Report on the investigation of

accident to lifeboat and fast rescue craft from

European Highway

in Zeebrugge on 1 December 2000

four injured

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Extract from

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(Accident Reporting and Investigation)

Regulations 1999

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

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GLOSSARY

AB	:	Able seaman
EC	:	European Council
EU	:	European Union
FRC	:	Fast rescue craft
HRU		Hydrostatic release unit
LSA	:	Lifesaving appliances
m	:	metre
MCA	:	Maritime and Coastguard Agency
ro-ro	:	roll on-roll off
SOLAS:		Safety of life at sea
UTC	:	Universal co-ordinated time
VHF	:	Very high frequency (radio)

SYNOPSIS

On 1 December 2000, the Marine Accident Investigation Branch was notified that four people had been injured after a lifeboat had fallen from the ro-ro passenger/cargo ferry, *European Highway*. An investigation began that day.

The ro-ro passenger/cargo ferry, *European Highway,* was berthed in Zeebrugge harbour during the morning of 1 December 2000. Her port lifeboat had been swung out and lowered slightly with three men on board. The weight of the lifeboat was being taken on hanging-off pendants, a pair of wires from which the lifeboat can be slung for maintenance or recovery purposes.

The operating lever of the suspension hook release mechanism was activated, and resulted in the lifeboat falling into the water shortly before 0933. It initially struck part of a support column for an adjacent walkway, and then fell into the water, inverted. Two men were trapped underneath the lifeboat, but the third fell into the water alongside.

Authorities ashore were alerted. The vessel's recently installed fast rescue craft (FRC) was launched to assist. During this operation, the hand-winding lever of the davit, which rotated as the FRC was lowered, injured the second officer. Once in the water the FRC was able to tow the lifeboat towards a nearby pilot boat.

With the aid of a quayside crane, the inverted lifeboat was lifted, and the two men beneath recovered on to the pilot boat. All three men had been recovered from the water by 0950. These three and the second officer were taken to hospital with a range of injuries, some serious.

While the FRC was being recovered, lack of vertical clearance prevented it from being swung over some adjacent liferaft canisters. While using the hand-winding lever to raise the FRC slightly, it involuntarily lowered on to a canister, and tipped towards the unguarded side of the vessel. However, the FRC's three crewmen were able to hold on until assisted from the craft on to the vessel's deck.

The lifeboat fell because the hanging-off pendants had been attached incorrectly. The second officer's injury was caused by the rotation of the FRC davit's hand-winding lever. A lack of headroom on the davit caused the FRC to tip during its recovery.

The owners have corrected the headroom problem on the FRC davit by increasing the height of its support column. Similarly, they have also changed the lifeboats' hanging-off pendant arrangement so that it is impossible to make the incorrect connections that occurred in this incident.

The owners of *European Highway* are recommended to supplement training and instruction material, and to modify procedures, with the aim of preventing a repetition of this incident. A recommendation is also made to the MCA to consider whether the standards required of FRC davits are sufficient to ensure the safety of all personnel involved with their operation.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF VESSEL AND INCIDENT

Name	:	*European Highway*
Official number	:	712775
Port of registry	:	Dover
Type	:	ro-ro passenger/cargo
Vessel operators	:	P&O Stena Line Ltd
Gross tonnage	:	22,986
Length	:	170.35m
Date built	:	1992
Builder	:	Schichau Seebeckwerft AG Bremerhaven Germany
Place of accident	:	Zeebrugge harbour, berth 113
Injuries	:	four
Damage	:	Serious damage to port lifeboat

Note: All times quoted are UTC

1.2 NARRATIVE

European Highway arrived at berth 113 in the port of Zeebrugge at 0900 on 1 December 2000. She berthed bows to the vehicle ramp with her port side alongside a pedestrian walkway supported by large columns.

The carpenter made plans to carry out maintenance checks to both of the vessel's lifeboats during the stay in Zeebrugge. He began by collecting tools and preparing the port lifeboat. The bosun allocated the storekeeper to assist in checking and greasing the fall blocks.

Meanwhile, a deck officer was giving a newly-joined deck cadet a familiarisation tour. They passed close to the port lifeboat during this tour and, with the aim of enhancing his knowledge, it was decided that the cadet should take part in the lifeboat work with the carpenter and storekeeper.

All three men wore overalls, inflatable lifejackets and safety boots. In addition, the cadet wore a hard hat.

The carpenter planned to lower the lifeboat sufficiently to take its weight on hanging-off pendants. He did not discuss his plans with the other two men. For this purpose hanging-off pendants were connected. Once all three men were in the lifeboat, the cadet was given some instruction on the purpose, and function, of the lifeboat's controls at the helmsman's position.

The carpenter operated the remote control for the winch's brake within the lifeboat. Initial movement of the davit arms released the automatic gripes. Further movement caused the arms to swing out to their maximum extent. The lifeboat's movement continued until it had been lowered about 300mm from the davit head. At this stage the carpenter released the brake control, and the winch stopped.

A fourth crewman on deck was requested to press the winch hoist button briefly to check the winch's power supply. The winch motor failed to work and this crewman, unable to restore supply, decided to find the electrician. Using his VHF radio set, the storekeeper in the lifeboat also attempted to locate the electrician.

Meanwhile, the carpenter continued to lower the lifeboat until its weight was taken by the hanging-off pendants and the falls went slack. He then released the winch brake remote release wire.

The carpenter described and demonstrated features of the suspension hooks' release gear to the cadet. He removed the safety pin from the hook release lever, and told the cadet to lift the release lever and pull it aft while he sucked on the hydrostatic release unit (HRU) vent tube.

When the release lever was pulled aft, the lifeboat fell. Initially it made contact with a support column for the pedestrian walkway adjacent to the ship. This impact tilted the lifeboat, causing it to enter the water by the bows and inverted.

As the lifeboat fell and rotated, the carpenter was thrown clear and fell into the water. The other two men remained in the lifeboat as it fell, and found themselves trapped underneath as it floated.

On returning from his efforts to restore the winch's power supply, the other crewman saw the inverted lifeboat in the water and raised the alarm. The time was about 0933.

The lifejackets of all three men inflated on entering the water. The carpenter swam towards the upturned lifeboat and, after swimming around it looking for his colleagues, climbed on to its hull.

Initially, the two men underneath the lifeboat had difficulties in assessing their situation. The light on the storekeeper's lifejacket did not illuminate but the one on the cadet's did. Although the men entered the water some distance apart, they were able to move closer together and share the illumination offered by the light on the cadet's lifejacket.

Meanwhile, preparations were made to launch the vessel's FRC into an area of water clear of the supporting column of the walkway. The FRC is stowed on the port side of the vessel, slightly aft of the lifeboat's davits, and is served by a single arm slewing davit.

The FRC davit was slewed out and the second officer cleared the FRC's painter while standing by the davit. One of the FRC's crew pulled the remote lowering wire control to lower the boat. The hand-winding lever on the davit began to rotate, hitting the second officer on the left arm. He suffered bruising and swelling. The hand-winding lever was manually disengaged, and the launching of the FRC continued.

Verbal contact between the carpenter and the two men beneath the lifeboat was made at 0935. This offered some reassurance. One minute later the ship's FRC was in the water and able to attach a line to the lifeboat.

The FRC towed the inverted boat alongside a nearby pilot launch at 0940 **(Figure 1)**. During this brief tow, the trim of the inverted lifeboat altered, causing a change in the height of the air pocket between forward and aft. The depth of the air pocket changed at a rate that alarmed the two men within.

Two minutes later, a line was attached between the lifeboat and a quayside crane. However, the first effort to lift the lifeboat was unsuccessful because the lifting strop failed. This allowed the lifeboat to drop, striking the two men and momentarily pushing them beneath the surface. They were both feeling very cold, weak and pessimistic about their likely fate.

Figure 1

FRC and inverted lifeboat alongside pilot launch

Helicopter and emergency services arrived on the quayside at 0945. Two minutes later a second attempt to lift the lifeboat was successful. The cadet was the first to be recovered at 0948.

Injury to the storekeeper prevented him from being recovered immediately. However, because there were concerns for his safety, positioned as he was between the pilot launch and the adjacent inverted lifeboat, he was pulled from the water at 0950.

The cadet was able to walk to an ambulance, but the storekeeper had to be carried on a stretcher.

Still with its crew of three on board, the FRC was reattached to its lifting hook and recovered to embarkation level, where the limit switch shut off the motor. It was then swung inboard but, because of insufficient clearance, could not be swung over the liferaft canisters stowed adjacent to the davit.

The hand-winding lever of the FRC davit was engaged to raise the FRC manually. As it was still not in a suitable position for them to disembark safely, the three crew remained in the FRC.

The hand-winding lever was then used to raise the FRC, but it dropped suddenly, making contact with the liferaft canisters and tilting to port, towards the unguarded deck edge of the vessel. The three crew managed to prevent themselves from being ejected from the FRC, and were assisted from the craft by other crew members.

Initial examination of the hanging-off pendants showed they had been connected to the recovery pendants, rather than the hanging-off points of the lifeboat's suspension hooks **(Figure 2)**. The lifeboat was towed away for later recovery and transport to the premises of Umoe-Schat-Harding, Gosport, UK.

Figure 2

Hanging off pendant shown connected to yellow lifting ring of recovery pendant

1.3 VESSEL AND CREW

Typically, *European Highway* makes two return voyages each day between Dover and Zeebrugge. Passage time is approximately 4 hours.

This service, and the respective berthing arrangements, results in her normally berthing port side alongside in both Dover and Zeebrugge. Consequently it is possible to launch the starboard lifeboat more frequently than the port. However, since this accident a second berth has become available in Zeebrugge, allowing the vessel to berth on both port and starboard sides.

All crew work a pattern of 7 days on the vessel, 7 days off. The majority exchange on Wednesdays.

1.4 THE LIFEBOAT'S 'CREW'

The carpenter first went to sea in 1976 and has served on numerous types of vessels. He holds a Class 4 deck officer's certificate of competency, obtained in 1984. There followed some service as mate and second mate on coastal vessels. Since 1988 he has sailed as carpenter and gained experience on several of the owner's ships. He joined *European Highway* in 1992.

Because of illness, the carpenter was away from the ship between August and November 2000, rejoining on 15 November.

The storekeeper who boarded the port lifeboat is also very experienced, having been at sea since 1970. He has sailed on numerous vessels and has sailed as bosun. He first joined *European Highway* in September 2000. While the vessel was in refit, during October 2000, he followed a fast rescue craft course.

The deck cadet joined the vessel 2 days before this accident. This was his first ship. He had previously followed a short college-based course, as part of his cadetship, and taken survival, fire-fighting and survival craft courses while at the college. His shipboard duties consisted primarily of familiarisation with the ship, its equipment and systems.

1.5 LIFEBOATS AND DAVITS

Two 60-person partially enclosed lifeboats are carried on *European Highway*. They are supported on gravity-operated single pivot swinging arm davits. A deck-mounted winch controls swinging out and recovery. Using a remote control wire connected to the winch brake, each lifeboat can be lowered from within. The lifeboats are arranged for embarkation in the stowed position.

Winch hoisting control is forward of the davits' structures.

In addition, a single FRC, together with its launching davit, is just aft of the port lifeboat davit. This davit also serves several inflatable liferafts and a means of recovery system.

1.6 ON/OFF LOAD SUSPENSION HOOKS

Each lifeboat is equipped with two suspension hooks capable of release either on or off-load.

Simultaneous release of both hooks is performed by use of a hand lever mounted on the starboard side of the helmsman's control console. Moving this lever aft releases the hooks. Inadvertent movement of the lever is prevented by a 'T' headed safety pin, which must be removed to allow the lever to move, and spring-loaded clevis pins.

A further safety device, in the form of a hydrostatic interlock, is also fitted. This prevents the hand lever being operated until the lifeboat is waterborne. The sensing device is a unit fitted to the bottom of the lifeboat which, by way of a diaphragm, senses the water pressure generated by a waterborne lifeboat. The diaphragm is deflected by water pressure and this movement is transmitted to an interlock lever by a cable. Until the lifeboat is waterborne, the interlock lever prevents the hand lever being moved **(Figure 3)**.

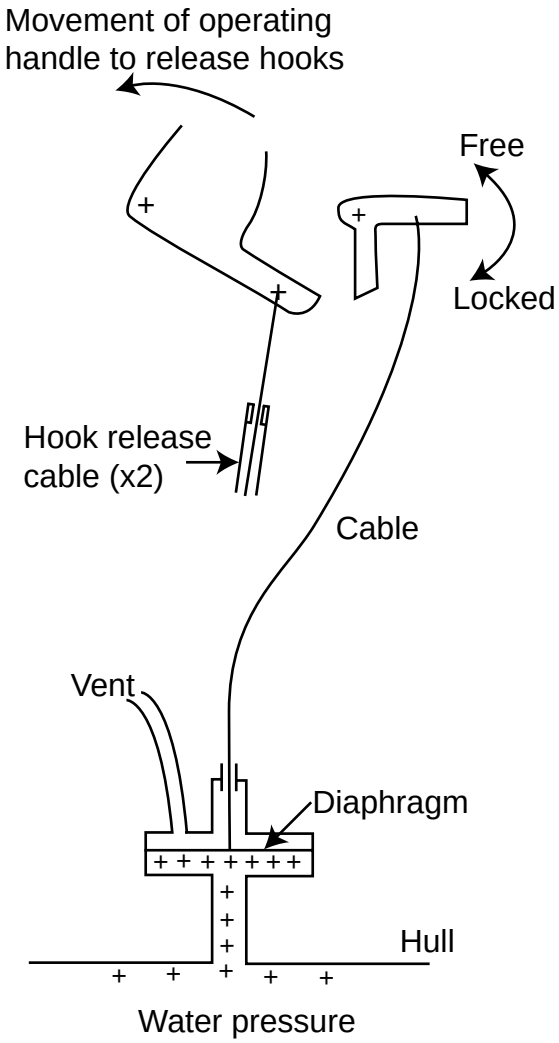
The underface of the diaphragm is exposed to water pressure but the upper face, although enclosed, is maintained at atmospheric pressure by a hose connection to the upper part of the diaphragm's housing. Normally the open end of this hose is led to the space above the battery housing in the helmsman's console, well above the loaded waterline of the lifeboat.

Provided the hydrostatic diaphragm is deflected upwards, and its cable causes a corresponding movement of the interlock lever, the hand lever can be moved to open the suspension hooks. A flexible cable transmits this movement to a release cam on each suspension hook. The hooks are then free to open.

This hydrostatic interlock may be overridden by moving the interlock lever by hand. This may be done in an emergency, after breaking its glass cover to gain access.

1.7 THE FOUL WEATHER RECOVERY SYSTEM

The foul weather recovery system for the lifeboats on *European Highway* consists of pairs of hanging-off pendants and recovery pendants for each boat. The vessel's training manual covers the procedures for the use of this system when recovering a lifeboat from the water, but not for its use during maintenance.



Hydrostatic interlock on suspension hook release lever

1.7.1 Recovery pendants (Figure 4)

These pendants are intended to assist a boat's recovery during poor weather conditions.

Until the vessel's refit during October 2000, they had been made of fibre rope and were a matt light brown colour. During refit these were replaced by pendants made of webbing, coloured red with a bright yellow lifting ring intended to engage with the suspension hook. These pendants normally remain connected to the lower block's suspension plates **(Figure 6)**.

Movement of a waterborne boat may make the attachment of lower block suspension plates to their hooks a hazard to the crew. The lower blocks are heavy items, and can pose a distinct danger to a crewman attempting to secure, manhandle and fit the plates to a boat's suspension hook.

Recovery pendants are intended to by-pass this hazard. They are comparatively short lengths of rope or webbing with a hard eye at each end. In use, one end is shackled to the lower block's suspension plate; the other is shackled to a lifting ring which can be fitted to the boat's suspension hook.

Thus, as a boat manoeuvres to a position beneath its falls, its crewmen need only control the comparatively lightweight lifting rings on these pendants. They then fit these rings to the suspension hooks without the danger of the lower blocks swinging and striking them or the boat's canopy.

The boat may then be lifted clear of the water using its normal winch and falls. However, before the boat can be hoisted to its stowed position, its weight must be transferred to its lower block suspension plates. Hanging-off pendants are used in this process.

1.7.2 Hanging-off pendants (Figure 5)

These allow the boat's weight to be taken on the davit arms without tensioning the falls. One is supplied for each davit arm. Each consists of a length of wire having a hard eye and shackle at each end. The davit's arms are designed to withstand a load applied in this way and have been tested to requirements.

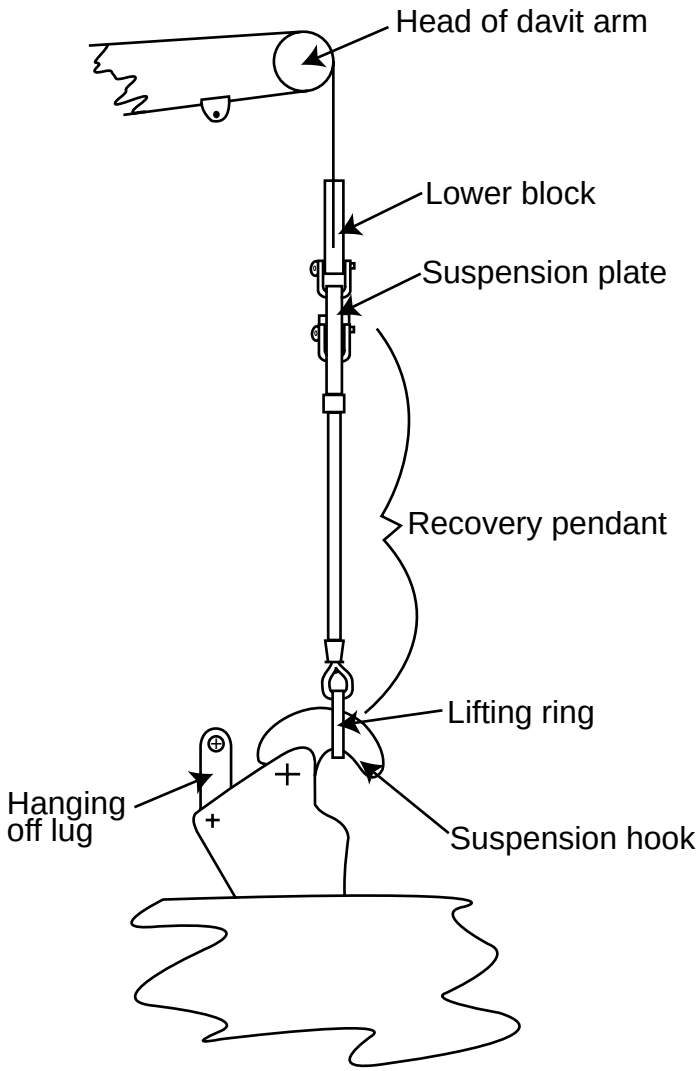
In use, one end of each pendant is shackled to a lug close to the head of its davit arm. The lower end is shackled to the pendant lug on the respective suspension hook assembly.

With the hanging-off pendants connected in this fashion, the boat can be lowered until the falls become slack and the hanging-off pendants take the boat's weight. No weight is taken on the suspension hooks so, in this condition, the falls and their suspension plates may be disconnected.

The hanging-off pendants can be used in conjunction with the recovery pendants. The former have to be attached to enable the removal of the latter so that the lifeboat can be hooked up to the fall block lifting ring during its recovery.

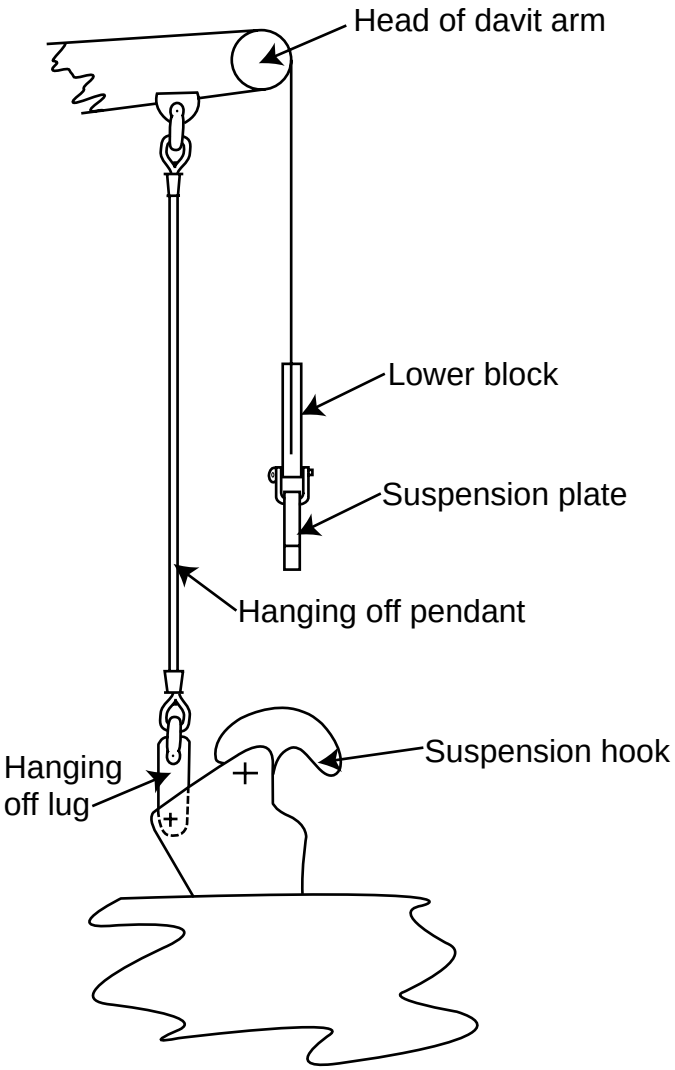
Alternatively, the hanging-off pendants can be used to enable inspection and maintenance of the lifeboat on-load release hooks and operating equipment.

Figure 4



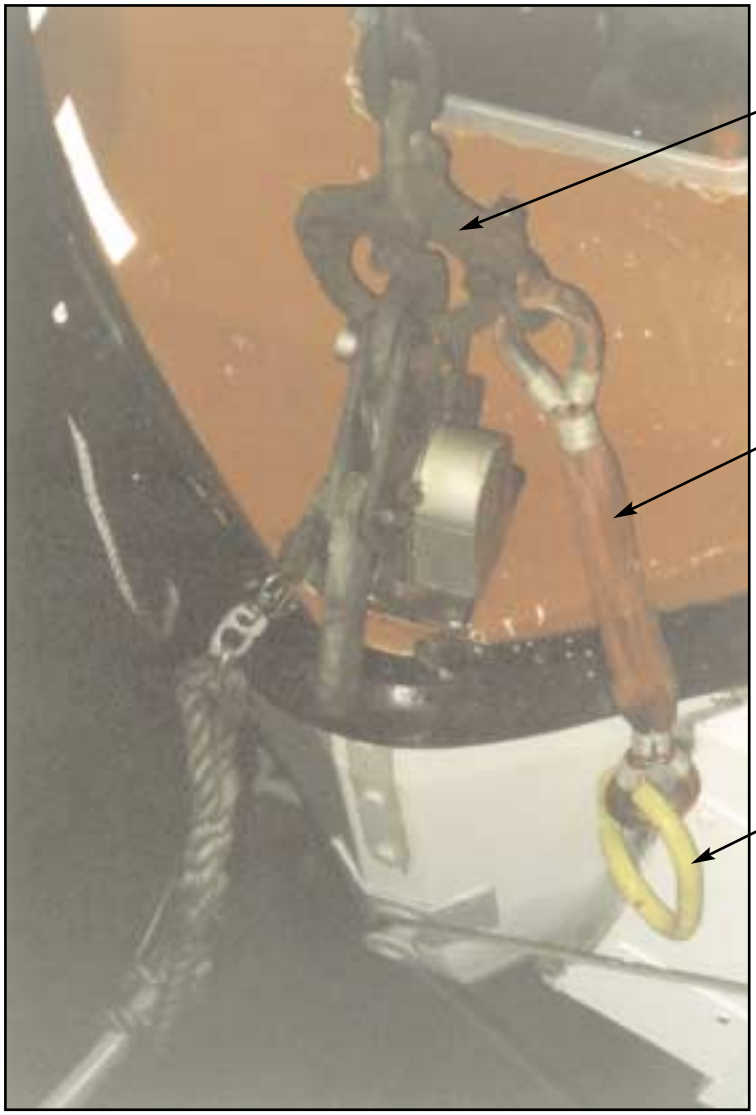
Recovery pendant connection between lower block and suspension hook

Figure 5



Hanging off pendant connection to support lifeboat's weight

Figure 6



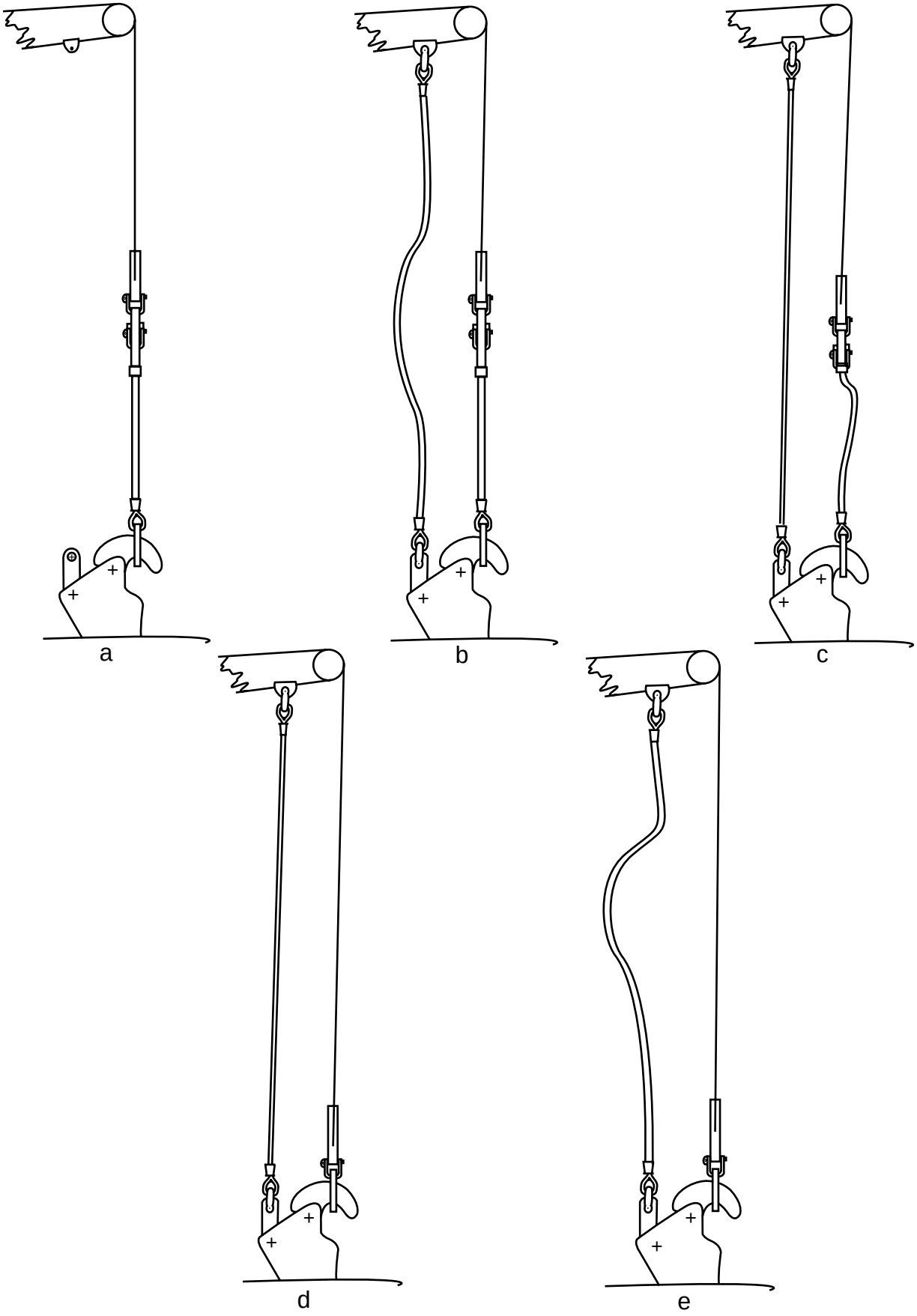
Normal stowage arrangement of recovery pendant

1.8 LOAD TRANSFER PROCEDURES (Figures 7a - e)

When recovery pendants are used to lift a lifeboat clear of the water, before attempting to transfer the boat's weight on to the lower block suspension plates, the hanging-off pendants must be connected between the davit heads and the hanging-off lugs on the suspension hooks **(Figures 7a & b)**.

Once these are connected, the winch may be paid out until the hanging-off pendants are taking the boat's weight and the falls are slack **(Figure 7c)**. The suspension rings of the recovery pendant can then be released from the suspension hooks and, after paying out the winch slightly, they can be replaced by the lower blocks' suspension plates **(Figure 7d)**.

The winch can then be hoisted until the falls take the boat's weight and the hanging-off pendants are slack **(Figure 7e)**. The hanging-off pendants can then be released from the boat's hanging-off lugs and secured in their stowage clips on the davit arms. The boat can then be fully stowed.



Sequence for transferring load from recovery pendants to lower blocks

1.9 MAINTENANCE PROCEDURES

A weekly and monthly maintenance and inspection regime is in place. Records show that the on/off load suspension hooks on the port lifeboat had been serviced on 29 November 2000. Those on the starboard lifeboat were serviced on 11 November 2000. Earlier records show that routine maintenance had been performed regularly.

The job record cards for this operation set out the following work requirements:

NB. BOAT MUST BE HUNG OFF OR IN THE WATER.

1. *Remove upper pair of bolts of hydrostatic lever cover, slacken lower pair and rotate down.*
2. *Remove "T" headed safety pin.*
3. *Check freedom of operation of hydrostatic locking lever.*
4. *Operate release mechanism.*
5. *At each hook, check that the hook can be swung clear of the cam release pin. Lightly lubricate the tail of the hook and cam.*
6. *Reset hooks and ensure operation of recocking levers does not require excessive force.*

Although the record cards highlight the importance of having the boat afloat or properly hanging off, in the LSA training manual there are no instructions on the method to be used for hanging-off for hook maintenance purposes.

1.10 RISK ASSESSMENT

No risk assessments have been undertaken for operations involving the use of hanging-off pendants on the lifeboats or use of the FRC.

1.11 TRAINING

The owners have requirements for crew to refresh their knowledge on critical safety systems after absences from ship exceeding one month.

Designated crew members, who are considered as having sufficient experience and knowledge, carry out training and assessment of crew new to the ship.

The carpenter is considered to be one crew member with sufficient knowledge to train others in the use and maintenance of davits, lifeboats and their on/off load release hooks.

1.12 FRC AND DAVIT (Figure 8)

At the time of this accident, on 1 December 2000, the FRC and its davit were very recent additions to the vessel. They were installed during the vessel's refit period in Falmouth during October. The system was demonstrated to a surveyor of the Maritime and Coastguard Agency (MCA) on 18 October while the vessel was in Dover.

This surveyor noted that the limit switch setting did not allow the FRC to be lifted from its stowage cradle, and that it was necessary to use the manual winding handle.

The davit was constructed as a rescue boat/means of recovery/liferaft handling system and manufactured to a design of: D-I Davit International gmbh, Sandstrasse 20, 27232 Sulingen, Germany. The manufacturer's designation is D-CRm.R.FR.21/4,5.

The FRC davit on board *European Highway* has no visible marks, in the form of the ship's steering wheel required by the European Marine Equipment Directive, to indicate it complies with requirements. However, a similar davit, fitted to a sister vessel operated by the same owners, is marked with the steering wheel mark of conformity and also has the markings 0801 2000 alongside. These marks indicate that the davit was approved by Germanischer Lloyd, Luxembourg and manufactured in 2000.

These two davits were purchased at the same time from the same manufacturer and were to the same design. There is thus no reason to believe that the davit on *European Highway* should not also have been marked in the same way.

Engagement or disengagement of the manual winding handle requires the operator to select the desired position with a separate control lever **(Figure 9)**. When the control lever is set to 'Motor', the winding handle is disengaged from the internal mechanism. In at least one other position the winding handle is engaged with the internal mechanism.

Slewing and lowering may be controlled remotely, from within the FRC, or locally at the davit's controls. Remote control is by two pull wires hanging from the davit head and synchronised to lower or hoist with the FRC.

Figure 8

Fast rescue craft and davit

Figure 9

Instruction label for disengaging hand winding handle of FRC davit

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 from occurring in the future.

2.2 INITIAL ASSESSMENT

Immediately following this accident, the vessel's own staff made an inspection of the port lifeboat's davits. They found the hanging-off pendants connected to the recovery pendants rather than to the hanging-off lugs **(Figure 2)**. This arrangement did not remove the lifeboat's weight from its suspension hooks. Knowing that the suspension hooks needed to be released to perform routine maintenance, they concluded that this incorrect connection had resulted in the lifeboat falling when they were intentionally opened. Nothing later established by the MAIB has cast doubt on this conclusion.

2.3 HOOK MAINTENANCE

The condition of the hooks and operating system was examined by the inspector who concluded there was no feature on the system that would have prevented it working as intended.

In particular, because of their importance to the correct operation of the system, the settings of the release cables and hook release cams were closely inspected and found to comply with manufacturer's recommendations.

Maintenance and adjustment was to a good standard, and there was no feature of the system which could have prevented the hooks from operating as designed.

Poor maintenance or system defect was, therefore, dismissed as a causal factor in the accident.

2.4 RELEASE OF THE ON/OFF LOAD RELEASE HOOK

The vessel operates a planned maintenance system, where a job card is allocated to each system or item of equipment. The job cards for the lifeboats' suspension hooks set out the work requirements for the job. This work should be undertaken by the carpenter. The job card specifies that the hook release mechanism is operated, and that the hooks are checked for free movement and lightly lubricated at the hook and cam contact faces.

To do this work the lifeboat's weight needs to be taken from the hooks. The job card indicates two ways to support the boat. These are by using the hanging-off pendants, or by placing the boat in the water.

Berthing arrangements and service requirements at Zeebrugge and Dover prevented *European Highway*'s port lifeboat being placed in the water. Therefore, hanging off the lifeboat was the routine method used to facilitate hook maintenance.

2.4.1 The carpenter

The carpenter, who was responsible for maintenance of the hooks, had had some formal training in the use and maintenance of the vessel's lifesaving appliances. He had also gained a sound working knowledge of the operating principles of the lifeboats' on/off load suspension hooks, and hanging-off pendants from working with competent service personnel during the vessel's refits. He was one of several designated crew members able to instruct and assess the competency of crew joining, or rejoining, the vessel. In particular, he instructed in the maintenance of the hooks and the use of the hanging-off pendants.

Although knowledgeable of recovery pendants, he was less practised in their use for recovering a lifeboat.

He was away from the vessel for a significant period before rejoining on 15 November. Although he rejoined the vessel just over two weeks before this accident, because of his work/leave pattern, the carpenter had served one complete week on duty, one off, and again rejoined three days before the accident. Thus he had served about 10 days on board since his period of sick leave. During these 10 days, he had not been required to service either of the lifeboats or their hooks.

He had serviced the port lifeboats' hooks on 18 June and on 2 July for the starboard lifeboat. The most recent service of the two was 5 months before the accident.

According to the owner's fleet regulations, an absence of this duration required him to refamiliarise himself with the ship on his return.

With respect to lifeboats and their equipment, the recovery pendants were items which had been changed during the carpenter's absence from the vessel. However, since his return to the vessel, he had made an effort to familiarise himself with these new items, and was in no doubt as to their function or correct method of operation.

The carpenter did not intend to connect the hanging-off pendants to the recovery pendants and, following the accident, openly acknowledged his error. He was puzzled at his actions and was unable to explain why he made this connection.

The carpenter's plan was to suspend the boat on the hanging-off pendants to check the on/off load hooks. He did not intend to connect the hanging-off pendants to the recovery pendants and, following the accident, openly acknowledged his error. In the absence of any identified factors such as distraction, pressure of work, or fatigue his error is seen as being due to a lapse of concentration.

2.4.2 The storekeeper

The storekeeper had sailed on vessels equipped with lifeboats having on/off load suspension hooks of the type fitted to *European Highway*, and had experience of their operation.

He is also very experienced in small boat work, with a comprehensive knowledge of the use of hanging-off and recovery pendants.

When given the task of assisting the carpenter, the storekeeper understood that the fall blocks were to be greased. He was unaware of any intention to release the suspension hooks. Given the potential dangers of transferring the lifeboat's weight from its hooks to the hanging-off pendants, even a brief discussion between the carpenter and the storekeeper before these operations began would have ensured that the eyes and knowledge of this experienced seaman were available to double-check this critical operation.

2.4.3 The cadet

Had the cadet not been passing the lifeboat during his tour of the vessel, it is possible he would not have become involved in this operation. Clearly, as a new entrant to the industry, it was important that he became familiar with the lifeboats and their launching systems. There is no doubt that this was a fine opportunity for him to add to his knowledge.

He had followed a course of instruction at a marine college, as part of an induction process. Some of the course material, covering the operation of on/off load suspension hooks, was very relevant to this accident. It is to this young man's credit that he had clearly understood many of the important safety related principles of these systems. Although it was he who activated the hook release lever when instructed, so initiating the fall, he understood the significance of his action but was persuaded that the carpenter had taken whatever steps were necessary to make the operation safe. Remembering he had served just 2 days on this his first ship, where no doubt he was being bombarded by information from people who were all more experienced than he, this is entirely understandable.

2.4.4 Personnel interaction

Routine safety related maintenance and checking is performed daily by experienced seamen on numerous ships. However, in some of its investigations the MAIB has found a reluctance for one seaman to question the actions of another. The reason frequently offered for this reticence is 'it would be insulting' (to the other seaman).

Based, as it probably is, on professional pride and mutual respect, this is an understandable view. However, this and numerous other accidents show that errors can be made by even the most knowledgeable and experienced. When an error has the potential to cause death or injury, even the most experienced should welcome the reassurance which another pair of eyes, hands or ears can offer. Common acceptance of the need for a second opinion might require a change of attitude in some parts of the industry. This needs to be cultivated.

In any potentially hazardous operation, cross-checking requires that all involved are first made aware of what is intended. This requires some form of briefing of, or at least discussion between, the key individuals involved. Neither took place before this accident.

2.5 RISK PERCEPTION

The more times a potentially hazardous operation is performed without incident, the lower becomes the perception of associated risk. Overriding the hydrostatic interlock, while the lifeboat was hanging off above a quay or other solid obstruction, posed serious risks. Overriding this important safety system on the port lifeboat had become a routine procedure on *European Highway* and, as a result, the perception of the associated dangers had diminished. The operation was then perceived as routine and, as such, no special precautions were seen as necessary. This perception must be altered and, at the very least, a disciplined procedure for checking that hanging off arrangements are correct should be introduced. Alternatively, performing maintenance to on/off load suspension hooks with the lifeboat hanging off should be avoided.

2.6 RISK ASSESSMENT

Although one of the vessel's senior officers reported to the MAIB that risk assessments were being compiled, at the time of these incidents none had been completed covering the use of lifeboat hanging-off pendants or the FRC and its davit.

A risk assessment might reasonably have judged the probability of an accident caused by incorrect use of hanging-off pendants as unlikely, or very unlikely. However, the severity of the consequences would probably be considered as very harmful. The resulting risk factor would indicate that, at the minimum, reasonable and sensible action should be taken.

This equipment is common to many ships, and little consideration is likely to be given to making modifications to reduce the risk. Thus, a control measure, which is typically applied to its use, is ‘training of personnel’ to use the equipment correctly.

In this regard, the expertise and experience of the carpenter, the person in control of the operation and himself a trainer of others in the use of lifeboats, might be difficult to enhance further. Apart from highlighting the possibility that even the most skilled personnel can make mistakes, this suggests that training alone might not always be a sufficient control measure for the reduction of risk.

It follows that the results of a risk assessment of this operation might not, because of the likely control measure of adequate crew training, have prevented this accident.

Additional possible measures are modifications to the equipment to avoid potentially hazardous connections between hanging-off and recovery pendants. This could be done by, for example, fitting shackles to the lower end of the hanging-off pendants which cannot fit the lifting ring on the recovery pendant. Other modifications to the dimensions of these or other components, giving similar results, might be possible.

Since this accident, the owners of *European Highway* have fitted modified recovery pendants which make inadvertent connection between the hanging-off and recovery pendants impossible, by virtue of the relative dimensions of their end fittings. However, masters, owners and crews of other vessels should be made aware of the possible hazards of inadvertent connections between these pendants so that they can make a fair risk assessment of their use and, if necessary, consider modifying equipment and procedures on their own vessels.

A factor, which a typical risk assessment of this operation might not have considered, is the relative hazard of performing this maintenance work over pontoons, a quayside or other solid structures, rather than over open water. It was the carpenter’s intention to hang off the port lifeboat because it could not be launched owing to the walkway’s support column being immediately beneath the lifeboat. However, the presence of this column increased the degree of risk.

The MAIB has investigated several accidents where ship’s lifeboats have fallen into open water, and/or where their crews have fallen into the water. Some of these falls have been from substantial heights, in the order of 20m or more. Lives have been lost due to drowning, but the majority of crews have survived, particularly if wearing lifejackets. The MAIB has no previous record of any lifeboat, or its crew, falling freely on to a quayside, pontoon or similar and can make no authoritative statement on survival rates. However, the MAIB suggests that a lifeboat and its crew falling on to such unyielding structures are likely to suffer more serious consequences than a fall into open water. Also, the MAIB suggests that this is a common sense conclusion, and one which needs no further argument for support.

It was fortunate that the port lifeboat made little more than a glancing blow with the support column; sufficient to cause the lifeboat to rotate and invert. Had the column been positioned nearer to the midlength of the lifeboat, the fall might have been arrested more abruptly, as might be expected from a fall on to a solid structure. The degree of crew injury might then have been different.

Because of the likely severity of injuries from a fall on to solid structures, there is a need for greater control measures to be in place when a manned lifeboat is swung out over such a structure.

Alternatively, and ideally, the operation should be avoided.

2.7 OTHER CONTROL MEASURES

Avoiding this operation is seen as difficult on some ro-ro vessels because of berthing arrangements in their regular ports. This was the case with *European Highway.* In both Dover and Zeebrugge she berthed port side alongside. It was simpler to launch the starboard lifeboat regularly, with the vessel berthed, to perform maintenance work on its suspension hooks. Launching the port lifeboat would need to be performed with the vessel clear of its berth and while still manoeuvring. This introduces its own hazards.

The on/off load suspension hooks system of this lifeboat is fitted with a hydrostatic interlock, a system intended to prevent the hooks opening unless the boat is afloat. Apart from an easily removed securing pin, and spring-loaded clevis pins on the operating handle, this hydrostatic interlock is the primary defence against the hooks being opened, either intentionally or inadvertently, allowing the lifeboat to fall. The interlock can be overridden by breaking a glass cover to reach a locking lever before releasing it to allow movement of the operating handle. This action is intended for use in an emergency only.

Another method of overriding the system is to simulate water pressure on the diaphragm unit, as the carpenter did by applying suction to the space above the diaphragm. Although not a practice recommended by the system's manufacturers, or the job card, this was his usual procedure when performing maintenance on the suspension hooks.

Routinely overriding such an important safety system, by whatever means, should be seen as sufficient justification for introducing a compensating procedure and/or hardware modifications. This principle might be seen as prudent when any safety related interlock is overridden on any system, even temporarily.

The owner's modifications to the recovery pendants are aimed at preventing their inadvertent connection to the hanging-off pendants and a repeat of this accident. However, unless these changes also prevent any other improper connection being made between the hanging-off pendants and the suspension rings, the danger of a similar accident remains. Checks should be made to ensure other links in the system cannot be misconnected.

A procedure which might be of value is an independent check of hanging off arrangements before hydrostatic interlocks on lifeboat suspension hooks are overridden. Such a check would also require the person in charge of the operation to brief a second person of his intentions; itself a sensible procedure. Notwithstanding the modifications already made to the dimensions of recovery and hanging-off pendants, the owners are recommended to introduce these procedures. Alternatively, performing maintenance on lifeboat hooks while hanging off should be avoided.

2.8 THE RESCUE

The carpenter made verbal contact with the two men beneath the inverted lifeboat a few minutes after it fell. While this was a reassurance to potential rescuers, it offered little to the storekeeper and cadet. They were trapped, both seriously injured, with very limited light, cold and unsure of the situation or of the plans for their rescue. Little wonder their experience seemed to extend over an eternity.

The vessel's FRC was launched very quickly, in spite of an incident with the davit's manual winding handle. Although they could only imagine the situation of the trapped men, the desire of the vessel's staff to effect a prompt rescue was very natural.

However, the movements of the inverted lifeboat while it was being towed towards the pilot launch and, later, during the first attempt to raise it, were traumatic for the men beneath it. While it is difficult to offer any preferable method of recovering the two men, their experience can be used to highlight the possible effects of towing or lifting an inverted boat to effect a rescue. Towing speeds need to be controlled to limit change of trim and reduce the chances of further immersing casualties who might not be able to change their position. Lifting needs to be performed with equipment of sufficient strength to prevent failure allowing the lifeboat to fall on the casualties.

Urgency must always be weighed against generating undesirable and potentially fatal movements of the lifeboat; a very difficult balance to achieve.

2.9 HANGING-OFF AND RECOVERY PENDANTS

There are no instructions on board *European Highway* setting out the procedures to be followed when using the hanging-off pendants while maintaining the boat's on/off load suspension hooks. The accident occurred during this maintenance process.

While the lifeboat is in the stowed position, the recovery pendants hang free from the lower block suspension plate, and the free ends of hanging off pendants are clipped clear **(Figures 6 & 10a)**.

When recovering the lifeboat from the water using the foul weather recovery system, the recovery pendant becomes free only after the hanging off pendants are attached to their lugs **(Figure 7d)**. The lifting rings of the recovery pendants are thus not free and available to be connected to the hanging off pendants.

The arrangement required for hanging off to maintain the hooks is shown in **Figure 10d**. This was the state the carpenter intended to achieve. The steps necessary to achieve this, when the lifeboat is in the stowed position, **Figures 10 a - d**, are not shown in the instructions.

Thus, the owners are recommended to supplement the on-board instructions to cover the use of hanging off pendants during maintenance work.

2.10 THE FRC DAVIT

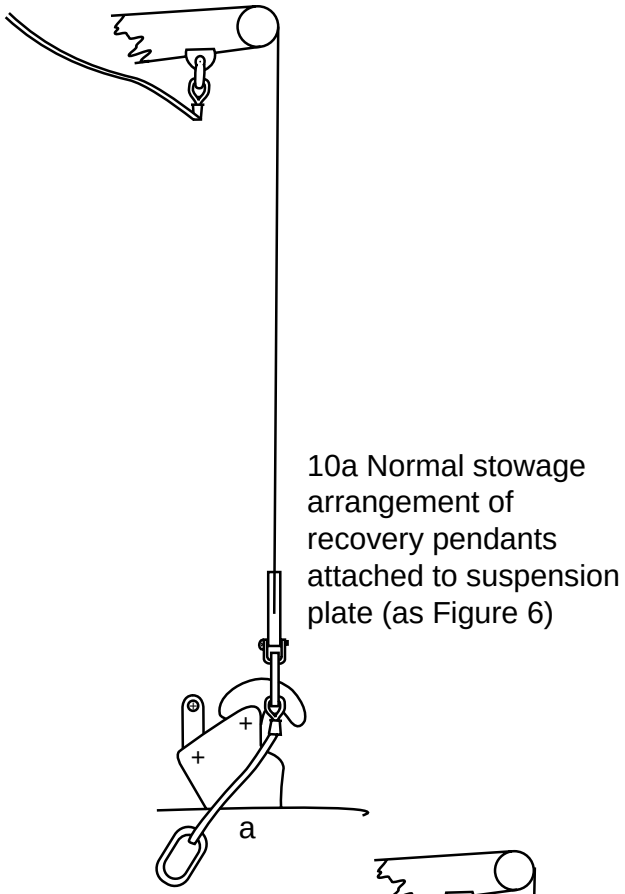
The launch and recovery of the FRC identified two areas of concern. Firstly, the manual winding handle rotated when the FRC crewman actuated the remote lowering wire. This resulted in the injury to the second officer. Secondly, the davit was unable to safely slew the FRC clear of the adjacent liferaft canisters while it was being restowed.

This second feature, namely lack of headroom, was implicitly identified by the MCA surveyor during the demonstration in October 2000, when he recommended adjustment of the davit's cutout switch. During the FRC's recovery on 1 December, lack of headroom resulted in the hand-winding lever being used to raise it slightly once the cutout had shut off power to the hoist motor. As this handle was being turned, both the fall wire and the remote control wires for the davit brake and slewing controls were hauled in together, as designed. However, the handle on the free end of the brake control wire made contact with the davit head and tensioned the control wire. This momentarily released the davit brake, allowing the fall wire, and also the FRC, to lower. The FRC made contact with the liferaft canister and tilted. It is fortunate that the crew were able to retain their positions in the FRC because the direction of tilt was towards the unguarded side of the vessel's deck. Otherwise, any of these men might have been tipped overboard and suffered severe injury, or worse.

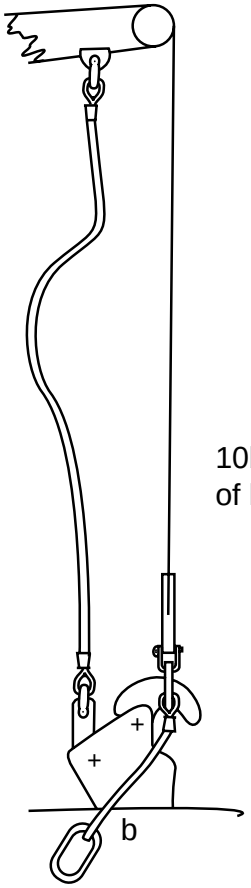
As a result of the MCA surveyor's comments, their experience from this accident in Zeebrugge, and their own observations following the davit's installation, the vessel's owners have increased the headroom of the davit by fitting a taller pedestal. This appears a reasonable solution, made with the knowledge of the MCA, and no recommendation is made on this matter.

However, the rotation of the manual winding handle is a feature of the davit's design. This requires approval, under The Merchant Shipping (Marine Equipment) Regulations 1999, by an EC notified body nominated by an EU Administration.

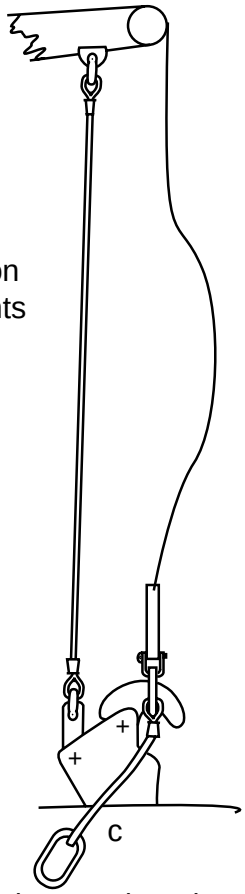
Figure 10a-d



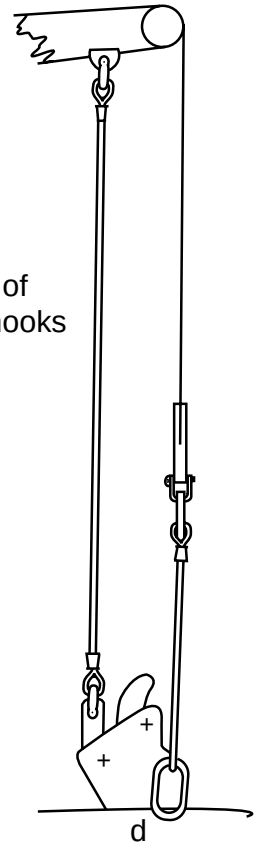
10a Normal stowage arrangement of recovery pendants attached to suspension plate (as Figure 6)



10b Initial connection of hanging off pendants



10c Weight taken on hanging off pendants by easing off winch



10d Release of suspension hooks

Sequence to support lifeboat on hanging off pendants after swinging out davits from stowed position

The standards against which the davit is required to be assessed for type approval are those contained in the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. The 1996 amendments to SOLAS contain, in Regulation III/34, a requirement that all life-saving appliances and arrangements shall comply with the applicable requirements of the International Life-Saving Appliance Code (LSA Code).

Chapter IV of the LSA Code covers Launching and Embarkation Appliances and at 6.1.2.6 it sets out:

An efficient hand gear shall be provided for recovery of each survival craft and rescue boat. Hand-gear handles or wheels shall not be rotated by moving parts of the winch when the survival craft or rescue boat is being lowered or when it is being hoisted by power.

The injury to the second officer was caused by the davit's hand crank rotating when the crewman in the FRC released the brake using the remote control wire, and suggests that requirements of the Code might not have been fully satisfied by the FRC davit. However, the MCA considers that the FRC davit has met the design criteria.

This suggests that the text of the requirements may need to be reviewed in order to ensure the safety of operating personnel.

The prevention of similar accidents may be possible by crew rigorously following procedures to manually disengage the winding handle before lowering the FRC. The investigation of many accidents by MAIB has shown that even the most experienced and best trained personnel sometimes make mistakes in procedures. This was demonstrated by the carpenter's error when he made the incorrect connections with the hanging off pendants in the early part of this incident. This was an error made by a highly experienced person who was an instructor and a trainer of others in the use of the equipment.

MAIB's view is that, wherever possible, no single error, inadvertent action or omission by an individual, should result in an accident that has unacceptable consequences.

As a result, MCA is recommended to consider whether the standards required of FRC davits are sufficient to ensure the safety of all personnel involved with their operation.

The associated onboard instruction manual covers the davit's use for launching and recovery of the FRC and liferafts. However, the instructions offer little guidance on the intended method of ensuring the manual winding handle is

prevented from turning when not required. Because of the importance of disengaging this handle, for the safety of personnel, clear and graphical guidance should be included in the manual on the proper settings for the control or selection lever. Notwithstanding doubts concerning the davit's conformity with requirements, and the recommendation that MCA reconsiders the standards required of the davit, the vessel's owners are recommended to supplement the manual to clearly cover these points.

SECTION 3 - CONCLUSIONS

3.1 FINDINGS

1. *European Highway* was berthed port side alongside a pedestrian walkway in the port of Zeebrugge on 1 December 2000. [1.2]

2. The vessel's port lifeboat was swung out for maintenance, which required the suspension hooks to be unloaded. [2.3]

3. The lifeboat's weight was taken on hanging-off pendants to allow for maintenance of the suspension hooks. [1.2]

4. Three men were in the lifeboat, two were experienced, the third was a cadet. [2.3]

5. The cadet was being instructed in the operation of the suspension hook release mechanism. [2.3]

6. The release lever of the lifeboat's suspension hooks was intentionally operated and the hooks released. [2.3]

7. The lifeboat fell on to a support column of the walkway and then into the water, inverted. [1.2]

8. Two men were trapped underneath the lifeboat, the third fell into the water and the vessel's fast rescue craft (FRC) was launched to assist. [1.2]

9. The second officer was injured by the manual winding handle of the FRC davit rotating. [1.2]

10. A quayside crane was used to lift the inverted lifeboat to recover the trapped men. [1.2]

11. As the FRC was recovered, a lack of headroom resulted in the FRC tilting on making contact with a liferaft canister stowed adjacent. [1.2]

12. The vessel's carpenter was in charge of the lifeboat's maintenance work. [2.3]

13. The carpenter is experienced in the maintenance work. [2.3]

14. The lifeboat and its davit is fitted with hanging-off and recovery pendants. [1.7, 1.8]

15. The colour of the recovery pendants had recently been changed. [1.7]

16. The carpenter had made himself familiar with the changes to the recovery pendants. [2.3]

17. There were no instructions on board setting out the correct method of suspending the lifeboat from the hanging-off pendants for the purpose of maintaining the on/off load suspension hooks. [2.8]

18. No risk assessment had been performed on the use of hanging-off pendants or the use of the FRC. [2.6]

19. The FRC had been fitted shortly before this accident. [1.12]

20. The hanging-off pendants were incorrectly connected on the morning of 1 December 2000. [2.1]

21. The lifeboat is fitted with on/off load suspension hooks which were well maintained and properly adjusted. [2.2]

22. There was limited communication between the two experienced men in the lifeboat. [2.3]

23. SOLAS requirements for FRC davits might not be adequate to ensure the safety of operators. [2.9]

24. A typical risk assessment might not have prevented this accident. [2.5]

25. Since the accident, the vessel's owners have made modifications to lifeboat hanging off arrangements and the headroom of the FRC davit. [2.9]

3.2 CAUSES

The lifeboat fell to the water because the hydrostatic interlock on the suspension hooks was overridden, and the release lever was operated intentionally. [2.3]

The hanging-off pendants were incorrectly connected, so that they did not remove the lifeboat's weight from the suspension hooks. [2.1]

The dimensions of the hanging-off pendant shackles, and the lifting rings on the recovery pendants, permitted the incorrect connection. [2.5]

There were no planning discussions between, or briefing of, those performing the work. [2.3]

Overriding the hydrostatic interlock on the suspension hook release system had become routine, resulting in a reduction in perception of the associated dangers. [2.4]

Berth design and vessel service made routine launching of the port lifeboat difficult. [2.3]

During the launch of the FRC, the manual crank of the davit rotated with internal components and injured the second officer. [2.9]

During recovery of the FRC, the davit had insufficient headroom to allow the FRC to clear liferaft canisters stowed adjacent to the davit. [2.9]

SECTION 4 - RECOMMENDATIONS

The Maritime and Coastguard Agency is recommended to:

1. Consider whether the standards required of FRC davits are sufficient to ensure the safety of all personnel involved with their operation.

The operators of *European Highway* (P&O Stena Line Ltd) are recommended to:

2. Supplement the lifesaving appliance onboard training and instruction manual to clearly show the correct setting of the control lever on the FRC's davit to ensure the manual winding handle is disengaged from internal moving parts.

3. Supplement the onboard training and instruction manual to clearly show the correct methods of using the lifeboats' hanging-off pendants when performing maintenance tasks on lifeboat suspension hooks.

4. Introduce procedures for having an independent check of lifeboat hanging off arrangements whenever it is intended to override the suspension hooks' hydrostatic interlock, other than during emergencies. Alternatively, the practice of performing routine maintenance on lifeboat on/off load suspension hooks, while the lifeboat is hanging-off, should be avoided.

Marine Accident Investigation Branch
January 2002