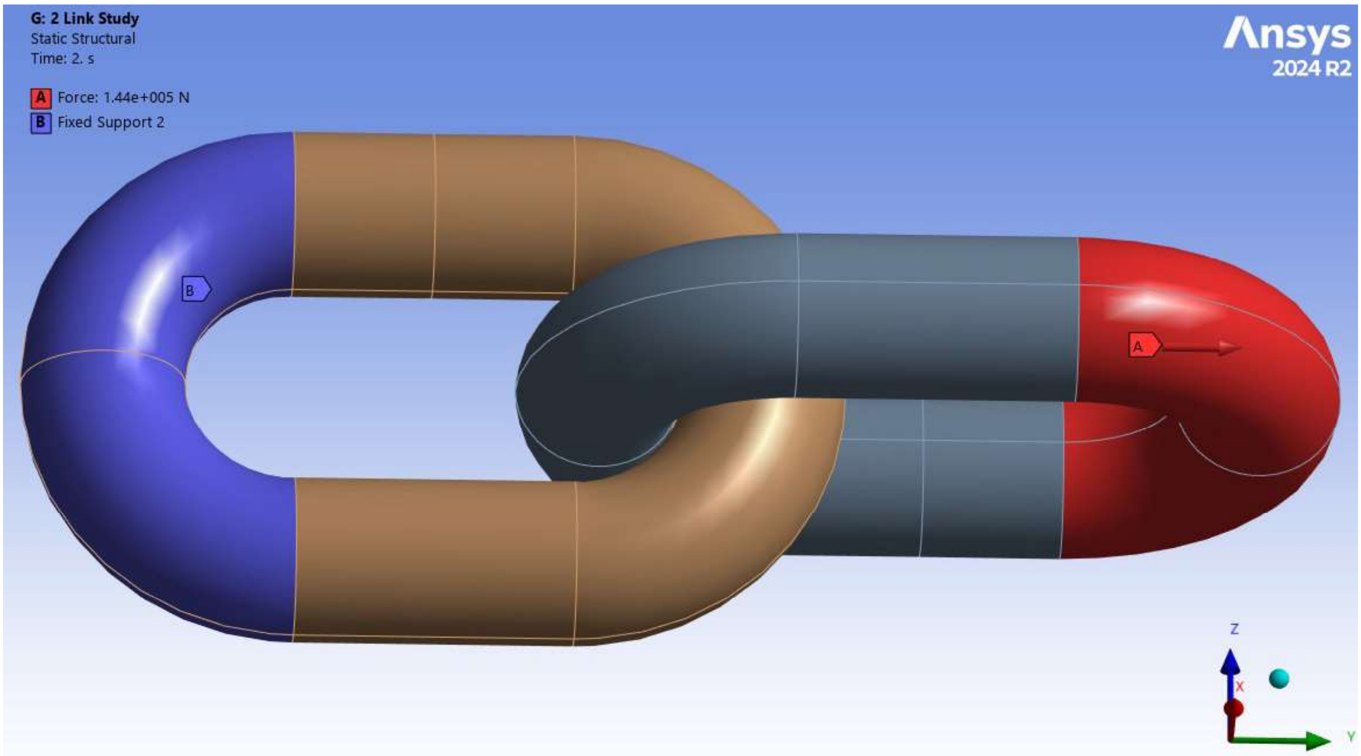


Figure 17 - Boundary Conditions - LC3

8.2 - Total Deformation

The total deformation is 0.01 mm as shown in Figure 18.

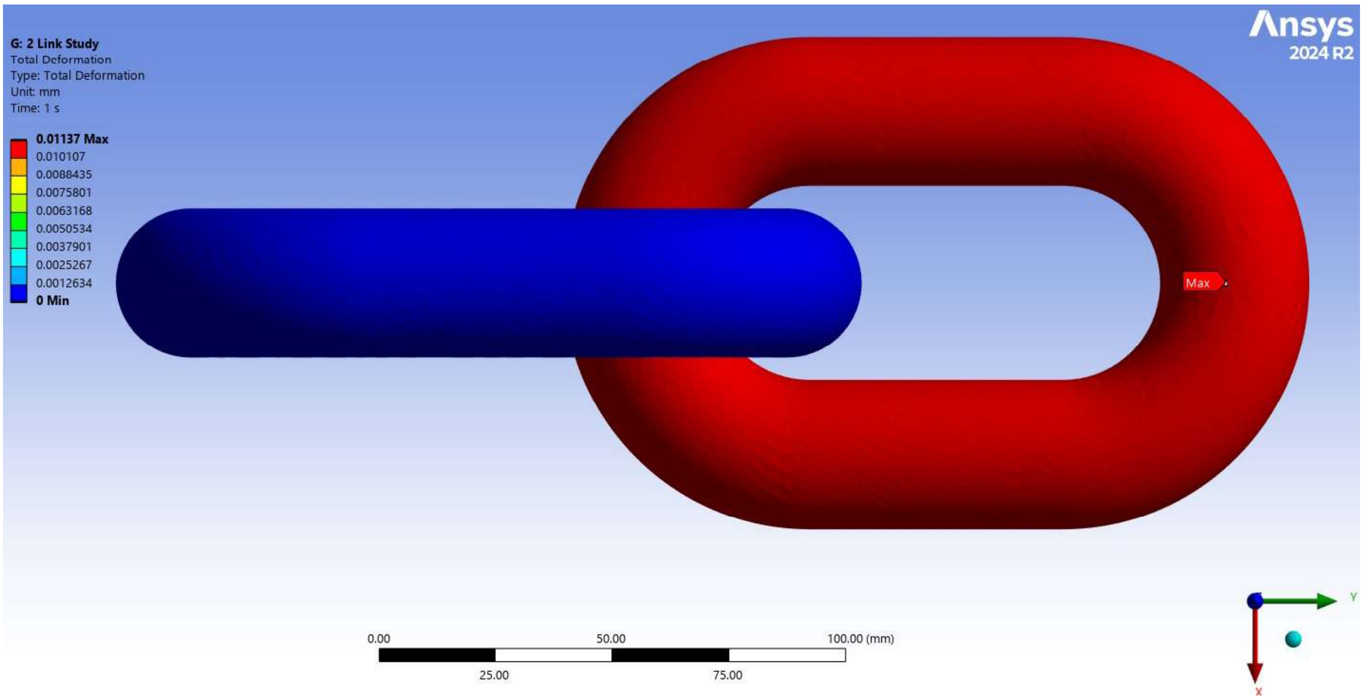


Figure 18 - Total Deformation - LC3

8.3 - Equivalent von-Mises Stress

The maximum equivalent stress is shown in Figure 19 and is 648.3 MPa. Figure 20 shows a cross section through the maximum stress location with the colour bar clipped at 640 MPa (yield stress). The stress exceeds the material yield strength of the link and therefore the plastic strain is also considered in Figure 21.

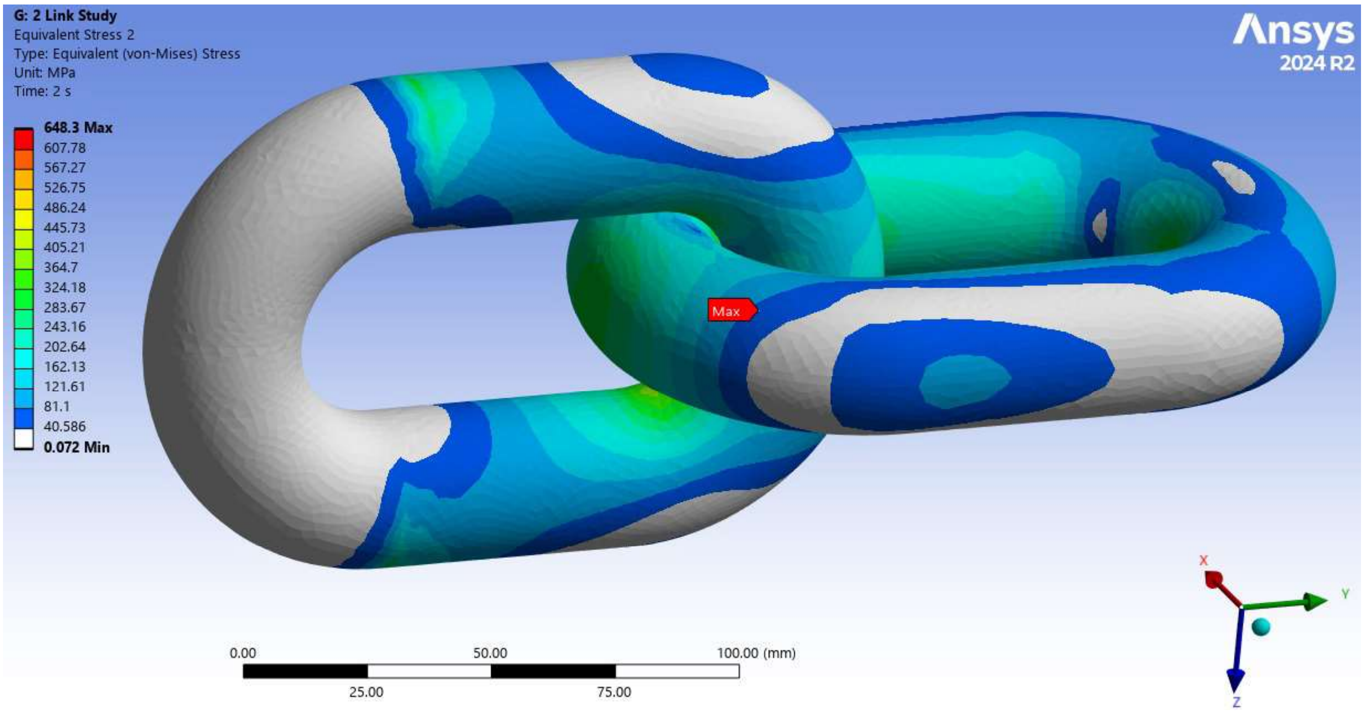


Figure 19 - Equivalent von-Mises Stress - LC3

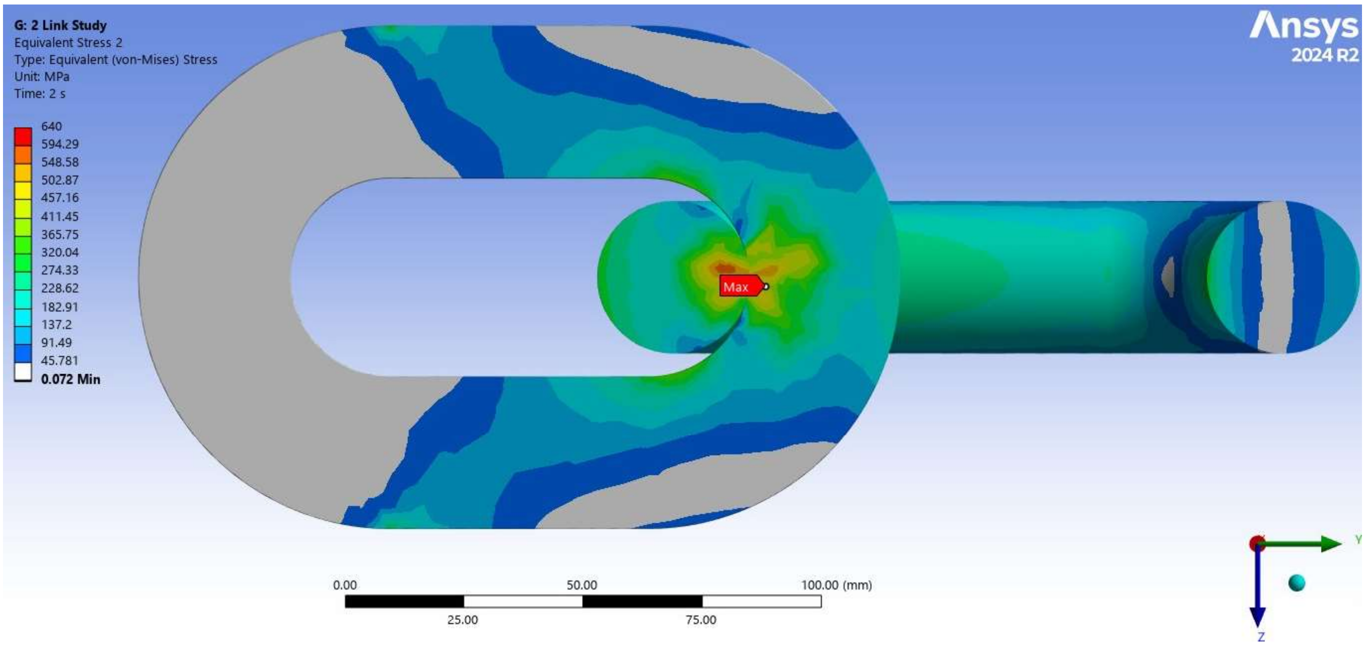


Figure 20 - Equivalent von-Mises Stress Cross Section - LC3

8.4 - Equivalent Plastic Strain

The equivalent plastic strain is shown in Figure 21. The maximum plastic strain is 1.2 % and the colour bar is clipped at 0.2% proof strength for visual clarity.

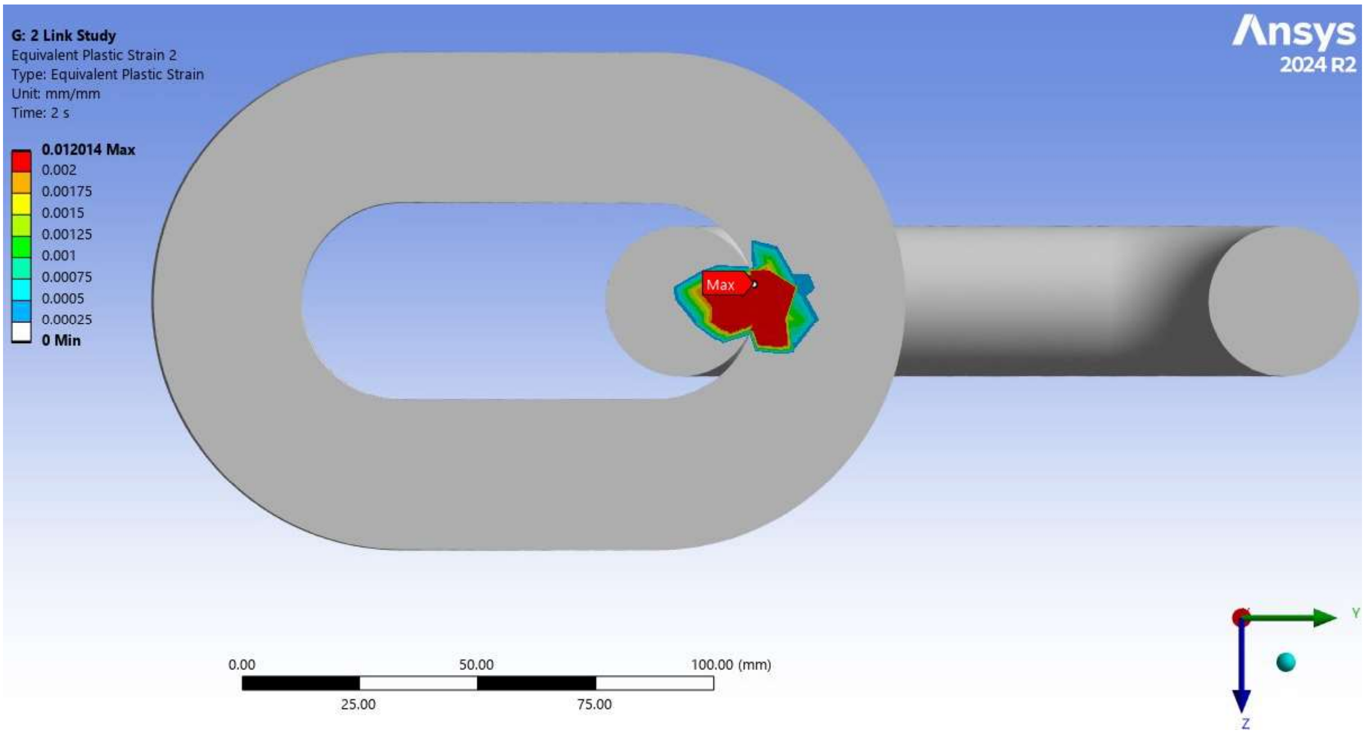


Figure 21 - Equivalent Plastic Strain - LC3

9. RESULTS SUMMARY

In every load case, plastic strain was reported and therefore it is not possible to report utilisation factors for the chain links. The results are summarised below for each load case:

1. LC1: 6.7 % plastic strain (Section 6.4).
2. LC2: 14.4 % plastic strain (Section 7.4).
3. LC3: 1.2 % plastic strain (Section 8.4).

10. CONCLUSION

1. Due to the stresses exceeding material yield strength and plastic strains reported on the links in every load case, it is not possible to perform a fatigue analysis.

2. In LC1 and LC2 the high stresses and plastic strains are induced from two point bending on Link 2, due to non-coincident location of the links around the static pin.

3. Regardless of the exact orientation of the links, the distal links 1 and 2 will always experience two point bending which will induce high local stresses and plastic strains. This is unavoidable given the the current design of the static pin and chain links, since it is impossible for the links to remain fully coincident to the surface around the diameter of the pin. Therefore there will always be unsupported regions on the links experiencing bending.

4. LC3 was undertaken to understand the integrity of the chain links during 14.4 tonne working load and when perfectly aligned and perpendicular to each other, without passing over a static pin. Even in this configuration the yield stress is exceeded and there is some small plastic strain present.

5. High compressive stresses are to be expected in chain link assemblies and are often not prohibited from design; in the case of grade 8 short link chain of size 32 mm, the Working Load Limit (WLL) is 31.5 tonne [Ref 4, Table 5] which is 2.2 times greater than the loading applied in LC1. The breaking force is 1290 kN [Ref 4, Table 5]. Although the chain link assembly may sustain the WLL regularly in pure tension, it is not tested when passing over a static pin, which induces more stress due to secondary bending effects.

6. To further compound item 5, the chain links are in a highly corrosive saline environment and stress corrosion cracking (SCC) is prevalent for carbon steels. SCC is cracking caused by the combined action of tensile stress and chloride-induced corrosion. Other factors such as hydrogen embrittlement, crevice corrosion cracking and especially fatigue corrosion are all accelerated in saline environments such as the the chain link assembly used on the Honeybourne III vessel.

7. The bending of the links around the static pin, has a more damaging effect on fatigue life when compared to pure axial tension. Load is transferred through curved surfaces - causing contact stress and bending at the interlink bearing points. Link deformation under tension is not purely axial: the straight portions of a link see axial tension, while the curved ends experience bending and contact pressure, especially at the crown. Misalignment (common in real-world use) can lead to secondary bending as seen in this report - increasing fatigue damage. Welding and heat treatment zones (in welded chain links) introduce residual stresses and stress concentrations where bending amplifies fatigue initiation.

8. The static pin design is unsafe and promotes secondary bending in the links and will induce fluctuating loads when not in use due to vessel motion. The stresses may be reduced by using a larger static pin diameter however, the size increase would be significant and impractical. A more suitable solution would be to use a sprocket and chain system which will reduce stress, wear, and fatigue risk.

11. ABREVIATIONS

1. FEA Finite Element Analysis
2. WLL Working Load Limit
3. SCC Stress Corrosion Cracking

Annex C

MAIB Safety Bulletin SB1/2024

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY BULLETIN

SB1/2024

FEBRUARY 2024

Extracts from The United Kingdom Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 Regulation 5:
"The sole objective of a safety investigation into an accident under these Regulations shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of such an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

Regulation 16(1):
"The Chief Inspector may at any time make recommendations as to how future accidents may be prevented."

Press Enquiries:
+44 (0)1932 440015

Out of hours:
+44 (0)20 7944 4292

Public Enquiries:
+44 (0)300 330 3000

NOTE
This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

All bulletins can be found on our website:
https://www.gov.uk/maib

For all enquiries:
Email: maib@dft.gov.uk
Tel: +44 (0)23 8039 5500

Fatal injury to a deckhand following a chain failure on the scallop dredger *Honeybourne III* (PD905) approximately 16 nautical miles south of Newhaven, England on 6 October 2023

Honeybourne III

MAIB SAFETY BULLETIN 1/2024

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of information available to date.

The Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

The Marine Accident Investigation Branch is carrying out an investigation into the fatal injury to a deckhand following the failure of a chain on the scallop dredger *Honeybourne III* (PD905).

The MAIB will publish a full report on completion of the investigation.

Captain Andrew Moll OBE
Chief Inspector of Marine Accidents

NOTE

This bulletin is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall not be admissible in any judicial proceedings whose purpose, or one of whose purposes, is to apportion liability or blame.

This bulletin is also available on our website: www.gov.uk/maib
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Public Enquiries: 0300 330 3000

BACKGROUND

At about 2345 on 6 October 2023, the lifting arrangement for the dredging gear that was suspended from the raised port derrick on the UK registered scallop dredger *Honeybourne III* (PD905) fell to the deck without warning. The gear struck a deckhand working below, causing serious head injuries.

The crew of *Honeybourne III* alerted His Majesty's (HM) Coastguard and administered first aid to the unconscious deckhand. HM Coastguard tasked a search and rescue helicopter and a Royal National Lifeboat Institution (RNLI) lifeboat to assist, but the deckhand was declared deceased by the attending helicopter paramedic.

INITIAL FINDINGS

The ongoing MAIB investigation has found that a section of chain in the port dredging gear quick-release assembly failed as the gear was being retrieved. A 32mm chain link, which was led over a static steel pin at the derrick head **(Figure 1)**, parted **(Figure 2)** and allowed the towing block, monkey face block and associated gear to fall to the deck below.

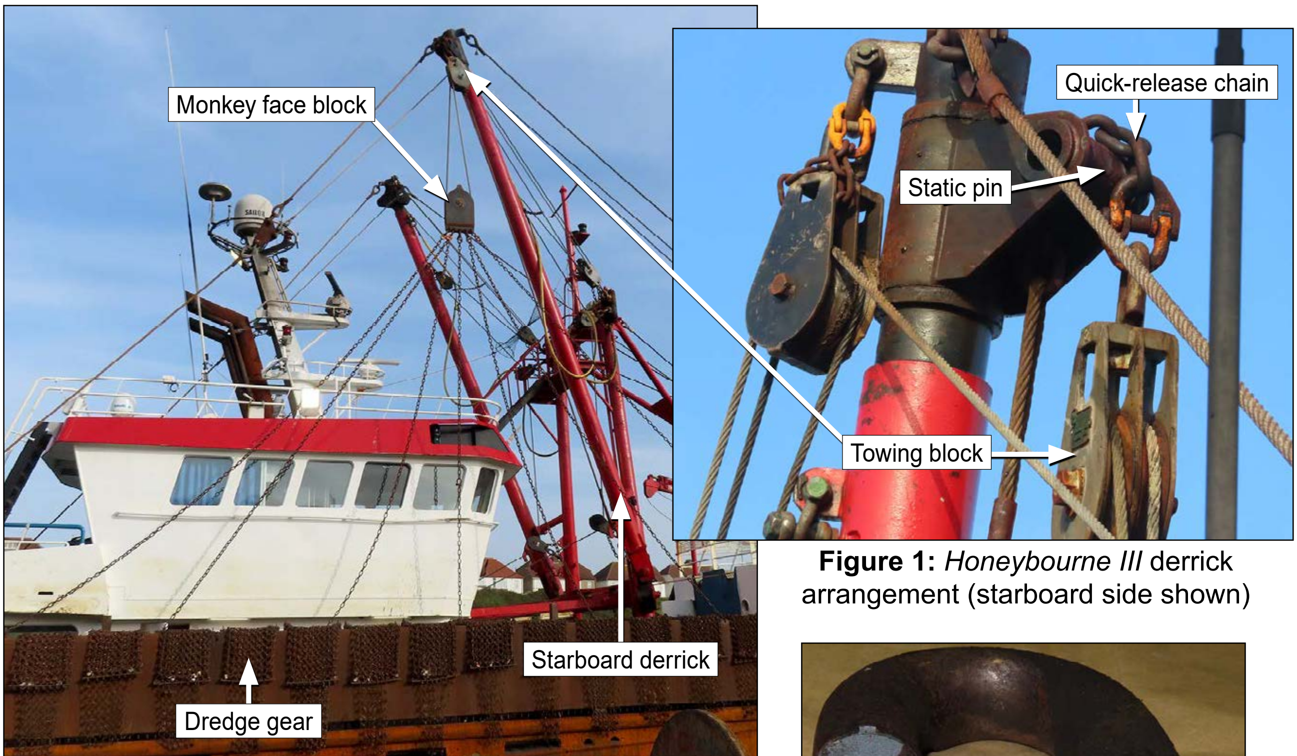


Figure 1: *Honeybourne III* derrick arrangement (starboard side shown)

Figure 2: Failed chain link on *Honeybourne III*

The configuration of a chain led over a static pin as part of a quick-release gear is commonly used on board scallop dredgers and beam trawlers. Such arrangements are known to have failed previously and chain fractures have been identified during routine inspections of quick-release gear **(Figure 3)**.

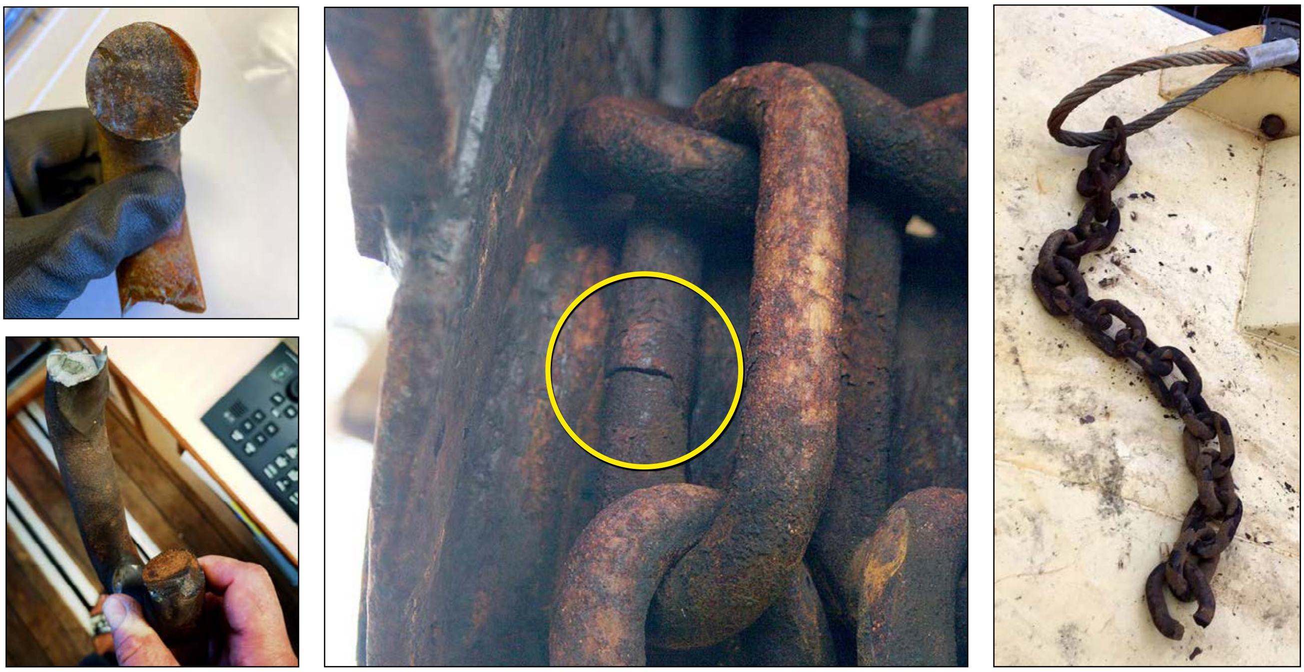


Figure 3: Identified chain defects in static pin arrangements

In February 2021, the failure of a similar chain to that which failed on board *Honeybourne III* resulted in the death of a deckhand on board the beam trawler *Cornishman* (PZ512). As a result, the Maritime and Coastguard Agency (MCA) issued Safety Bulletin 20[1] in August 2021. The safety bulletin highlighted the need for action by owners, operators, skippers, crew and safety advisors to ensure that for vessels under their control they:

- *Have an inspection regime sufficient to inspect all items of lifting equipment including those likely to be subject to high load, high wear and high impact;*
- *Have provided the competent person sufficient opportunity under appropriate conditions to be able to make an assessment for continued operation – which may require inspection techniques other than visual;*
- *Have determined the parameters within manufacturer's recommendations for continued acceptance of items of lifting equipment;*
- *Have determined the frequency of inspection, and where the risk indicates possibility of premature failure, to increase the frequency of inspection in accordance with the Regulations[2];*
- *Have a system to record all inspections and changes to lifting equipment.*

Safety Bulletin 20 built on concerns raised in MCA Safety Bulletin 17, issued in October 2020[3], regarding the safety of lifting operations on fishing vessels. That safety bulletin noted that:

> *It is the owner's responsibility to identify key areas of risk in respect of lifting operations in accordance with the Fishing Vessels (Health and Safety at Work Regulations 1997 (SI 1997/2962)…*

[1] MCA Safety Bulletin 20: Safety concern over lifting equipment inspections on fishing vessels (https://www.gov.uk/government/publications/safety-bulletin-20-safety-concern-over-lifting-equipment-inspections-on-fishing-vessels).

[2] Merchant Shipping and Fishing Vessels (Lifting Equipment and Lifting Operations Regulations) 2006 (SI 2006/2184).

[3] Safety Bulletin 17: Safety concern over lifting operations on fishing vessels (https://www.gov.uk/government/publications/safety-bulletin-17-safety-concern-over-lifting-operations-on-fishing-vessels).

…If a lifting operation cannot be undertaken safely then it shall not continue.

In May 2022, the MAIB issued an interim report on the investigation into the fatal accident on board *Cornishman*. The interim report highlighted that an arrangement containing a chain passing over a static pin makes it *very difficult to calculate the tensile strength of the arrangement and makes it more susceptible to failure*. The interim report further stated that:

> *It is therefore imperative in the short-term that these types of release mechanisms and derrick head pins are subject to regular inspection and replaced at the earliest sign of wear.*

Alternative arrangements for the quick-release mechanisms at the derrick head that either do not include a chain passing over a static pin, or remove the risk of the gear falling in the event of a failure, have been fitted to vessels to mitigate the risk of gear falling from height in the event of a failure of the chain arrangement. The alternative configurations observed by the MAIB have included the use of wire and sheave arrangements **(Figure 4)**, the replacement of the derrick head arrangement with a swinging arm mechanism **(Figure 5)**, and the provision of warp tension monitoring and release systems. Options have also been suggested for a secondary means of retaining the gear, in addition to the chain, to prevent the gear from falling in the event of a chain failure while still allowing the release of the gear in an emergency **(Figure 6)**.

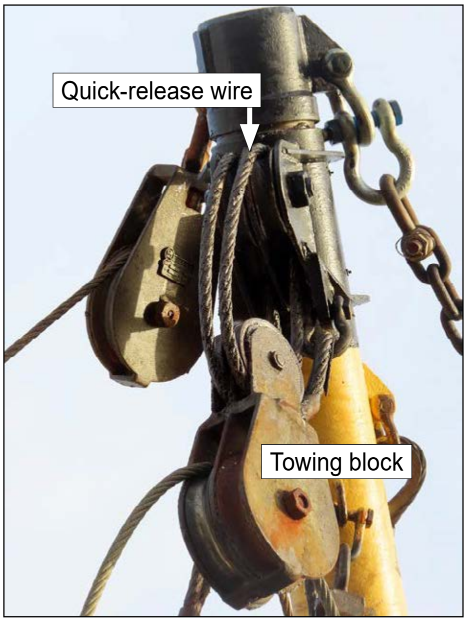


Figure 4: Quick-release arrangement with derrick head quick-release wire and sheave

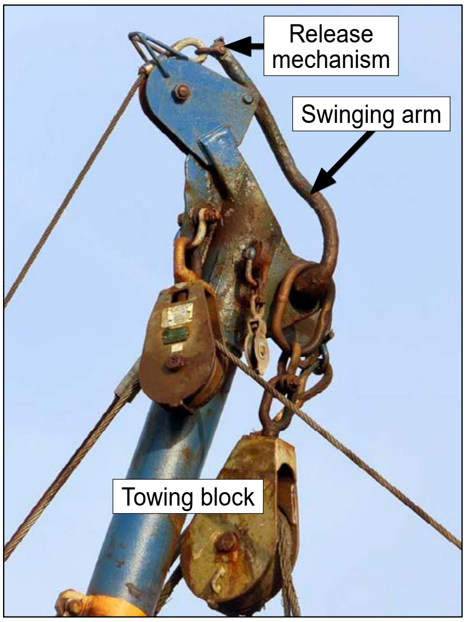


Figure 5: Quick-release arrangement with derrick head swinging arm

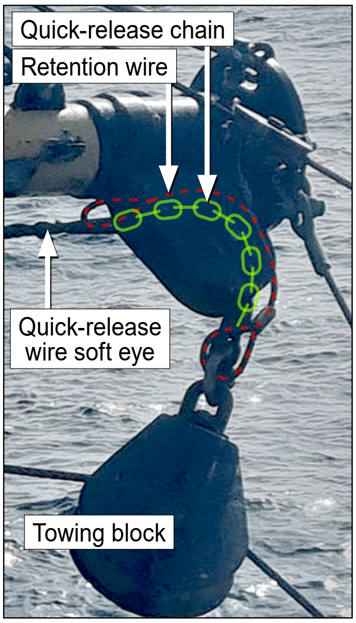


Figure 6: Quick-release arrangement with secondary means of gear retention

SAFETY ISSUES

The initial stages of the investigation have identified that:

- The recent recorded accidents and failures of chain links leading over a static pin as part of a quick-release mechanism indicate the significant risk of such arrangements failing when loads are applied to the chains. These arrangements can induce complex loading forces in the chain links, leading to excessive wear on the chain links and significantly reducing the chain strength.

- The location of the chain links at the derrick head and the fact that the deterioration of the chain links may not be easily visible mean that it can be difficult to inspect and identify issues with the quick-release arrangement.
- The potential failure of chains used in this manner presents an unacceptable level of risk to crew members working on the deck below.

RECOMMENDATIONS

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

S2024/101 Conduct a focused inspection campaign on board UK scallop dredgers and beam trawlers fitted with derrick head quick-release mechanisms that incorporate chain to:

- raise awareness among skippers and crews of the significant hazards associated with the use of chain links passing over a static pin as part of the derrick head quick-release mechanism;
- confirm that the risk of a failure of the derrick head quick-release mechanism has been assessed, mitigated and documented by the owner, operator and/or skipper of the vessel; and
- verify that the crew has been informed of the findings of the risk assessment and the measures taken for their protection in the event of a failure of the derrick head quick-release mechanism.

All owners, operators and skippers of UK scallop dredgers and beam trawlers that use chain as part of the derrick head quick-release mechanism on board their vessels are recommended to:

S2024/102M Urgently ensure that a suitable and sufficient assessment of the risk of a failure of the derrick quick-release mechanism chain has been undertaken and documented, noting the safety issues identified in this safety bulletin, and that:

- mitigations are identified and immediately implemented to reduce the risk to the crew associated with a failure of the derrick quick-release mechanism to a level that is as low as reasonably practicable; and
- the crew are informed of the findings of the risk assessment and the measures taken for their protection.

Safety recommendations shall in no case create a presumption of blame or liability

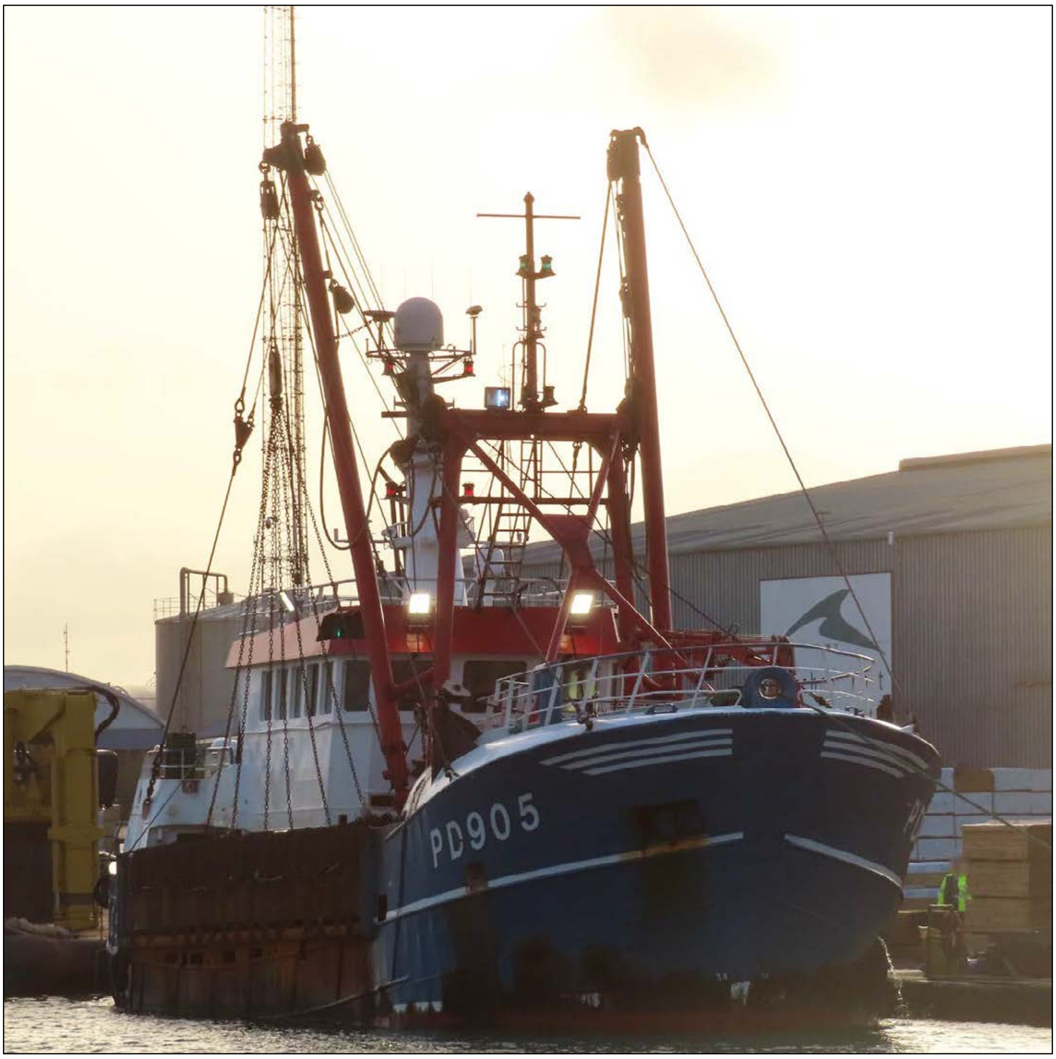
Issued February 2024

MAIB safety flyer to the fishing industry

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SAFETY FLYER TO THE FISHING INDUSTRY

Fatal accident to a deckhand on board the scallop dredger *Honeybourne III* (PD905) 16 nautical miles south of Newhaven, England on 6 October 2023



Honeybourne III

Narrative

At 2345 on 6 October 2023, a deckhand on the scallop dredger *Honeybourne III* (PD905) was fatally injured when he was struck by a towing block that had fallen from the head of the port derrick. A section of chain supporting the fishing gear failed, releasing the gear that fell to the deck below, striking and fatally injuring the deckhand.

The chain that failed formed part of a quick-release assembly designed to enable the crew to release the gear from the derrick head should the dredging gear snag on the seabed and endanger the stability of the vessel.

Safety lessons

The investigation concluded that the training provided to people carrying out inspections of lifting equipment across the fishing industry is ineffective. The guidance supporting them also lacks clarity in the level of knowledge and competency required to ensure that the lifting equipment remains safe for use.

This safety flyer supplements the safety issues identified in the MAIB report into its investigation of a similar fatal accident to a deckhand on board the beam trawler *Cornishman* (PZ 512) on 6 February 2021 (MAIB report 8/2025[1]), where the inspections carried out on the vessel's quick-release assembly did not identify the risk of failure.

It is vital that inspections of lifting equipment are carried out by someone who has the necessary knowledge and information to enable them to identify faults and make an informed decision as to whether the gear remains fit for purpose. The lifting equipment on fishing vessels operates in a harsh environment at high loads. Any failure places fishermen working in nearby at a serious risk of injury.

This flyer and the MAIB's investigation report are posted on our website: www.gov.uk/maib

For all enquiries:
Marine Accident Investigation Branch
First Floor, Spring Place
105 Commercial Road
Southampton
SO15 1GH

Email: maib@dft.gov.uk
Tel: +44 (0)23 8039 5500

Publication date: January 2026

1 https://www.gov.uk/maib-reports/fatal-accident-on-the-beam-trawler-cornishman-with-loss-of-1-life?cachebust=1750323728

Marine Accident Report

INVESTORS IN PEOPLE