Report on the investigation of failure of

lifeboat winch brake on

Marine Explorer

in Harwich on 14 March 2001

Two injured

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Extract from

The Merchant Shipping

(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

m	:	metre
MCA	:	Maritime and Coastguard Agency
UTC	:	Universal co-ordinated time

SYNOPSIS

On 14 March 2001, the Marine Accident Investigation Branch (MAIB) was notified of an accident which had taken place in Harwich, UK, involving a brake failure on a lifeboat winch. The MAIB began an investigation the next day.

On 14 March 2001, the 2,198gt UK-registered research vessel *Marine Explorer* was berthed port side alongside Parkeston Quay, Harwich, UK. The vessel's port lifeboat had been returned, by lorry, to the quayside following repairs to its suspension hooks.

While it was still on the lorry, two crewmen climbed into the lifeboat at about 1530 to secure lifting gear. They remained in the lifeboat while a mobile crane lifted it from the lorry and suspended it vertically beneath the heads of the davit's arms on the port side of the vessel. Welded repairs had recently been made to these davit arms.

The two crewmen then connected the davit's falls, or lifting wires, to the lifeboat's suspension hooks. These two men remained in the lifeboat. The mobile crane was then lowered and moved clear so that the davit took the lifeboat's weight.

The davit's winch was then used to hoist the lifeboat. Hoisting continued until the lifeboat had almost reached its fully stowed position, when the winch motor's limit switch shut off the power, as designed.

The winch then began to run out, the davit arms swung out and then the lifeboat lowered. It continued to lower until it struck the edge of the quay and, despite efforts to apply the winch's brake, continued into the water. The two men in the lifeboat were slightly injured.

It was found that the winch ran away because its hand-operated brake had been assembled incorrectly. This had recently been dismantled in preparation for load testing of the davits and the lifeboat's suspension hooks. The test was required to satisfy Maritime and Coastguard Agency (MCA) requirements.

No risk assessment was undertaken before these operations began, and the dangers associated with allowing personnel to be carried on an untested system were not recognised.

The vessel's owners are recommended to:

1. Issue instructions that for planned, routine, non-emergency activities no personnel are to be in lifeboats, or on any other item supported by testable loadbearing systems, unless and until that system has been fully and satisfactorily tested under load, and for proper functioning, as required by the relevant regulations.

2. Place on board the vessel winch maintenance, adjustment and repair data, so as to be available to ship's staff and others who might undertake work on the lifeboat winches.

Photograph courtesy of FotoFlite

Marine Explorer

SECTION 1- FACTUAL INFORMATION

1.1 PARTICULARS OF VESSEL AND INCIDENT

Vessel name	:	*Marine Explorer* Formerly *Trinity Explorer - 91* *Sir Tristan - 90* *Sir Walter Raleigh - 87* *Swanella - 84* *British Viking - 82* *Vickers Viking - 79* *Dortmund - 74* *Danasbank - 70* *Hamburg - 67*
Port of registry	:	Plymouth
Type	:	Research
Official number	:	359119
Gross tonnage	:	2,198
Registered Length	:	83.6m
Built	:	AG Weser, Werck Seebeck Bremerhaven
Date built	:	1965
Owners	:	Eidesvik Shipping UK Aldridge House 4 Elms Road Hook Basingstoke RG27 9DG
Position of incident	:	Parkeston Quay, Harwich, UK
Date and time	:	14 March 2001, 1530 UTC
Injuries	:	Two people injured
Damage	:	Damage to lifeboat hull

1.2 BACKGROUND

Marine Explorer's port lifeboat had been repaired in a shore-based workshop, and was being returned to the vessel while she was berthed at Parkeston Quay, Harwich. Some repairs had also been made to the port lifeboat's davits. Following these repairs, the MCA required that the lifeboat and davit be subjected to a load test.

In preparation for this test, the brake assembly on the davit's winch was opened for examination. No faults were identified and the brake was reassembled.

1.3 NARRATIVE

Marine Explorer was berthed port side alongside Parkeston Quay, Harwich, on 14 March 2001. The vessel's port lifeboat had been transported to the quayside by a lorry and was about to be unloaded.

At about 1530, two crewmen, who were not wearing lifejackets, boarded the lifeboat while it was still on the lorry, to secure lifting gear. They remained in the lifeboat while a mobile crane lifted it from the lorry, and moved it beneath the heads of the davit's arms, already swung out ready to receive the lifeboat.

Once the lifeboat was plumb beneath the heads of the davit's arms, the two crewmen attached the lower blocks to the lifeboat's suspension hooks. The mobile crane was then lowered and moved clear so that the lifeboat's weight was taken on the falls and davit. The two crewmen remained in the lifeboat.

The davit's winch was then switched to power hoist. The lifeboat rose until the lower blocks contacted the davit heads and then the davit arms began to swing inboard, as expected.

The davit arms continued to swing inboard until almost at their fully stowed position, when the limit switch shut off the power supply to the winch motor.

Once power supply was off, the winch began to run out and the davit arms began to swing outboard. When fully outboard, the lifeboat began to lower. Efforts to arrest these movements, by placing extra weight on the gravity brake lever of the winch, were unsuccessful.

The downward motion of the lifeboat continued for about 4 metres until it made contact with the edge of the quay and a ladder built into the face of the quay. As a result of this impact, the lifeboat tipped slightly to starboard and then lowered a further 2 metres until it was waterborne between the vessel and the quay.

The two crewmen were injured and taken to hospital.

The mobile crane was used to recover the lifeboat to the quay. The davit arms were hoisted to their stowed position. However, to retain the arms in position it was found necessary to fit the harbour pins.

The lifeboat's hull suffered moderate impact damage.

1.4 DAVITS

Two open lifeboats are carried on *Marine Explorer*. The port lifeboat is of 48-person capacity, the starboard 46-person. Each is served by a set of single pivot, swinging arm gravity davits **(Figure 1)**. Each has a safe working load of 6.2tonnes.

The inboard face of the arms on the port davit had suffered some wear in way of the mechanical stops. Welded repairs had been made to these areas shortly before this accident. Although the owners were making preparations for a load test to MCA's requirements, this test had not been performed at the time of this accident.

An electrically-powered winch mounted on the adjacent deck serves each set of davits.

Figure 1

The port lifeboat davits

1.5 HISTORY OF PORT DAVIT WINCH

Other than the results of the winch brake examination performed in anticipation of the load test, the vessel has no other records of work performed on the port winch.

This examination was limited to the gravity brake. Its operating lever was removed, followed by the cover, which was removed complete with the eccentric and brake sector or shoe. Inspection of the friction surfaces of the gravity brake was possible in this state, and no further dismantling was performed.

The brake cover/eccentric and shoe assembly was reinstalled and the operating lever reattached. Although a full test was not possible, operation of the gravity brake appeared satisfactory.

Staff from a marine engineering/ship repairing company, having a substantial portfolio of major ship repair and refurbishment projects, undertook this work.

1.6 INSPECTION OF PORT WINCH (POST ACCIDENT)

The port lifeboat davit winch was partially dismantled during the day following this incident. The work was observed by the MAIB inspector.

The work was performed by the same repair company's staff who had previously dismantled the winch brake in preparation for the load test required by MCA.

Before dismantling began, it was noted that the brake operating lever was resting on the external stop **(Figure 2)**. The lever's securing screw was first removed which allowed the lever to be slid from its splines on the eccentric. Once the lever was clear of the splines, it was clear, from the relative position of the securing screw's slot in the eccentric, that the lever had been at the limits of its adjustment. This position corresponded to worn friction linings **(Figure 3)**.

The setscrews securing the cover were removed, and the cover levered off. As this cover was being removed, the position of the brake shoe was seen as in **Figure 4**. The assembly of cover, eccentric and shoe were lifted clear and then dismantled.

The eccentric was not a smooth running fit in the cover bearing and required several blows to remove. The bearing surfaces were dry and partially covered in unidentified deposits. The brake shoe was a smooth running fit on the eccentric, and the friction material was not seriously worn or contaminated **(Figure 3)**.

1.7 ON-BOARD DATA

The vessel carries no documentation giving details of winch construction, maintenance, adjustment and operation. Neither does it carry any records showing date and extent of routine maintenance.

Figure 2

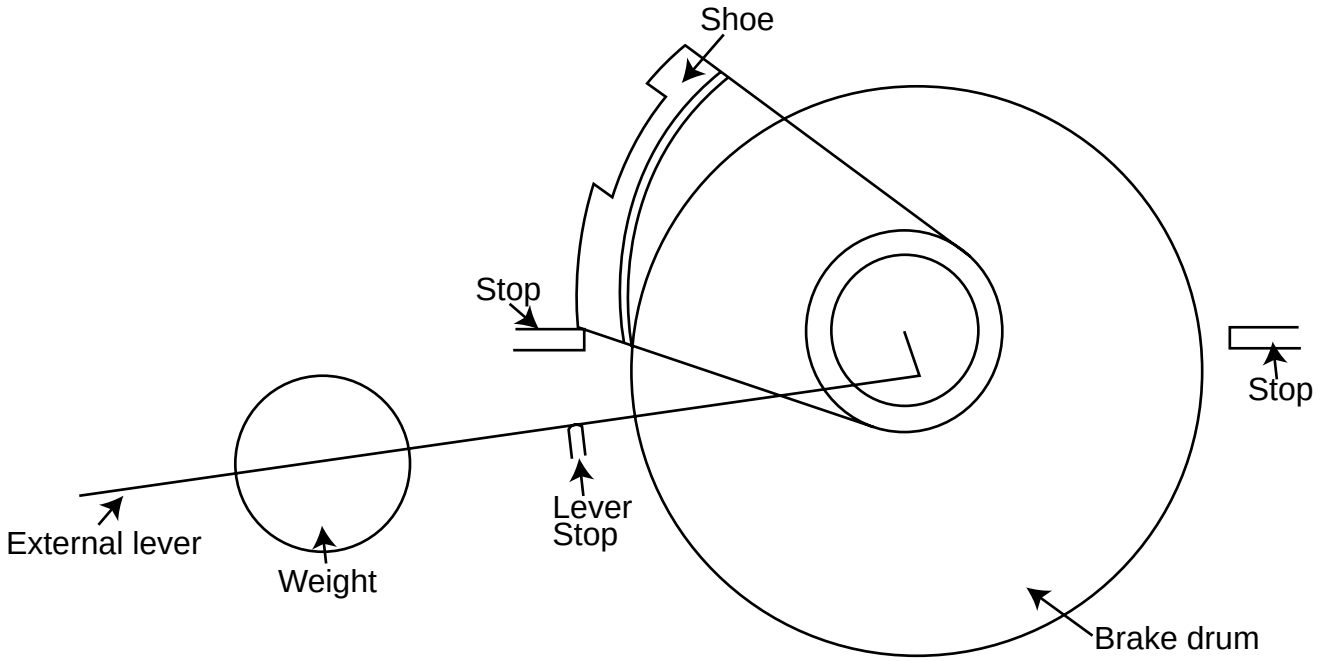
Brake housing of winch

Figure 3

White mark shows position of lever's adjusting screw

Splines of eccentric (left)
Brake shoe, or sector (right)

Figure 4



Position of brake sector as found after incident

1.8 WINCH BRAKES

Two brakes are fitted to this type of winch. Both act on the same shaft, which is also the shaft on which the hand-cranking lever is fitted for manual operation. This shaft is geared to the main wire drum and rotates when this drum moves, both when hoisting and lowering. Both brakes are enclosed in a common housing.

One brake is of the centrifugal type, which automatically limits the lowering speed of the winch. The brakes' shaft also rotates when hoisting but, because this happens at a much lower speed than when lowering, the centrifugal brake does not influence the process.

The second brake is normally referred to as a gravity brake, largely because its external operating lever is fitted with a heavy weight having the effect of applying the brake by gravity. This brake may be released manually by raising the lever, so allowing the winch to lower the boat under gravity, with the speed of lowering controlled by the centrifugal brake. Releasing this lever at any stage while the winch is lowering will normally stop the operation. Braking forces are generated between the external surface of the brake drum, and the friction lining of the brake shoe of the gravity brake. This lining is on the inner curved surface of the shoe.

Hoisting may be performed by hand, using a portable hand-winding crank, or under power from an integral electric motor.

Manual release of the gravity brake, when hoisting under power, is not necessary as, when correctly adjusted, it is designed to release automatically whenever the brake drum is rotated in the hoist direction.

1.9 GRAVITY BRAKE (working principles)

The major components of the gravity brake are:

- drum mounted on brake shaft;
- sector shaped shoe bearing on the outer surface of the drum;
- eccentric; and
- external hand lever **(Figure 5)**.

The external hand lever is fitted on splines cut in one end of the eccentric. The lever can be moved from spline to spline to give suitable adjustment of the brake. A securing screw then locks the lever on the splines. A slot in the eccentric limits this adjustment by preventing the lever's securing screw from being fitted beyond certain limits.

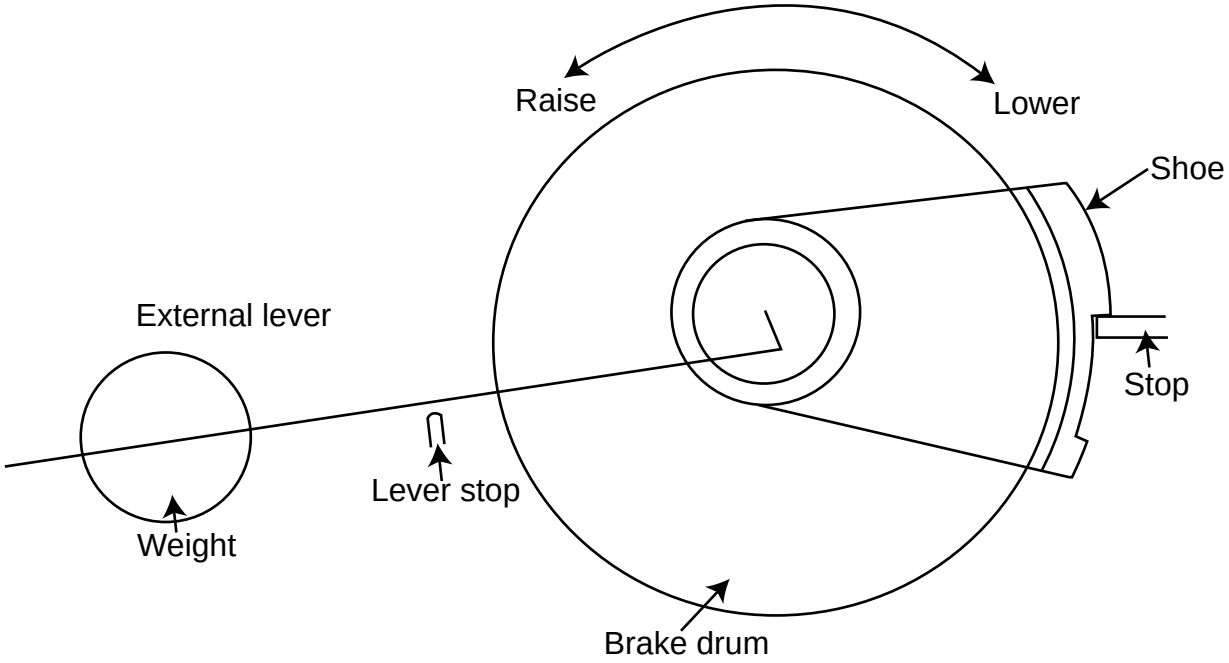
Also mounted on the eccentric, but housed behind the brake casing's cover, is the brake shoe. The eccentric passes through the brake cover and transmits motion of the handle to the brake shoe. Lifting the handle moves the shoe radially, outwards, so freeing it from the drum **(Figure 6)**. As the shoe acts on the outer diameter of the drum, releasing the lever pulls the shoe on to the drum and applies the brake.

Because the brake shoe is free to rotate on the eccentric, a stop is fitted on the inside diameter of the brake housing. The brake shoe has a cut-out on its outer surface which straddles this stop.

This stop not only limits the shoe's movement when the brake is applied, but it also retains the shoe in position when the hoisting motor is operating under power. The geometry of the eccentric and brake shoe causes the shoe to lift when the motor is turning the brake drum. Only a small amount of lift is required to release the shoe from the drum and thus also release the brake **(Figure 7)**. Excessive lift is prevented by the stop. This allows the winch to hoist freely.

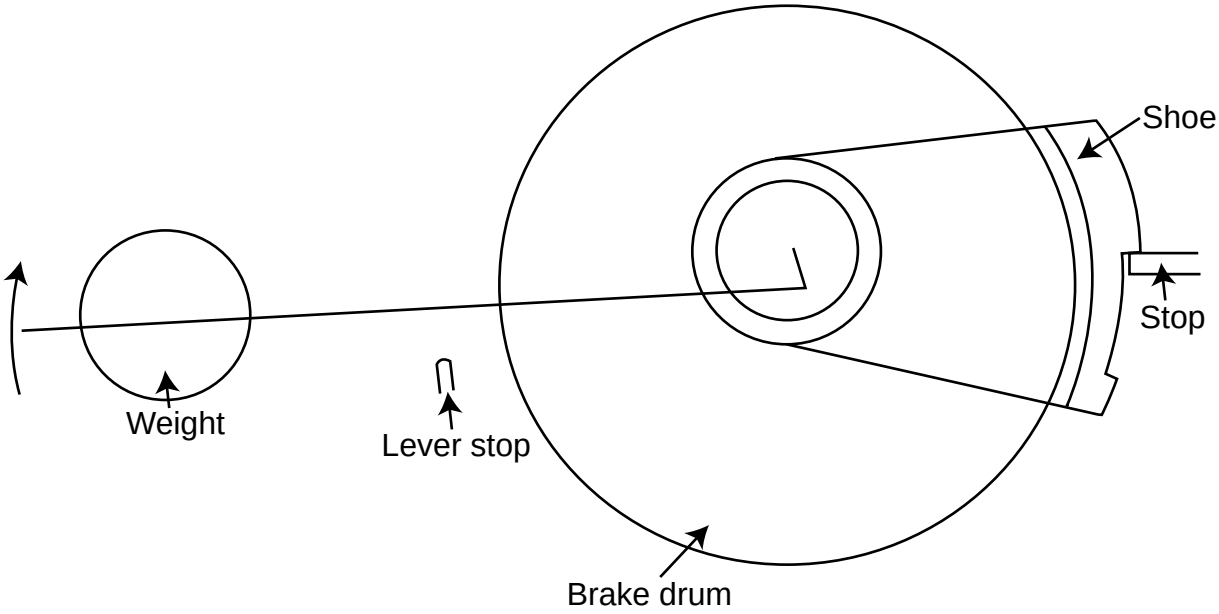
When the motor stops, the brake drum comes to rest and the brake shoe drops slightly. Slight reversal of rotation of the drum then pulls the shoe down to the stop, lifting the lever from its stop so applying the brake and bringing the winch to rest.

Figure 5



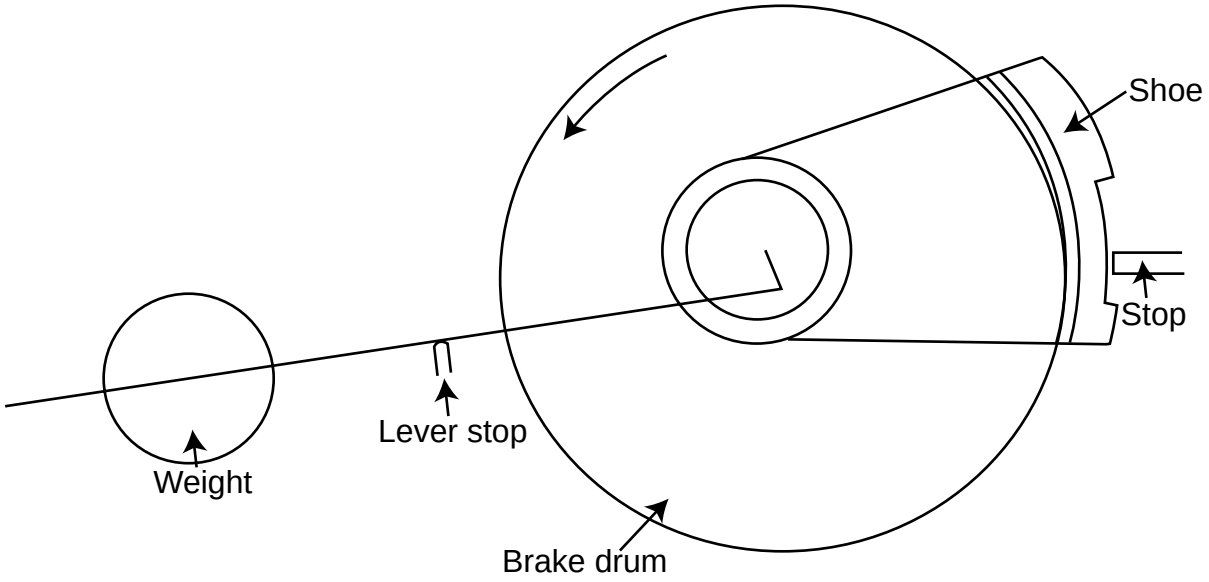
Gravity on hand brake system with brake applied

Figure 6



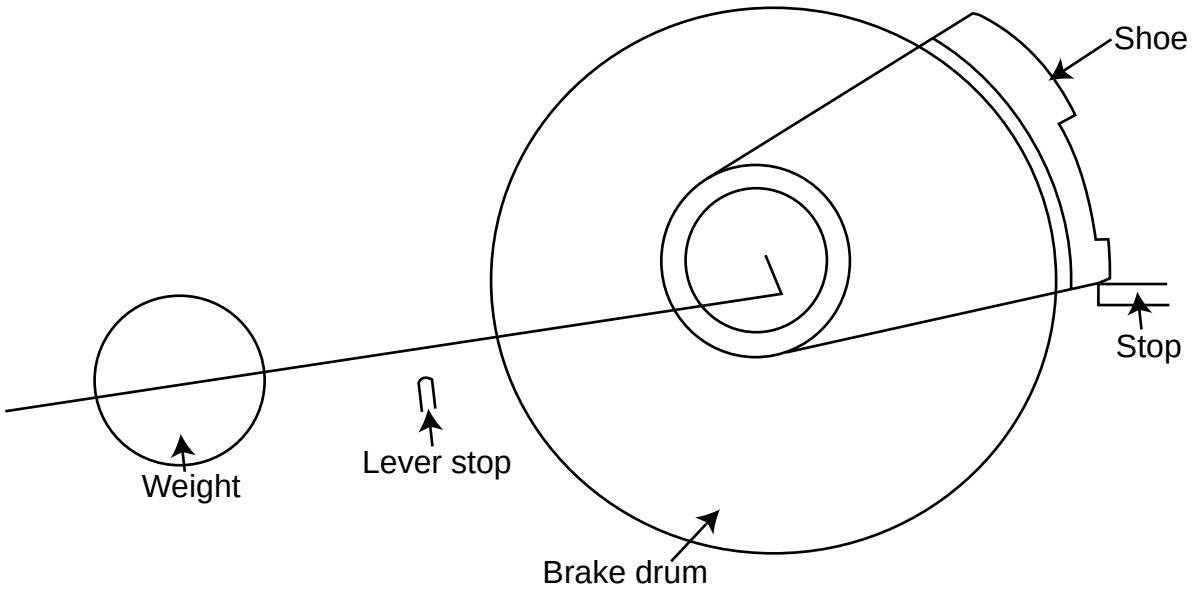
Brake released by raising lever

Figure 7



Automatic release of brake when hoisting

Figure 8



Brake, as assembled

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 GRAVITY BRAKE FAILURE

As shown by the post-accident examination, the brake shoe was not properly located by its stop pin **(Figure 4)**. In the position found, there was no contact between the friction surfaces of the shoe and drum. Further, because the operating lever was in contact with its stop, the brake could offer no resistance to the drum and winch rotating, no matter how great the effort applied to the lever. This is why efforts to apply the gravity brake during the unintended descent of the lifeboat were unsuccessful.

This, however, could not have been the position of the brake shoe when it was previously reassembled following the inspection, otherwise the weight of the lifeboat could not have been taken by the davits when the mobile crane was removed immediately before this accident.

Clearly, when the weight of the lifeboat was transferred from the mobile crane to the davit, the winch and its brake were able to support the lifeboat's weight. This was possible because the brake shoe was sitting on its stop pin with the lever at its extreme limit of adjustment. Any tendency of the brake drum to move in the lowering direction was resisted by the shoe and stop pin **(Figure 8)**.

However, when the winch's motor began to hoist the lifeboat, there was contact between the drum and the brake shoe. The friction force between them allowed the drum, now moving in the hoist direction, to accelerate the shoe away from its stop pin. This acceleration was sufficient to cause the shoe to swing over to the stop pin on the opposite side of the casing. In this position there was no contact between the shoe and the drum, and thus no means of returning the shoe to a position where it would provide effective braking **(Figure 4)**.

2.3 LIFEBOAT'S DESCENT

The limited damage to the lifeboat's hull suggests that the speed of its impact with the quay was not as high as might be expected from a free fall. Although there was a total absence of braking force from the gravity brake, the winch lowering speed remained under the control of the centrifugal brake.

While not a state of gravitational free-fall, the rate of fall was certainly unsettling to the two crewmen in the lifeboat. Their equilibrium was further upset by the lifeboat tilting after hitting the quay, before lowering further to the water. Apart from the disturbing sense of being in a lifeboat which was apparently running out of control, they were at significant risk from the consequences of the impact with the quay.

Had the operation been performed over open water, the lifeboat could have lowered until it became waterborne, in a fashion and at a speed no different from a normal launching operation. However, the hazard posed by the quay was not recognised.

2.4 WINCH MAINTENANCE

The MAIB's *Review of Lifeboat and Launching Systems' Accidents*, published in February 2001, records shortcomings in winch maintenance, repair and assembly as a common factor in many accidents involving these systems. The *Review* also identified the use of non-specialist engineering contractors and poor maintenance manuals as major contributors to this state of affairs.

The port lifeboat winch on *Marine Explorer* had been partly dismantled by engineering contractors for inspection in preparation for a load test on the davit and the lifeboat. The work consisted only of removing the cover of the brake housing so that brake friction surfaces could be examined. This was a precautionary measure and no defect was identified during the inspection. The same contractors reassembled the winch following this inspection.

The work was performed without the aid of the winch manufacturer's data. Indeed, there was none on board the vessel. The immediate cause of the brake's failure was incorrect reassembly following the inspection. With no data for guidance, and limited equipment-specific knowledge, this error is understandable and reflects the lessons found during the MAIB *Review*.

The carriage of instructions for on board maintenance and repair are a requirement of *The Merchant Shipping (Life-Saving Appliances for Ships Other Than Ships of Classes III to VI(A)) Regulations 1999* as contained in *Schedule 14, Part 2 of Merchant Shipping Notice 1676(M)*.

The owners are recommended to place winch maintenance, adjustment and repair data on board the vessel, so as to be available to ship's staff and others who may undertake work on the lifeboat winches.

2.5 PLANNING

In the sense that little consideration was given to any unusual risks which might be posed, this operation was seen as comparatively routine.

Structural repairs to the davit arms had just been completed, but not yet load tested. Repairs had been carried out on the lifeboat's suspension hooks, but not yet load tested. The winch had been partially opened and reassembled, but not yet tested under all operational conditions. These features suggested there were greater risks with this operation than with the routine launching and recovery of the lifeboat. These risks were not assessed, and no control measures were put in place.

Another hazard apparently overlooked was the possibility of immersion of the crew in water. Although the lifeboat was partially over the quay, there remained a significant area of water between *Marine Explorer*'s side and the quay. Either of the two men in the lifeboat could have been thrown into the water as the lifeboat tipped when it hit the quay, or even while moving within the lifeboat. However, neither man was wearing a lifejacket.

It is normal procedure for all crew to wear lifejackets while launching and using lifeboats; a universal practice during drills and musters. This operation was not seen as a drill and, probably as a result, insufficient consideration was given to any unusual risks which might have been present.

2.6 RISK ASSESSMENT

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997, require assessments to be made of the risks to health and safety arising in the normal course of the activities or duties of crew or other workers on board. The assessment is not expected to cover risks which are not reasonably foreseeable.

Efforts aimed at minimising the hazards associated with load testing of the lifeboat and its davits had been made. This was the objective of inspecting the winch's brake mechanism. However, this had the unintentional result of introducing another untested element in the davit and winch system.

The consequences of failure of any component of the winch and davit system cannot be accurately anticipated, so cannot easily be considered in a risk assessment. However, the fundamental principle of not expecting a loadbearing system to perform until it has proven its capability, with a load and function test, is one which is commonly accepted. Until those tests have been satisfactorily performed no loadbearing system, particularly one which supports or carries personnel, can be considered safe.

This principle was overlooked in this case. Consequently, the vessel's owners are recommended to issue instructions that for planned, routine, non-emergency activities, no personnel are to be on or in lifeboats, or on any other item supported by testable loadbearing systems, unless that system has been fully and satisfactorily tested under load, and for proper functioning, as required by the relevant regulations.

This guidance can then be used by ship's staff when formulating control measures following future risk assessments.

SECTION 3 - CONCLUSIONS

3.1 FINDINGS

1. At 1530 on 14 March 2001, the port lifeboat of *Marine Explorer* was suspended from its davits with two crewmen on board. [1.3]

2. The davit's winch hoisted the boat until it was almost at its stowed position. [1.3]

3. When the davit's limit switch shut off the motor's power, the winch ran out. [1.3]

4. The lifeboat lowered at a speed regulated by the winch's centrifugal brake. [1.3, 1.8, 2.3]

5. Efforts to stop the lifeboat, using the winch's handbrake, were unsuccessful. [1.3]

6. The lifeboat made contact with the quay, sustaining damage, before entering the water. [1.3]

7. The two crewmen were slightly injured. [1.3]

8. The handbrake of the winch had been incorrectly assembled during an earlier inspection. [1.6, 1.9, 2.2]

9. The vessel carried no documentation showing the correct assembly arrangement of the winch's handbrake. [1.7]

10. The brake inspection work was performed by shore-based non-specialist engineering contractors. [2.4]

11. No risk assessment of the operation was undertaken. [2.6]

3.2 CAUSES

The lifeboat ran away because the winch's handbrake had been assembled incorrectly. [1.6, 1.9, 2.2]

The hazards associated with the operation were not fully recognised. [2.5, 2.6]

SECTION 4 - RECOMMENDATIONS

Eidesvik Shipping (UK), the vessel's owners, are recommended to:

1. Issue instructions that for planned, routine, non-emergency activities no personnel are to be within lifeboats, or on any other item supported by testable loadbearing systems, unless and until that system has been fully and satisfactorily tested under load, and for proper functioning, as required by the relevant regulations.

2. Place on board *Marine Explorer*, winch maintenance, adjustment and repair data, so as to be available to ship's staff and others who might undertake work on the lifeboat winches.

Marine Accident Investigation Branch
January 2002