Report on the investigation of

the loss of the fishing vessel

***Amber* (PH78)**

in the Firth of Forth on

6 January 2003

with the loss of one life

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Extract from

The Merchant Shipping

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Regulations 1999

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

NOTE

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

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

fv	-	Fishing Vessel
The Code	-	The Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations 2001
kW	-	Kilowatts
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MSN	-	Merchant Shipping Notice
m	-	metres
RN	-	Royal Navy

SYNOPSIS

On 6 January 2003 the fishing vessel *Amber* was lost suddenly in the Firth of Forth. The skipper drowned as a result.

Amber had departed from Pittenween harbour with just the skipper on board. His son, who normally crewed for him, had been unable to join him because he was ill.

The skipper trawled for prawns in a westerly direction off Largo Bay. At about 1715, he hauled his gear and it became apparent that he had a heavy object in his net. The dog rope parted when he tried to haul in the cod end. The skipper then wound as much of the net as he could on to the net drum and started to tow the heavy object towards Methil. He decided to tow it into the harbour so that he could then get some assistance to remove it.

During the towing process, the skipper was in contact with other fishermen, and at 1915 he called the owner on his mobile telephone. The owner advised him to call the coastguard to be on the safe side. At 1954, the coastguard received a “Pan-Pan” urgency call.

At 2012, communications with *Amber* were lost and a search for the missing vessel started. A diesel slick, wreckage and an inflated liferaft were discovered during the night and, at 0624 the following day, a search vessel reported that she had located the vessel on the seabed in Forth Ports’ ‘Kilo 6’ anchorage. Divers were sent down the next day and recovered the skipper’s body from the wheelhouse.

After the wreck was surveyed on the seabed, the vessel was salvaged and then taken to Burntisland where a survey and inclining experiment were conducted.

Amber was bought by the owner in 1999 and had been modified extensively; the gunwale was raised, a steel shelter was added, and a net drum was installed. The owner was not aware of the Code of Practice for the Safety of Small Fishing Vessels, or of the requirement to conduct a risk assessment.

The inclining experiment, and its subsequent analysis, indicated *Amber*’s stability to be poor. From the evidence, it was apparent that she was lost suddenly, probably as a result of capsizing. This was through too great a heeling moment being applied because of the rock in the net, or by water on the main deck, with its associated free surface, raising the centre of gravity, or by a combination of the two.

Safety issues raised by this accident investigation include requirements and awareness of stability for small fishing vessels, awareness of the regulations, risk assessment requirements and formal training of fishermen. Many of the safety issues arising are common with those identified following the loss of *Kirsteen Anne* on 31 December 2002, and a further recommendation is made, which, if implemented, should prevent future similar accidents.

Figure 1

Amber

SECTION - FACTUAL INFORMATION

1.1 PARTICULARS OF *AMBER* (PH78) AND ACCIDENT (Figure 1)

Vessel details

Registered owner	:	David Galloway
Port of registry	:	Pittenween
Flag	:	UK
Type	:	Fishing vessel
Built	:	1989, Radmore & Hill, Plymouth
Classification Society	:	None
Construction	:	Steel
Length overall	:	9.98m
Gross tonnage	:	9.16
Engine power	:	95kW

Accident details

Time and date	:	2012 on 6 January 2003 (UTC)
Location of accident	:	56° 08’.32N 003° 02’.48W
Persons on board	:	One
Injuries/fatalities	:	One fatality
Damage	:	Vessel lost (later salvaged)

1.2 NARRATIVE

(All times are UTC)

At about 1200 on 6 January 2003, *Amber'*s skipper went to the owner's house to ask for some chain. Before this, he had also called in to pick up his son, who crewed for him, but he was ill and unable to go with his father. His passing remark to his son had been that he had "better get well soon" as they were going down to fishing grounds off the coast of Sunderland the next day. He had not given the impression he was going fishing that day to anyone he spoke to that morning.

Sometime between 1230 and 1330, the skipper left Pittenween harbour in *Amber* alone. The weather was fine and clear with light winds. The skipper made contact with a fellow fisherman on fv *Pegasus*. They shot away their gear roughly together, at about 1415, and trawled west up the Firth of Forth on parallel courses off Largo Bay. They hauled their gear simultaneously at about 1715.

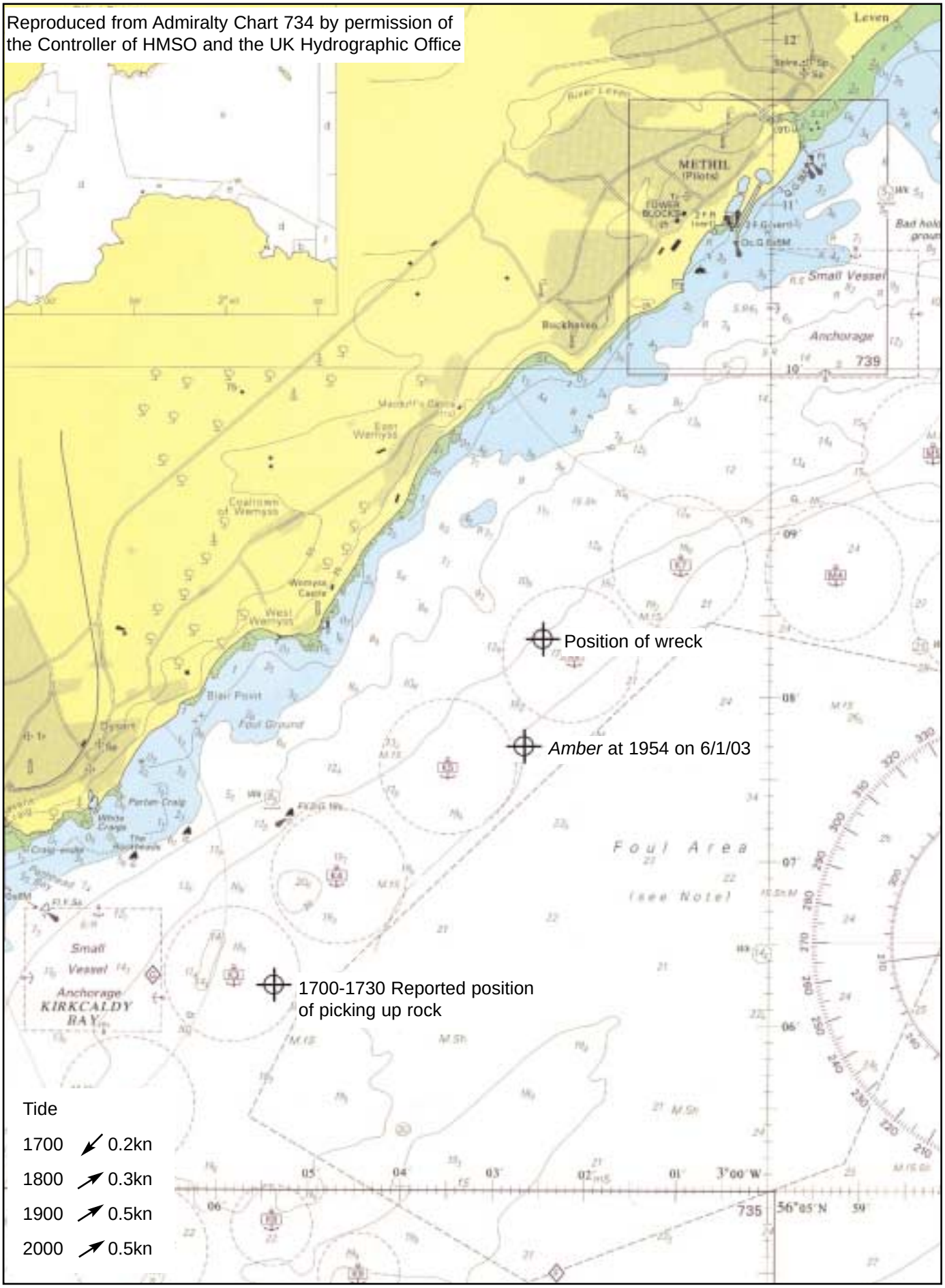
It became apparent to *Amber'*s skipper that a heavy weight had become caught in his net. His position was approximately 50° 06'. 22N 003° 05'.31W **(see chart opposite)** at the time, with a water depth of 20m. He tried to retrieve the cod end using the dog rope, but this broke in the process. He then wound as much of the net as he could on to the net drum.

At around 1800, *Amber'*s skipper spoke to the skippers of both fv *Pegasus,* and fv *Guide Me On,* which was another vessel in the vicinity. It was dark by that time. Assistance was offered by both vessels*,* but *Amber*'s skipper decided the best option open to him was to tow the object back to Methil harbour, where a digger could be used to lift it ashore. It was about 5½ miles back to Methil, and *Amber* was only managing 1.8 knots on full throttle, even with 0.5 knot of ebb tide in her direction.

At around 1915, the skipper phoned the owner to let him know what had happened. The owner told the skipper to call the coastguard 'just to be on the safe side'. At 1954, Forth coastguard received a "Pan-Pan" urgency call from *Amber*. Her position was 56° 07.7'N, 003° 02.69'W **(see chart opposite)**.

Communications with *Amber* were lost at 2012. Continued attempts were made to try to make contact and, at 2029, an extensive search was launched, involving local lifeboats and fishing vessels, as well as a search-and-rescue helicopter. Wreckage and a diesel slick were found, along with an inflated empty liferaft. By 0624 the next morning, *Pegasus* confirmed that she had located the wreck on the seabed at 56° 08.32'N 003° 02.48'W.

On 8 January, RN divers retrieved the skipper's body from *Amber'*s wheelhouse.


Reproduced from Admiralty Chart 734 by permission of the Controller of HMSO and the UK Hydrographic Office
Leven
METHIL
(Pilots)
Small Vessel
Anchorage
739
Buckhaven
Macduff's Castle
East Wemyss
Coaltown of Wemyss
Wemyss Castle
West Wemyss
Position of wreck
Amber at 1954 on 6/1/03
Blair Point
Foul Ground
Foul Area
(see Note)
Small Vessel Anchorage
KIRKCALDY BAY
1700-1730 Reported position of picking up rock
Tide
1700 0.2kn
1800 0.3kn
1900 0.5kn
2000 0.5kn
3°00'W
56°05'N
735

1.3 SURVEY AND SALVAGE

On 9 January 2003, divers surveyed the wreck, which was resting in 18m of water. She was bow up with the keel from amidships upwards clear of the seabed, heeled 10° to port. Her stern below deck level was buried in the seabed. Silt was also present up to the gunwale just forward of the transom within the vessel. The net ran at 45° to port from the transom, and was tight from the net drum to the object in the net. The object was caught in the cod end. It was approximately 28m from the object to the net drum. In the wheelhouse the throttle was fully forward. All the visible freeing ports were clear. The fish hatchcover was not in place and was found mostly buried in silt aft and to starboard of the fish hatch itself. Only one of the two dogs used to secure the hatch was present on the hatch coaming, and this was unscrewed to such an extent that it could not have been in use at the time of the accident.

The object in the net was found to be a rock **(Figure 2)** which, after recovery, was weighed at Methil harbour and was found to be 1.775 tonnes.

As *Amber* had sunk in 'Kilo 6' designated anchorage, there was an instruction from Forth Ports to move the wreck. Rather than simply dragging the wreck out of the anchorage, the MAIB requested that *Amber* be refloated. She was raised near to the surface using air bags, but unfortunately turned upside down in the process. She was towed closer inshore and lowered back to the seabed, righting herself.

The MAIB then arranged for *Amber* to be lifted using a mooring tender **(Figure 3)**. This was done successfully and she was pumped out and towed to Burntisland to allow a detailed survey and inclining experiment to take place.

Immediately after being raised, two seacocks had to be shut off in the engine room to prevent ingress of water. An unused seacock on the port side of the engine had to be closed off fully as it was leaking. A seacock on the starboard side of the engine was shut off, as the hose connected to it had split and was leaking.

The autopilot was found set on a course of 350° and turned on. The ship's wheel was found tethered, another indication that the autopilot was in use when the vessel was lost, because the tether prevented the wheel from turning when the autopilot was engaged.

1.4 SKIPPER AND OWNER

*Amber'*s skipper had fished for 15 to 20 years. He was an experienced fisherman, and before his time in *Amber,* had skippered *Pegasus*, a similar sized vessel. He took over as *Amber'*s skipper during March/April 2001, and had been her sole skipper ever since. He had attended two of the mandatory safety courses in sea survival and fire-fighting. He had not attended the voluntary one day safety awareness course.

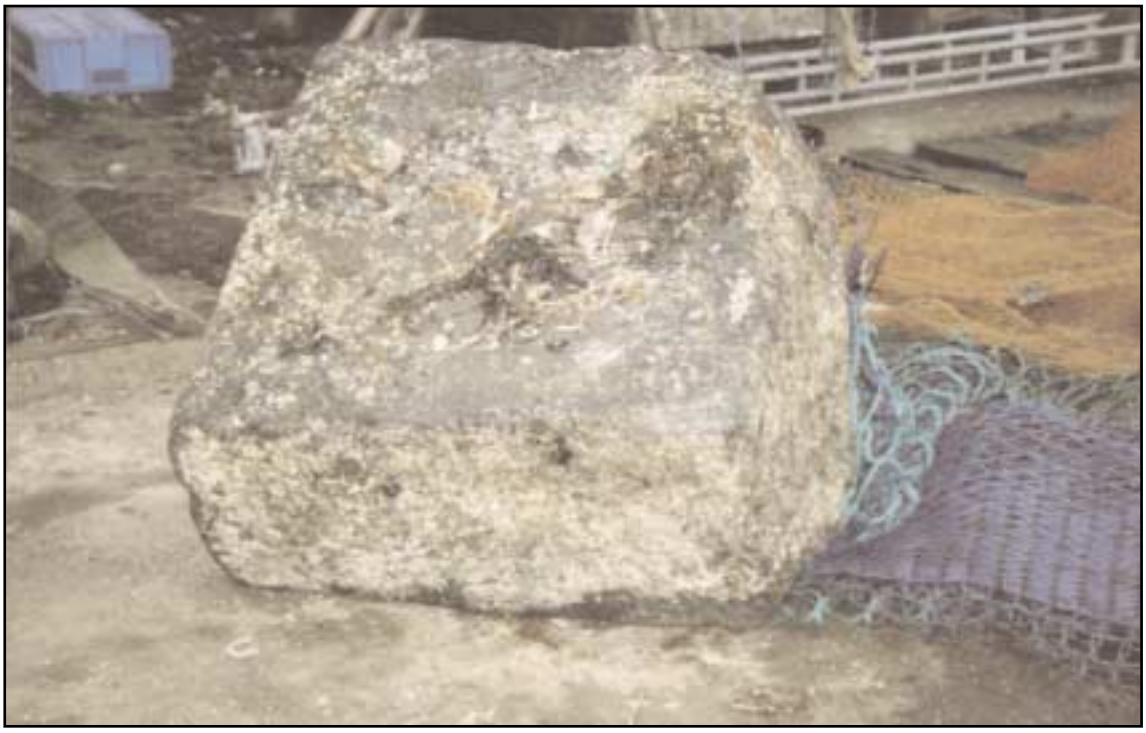


Figure 2 - Rock recovered from net

Figure 3

Amber being raised

The owner was not a fisherman. He invested money in *Amber* in partnership with a friend who, initially, was the vessel's skipper. In 1999, the present owner and his partner bought *Amber,* having had a survey conducted beforehand. When the partner died late in 2001, he became the sole owner. It was then left to an accountant to deal with the paperwork involved and the business of fishing was left to the skipper.

1.5 REGULATIONS

The Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations 2001, or 'the Code' as referred to in this report, came into force in April 2001. A copy of it, reproduced in MSN 1756 (F), is included at **Annex 1**. The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 came into force in April 1998. MGN 20 (M+F) contains the relevant guidance for these regulations and, in particular, how to conduct a risk assessment.

The Code was developed in collaboration with the industry, and when first issued, was applicable to vessels under 12m registered length. However, it has since been expanded to cover vessels under 15m length overall. Owners must ensure they carry safety equipment as detailed in a particular checklist. They must also complete a health and safety risk assessment for risks arising in the normal course of work activities or duties, as detailed in MGN 20 (M+F). Annually, the vessel owner must self-certify that the vessel complies with the Code, and have the certificate ready for inspection at any time. From the introduction of the Code until July 2003, about a third of the small fishing vessel fleet has been inspected. This equates to about 2000 out of 6000 vessels.

In *Amber*'s case, the owner was not aware of the Code, nor of the need to conduct a risk assessment. However, he had arranged for inspection and certification of *Amber* via Fife Council, to allow anglers to be taken out on day trips. This involved a survey by a local harbourmaster who inspected the vessel against a certificate of fitness checklist. One of the items to be checked was that the vessel had an efficient bilge pumping system. However, there was no requirement to have a bilge alarm, unlike in the Code. Although granted approval, *Amber* never took out any anglers.

The Code does not stipulate any stability requirements for under 15m fishing vessels. No one had any idea of *Amber*'s stability limitations as no check had ever been carried out. Additionally, MGN 20 (M+F) indicates that hazards which imperil the vessel do not have to be considered when conducting the risk assessment.

1.6 VESSEL DESCRIPTION

Amber was constructed in Plymouth in 1989 by Radmore and Hill. She was a one-off design and was made from steel. She was powered by a fresh water keel-cooled diesel engine, and was fitted with a main winch with a 2 tonne pull. The wheelhouse was forward, offset to port, with steps down into the forepeak cabin. Underneath the wheelhouse was the engine room, which also contained port and starboard integral diesel tanks and an integral hydraulic oil tank. Next to the engine room was the fish hold. Beyond that was a watertight steering gear compartment.

The vessel had an engine-driven deck-wash pump which also could pump the engine room bilge. The fish hold had an electric pump housed in a well to ensure melt water from any ice carried could be pumped out. Lastly, there was a manual bilge pump operated from under the shelter, which served both the fish hold and the engine room. No bilge alarm was fitted. The main deck was fitted with three freeing ports on the starboard side and two on the port side. Each was 380mm by 85mm in cross-section and had a shutter stored nearby.

In August 1999, the gunwale was raised by approximately 0.23m, to increase crew protection when they were working on deck **(Figure 4)**.

In January 2000, the steel shelter was added and the net drum was installed **(Figures 4 and 5)**. The objective of both additions was to ease fishing operations and to further increase crew protection. The net drum was directly driven by the main winch.

A new autopilot was fitted during the summer of 2002, as the original was in need of replacement. However, the new autopilot was unreliable and the owner was still trying to arrange for a technician to rectify the problem when the vessel was lost.

Figure 4

Amber showing raised gunwale and shelter

Figure 5

Net drum on *Amber*

In October 2002, the engine was replaced because the original engine had started to burn lubricating oil. It was replaced with the same model, but was sea water, not fresh water cooled and, hence, the keel cooling pipes became redundant. The two pipe ends of the keel cooling system had not been closed off before the vessel was lost. A seacock on the starboard side of the engine was used initially as the sea water cooling inlet, but it was found to be prone to becoming blocked by prawns. A spare seacock on the port side was used instead.

Shortly after fitting the new engine, the skipper and his son were fishing off the coast of Sunderland. They caught a trawl door on a wreck and had to cut the trawl wire on that side. They then retrieved the gear on the opposite side, although the snagged trawl door was lost. That terminated the fishing for the trip, and on return to the Forth it was found that the main winch **(Figure 6)** needed to have its main bearings replaced. This was carried out in November-December 2002. It appears that the fatal accident was the first occasion on which *Amber* had put to sea since having the winch refurbished.

Figure 6

Amber main winch and fish hatch

1.7 STABILITY

After *Amber* was salvaged, she was bailed out and all sodden items were removed. An inclining experiment was then conducted in the non tidal basin at Burntisland. Additionally, as no drawings were available for *Amber*, a theodolite survey was carried out on the quayside to derive the hull offsets. The inclining experiment and subsequent stability analysis can be found at **Annex 2**.

The analysis indicates that when *Amber* sailed from Pittenween, her freeboard was low and her stability was poor. With the rock caught in the net, the situation was very grave. *Amber* would have simply capsized if the rock had been lifted off the seabed momentarily and the weight had been acting off centre. Alternatively, if the weight had been kept directly on the centreline, and there was no heeling moment, only 50mm, or 0.75 tonnes, of water on the main deck would have resulted in *Amber* losing all stability.

With no regulatory requirement to assess stability, the owner had been unaware of the possible stability implications that the modifications would have had, and the marine survey conducted before purchase gave no indication of the existing stability performance.

The displacement calculated from the inclining experiment was 19 tonnes. All the modifications carried out had added weight above the centre of gravity, causing the overall centre of gravity to rise and the freeboard to reduce. The estimated freeboard on the day of the accident, before the rock was picked up in the net, was approximately 0.20m. Another factor which decreased the freeboard was the stowage of significant amounts of spare gear and tools, found on board after the vessel was salvaged.

1.8 *KIRSTEEN ANNE* AND OTHER INCIDENTS

Six days before the loss of *Amber*, *Kirsteen Anne* was lost off the west coast of Scotland. The two crew lost their lives. *Kirsteen Anne* had been modified extensively, with no freeboard or stability considerations. She was only 6.24m in length and, therefore, there were no specific requirements for stability or freeboard. As with *Amber*, *Kirsteen Anne*'s stability was poor and on the day of the accident she was heavily loaded with creels. Her crew knew of no loading limitations for the vessel.

Since 1991, at least 38 small UK fishing vessels have capsized. Half of these was as a result of heavy catches on deck and/or shifting cargoes. The other half was because of problems with beam or stern trawling gear. Weather conditions were a contributory factor in a quarter of all these accidents. A common trend was that the stability limitations, and hence loading limits of these vessels, were not known or appreciated by their skippers and crews. As a result of these 38 capsizes, 31 people have lost their lives.

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the underlying safety issues of the accident as a basis for making recommendations to prevent future accidents.

2.2 LOSS SCENARIO

The evidence indicates that *Amber* was lost suddenly, probably through capsizing and then sinking by the stern. This was through too great a heeling moment being applied as a result of the rock in the net, or by water on the main deck, with its associated free surface, raising the centre of gravity, or by a combination of the two. Once capsize had started, rapid flooding caused the vessel to sink by the stern.

As she sank, *Amber* assumed a stern-first downward trajectory very quickly. This is demonstrated by the silt caught inside the transom, and the corresponding position of the fish hatchcover. On hitting the seabed, the stern embedded itself and then *Amber* rotated bow downwards to lift the top of the transom out of the silt.

2.3 STABILITY AND FREEBOARD

The results of the stability analysis at **Annex 2** demonstrate that *Amber* had poor stability. Had the 1.775 tonne rock, which was in the net, been lifted off the seabed, the combination of its weight, a high suspension point, and the likely offset from the centreline, could have caused *Amber* to capsize. In reality, the rock might never have left the seabed as the length of net was greater than the depth of water. Instead, the rock might have muddied up as it was dragged on the up-slope of the seabed towards Methil harbour, increasing the drag that was experienced by the vessel.

Alternatively, if it is assumed that the load was kept directly astern, with low freeboard aft, water might have built up on the main deck without the skipper noticing. This might have occurred as the moment caused between the propeller thrust and the drag from the rock increased the stern trim to a point where the aft freeing ports were submerged. During the stability analysis, it was found that with only 50mm of water spread over the main deck, and its associated free surface, *Amber's* stability would have completely vanished and she would have capsized.

The stability performance when the vessel was built is unknown, but what is certain is that the modifications carried out since 1999, which were completed with crew protection in mind, effectively degraded the stability and lowered the freeboard. Having spare gear on board is essential to conduct running repairs.

However, keeping copious amounts of spare gear and tools on board also contributes to lowering the freeboard. The cumulative effect of these additions was significant, but their effect was never properly considered. When making alterations, especially to small fishing vessels, owners must consider freeboard, stability and other safety issues such as access. Capsize and flooding can occur rapidly, and, if lifesaving gear is to be effective, the occupants of enclosed places must be able to get out quickly.

Stability standards, like those applied to fishing vessels greater than 15m overall length, exist to try to ensure vessels have some reserve against external forces like wind, waves and having weights suspended from derricks. At the very least, assessing a vessel to a standard ensures suitable loading limits can be derived. In the case of *Amber*, the skipper would not have been aware of any loading limits other than what had been achieved in past operations. However, in previous operations the skipper would not have known how close he was to the vessel's capabilities.

It is also possible that internal flooding might have contributed to the loss of *Amber*. After salvage, two leaks were found. These might have been the result of the vessel sinking. However, if water had been entering the vessel on the day of the accident, the skipper would probably have been unaware of the problem as no bilge alarm was fitted. The effect of any floodwater would have been to reduce the freeboard even further and provide a free surface, effectively raising the centre of gravity.

2.4 AWARENESS OF REGULATIONS

The MCA carries out inspections to ensure compliance with the Code, and it is the intention, in time, that all vessels will be inspected. However, in the first two years of the Code being in place, over 60% of under 15m fishing vessels have not yet been inspected. Many fishing vessel accidents investigated by the MAIB in the last two years have identified skippers and owners who are unaware of the Code's existence, or of the need to conduct a risk assessment.

Disciplining fishermen who do not know what is required of them by law is unlikely to improve safety. Further measures are needed to highlight to all those involved in fishing what is required of them, and then to ensure compliance.

- One measure would be to ensure all vessels are inspected as soon as is practicable.

- Another possible measure would be to require positive feedback from operators that they have completed the self-certification requirements. This would enable inspections to be targeted.

- Another measure would be to dispatch information regarding the relevant code of practice and other key regulations to a new owner following a change of ownership. This would be especially important when owners are not fishermen, as was the case of *Amber* and *Kirsteen Anne,* since they are less likely to be aware of the requirements.

Safety equipment specified in the Code is the minimum required. A bilge alarm is specified because it provides essential early warning of flooding, and ensures that those on board have time to react. *Amber* had no bilge alarm fitted. Therefore, her skipper would not have been automatically alerted to any ingress of water, which would have affected the vessel's freeboard and stability.

2.5 RISK ASSESSMENT

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 detail the requirements of risk assessment, and are referenced in the Code. However, MGN 20 (M+F) advises that the hazards that need to be considered specifically exclude those which imperil the vessel. This omission has been highlighted by the MAIB on several occasions, and has yet to be addressed by the MCA.

Additionally, under certain contractual arrangements, as with share fishermen, no risk assessment is required at all. Essentially, in these circumstances, operators merely have to comply with the relevant safety equipment checklist contained in the Code.

These omissions should be addressed if meaningful risk assessments are to be conducted. This links closely with the training of fishermen to enable them to conduct their assessments effectively.

2.6 TRAINING OF FISHERMEN

The lack of any mandatory formal safety awareness training for fishermen of small fishing vessels, probably leaves many ill-prepared to deal with unusual situations. Education in the possible dangers and risks involved, can provide a safe environment in which to explore specific situations, and devise appropriate emergency procedures and other control measures. In this accident, the skipper would not necessarily have assessed he was in any immediate danger, as he believed he was operating the vessel within her capabilities. Although the skipper perceived there was no need to alert the coastguard early on, because of the unusual situation in which he found himself, it would have been prudent to do so.

The decision when to contact the coastguard might also have been affected by the skipper operating the vessel alone. Clearly, he had concerns on his mind at this time, and he was probably preoccupied with the task of taking his boat to safety. Without another person on board, he lacked a second pair of hands, eyes and an important second opinion which only another person familiar with all the immediate difficulties could offer.

Single-handed fishing exposes fishermen to additional risks. If something goes wrong, initially, there is no one else to help. Some risks which require no mitigation when a vessel is fully crewed may represent a significant hazard when fishing alone. Being aware of the additional risks will enable fishermen to be better prepared and to know their safe limits of operation.

Single-handed fishing normally necessitates the use of an autopilot. However, to be effective, it must be fit for purpose and not pose an additional risk to the operation of the vessel. It is uncertain if the autopilot contributed to this accident, by suddenly turning the vessel and causing a heeling moment, but its history of erratic operation does raise the possibility.

The one-day safety awareness course provided by Seafish is an example of the type of training which is required to provide fishermen with the basic tools of improving vessel safety. Until April 2004, there is no charge for attending the course. It will then be made mandatory for all fishermen. The course provides not only relevant safety information, but also an opportunity to exchange experiences and ideas with other fishermen.

SECTION 3 - CONCLUSIONS

The following are the safety issues which were identified as a result of the investigation. They are not listed in any order of priority.

1. The lack of a stability requirement, or any effective guidance, places skippers of small fishing vessels at great risk. Without a stability standard, adequate stability awareness and knowledge of the loading limits of their particular vessels, they are unable to judge when it is safe to lift, tow or carry heavy loads [2.3].

   The MAIB believes that the number of known capsizes of small vessels warrants the Department for Transport to develop a simple method of assessing the stability of small fishing vessels and issue guidance accordingly and, in particular, the MCA to:

   - conduct a formal safety assessment of the introduction of a mandatory stability requirement for existing fishing vessels under 15m in length; and

   - investigate how stability awareness can be increased among the owners and crews of fishing vessels under 15m in length.

2. A number of fishing vessel owners and skippers are unaware of the existence of the Code of Practice for the Safety of Small Fishing Vessels, or of the need to conduct a risk assessment. Unless the requirements are made known to them, and then effectively enforced, safety awareness in small fishing vessels will not improve, and accidents in this sector of the industry are likely to continue at the current rate [2.4].

   Possible measures to heighten awareness and implementation include:

   - developing a risk-based approach to target uninspected fishing vessels, so that all under-15m fishing vessels are inspected as soon as practicable;

   - a requirement for positive feedback from small fishing vessel operators to the MCA that they have completed the required self-certification, so as to enable more targeted inspections;

   - on change of ownership of vessels, providing new owners with a pack of information, including the relevant Code of Practice and other key regulations to be followed.

3. Marine Guidance Note 20 (M+F) expressly excludes the need for health and safety risk assessments to consider hazards which imperil the vessel. Additionally, under certain contractual arrangements, as with share fishermen, no risk assessment at all is required [2.5].

   With no specific prescriptive legislation to cover hazards which imperil the vessel, reliance must be placed on owners and skippers to conduct their own risk assessments. However, with no requirement to do so, such hazards are unlikely to be considered and controlled by the operators, and accidents are likely to continue at the current rate.

   With no requirement to conduct risk assessments in vessels crewed by share fishermen, inadequate consideration for safety may result, and accidents to, and on board, such vessels are unlikely to be reduced.

4. Until the one-day safety awareness course provided by Seafish is made compulsory, there is no assurance that fishermen will have sufficient awareness to conduct their health and safety risk assessments thoroughly and effectively [2.6].

SECTION 4 - RECOMMENDATIONS

Many of the recommendations made in this report correspond to those already made following the *Kirsteen Anne* accident investigation report[1].

These include, to the **Department for Transport** and the **Maritime and Coastguard Agency,** to:

1. Develop a simple method of assessing the stability, including freeboard, of small fishing vessels, and issue guidance accordingly.

and to the **Maritime and Coastguard Agency:**

2. To conduct a formal safety assessment for existing under-15m fishing vessels, to ascertain whether or not a mandatory stability requirement would be appropriate.

3. On a vessel's change of ownership, provide new owners with information regarding the relevant Code of Practice and other key regulations to be followed.

4. To ensure The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 apply to all vessels regardless of the contractual arrangements of the crew.

5. To ensure that hazards which imperil a vessel are included in risk assessments that are required by The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997.

6. To investigate how stability awareness can be raised among the owners and crew of fishing vessels under 15m.

7. Develop a risk-based approach to target uninspected fishing vessels of less than 15m overall length, so as to achieve 100% inspection as soon as is practicable.

Marine Accident Investigation Branch
October 2003

[1] Marine Accident Investigation Branch Report No.19/2003

ANNEX 1

MSN 1756 (F) The Fishing Vessel Code of Practice for the Safety of Small Vessels Under 12 Metres in Length

NOTE

MSN 1756(F) Amendment No 1 was issued in June 2002, extending the coverage to fishing vessels under 15m in length overall. It is not included here, as it has no relevance to *Amber.*

MERCHANT SHIPPING NOTICE

MSN 1756(F)

The Fishing Vessels Code of Practice for the Safety of Small Fishing Vessels under 12 metres in length

Notice to Designers, Builders, Owners, Employers, Skippers and Crew of Fishing Vessels

This Notice should be read in conjunction with the Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations SI 2001 No.9 and the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 **(Note 1)** *, as amended.*

Summary

This notice draws attention to the Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations 2001 and incorporates the full text of the Code of Practice for the Safety of Small Fishing Vessels with a registered length of less than 12 metres.

1. This Merchant Shipping Notice is associated with The Fishing Vessels (Code of Practice for the Safety of Small Fishing Vessels) Regulations 2001. It sets out the full text of the Code of Practice for the Safety of Small Fishing Vessels.

2. The Regulations give statutory force to the Code of Practice for the Safety of Small Fishing Vessels and replace the requirements of the Fishing Vessels (Safety Provisions) Rules 1975 and the Fishing Vessels (Life Saving Appliance) Regulations 1988 as they apply to fishing vessels with a registered length less than 12 metres.

3. The Regulations and the Code have been introduced following consultation with the industry and other interested bodies. Their introduction represents part of a wider review of the Fishing Vessels (Safety Provisions) Rules 1975 to update existing requirements in order to increase the safety of fishing vessels in foreseeable operating conditions, and the survival of the crew in the event of an accident.

4. To comply with the Code of Practice for the Safety of Small Fishing Vessels, a vessel owner will be required:

- to carry safety equipment on the vessel appropriate to its length and construction;
- to complete, or arrange for the completion of, an assessment of the health and safety risks arising in the normal course of work activities or duties on the vessel in accordance with the provisions of the Merchant Shipping and Fishing Vessel (Health and Safety at Work) Regulations 1997
- to certify annually that the vessel complies with the Code, by declaring that the safety equipment has been properly maintained and serviced in accordance with manufacturers' recommendations and that an appropriate and up to date health and safety risk assessment has been completed; and
- to present the vessel for inspection by the MCA in accordance with the provisions of the Code.

5. Additionally, the owner of a new vessel should ensure that the vessel is constructed in accordance with the Construction Standards issued by the Seafish Industry Authority (SIFA or Seafish) or an equivalent standard recognised by the MCA.

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March 2001

File ref. MS 088/001/0291

Maritime and Coastguard Agency

THE CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS

The Maritime and Coastguard Agency
Spring Place
105 Commercial Road
Southampton SO15 1EG

Telephone: 023 8032 9150
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Effective from 1 April 2001

1. Foreword

1.1 The aim of this Code of Practice is to improve safety in the under 12 metre sector of the fishing industry and to raise the safety awareness of all those involved with the construction, operation and maintenance of fishing vessels with a registered length of less than 12 metres.

2. Development

2.1 In 1992 the National Audit Office, in its report entitled "Department of Transport: Ship Safety" noted an increase in the fishing vessel accident rate in the period 1978 to 1989 due in part to an increase in the numbers of smaller vessels, and it observed the absence, until 1990, of any programme of inspection of fishing vessels with a registered length of less than 12 metres. At about the same time a House of Lords Select Committee on Science & Technology recommended that fishing vessels down to 7m in length should be brought within the licensing, crew certification and structural safety regimes for fishing vessels.

2.2 In response, the Surveyor General's Organisation of the Department of Transport (now the Maritime & Coastguard Agency (MCA)), in consultation with industry members of the Fishing Industry Safety Group (FISG), decided to develop a Code of Practice for fishing vessels with a registered length of less than 12 metres as part of a wider review of fishing vessel safety regulations.

2.3 This Code has been developed by the MCA. The content of the Code has been the subject of extensive discussion with representatives of the under 12 metre sector of the fishing industry within a Steering Committee set up by FISG to oversee the Code's development.

2.4 If the Code needs to be up-dated at any time to take account of new statutory requirements that apply to vessels operating under the Code, the organisations involved in the development of the Code will be consulted. Code requirements, including inspection arrangements, will in any event be reviewed not more than 2 years after the Code comes into force, and thereafter at no more than five-yearly intervals, by a Committee comprising of representatives of those organisations involved in the development of the Code, to take into account experience gained from its application.

3. Application

3.1 The Code will apply from 1 April 2001 to all United Kingdom registered fishing vessels with a registered length of less than 12 metres.

4. Code Requirements

4.1 To comply with the Code a vessel owner will be required:

4.1.1 To carry safety equipment on the vessel appropriate to its length and construction (i.e. decked or open). Checklists are at ANNEX 1.1 to 1.4.

4.1.2 To complete, or arrange completion of, an assessment of the health and safety risks arising in the normal course of work activities or duties on the vessel in accordance with the provisions of the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 and MGN 20 (M+F). Paragraphs 4.4 to 4.7 below describe the process of risk assessment and current best practice.

4.1.3 To certify annually (using the declaration at ANNEX 2) that the vessel complies with the Code, by declaring that the safety equipment has been properly maintained and serviced in accordance with manufacturers' recommendations and that an appropriate, up to date health and safety risk assessment has been completed. This document should be retained by the vessel owner and produced when requested by the MCA.

4.1.4 To present the vessel for inspection either voluntarily or as requested by the MCA in accordance with the provisions of section 5.

4.2 Additionally, the owner of a new vessel should ensure that the vessel is properly constructed in accordance with the provisions of section 5(1) and the equipment detailed in this Code is properly maintained.

4.3 It is the owner's/skipper's responsibility to ensure that the vessel is operated in accordance with the Code and other relevant regulations at all times.

Risk Assessment

4.4 The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 came into force on 31 March 1998. Under those regulations employers are required to make a suitable and sufficient assessment of the risks to the health and safety of workers arising in the normal course of their activities or duties. Guidance on these regulations and on the principles of risk assessment is contained in a Marine Guidance Note (currently MGN 20 M+F).

4.5 A risk assessment is intended to be a careful examination of what, in the nature of operations, could cause harm, so that decisions can be made as to whether enough precautions have been taken or whether more should be done.

4.6 The assessment should first identify the hazards that are present and then establish whether a hazard is significant and whether it is already covered by satisfactory precautions to control the risk, including consideration of the likelihood of the failure of those precautions that are in place.

4.7 It is not a requirement of the Merchant Shipping and Fishing Vessels (Health and Safety at Work Regulations) 1997 that risk assessments be written. **Nevertheless, the MCA strongly recommends that such assessments be written**. An example of a suitable standard of written risk assessment is included in the Fishing Vessel Safety Folder developed by and available from Seafish, which also provides pro-forma guidance on fishing vessel risk assessment, both generally and in relation to particular modes of fishing.

5. Compliance Procedures and Inspections

New Vessels

5.1 New fishing vessels, with a registered length of less than 12 metres, (defined as those for which a keel was laid or construction or lay-up was started after 1 April 2001) must comply with the Construction Standards issued by Seafish or an equivalent standard recognised by MCA prior to commencement of construction. A certificate showing compliance with the Seafish standards or an equivalent standard must be issued by the construction standard authority.

5.2 To operate a new vessel under the Code the owner must complete a health and safety risk assessment, the vessel must have been inspected by MCA and an Inspection Form issued, and a compliance certificate must have been issued by the construction standard's authority. Thereafter, the vessel must maintain compliance with The Code.

Existing Vessels

5.3 The owner of every existing fishing vessel with a registered length of less than 12 metres must ensure that the vessel complies with the checklist of requirements appropriate to the length and construction of the vessel, that a health and safety risk assessment has been completed, and that a self-certification declaration has been completed.

5.4 One month before the Code comes into effect the MCA will write to owners of all existing fishing vessels with a registered length of less than 12 metres explaining the

action to be taken on entry into force of the Code.

All Vessels

Inspections

5.5 A vessel may be inspected by the MCA at any time to check compliance with Code requirements. On satisfactory completion of the inspection an Inspection Form will be issued. If deficiencies are found which necessitate follow-up visits, fees will be charged to the owner in accordance with the MCA fee regulations applicable at the time of the follow-up visit.

Annual Self-Certification

5.6 Within 1 month of the anniversary of the vessel's registration, the owner (or other competent person employed by the owner) must inspect the vessel to confirm that the safety equipment carried on board the vessel has been suitably maintained, that the safety and other specified equipment continues to comply with the checklist of safety equipment appropriate to the length and construction of the vessel. The health and safety risk assessment must also be checked to ensure that it remains appropriate to the vessel's fishing method and operation. If there has been a change of fishing method or of operational practice since the previous health and safety risk assessment was completed, the assessment should be revised accordingly.

5.7 On completion of these annual checks, the owner should sign a self-certification declaration confirming that the vessel complies with the Code, and retain the declaration for inspection purposes.

Change of ownership

5.8 Risk assessments of the vessel are particular to each employer. When a vessel is sold, the new owner must complete, or arrange the completion of, a new risk assessment and self-assessment in accordance with paragraph 5.6.

Penalties

5.9 A vessel that is found, in the course of inspection, not to have been equipped, the safety equipment properly maintained, assessed and self-certificated in accordance with the Code will be liable to detention by the MCA. An owner whose vessel fails to comply with the Code or who makes a false declaration may be liable to prosecution. A skipper who fails to operate the vessel in accordance with the Code may be liable to prosecution.

Appeal Procedures

5.10 If an owner is dissatisfied with an inspection and agreement cannot be reached with the person who carried out the inspection, the owner may refer the matter to the Principal Marine Surveyor (Fishing Vessels) in the Region where the vessel was inspected.

5.11 Should the above procedure fail to resolve the disagreement, the owner may refer the matter to the Head of Maritime Operations at MCA headquarters, and, if necessary, to the MCA Chief Executive who will ensure the complaint is looked into thoroughly.

5.12 If an owner is still not content with the way in which the complaint has been handled by the MCA, a request may be made for it to be referred to an adjudicator who is independent of the MCA.

CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS: CHECK LIST OF REQUIREMENTS

DECKED Vessels 10m and above Registered Length to less than 12m Registered Length

ITEM	Remarks/compliance	Expiry/Service Date
Lifejackets - 1 per person		
Liferafts		
2 Lifebuoys (1 with 18m buoyant line attached) or 1 Lifebuoy (fitted with 18m buoyant line) +1 Buoyant Rescue Quoit		
3 Parachute flares		
2 Hand-held flares		
1 Smoke Signal (buoyant or handheld)		
1 Fire bucket + Lanyard		
1 Multi-purpose Fire Extinguisher (fire rating 5A/34B)		
1 Fire Blanket (light duty) in galley or cooking area (if applicable)		
1 Fire Pump + Hose or 1 Fire Bucket + 1 Multi-purpose Fire Extinguisher (fire rating 5A/34B) + 1 fixed Fire Extinguishing system for the machinery space		
1 Multi-purpose Fire Extinguisher for oil fires (fire rating 13A/113B)		
VHF Radio - fixed or hand held		
Bilge Pump		
Bilge Alarm		
Navigation Lights & Sound Signals		
Compass		
Waterproof Torch		
Medical Kit		

Notes:

(i) Equipment need not be MCA approved provided it is fit for its intended purpose.
(ii) "Decked vessels" means a vessel with a continuous watertight weather deck that extends from stem to stern and has positive freeboard throughout, in any condition of loading the vessel.
(iii) VHF using DSC is highly recommended in view of cessation of the Coastguard's Channel 16 dedicated headset watch on 1st February 2005.

CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS: CHECK LIST OF REQUIREMENTS

ALL DECKED Vessels up to 10m Registered Length

Item	Remarks/compliance	Expiry/Service Date
Lifejackets - 1 per person		
2 Lifebuoys (1 with 18m buoyant line attached) or 1 Lifebuoy (fitted with 18m buoyancy line) + 1 Buoyant Rescue Quoit		
3 Parachute Flares		
2 Hand-held Flares		
1 Smoke Signal (buoyant or hand held)		
1 Fire Bucket + Lanyard		
1 Multi-purpose Fire Extinguisher (fire rating 5A/34B)		
1 Fire Blanket (light duty) in galley or cooking area (if applicable)		
1 Fire Pump + Hose or 1 Fire Bucket		
1 Multi-purpose Fire Extinguisher for oil fires (fire rating 13A/113B)		
VHF Radio – fixed or hand held		
Bilge Pump		
Bilge Alarm		
Navigation Lights & Sound Signals		
Compass		
Waterproof Torch		
Medical Kit		

Notes:
(i) Equipment need not be MCA approved provided it is fit for its intended purpose.
(ii) "Decked vessels" means a vessel with a continuous watertight weather deck that extends from stem to stern and has positive freeboard throughout, in any condition of loading the vessel.
(iii) VHF using Digital Selective Calling (DSC) is highly recommended in view of cessation of the Coastguard's Channel 16 dedicated headset watch on 1st February 2005.

CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS: CHECK LIST OF REQUIREMENTS

OPEN Vessels 7m and above to less than 12m Registered Length

Item	Remarks/compliance	Expiry/Service Date
Lifejackets - 1 per person		
2 Lifebuoys (1 with 18m buoyant line attached) or 1 Lifebuoy (with 18m buoyant line) + 1 Buoyant Rescue Quoit		
3 Parachute Flares		
2 Hand-held Flares		
1 Smoke Signal (buoyant or hand held		
1 Fire Bucket + Lanyard		
1 Multi-purpose Fire Extinguisher (fire rating 5A/34B)		
1 Fire Blanket (light duty) in galley or cooking area (if applicable)		
1 Fire Pump + Hose or 1 Fire Bucket		
1 Multi-purpose Fire Extinguisher for oil fires (fire rating 13A/113B)		
VHF Radio – fixed or hand held		
Bilge Pump		
Navigation Lights & Sound Signals		
Compass		
Waterproof Torch		
Medical Kit		

Notes:

(i) Equipment need not be MCA approved provided it is fit for its intended purpose.
(ii) VHF using Digital Selective Calling (DSC) is highly recommended in view of cessation of the Coastguard's Channel 16 dedicated headset watch on 1st February 2005.

CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS: CHECK LIST OF REQUIREMENTS

OPEN Vessels less than 7m Registered Length

Item	Remarks/compliance	Expiry/Service Date
Lifejackets – 1 per person		
1 Lifebuoy (with 18m buoyant line attached)		
2 Parachute Flares		
2 Hand-held Flares		
1 Smoke Signal, buoyant or hand held		
1 Fire Bucket + Lanyard		
1 Multi-purpose Fire Extinguisher (fire rating 5A/34B) - if vessel has in- board engine		
1 Fire Blanket (light duty) if vessel has galley or cooking area		
VHF Radio – fixed or hand held		
Bailer		
Navigation Lights & Sound Signals		
Compass		
Waterproof Torch		
Medical Kit		

Notes:

(i) Equipment need not be MCA approved provided it is fit for its intended purpose.
(ii) VHF using Digital Selective Calling (DSC) is highly recommended in view of cessation of the Coastguard's Channel 16 dedicated headset watch on Ist February 2005.

THE FISHING VESSELS (CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS)
REGULATIONS 2001

ANNUAL SELF CERTIFICATION (Owner to verify and sign in spaces below that vessel complies)

Name of Owner .....

Address of Owner .....

.....

.....

Name of Vessel.....

RSS No..... Length Overall .....

Registered Length ..... Date of Registration .....

Hull Identification No..... Mode(s) of Fishing .....

Port letters and number.....

I HEREBY CERTIFY, in respect of the above named vessel, that:

i. The safety and other specified equipment have been checked in accordance with the attached checklist;

ii. Such safety and other specified equipment carried are in accordance with the requirements of the Code;

iii. Such safety and other specified equipment has been properly maintained and serviced in accordance with manufacturers' recommendations;

iv. Where applicable a risk assessment* of work activities and duties has been completed in accordance with the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997;

*The health and safety risk assessment is written - Yes/No (delete as appropriate)

1st Signature of Owner ..... Date.....

2nd Signature of Owner ..... Date.....

3rd Signature of Owner ..... Date.....

4th Signature of Owner ..... Date.....

5th Signature of Owner ..... Date.....

Lifejackets should be of the solid-filled type, or should comply with BS EN 396 or BS EN 399, with automatic gas inflation and at least 150 Newtons buoyancy. One lifejacket per person carried, fitted with light, whistle and reflective tape.

Liferafts should either be float free, fitted with an hydrostatic release unit (HRU), or stowed in a position where it is accessible for deployment in an emergency. It/they should have a capacity sufficient for the total number of persons on board.

Lifebuoys should be marked with the vessel name and port of registry or fishing vessel number and fitted with reflective tape and may be circular or horseshoe in shape.

Flares and smoke signals should be of an acceptable type and within their expiry date.

Fire buckets should be heavy duty with a Lanyard.

Fire extinguishers should where practical comply with the stated fire ratings. However existing extinguishers of equivalent capacity, provided they have been maintained and serviced are acceptable. All extinguishers should be inspected and serviced annually by a competent person.

Fire blankets for the galley or cooking appliance should be of light duty to BS 7944 (this standard has superceded 6575) or a recognised equivalent BS EN 1869

Fire pumps can be a hand pump or any other pump that supplies water from the sea onto the deck with a hose suitable for fire fighting purposes.

Fixed fire-fighting systems should be an approved system or a fixed fire extinguisher of sufficient capacity arranged to discharge directly into the machinery space.

Navigation lights and sound signals:

1. Any vessel that operates between sunset and sunrise or in times of restricted visibility must exhibit the navigation and fishing lights prescribed in the Collision Regulations.
2. A masthead light or all round white light of 2-mile range, is to be 1 metre higher than sidelights.
3. Sidelights of 1 mile range at a height above the uppermost continuous deck not greater than three-quarters the height of the masthead light.
4. A Stern light of 2-mile range if the masthead light (number 2) is carried.
5. An all-round white light of 2 mile range when trawling or fishing as referred to in number 7 below (that may also on its own be used as an anchor light). An all-round white anchor light is required if anchored in or near a narrow channel, fairway or anchorage, or where other vessels normally navigate.
6. The all-round white light (number 5) to be more than 2 metres above the gunwales and above the sidelights (number 3) at more than twice the distance between the vertical lights (numbers 5 and 7).
7. An all-round light (green if trawling, red if fishing other than trawling) at least 1metre above the all-round white light (number 5) and of 2 mile range.
8. Alternatively, a vessel under 7 metres, with speed less than 7 knots may instead of the above lights exhibit one all-round white light of 2 mile range and if practical, sidelights or a combination lantern.
9. Additionally for vessels of greater than 12 metres overall length, a bell is required and the range of the masthead light is extended to 3 miles.

ANNEX 2

Inclining experiment and stability analysis

Stability Analysis for Amber

To establish the stability characteristics of *Amber* at the time of the accident, an inclining experiment was conducted. This was carried out on 28 February 2003 in the non tidal basin at Briggs Marine, Burntisland.

To build up the condition in which the vessel was lost, known weights and estimates were used to create weights-on. A weights-off list for the added equipment used for the inclining experiment was also compiled. An estimate of 95% was assumed in the port and starboard fuel tanks as well as the hydraulic oil tank. The former is a fair assumption, as it would appear *Amber* filled up her fuel tanks before Christmas 2002.

An estimate for the weight of the rock caught in the net was derived by taking the weight in air and deducting the buoyancy it would have had in water. The rock weighed 1.775 tonnes, allowing for buoyancy a weight of 1.215 tonnes was assumed. This load was included in the vessel's condition on the centreline, acting from the net drum, and then an applied lever was calculated for a possible offset in the weight. It must be noted that this approach is only an approximation, as in reality the forces involved would have been more complicated.

A stability model of *Amber* was produced after deriving the hull offsets from a theodolite survey of the vessel conducted on the quayside. Two conditions were analysed and GZ curves produced. These were with, and without, the rock in the net. The hull was only taken up to the deck. The fish hatch wheelhouse door and forward vent were highlighted as downflood warning points. The stability criteria applied to over-15m fishing vessels are included in the results for comparison and to provide an indication of stability performance.

Results

The stability performance before any fishing gear is deployed is very poor. The freeboard is low and after heeling 5° the freeing ports are immersed. Additionally, at 30° the fish hatch is also immersed. The maximum GZ is less than 0.1 m although initial GM is healthy at 0.47 m. It is evident that there was little margin of safety when *Amber* proceeded to sea.

With the rock caught in the net, the stability is worse. When the heeling lever is applied, it is evident that the *Amber* could not cope with a weight of this magnitude.

An estimate was also made for how much water on deck would be needed to make the vessel unstable. By progressively increasing the water on deck until there was no righting arm, it was found that 0.75 tonnes of water was all that was needed. This equates to a depth of 50mm of water.

Inclining Experiment of Amber

Date: Friday 28 February 2003

Time: 1530-1730 in dock basin

Place: Briggs Marine, Burntisland

Weather: Dry, negligible breeze.

Mooring: The vessel had a bow line anchored to a moored barge and a stern line from the gallows to the shore

Those present: Graham Wilson MAIB (fwd pendulum)
Nicholas Hance MAIB (aft pendulum)

Freeboards measured-

Waterline fwd: 1.28 m below the lower gunwhale
(measured along the sloping line of the stem)

Waterline at port aft f-p:	0.18 m below deck*	1.945 above keel
Waterline at stbd aft f-p:	0.19 m below deck*	1.945 above keel
At port midships f-p:	0.13 m below deck*	1.763 above keel
At stbd midships f-p:	0.17 m below deck*	1.763 above keel

(*measured from centre of freeing port down to waterline)

Drafts-

Draft fwd:	1.184	1.142	m (At FP from baseline USK)
Draft aft:	1.760	1.781	m (At 9.77 aft of FP)
Mean draft:		1.462	m (to the baseline)
Trim:		0.64	m (by stern)

MAIB hydrometer

Specific gravity fwd: 1.0268 average sg 1.027
Specific gravity aft: 1.0265

Hydrostatics at draught reading for correction for missing MAIB inspectors

LCF 5.730 m MCT 0.139 1 cm tem TPC 0.260

	Wt	LCG	LCG (lcf)	LMom
MAIB inpector 1	0.076	7.000	1.270	0.097
MAIB inpector 2	0.070	2.640	-3.090	-0.216
	0.146			-0.120

Parallel sinkage 0.562 cm Trim inc. -0.862 cm by the stern
Draft and trim during inclining experiment

Mean Draft: 1.467 m (to the baseline) Trim: 0.63 m (by stern)

Hydrostatics:

Disp.	19.57	te	KMT	2.164	m	LBP	9.77 m
LCB	5.764	m	VCB	1.102	m		

Movement	Weight in tonnes	Distance in metres	Applied Moment	Deflection fwd pend in mm	Deflection aft pend in mm	def/mom* fwd	def/mom* aft
-							
A-port	0.102	2.30	0.235	44.0	70.0	187.553	298.380
C-port	0.102	2.30	0.235	43.5	71.0	185.422	302.643
C-stbd	0.102	2.30	0.235	42.5	67.0	181.159	285.592
A-stbd	0.102	2.30	0.235	44.0	70.0	187.553	298.380
B-stbd	0.104	2.30	0.239	44.0	70.5	183.946	294.732
D-stbd	0.103	2.30	0.237	44.0	70.5	185.732	297.594
D-port	0.103	2.30	0.237	43.0	67.5	181.511	284.930
B-port	0.104	2.30	0.239	43.0	68.0	179.766	284.281
-							
						1472.644	2346.533

*change in deflection per unit change of moment = m
length of pendulum = l
max angle of heel 3.0 degrees

$$GM = \frac{l}{m\,\Delta}$$

Average def/mom fwd 184.0805
Average def/mom aft 293.3167

Fwd pendulum length 1638 mm
Aft pendulum length 2618 mm

GM fwd 0.455 m
GM aft 0.456 m

GM 0.455 m

Displacement 19.57 tonnes
VCG 1.709 m above baseline
LCG 5.725 m Corrected for trim, aft of stn 0

No free surface correction required

$$LCG = LCB - \left[\left(\frac{trim}{LBP}\right) \times (VCG - VCB)\right]$$

Amber Weights on/off for Stability Analysis

WEIGHTS SUMMARY	Wt(t)	LCG (m)	L Mmt	VCG (m)	VMmt	FS (t.m)	
As inclined	19.57	5.725	112.036	1.709	33.438		
Weights off	-2.343	6.040	-14.152	1.412	-3.309		
Weights on	0.765	5.885	4.502	2.045	1.565		
Totals (ex fluids)	**17.992**	**5.691**	102.386	**1.762**	31.693		
Fluids-							
Fuel tank port	0.469	5.45	2.556	1.033	0.484	(Included on model)	95%
Fuel tank stbd	0.469	5.45	2.556	1.033	0.484	(Included on model)	95%
Hydraulic Oil Tank	0.055	3.531	0.194	0.923	0.051	(Included on model)	95%
Totals (with fluids)	**18.985**	**5.672**	107.692	**1.723**	32.713		

WEIGHTS ON	Wt (t)	LCG (m)	L Mmt	VCG (m)	V Mmt	FS (t.m)	
Trawl Doors	0.120	9.500	1.140	3.100	0.372		
Anchor & chain	0.040	3.000	0.120	2.600	0.104		
Liferaft	0.020	4.500	0.090	3.900	0.078		Wheelhouse top
Life buoys	0.010	4.500	0.045	3.850	0.039		Wheelhouse top
Flares	0.006	1.000	0.006	1.5	0.009		Fwd locker in forepeak
Lifejackets	0.009	1.000	0.009	1.500	0.014		Fwd locker in forepeak
Single crew	0.075	4.500	0.338	2.400	0.180		
Clothing	0.068	3.500	0.238	2.000	0.136		
Carpet	0.025	1.700	0.043	0.860	0.022		
Cushions in cabin	0.018	1.700	0.031	1.250	0.023		
Sleeping bags and pillows	0.005	1.7	0.009	1.3	0.007		
2nd seat in wheelhouse	0.014	2.2	0.031	2.2	0.031		
Jerry can	0.01	4.5	0.045	1.8	0.018		
Tools & miscellaneous	0.03	4.75	0.143	1.75	0.053		
Oil drum	0.050	3.500	0.175	0.700	0.035		ER
Pound boards/timber	0.060	6.750	0.405	1.400	0.084		Fish hold
Fish boxes/baskets	0.100	7.000	0.700	1.500	0.150		Fish hold
Shovels	0.005	7.000	0.035	1.250	0.006		Fish hold
Wires and ropes	0.040	9.500	0.380	2.050	0.082		On deck
Dog rope	0.030	9.000	0.270	2.100	0.063		assumed on deck after recovery
Pound flooring	0.030	8.400	0.252	2.050	0.062		On deck
Totals	**0.765**	**5.885**	**4.502**	**2.045**	**1.565**	**0.096**	

WEIGHTS OFF	Wt(t)	LCG (m)	L Mmt	VCG (m)	VMmt	FS (t.m)	
Inclining weights	0.629	3.900	4.540	1.215	1.194		
Spare weights (beside hold hatch)	0.210	7.050	1.481	1.900	0.399		
Aft trough	0.031	7.200	0.223	1.400	0.043		
Fwd trough	0.031	3.130	0.097	1.050	0.033		
MAIB inspector 1	0.076	7.000	0.532	1.700	0.129		
MAIB inspector 2	0.070	2.640	0.185	1.250	0.088		
Portable electric bilge pump	0.018	8.800	0.158	2.300	0.041		
Pound Flooring	0.030	8.960	0.269	2.750	0.083		
Hydraulic Tank	0.070	3.530	0.247	0.931	0.065	-	full sw
Fuel Tank Port	0.589	5.450	3.210	1.048	0.617	-	full sw
Fuel Tank Stbd	0.589	5.450	3.210	1.048	0.617	-	full sw
Totals	**2.343**	**6.040**	**14.152**	**1.412**	**3.309**	**0.000**	

ESTIMATED LOADING OF ROCK IN NET

	Weight (te)	LCG (m)		VCG (m)		TCG (m)	
Dry weight	1.775						
Buoyancy	0.55						
Net weight acting	**1.23**	**9.60**	**11.760**	**3.670**	**4.496**	**-0.500**	**-0.613**

INCLINING WEIGHTS DETAILS

	Weight (tonnes)	LCG (m) aft stn 0	Lmom	VCG (m) above base	Vmom	TCG (m) +ve to stbd	Tmom	
A1	0.052	5.29	0.27482	1.75	0.091173	-1.15	-0.0598	Not used in shifts
A2	0.052	5.44	0.28262	1.76	0.091756	-1.15	-0.0598	
A3	0.050	5.59	0.27925	1.78	0.088788	-1.15	-0.0575	
B1	0.056	7.11	0.39788	1.89	0.105809	1.15	0.0644	Not used in shifts
B2	0.050	7.26	0.36275	1.90	0.095034	1.15	0.0575	
B3	0.054	7.41	0.39987	1.91	0.103242	1.15	0.0621	
C1	0.052	7.58	0.39416	1.92	0.100099	-1.15	-0.0598	Not used in shifts
C2	0.052	7.73	0.40196	1.94	0.100683	-1.15	-0.0598	
C3	0.050	7.88	0.394	1.95	0.097371	-1.15	-0.0575	
D1	0.058	8.26	0.47879	1.98	0.114577	1.15	0.0667	Not used in shifts
D2	0.049	8.41	0.411845	1.99	0.097348	1.15	0.05635	
D3	0.054	8.56	0.46197	2.00	0.107887	1.15	0.0621	
Totals	**0.629**	**7.22**	4.539915	**1.90**	1.193768	**0.02**	0.01495	

AMBER WARNING POINTS	LCG	VCG	TCG
Freeing port fwd	4.17	1.57	1.70
Freeing port midships	6.85	1.74	1.70
Freeing port aft	9.44	1.95	1.38
AMBER DOWNFLOOD POINTS			
Fish hold hatch aft end	7.51	2.05	0.53
Fish hold hatch fwd end	6.59	2.05	0.53
Wheelhouse door	4.91	1.94	0.35
Vent	3.30	2.17	1.00

Dimensions in metres

Vessel: AMBER (PH78)
Condition: **At sea 6/1/03**

Water SG: 1.025
Longitudinal dimensions about bow stem (+ve aft, -ve forward) Dimensions in metres
Vertical dimensions about baseline (USK) (+ve above) Trim by the stern positive

	Deadweight Item	Weight tonnes	LCG metres	Longitudinal moment t.m	VCG metres	Vertical moment t.m	Free Surface moment t.m
1	Weights off	-2.343	6.045	-14.163	1.412	-3.308	-
2	Weights on	0.765	5.885	4.502	2.045	1.564	-
3	Hydraulic Oil Tank	0.055	3.531	0.194	0.923	0.051	0.002
4	Port Diesel Tank	0.469	5.45	2.556	1.033	0.484	0.047
5	Starboard Diesel Tank	0.469	5.45	2.556	1.033	0.484	0.047
	DEADWEIGHT TOTAL	-0.585	7.445	-4.355	1.238	-0.724	0.096
	LIGHTSHIP	19.57	5.725	112.038	1.709	33.445	-
	DISPLACEMENT	18.985	5.672	107.683	1.724	32.721	0.096
	Free Surface Correction (Total Free Surface Moment/Displacement)				0.005		
				VCG fluid	1.728		

STABILITY DATA

Heel angle degrees	Trim on LBP	Draft Midships	Righting mom tonne.metres	GZf metres
0	0.506	1.454	0.061	0.003
5	0.502	1.447	0.81	0.043
10	0.5	1.43	1.412	0.074
15	0.529	1.407	1.656	0.087
20	0.594	1.378	1.713	0.09
25	0.684	1.339	1.686	0.089
30	0.788	1.287	1.556	0.082
35	0.903	1.223	1.348	0.071
40	1.019	1.148	1.015	0.053
45	1.13	1.066	0.554	0.029
50	-	-	0	0

STABILITY SUMMARY	Minimum	Actual	f/p immerse
Angle of immersion of fish hatch and stbd fwd f/p (degrees)		30.342	5.11
Area under GZ curve between 0 & 30 degrees (metre.radians)	0.055	0.038	
Area under GZ curve between 0 & 40 degrees (metre.radians)	0.09	0.038	
Area under GZ curve between 30 30.34 & 40 degrees (metre.radians)	0.03	0	
Maximum GZ (metres)	0.2	0.09	
Angle of heel at which maximum GZ occurs (degrees)	30	20.908	
Positive GZ heel range (degrees)		50.00	
GMF (metres) (upright)	0.35	0.469	

Key f/p- freeing port

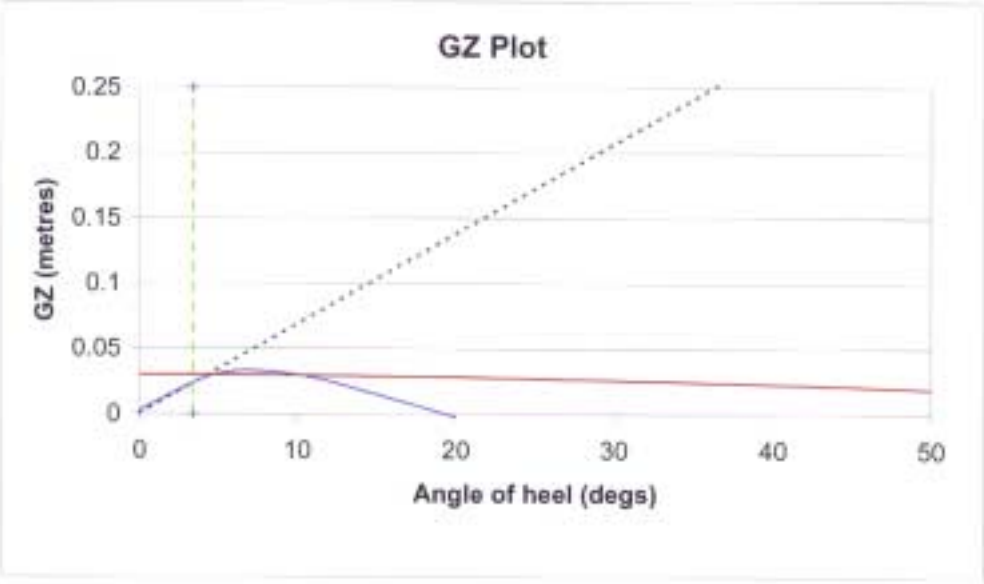
Vessel: AMBER (PH78)
Condition: **Rock in net 6/1/03**

Water SG: 1.025
Longitudinal dimensions about bow stem (+ve aft, -ve forward) Dimensions in metres
Vertical dimensions about baseline (USK) (+ve above) Trim by the stem positive

	Deadweight Item	Weight tonnes	LCG metres	Longitudinal moment t.m	VCG metres	Vertical moment t.m	Free Surface moment t.m
1	Weights off	-2.343	6.045	-14.163	1.412	-3.308	-
2	Weights on	0.765	5.885	4.502	2.045	1.564	-
3	Hydraulic Oil Tank	0.055	3.531	0.194	0.923	0.051	0.002
4	Port Diesel Tank	0.469	5.45	2.556	1.033	0.484	0.047
5	Starboard Diesel Tank	0.469	5.45	2.556	1.033	0.484	0.047
6	Rock in net	1.215	9.3	11.3	3.67	4.459	-
	DEADWEIGHT TOTAL	0.63	11.023	6.944	5.928	3.735	0.092
	LIGHTSHIP	19.57	5.725	112.038	1.709	33.445	-
	DISPLACEMENT	20.2	5.89	118.963	1.841	37.18	0.092
	Free Surface Correction (Total Free Surface Moment/Displacement)				0.005		
				VCG fluid	1.845		

STABILITY DATA

Heel angle degrees	Trim on LBP	Draft Midships	Righting mom tonne.metres	GZf metres	Applied Lever
0	0.813	1.471	0.061	0.003	0.030
5	0.813	1.464	0.618	0.031	0.030
10	0.861	1.456	0.606	0.03	0.030
15	0.954	1.443	0.312	0.015	0.029
20	1.072	1.42	-0.034	-0.002	0.028
25					0.027
30					0.026
35					0.025
40					0.023
45					0.021
50					0.019



STABILITY SUMMARY			Minimum	Actual
Angle of immersion of midships freeing port (degrees)				3.376
Area under GZ curve between 0 &	30	degrees (metre.radians)	0.055	0.007
Area under GZ curve between 0 &	40	degrees (metre.radians)	0.09	0.007
Area under GZ curve between 30	40	degrees (metre.radians)	0.03	0
Maximum GZ (metres)			0.2	0.034
Angle of heel at which maximum GZ occurs (degrees)			30	7.4
Positive GZ heel range (degrees)				19.514
GMF (metres) (upright)			0.35	0.395