

Report on the investigation of

the capsizing of

Breakaway 5

River Bure, Norfolk

19 July 2003

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Extract from
The Merchant Shipping
(Accident Reporting and Investigation)
Regulations 1999

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

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 similar accidents in the future.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

APCO	-	Association of Pleasure Craft Operators
bhp	-	Brake horse power
BMF	-	British Marine Federation
CD	-	Compact Disc
cm	-	centimetre
DEFRA	-	Department for Environment, Food and Rural Affairs
DETR	-	Department of the Environment, Transport and the Regions
DfT	-	Department for Transport
DTI	-	Department of Trade and Industry
EC	-	European Commission
EEA	-	European Economic Area
ESR	-	Essential Safety Requirement
GRP	-	Glass reinforced plastic
HSE	-	Health and Safety Executive
HSWA	-	Health and Safety at Work Act
IBTC	-	International Boat Building Training College
ISO	-	International Standards Organisation
kg	-	kilogram
LPG	-	Liquid Petroleum Gas
MCA	-	Maritime and Coastguard Agency
MSCC	-	Marine Safety Co-ordinating Committee
OS	-	Ordnance Survey
RAF	-	Royal Air Force
RCD	-	Recreational Craft Directive
SI	-	Statutory Instrument
STCW	-	Standards of Training Certification and Watchkeeping
UK	-	United Kingdom
UTC	-	Universal Time Co-ordinated

SYNOPSIS

On 19 July 2003, the hire boat *Breakaway 5* capsized on the Norfolk Broads, trapping two of her ten passengers in the upturned hull. Rescue services managed to release the trapped people within about 90 minutes, but unfortunately one passenger had drowned. An MAIB preliminary examination was started that day.

The vessel was recovered by the police, assisted by the Broads Authority, and examined by MAIB inspectors, who also conducted an inclining test to determine her stability characteristics. It is concluded from this test that the loss of stability was caused by the weight and distribution of the passengers on board.

The boat's maximum passenger capacity of ten people was determined by the number of seats alone. No formal or recorded stability tests were considered to be required, and no independent checks were required to assess if the boat was fit for the purpose of being let for hire.

Although this is the first fatality the MAIB is aware of resulting from the capsizing of a hire boat operating on UK's inland waterways, this investigation has highlighted that the regulation of such vessels is inconsistent, with a mix of European trading and national public health and transport legislation having a bearing and applied to varying degrees.

In some areas of the country, where the safe operation of hire boats is regulated, the extent of such regulation is dependent on the various conditions set by the numerous local or inland navigation authorities, and, in the case of new vessels, can be constrained by European trading legislation. In other areas, such as the Norfolk Broads, where the safe operation of hire boats is not regulated, there is a reliance solely on the safety measures adopted by the boat operators themselves.

As a *Breakaway* class vessel, with the equivalent of ten people on board, subsequently passed stability tests conducted in accordance with the relevant international standard, it is clear that this standard is insufficient.

Recommendations aimed at improving the safety of hire boats include the establishment of a national code of practice for their operation by the MCA, and the need for appropriate authorities on all UK waterways to regulate the code through licensing regimes. Other recommendations, which will also benefit the safety of many small commercial and pleasure vessels operating in the UK include: the introduction of safety margins to the methodology of several widely used stability tests; the review of the validity of using 75kg to represent a person's weight during such tests; and the introduction of a measure to audit the methods used by boat builders to show conformity with the requirements of the relevant European trading directive.



Photograph of a *Breakaway* model

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *BREAKAWAY 5* AND ACCIDENT

Vessel details

Registered owner	:	Barnes Brinkcraft Ltd
Type	:	Hire day boat
Built	:	2001, Wroxham, Norfolk
Construction	:	GRP
Length overall	:	6.77m
Engine power and/or type	:	Diesel, 21 bhp
Service speed	:	6 knots

Accident details

Time and date	:	1800 on 19 July 2003
Location of incident	:	O.S. Grid Reference 637088, 316022, on the River Bure, near Horning Hall, Norfolk
Persons on board	:	10
Injuries/fatalities	:	1 fatality
Damage	:	Total constructive loss

1.2 NARRATIVE (ALL TIMES ARE UTC+1)

1.2.1 Arrival and briefing

At about 1245 on 19 July 2003, two families, each comprising two parents and three children, arrived at Barnes Brinkcraft's premises in Wroxham, Norfolk, to collect a boat they had booked for hire from 1300 until 1800 that day. The children were either young adults or teenagers. Although several of the group had occasionally been on board small hire boats previously, none had any significant knowledge or experience of boat safety.

After checking in at the company's quay-side office, the group was shown to *Breakaway 5*, the boat they had been allocated. After loading several bags of food, drink, and utensils into the cabin, a manager from Barnes Brinkcraft then boarded and briefed the group about the boat and the local waterways. The brief, directed mainly to the person who had made the booking, included: how to start the engine, use of the engine gear and throttle, use of the cooker, fridge, toilet and CD player, and the rules of the river. The brief lasted for several minutes. Before leaving the boat, the manager told the group to be back before dark and to put the boat keys through the company's office letterbox on its return.

1.2.2 The trip

The boat departed at about 1300 and headed eastwards along the River Bure towards Horning (**Figure 1**). It was a warm sunny day with just a light breeze. During the passage, one of the group raised the deck cover over the engine to see if it was possible to make the boat go faster. After assessing that it was not, the deck cover was replaced. While the deck cover was raised, a small amount of oily water was seen at the bottom of the boat, but was insufficient to give cause for concern. After stopping for a barbecue lunch to the east of Horning, between 1400 and 1600, the group continued eastwards and stopped at Thurne at about 1700 for ice creams. At about 1720, the boat left Thurne to return to Wroxham.

Between about 1740 and 1745, two of the children rocked the boat intentionally by standing on the rubbing strake on opposite sides of the boat, outboard of the main superstructure. One swayed inboard while the other swayed outboard. After several movements from side to side, the rocking was stopped by the intervention of the parents. During this rocking movement, the boat did not feel as though it was likely to capsize, although an onlooker on a nearby boat was concerned by the large angle of heel achieved.

Shortly after, at about 1800, with the throttle at full ahead, the boat started to list to starboard towards the bank. The driver reacted by turning the helm quickly to port to try and correct this movement. The boat continued to roll steadily to starboard and within about 5 seconds had capsized, despite one of the children



Map showing location of the accident

trying to counter the heel by moving quickly to the guardrail on the port side of the foredeck. It then quickly turned turtle. No deceleration or bump was noticed immediately before capsizing and no unusual sounds were heard, other than a possible change in the noise of the engine. The party had not previously noticed any signs of the boat being unstable.

Seven of the group were able to clear themselves immediately from obstructions and come to the surface. Initially, the driver was trapped under the boat until quickly freed by his nephew. It was soon apparent, however, that the mothers in the two families, who were sisters, were both missing.

1.2.3 The rescue

The capsizing was seen by the occupants of an 8.5m (28 feet) long motor cruiser, which was about 100m behind *Breakaway 5* and travelling in the same direction. The motor cruiser immediately headed for the overturned boat, recovered the eight people from the water, and alerted the emergency services via mobile telephone. The skipper then secured the motor cruiser alongside the overturned *Breakaway 5*. One of the eight survivors then returned into the water, with a lifeline attached for personal safety, to try and locate the missing people. Visibility in the muddy river water, however, was extremely poor, and the attempt had to be aborted.

Contact was then made with one of the missing mothers in the cabin of the boat, first by tapping, and then by shouting through the hull. She was alone, and had managed to find a small air pocket. After realising that her sister was still missing, however, she dived under the water and found her. Her sister was unconscious on the outside of the open cabin door. She pulled her sister into the cabin and started mouth to mouth resuscitation, although this was difficult in the confined conditions. The unconscious lady was not a strong swimmer, and had opted to wear buoyancy aids provided during two previous hire boat trips on the Thames and on Lake Windermere, but was not wearing one on this occasion.

The Hemsby inshore rescue team and an RAF rescue helicopter, which had been activated by the coastguard, arrived at the scene at about 1830, and were soon joined by the police, fire service and an air ambulance. A hole was made in the hull using an axe and a saw, allowing paramedics to assist with the resuscitation attempts. At 1925, the two trapped people were recovered into an inflatable boat before being hoisted to the RAF helicopter and taken to the Norfolk and Norwich University Hospital. Attempts to resuscitate the unconscious person continued en route to, and on arrival at, the hospital, but were unsuccessful.

1.3 RECOVERY AND INSPECTION

On 20 July, MAIB inspectors visited *Breakaway 5* at the scene of the accident. Other than the hole cut to allow the removal of the two trapped people, and a very shallow scratch running along the length of the underside of the boat's hull on her starboard side, no other significant damage was evident (**Figure 2**).

On 22 July, a temporary repair was made to the hole in the hull of *Breakaway 5*, which was then righted and refloated by the Norfolk Constabulary, assisted by the Broads Authority (**Figure 3**).

An initial inspection of the boat was then conducted before it was towed to a boathouse at Horning Hall. A detailed inspection followed the next day, after which *Breakaway 5* was taken to the Broads Authority boatyard at Horsefen, Ludham, and lifted out of the water. On 29 July, tests were conducted on the engine cooling system, bilge pump, and through-hull fittings. Key findings of the inspections and tests conducted were:

- The engine throttle was in the full ahead position
- There was no evidence of water ingress via through-hull fittings below the normal waterline, other than a small weep through the rudder stock
- The steering gear was serviceable
- The engine cooling and exhaust systems were free of leaks when pressure tested
- None of the skin fittings on the topsides of the hull were likely to cause backflooding into the hull
- The bilge pump was serviceable, and its float switch functioned as intended
- The bilge pump switch was in the 'off' position

During and after the boat's recovery, the riverbed at the position of the accident was searched by police divers, and several artefacts were recovered. These were mainly personal effects and boat's fittings, although two pieces of timber were removed from a position 1 metre from the boat's stern. One piece of timber was lying flat on the riverbed, and the other was protruding from the riverbed at an angle of between 30° and 40°. The distance from the top of this timber to the surface of the water was about 1 metre. This piece was hardwood and measured 98cm long, 24cm wide and 4cm thick. One end of the timber appeared to have been bedded in silt to a depth of between 40cm and 65cm. The depth of water at the site of the accident was between 1.5 and 2m.

Figure 2



Photograph of *Breakaway 5* capsized

Figure 3



Photograph taken during the recovery of *Breakaway 5*

1.5 BARNES BRINKCRAFT

Barnes Brinkcraft, a family business, was started in 1964. It employed 20 full-time staff, but took on many more during the peak holiday season between Easter and October. The company specialised in building and hiring boats but also repaired private craft. It operated 50 boats used for holiday cruises and 30 boats used for day hire, all of which were built and maintained by the company. The hiring of day boats was started in 1996 and was managed separately from the hiring of boats for cruise holidays. The day boat fleet comprised 16 Brinklet class, five Dory class, five Picnic class, and four Breakaway class.

1.6 BREAKAWAY 5

1.6.1 Design and construction

Breakaway 5 was one of four *Breakaway* class built and operated by Barnes Brinkcraft in its day boat fleet; another two were part of its cruise fleet. The *Breakaways* were built between 2000 and 2001. Like the Brinklets and Picnics (**Figure 5**), which were built by Barnes Brinkcraft in 1996, they were based on a hull form purchased from another hire-boat builder and operator in the same area, which had been used safely for about 30 years. Barnes Brinkcraft modified this hull by making the corners more rounded and making the boat longer at the stern. A swimming platform, accessed via a cutaway in the vessel's stern transom, was also fitted.

In an attempt to create a sports cruiser type boat, the *Breakaway's* superstructure had been styled on a Falcon 22 made by the Falcon boatyard in Brundall, which had a completely different hull form to that used by Barnes Brinkcraft. The forward part of this superstructure was sloped at an angle of about 14°. No detailed design or lines plans were produced. Both the hull and superstructure were made of GRP.

1.6.2 Stability

The company allowed a maximum of ten people on board when hired as a day boat, and two people when hired for a cruise holiday. These limits were based on the seating and sleeping capacity respectively.

Although the boat was test-driven with ten people on board, to check its handling characteristics before being put into service, no formal stability trials or measurements were considered to be necessary because of the hull's safety record over many years. The builder considered the addition of the Falcon 22-style superstructure had not changed the hull's stability characteristics because it was not intended for people to use the foredeck when underway. Instead, they were expected to sit in the allocated spaces. After the boat had entered service, however, he had been made aware of hire groups being sighted out of the cockpit area. On some occasions, groups were also seen to rock the vessels deliberately.

The boat's sloping foredeck had low guardrails, was more sensitive to movement compared to the aft deck, and people in this area could impair the driver's visibility. Consequently, Barnes Brinkcraft decided that, when access was required to the foredeck for anchoring and mooring, this would be limited to a maximum of two people. However, no warning signs were placed on the vessel warning customers of this restriction. Access to the foredeck was via a small ladder sited adjacent to the driver's position.

1.6.3 Experience of the builder

The person responsible for building the *Breakaway* class was a director of Barnes Brinkcraft. He had maintained a keen interest in boats from an early age, and had been a junior national champion in powerboat racing, and a member of junior national sailing squads. On leaving school at the age of 16, he attended a one-year boat building course at the International Boat Building Training College at Oulton Broad. This concentrated on the practical aspects of boat building and did not contain any significant theory in stability. He then worked for a local firm producing Oyster yachts for between 2 and 3 years before joining the family business. He was a member of the Broads Hire Boat Federation and chairman of its technical and safety committee.

Figure 5



Photograph of a Picnic

1.7 SAFETY EQUIPMENT

Breakaway 5 was fitted with an electric bilge pump sited in the keel below the shaft. The pump was controlled from a dashboard-mounted rocker switch with 'on', 'off', and 'auto' positions. The switch needed to be held in the 'on' position when controlling the pump's operation manually. The bilge outlet was sited amidships on the port side, about 7cm above the normal waterline.

The boat had a 15.7kW (21bhp) Nanni diesel marine engine, but speed was limited to about 6 knots by a stop mounted on the engine throttle at the driver's position. Fire extinguishers, and a lifebuoy and line were carried on board.

The company stored buoyancy aids, which were available for use by its customers, in its shore-side offices. None were kept on its boats because of the day to day variations of the sizes required.

1.8 MAINTENANCE AND USAGE

Maintenance records show that a Barnes Brinkcraft engineer serviced *Breakaway 5* on 17 July. The boat was hired the same evening, but was only moved a short distance to a nearby hotel in Wroxham, where it remained overnight with three people on board. The following day, it cruised between Wroxham and Horning until being returned to the Barnes Brinkcraft yard at 1800. The person hiring the boat on 17-18 July reported that during the 5 to 6 hours the boat was underway, it was easy to control and no handling problems were experienced.

At 1045 on 19 July, an employee at Barnes Brinkcraft boarded *Breakaway 5* to prepare the boat for hire. The diesel tank was filled, after which the engine was started and the bilge was pumped out by depressing the switch on the dashboard. The bilge pump was operated for about 20 seconds, by which time the bilge was pumped dry; the switch was then put to 'automatic'. The boat was then cleaned.

Maintenance folders were maintained on each of the company's cruiser hire fleet, and were updated each time a new part was fitted. Similar records were not maintained for the day hire fleet. All boats, however, were serviced about once a week. Although not required to do so, it was policy to adhere to the engineering and maintenance standards laid down by the Boat Safety Scheme, of which the manager of the day hire fleet was both an examiner and an examiner assessor.

1.9 THE BRIEFING

Before a day boat was released for hire, it was company policy for its customers to be advised of key aspects of boat operations. To assist its staff in this task, a *Handover Procedure Guide For Employees (Annex A)* had been produced, a copy of which was available in its day boat hire office.

The same procedure was used for customers hiring cruise boats, although they were also provided with a folder containing relevant safety information, and were requested to sign a boat acceptance certificate (**Annex B**).

On 19 July, it was a busy day at Barnes Brinkcraft, with the majority of its day boat fleet booked for hire. The briefing on *Breakaway 5* was conducted by the manager of the day boat hire operation, who was aware that one of the older children had taken out one of the company's day boats previously, but directed his comments mainly at the person who had hired the boat. During the briefing, the families were distributed around the vessel, with at least two people positioned on the foredeck. The *Handover Procedure Guide* was not used, but the manager had given the brief many times and it was a routine procedure, which included operating the bilge pump while talking, to remove any water in the bilge. The switch would then be left in the 'auto' position. The manager considered that he would have mentioned all of the points noted in the guide, but is not absolutely certain of this. The families, however, do not recollect being offered buoyancy aids or being advised of the maximum number of people permitted on the foredeck. A copy of the handover guide was available in the cabin, along with a copy of 'Broadcaster', issued by the Broads Authority, containing relevant information on its waterways.

1.10 THE RECREATIONAL CRAFT DIRECTIVE

1.10.1 Application

In 1994, Directive 94/25/EC (Recreational Craft Directive) was adopted by the European Commission to ensure a uniform level of safety in the design and manufacture of recreational craft throughout the European Economic Area. This established the free movement of recreational craft within the single market, and was implemented in the UK by the Recreational Craft Regulations 1996 S.I. 1996/1353. The provisions of the RCD applied within the UK on a non-mandatory basis from 1996 until becoming mandatory in 1998. Before its introduction, no comparable regulation existed within the UK.

The RCD seeks to prevent barriers to trade and create a single market by the harmonisation of Member States' laws, regulations and administrative provisions relating to the safety characteristics of recreational craft. It applies to all craft (with some exemptions) placed on the market or put into service and intended to be used for sporting and recreational purposes with a hull length of between 2.5 and 24 metres. This is achieved through a series of Essential Safety Requirements (ESRs) laid down in Annex 1 of the Directive, supported by specified conformity assessment procedures.

The Directive does not contain any retrospective provisions, and as such, existing boats in use in the EEA lie outside the Directive. As a trade directive, it bears on the first point of sale (or hire), and member states are unable to elaborate on its rules in the conditions they, themselves, impose on new craft.

At the national level, the Department of Trade and Industry (DTI) has responsibility for the Recreational Craft Regulations, with enforcement being the responsibility of local authority trading standards departments.

With regard to additional requirements of member states, the Directive states:

The provisions of this Directive shall not prevent Member States from adopting, in compliance with the Treaty, provisions concerning navigation on certain waters for the purpose of protection of the environment, the fabric of waterways, and ensuring the safety of waterways, providing this does not require modification to craft conforming to this Directive.

1.10.2 Stability requirements

The Directive's essential safety requirements regarding stability include:

- *Stability and freeboard*

The craft shall have sufficient stability and freeboard considering its design category..and the manufacturer's maximum recommended load..

- *Buoyancy and floatation*

The craft shall be constructed to ensure that it has buoyancy characteristics appropriate to its design category....and the manufacturer's maximum recommended load.

- *Manufacturer's maximum recommended load*

The manufacturer's maximum recommended load (fuel, water, provisions, miscellaneous and people (in kilograms) for which the boat was designed, ...shall be determined according to the design category, stability and freeboard, and buoyancy and flotation.

1.10.3 Testing requirements

Requirements for testing by notified bodies, which are professional bodies such as classification societies, are specified in a series of 'modules'. These are based on a craft's design category, size, and whether harmonised standards have been used. At the time of build, the *Breakaway* craft were categorised for use in 'Sheltered waters' (RCD Category D - *designed for voyages on small lakes, rivers, and canals where conditions up to, and including, wind force 4 and significant wave heights up to, and including 0.5m may be experienced*). As a consequence, they fell within Module A (*Internal Production Control*), which permitted Barnes Brinkcraft to assess the vessels' conformity with the prescribed essential requirements itself. No verification by an external body was required.

Where manufacturers do not use harmonised standards to demonstrate conformity with the RCD, they are obliged to prove compliance by means of their own choosing. At about the time of manufacture, the builder had been advised that experience of use was an acceptable means of satisfying the requirements of the Directive, providing this was adequately documented.

1.10.4 Administrative requirements

Administrative requirements of the Directive include the marking of craft with a CE logo, usually on the builder's plate, and the compilation of a file of technical information. In the case of complete craft or hulls, this file is to include test reports or calculations demonstrating that the craft has adequate stability in the anticipated sea conditions. The manufacturer also has to complete a Declaration of Conformity.

In compliance with these requirements, Barnes Brinkcraft produced both a technical manual and an owner's manual for *Breakaway 5*. Stability information included in the technical manual is at **Annex C**. This data was completed using a template containing example test information, and was probably issued to the builder by IBTC to help student boat builders during the implementation of the RCD. The only information added by the builder to the template was:

- The boat's categorisation – Category D
- The crew limit and maximum load – 10 persons and 1750kg
- The maximum speed - 5 knots
- A limit of two people on the foredeck while boat is in motion, and
- A comment that '*6 years of operating this hull shape has established this*' adjacent to the offset load test.

None of the *Breakaway* craft were fitted with a builder's plate detailing the category of waters in which the boat was designed to operate, or their maximum capacity. A plate, however, was illustrated in the boat's technical manual (**Annex D**), but again it is presumed that this was also based on a template, as both the builder and design categories were incorrect. The maximum number of people to be carried shown in the owners' manual was twelve (**Annex E**), which was at variance with maximum number determined and used by the builder.

1.11 STABILITY STANDARDS

In broad terms, harmonised standards are European standards which have been adopted by the European Standards Organisations, and match the essential requirements of the Directive.

Between 2000 and 2002, when ISO 12217-1, the stability standard for non-sailing recreational craft of 6m or over in length, was harmonised, there was no recognised stability standard for small recreational craft within the UK. During this period, it is reported that while some notified bodies used a draft version of the standard, the use of traditional methods and previous experience were also viewed as acceptable means of demonstrating compliance with the requirements of the RCD, particularly with regard to scantlings.

The harmonised standard used for determining maximum load capacity is ISO 14946, which details that the weight of one person equates to 75kg. This is also the weight used when conducting the physical tests in accordance with ISO 12217-1.

1.12 STABILITY TESTS

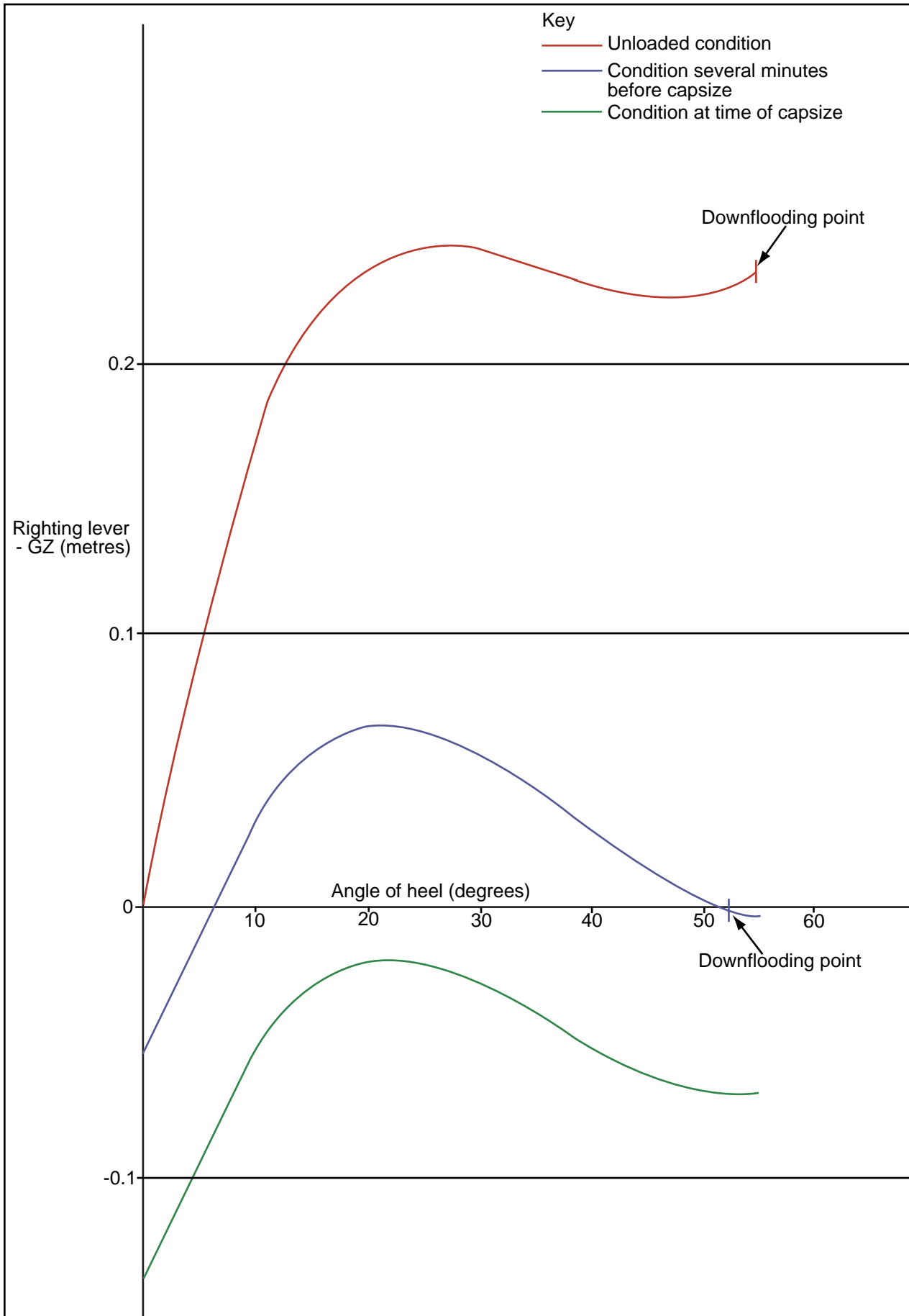
1.12.1 Inclining test

An inclining experiment to determine the craft's stability characteristics was conducted by the MAIB on 29 July 2003 using one of *Breakaway 5*'s sister vessels. An identical hull was also accurately measured using a theodolite. With the assistance of computer modelling, the information gathered from the inclining test and measurement of the hull was then used to determine the craft's stability in three conditions: the unloaded condition; an approximation of the condition several minutes before the accident; and the condition at the time of capsize. The resulting stability curves for these conditions are shown at **Figure 6**. A summary of the inclining test is at **Annex F**. This data is based on the vessel being static, and therefore does not take into account any dynamic effects such as heel induced by the vessel turning.

1.12.2 Offset load test

This test is an acceptable method within ISO 12217-1 of demonstrating that a craft has sufficient stability when the maximum recommended number of people on board are crowded to one side. After the inclining test conducted by the MAIB, Barnes Brinkcraft was advised to arrange for an offset load test to be conducted on a *Breakaway*. An independent marine surveyor completed this on 22 August 2003, and concluded that the boat was within the acceptable parameters specified by the standard. The test assumed that the foredeck area was not to be used. A summary of the results of this test is at **Annex G**.

Figure 6



Breakaway 5 - GZ curves

A further offset load test sponsored by BMF was conducted on 24 October 2003. The test was completed by a naval architect actively involved with the drafting of the ISO standard. On this occasion, separate measurements assuming a maximum of two people on the foredeck, and unrestricted use of the foredeck, were taken. Both confirmed that the *Breakaways* were within the parameters accepted by the standard. Computer modelling by the MAIB, using identical conditions, produced almost identical results.

During the offset load tests on 24 October, measurements of the vessel's downflooding height, when upright, and residual downflooding height, when heeled, were taken in accordance with ISO 12217-1 to determine if there was sufficient freeboard and margin of heel before significant quantities of water could enter the boat. The vessel did not meet the criteria required by the standard in this respect. A summary of the results of the tests arranged by BMF is at **Annex H**.

1.13 THE BROADS AUTHORITY

The Broads Authority was established by the Broads Act of 1988 to manage the Norfolk Broads, which includes the River Bure.

It is the third largest inland navigation authority in the UK after British Waterways and the Environment Agency. About 13000 boats use its waters, of which 8000 are cabin cruisers. Of these, about 1150 are hire boats for cruising and 308 are day hire boats.

All vessels navigating through waters controlled by the Broads Authority must pay an annual toll allowing them to do so. Hire boats are charged three times more than private users. The permit is proof of payment of the toll; it is not a licence to operate as a hire boat. The toll for *Breakaway 5* was first paid in December 2001. The Broads Authority does not have powers to demand evidence of boats' fitness for use, or any other safety requirements, before issuing a permit.

1.14 LOCAL AUTHORITY POWERS AND RESPONSIBILITIES

1.14.1 Licensing

Section 94 of the Public Health (Amendment) Act 1907 (**Annex I**), allows a local authority to grant licences for pleasure boats and pleasure vessels to be let for hire, with such conditions as it thinks fit. The local authority in this case was the North Norfolk District Council, which did not issue, or have any record of issuing licences for hire boats. The council did not have adequate resources or expertise to undertake its statutory powers in this respect, particularly in the verification of any conditions imposed.

1.14.2 Health and safety

Under the Health and Safety (Enforcing) Authority Regulations 1998, the Environmental Health Department of the North Norfolk District Council was responsible for enforcing health and safety legislation among boat hire companies, where hiring was the main commercial activity. Where hiring was not the main activity, the responsibility for this duty fell to the HSE. However, neither the use of private leisure craft, nor hired pleasure craft, is subject to the HSWA.

Barnes Brinkcraft was inspected by the Environmental Health Department of the North Norfolk District Council in 1996 and 1997. These inspections focused on the company's premises and risk assessment; there was no indication in the inspection reports that the company's boats had been checked. The company was also visited in 1999 and 2000, but these visits were made with regard to specific engineering issues unrelated to its boats.

At the time of the accident, the items on which the environmental health officer responsible for inspecting boat hire companies focused, during visits to hire companies, included: the provision of instructions for boat use and navigation, and the availability of lifesaving aids. The officer had no training or experience on boats, and was not aware of the essential requirements of the RCD. Boats were not inspected regarding their fitness for use, and reliance was placed on the operator to determine their carrying capacities.

There was no requirement for individuals, or companies engaged in the hire of pleasure boats, to inform a local authority's Environment Health Department or the HSE when starting to trade.

1.14.3 Trading standards

The Trading Standards Department of Norfolk County Council was responsible for enforcement issues regarding the compliance with the RCD of new boats placed on the market for the first time in its area. The DTI issued guidance on the directive to all boat builders via a product standards leaflet before its introduction, which stated:

The enforcement authorities have available to the various powers under the Consumer Protection Act....relating to suspension, prohibition and prosecution. Where a product bearing the CE marking is suspected of not complying with any of the provisions of the Regulations a compliance notice may be served, On the manufacturergiving the opportunity to secure conformity before further enforcement action is taken.

The Trading Standards Department of Norfolk County Council visited boat builders and hirers in its area at a frequency determined by complaints and risk assessments. Barnes Brinkcraft was last visited in October 2002, and was

assessed as being low risk for both fair-trading, and credit and safety. During the visit, the inspector focused on the areas of business, terms and conditions, the instructions given to customers, the safety of gas appliances and fridges, and the availability of buoyancy aids. None of the inspectors within the department had the expertise to check the conformity of boats with the essential requirements of the RCD. Therefore, when they visited boat builders and hirers, technical data was not reviewed.

As is also the norm with hired vehicles, the fact that a hired boat is involved in an accident was not considered by the Trading Standards Department to be sufficient grounds to enquire about the safety of the product or its conformity with the RCD.

There was no requirement for companies engaged in the hire of pleasure vessels to inform trading standards departments when introducing a new vessel, or when starting trading. The Trading Standards Department of Norfolk County Council relied on the experience of its inspectors and the Yellow Pages database to determine the whereabouts of hire boat operators in its area.

1.15 INLAND WATERWAY NAVIGATION AUTHORITIES

UK's inland waterways are not an integrated national network. About half the system was nationalised in 1948, with the remainder left in private hands or in those of public river authorities or drainage authorities. There are currently about 30 statutory navigation authorities, some of them public bodies, others private or voluntary. There are also a number of non-statutory authorities responsible for major inland waters. A list of the statutory and non-statutory authorities is at **Annex J**. Historically, navigation authorities have managed their waterways in different ways, reflecting the nature or the use of the water in question and the wider responsibilities of the body concerned. In 1996, the Association of Inland Navigation Authorities was formed to provide a single voice on waterways management.

British Waterways, the Environment Agency and the Broads Authority together manage about three-quarters of the length of UK's inland waterways.

1.16 LICENSING IN THE UK

1.16.1 Local authorities

In England and Wales, a number of local authorities exercise the powers given to them in the Public Health Act Amendment Act 1907 and issue licences to operators of hire boats, subject to payment and conditions. Examples include South Lakeland Council, Allerdale Borough Council and Eden District Council, which license a wide variety of pleasure craft. These include motor boats, sailing boats with auxiliary engines, sailing boats without auxiliary engines, rowing boats, sailboards, canoes, canadian canoes, kayaks, pedalos, and sea cycles.

In Scotland, local authorities also have discretionary powers to license hire boats under section 38 of the Civic Government (Scotland) Act 1982. A number of exemptions are detailed in this legislation, including fishing boats on non-tidal waters.

Although the conditions of licensing imposed by the councils differ in detail, common features include:

- The inspection of craft by suitably qualified persons
- The display and adherence to maximum capacities
- Fitness for purpose
- The prohibition of material changes to a vessel's layout without prior consent
- The provision of lifejackets or buoyancy aids
- The application of age restrictions
- The unsuitability of persons under the influence of alcohol or drugs
- The carriage of safety equipment
- Insurance

In determining the maximum number of people to be carried when licensing a hire boat, South Lakeland Council adheres to the number shown on the builder's plate, if built since the introduction of the RCD. Where this is not applicable, it is left to the judgment of the inspector to decide.

Some local authorities require applicants for boat hire licences to possess qualifications such as a Boatmaster's Licence or equivalent, and that people briefing the customers when hiring out the craft meet laid down criteria regarding age, health standards, and knowledge of statutory rules and bylaws.

1.16.2 British Waterways

British Waterways is a public corporation responsible for managing and maintaining 2600km of navigable inland waterway in England and Wales, and, as such, is the largest inland navigation authority. Under the Transport Act 1962, it is empowered to issue licences to businesses, including licences to operate hire craft, subject to conditions. Such craft using its waters are not required to be licensed by a local authority, where such authorities have elected to use their statutory powers in this respect. Examples of the general conditions of licensing imposed by British Waterways are at **Annex K**.

1.16.3 The Environment Agency

The Environment Agency is a non-departmental public body sponsored by DEFRA. It manages 875km of navigable waterway in England and Wales, nearly all of it rivers, and is the second largest inland navigation authority. Although the agency requires all boats using its waters to possess either a boat safety certificate, or a declaration of conformity with the RCD, it is not empowered to issue business licences with additional conditions. The agency, however, is seeking approval to amend its governing legislation to enable it to do so, but has yet to decide on the conditions to enforce.

1.17 THE BOAT SAFETY SCHEME

The Boat Safety Scheme, introduced in 1997, was a joint initiative of British Waterways and the Environment Agency to promote safety on the inland waterways in respect of boats, their installations and components.

The scheme's standards are legally enforceable by participating inland navigation authorities via local acts or bylaws. The navigation authorities generally enforce the legal requirement by requiring boat owners to submit a boat safety certificate before a licence to navigate is issued. Over 39,000 boats currently possess boat safety certificates.

A boat safety certificate is issued following successful independent examination of a craft against predetermined standards covering: inboard engines; electrical installations; electrically-propelled vessels; outboard and portable engines; fire prevention and extinguishing equipment; LPG installations; appliances, flueing and ventilation; and pollution. It is valid for four years, and the boat must be re-inspected before it can be renewed. In respect to hire boats, in addition to the standards applicable to other vessels, the scheme also specifies standards to be adhered to regarding lifebuoys, handrails, hull openings, ventilation, and the use of safety glass. The scheme does not specify standards of stability of any vessel, nor requirements of operation with regard to hire boats.

The Broads Authority does not operate the Boat Safety Scheme but has undertaken to do so by 2005. This will require a change in its bylaws to be approved by the Ports Division of the DfT, or other legislative changes.

1.18 THE MARITIME AND COASTGUARD AGENCY

In August 2003, the DfT published a report titled *Inland Water Safety – Final Report of Scoping Study*. With reference to UK legislation regarding vessel safety the report stated:

*At a national level, the body primarily charged with regulating the safety of vessels on inland waterways is the MCA. Its role derives from similar duties it has in relation to estuarial and tidal rivers. While both its statutory duties and its non-statutory functions are important, none is exercised **exclusively** on inland water.*

The regulations made by the MCA for the safety of vessels operating on inland waterways and those on them include:

- Certification of passenger vessels carrying more than 12 passengers;
- The issuing of boatmasters' licences to be held by skippers of all domestic passenger ships not covered by STCW;
- The regulation of the qualifications for recreational boaters (eg Yachtmaster);
- The categorisation of inland waters as a basis for determining the detailed statutory requirements which apply to passenger vessels carrying more than 12 passengers on them;
- The enforcement of statutory standards laid down for non-passenger vessels covering areas such as fire, quality of navigation visibility, and lifesaving appliances; and
- The confirmation of bylaws for the regulation of pleasure boats and vessels let for hire to the public made by local authorities in England.

The MCA, in association with AINA, is due to publish in February 2004 a Code of Practice for the safety of small passenger vessels carrying up to 12 passengers on inland waterways, which includes stability and operations procedures. The Code was developed by a working group established by the Marine Safety Co-ordinating Committee (MSCC) to develop national standards for these vessels. The working group, which comprised all interested parties, set out to establish standards of safety and protection for all on board. The level of safety the Code set out to achieve was considered to be in line with the expectations of the general public.

The MCA does not, however, regulate pleasure vessels, or pleasure vessels let or hired on inland waterways, other than class XII pleasure vessels (over 13.7m in length).

1.19 PREVIOUS ACCIDENTS

The MAIB is not aware of any previous fatalities which have resulted from the capsizing of a hire boat operating in inland waterways. Whilst there is a mandatory requirement to report accidents affecting commercially operated boats on UK inland waterways to the MAIB, operators/hirers are not always aware of this requirement. Consequently, the frequency of accidents on these waters is unclear, but is considered to be higher than the MAIB records show. The current regulations are being reviewed to address this problem.

Two other similar accidents have been previously reported to the MAIB. One involved the narrowboat *Sandpiper* on the River Avon in July 1989. *Sandpiper* capsized with fourteen people on board, ten of whom were sitting on the cabin top at the time of capsizing. The vessel was specified to carry only four adults. One of the passengers was trapped in the upturned hull for an hour before being successfully rescued by the fire brigade. Conclusions of the resulting MAIB investigation included:

- *Sandpiper* capsized because the number and position of the people on board caused the boat to become unstable.
- There was no effective control by management to ensure that the number of people contracted to use the boats did not exceed the specified maximum limit.
- British Waterways does not examine the stability of vessels using the network of rivers and canals under its control.

The resulting recommendations included:

- Hire boats using British Waterways controlled canals and rivers should satisfy certain stability conditions before a certificate of compliance is issued to the boat.

(The certificate was given to show compliance with the then extant British Waterways code of practice, 'Standards of Equipment and Construction of Pleasure Boats and House Boats.')

- A permanent notice should be clearly displayed indicating the approved maximum number of people allowed on the hire boat using British Waterways canals and rivers.
- Management should warn users of the dangers of overloading a boat.

The first of these recommendations was not accepted by British Waterways because it considered the capsizing would not have occurred had the operator passed on information regarding the vessel's maximum capacity and the dangers of overloading.

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 CAUSE OF THE CAPSIZE

Breakaway 5 had operated successfully with a maximum of ten people on board for 2 years. On 19 July 2003, however, she capsized without warning, after appearing stable during the 5 hours she had been on hire that day.

From the stability data shown at **Figure 6**, it is evident from the area below the GZ curve that the boat's standard of stability in the unloaded condition is good. Indeed, it almost meets the requirements for vessels operating at sea. In the approximated condition several minutes before the accident, although there is an initial list of about 6° to starboard, a positive righting moment up to about a 50° heel remains. In the condition at the time of capsize, however, which was achieved by moving just three of the party in the previous condition, stability is reduced to the extent that the righting levers do not reach a positive value.

It is, therefore, concluded that the weight and distribution of the people on board, which was biased forward and to starboard of the centreline, caused *Breakaway 5* to become unstable and capsize. Once the craft had started to heel to starboard, the resulting involuntary movement to starboard of many of the people, and the turn to port, would have exacerbated the boat's instability and increased the speed of capsize. It was not surprising that the movement of one of the young adults to the port side did not check the boat's movement, as a much larger weight would have been needed to counter the momentum of the heel.

There is little to support the possibility that there was sufficient water in the bilge to adversely affect the boat's stability. The bilge was pumped during the morning of 19 July, there was only a small amount of fluid seen in the bilge when the engine cover was raised, and there was no evidence of any water ingress into the hull via the engine cooling system or hull fittings. The only evidence of water entering the bilge was via the rudder stock, and, although it is expected that a small amount would also have entered through the stern gland to provide cooling lubrication when the propeller shaft was turning, this would have been insignificant over the course of the day. The fact that the bilge pump switch was found in the 'off' position, therefore, is not considered to be significant.

Had an appreciable amount of water been in the bilge, the resulting free surface effect would have reduced stability to the extent that those on board would have possibly noticed a change in the way the boat was handling.

Although the *Breakaway* later failed a downflooding height test conducted in accordance with ISO 12217-1 (**Annex H**), the point of failure was the access between the cockpit and the swimming platform at the stern. As the residual downflooding height increased with the angle of heel to starboard during the offset load test, it is considered that this deficiency had no bearing on the accident.

It is also improbable that an underwater obstruction contributed to the capsize. The pieces of wood found aft of the upturned boat were close to the bank and did not protrude sufficiently from the riverbed to have made contact with the vessel in her upright condition. It is also significant that nobody on board heard or felt the boat hit an obstruction, and that no damage was evident on the port underside of the hull. The shallow scratch on the starboard underside of the hull is not considered to be significant in relation to the cause of the accident.

2.3 ASSESSMENT OF STABILITY

The capsize of *Breakaway 5* on a calm inland waterway with the builder's recommended maximum number of people on board, showed that it did not conform with the essential stability requirements of the RCD, namely: "*The craft shall have sufficient stability and freeboard considering its design category and the manufacturer's maximum recommended load*".

Breakaway 5 was not designed, it was a hybrid created by adapting and transferring the superstructure from one boat to a completely different hull form of another. The resulting vessel was very different to the boats previously constructed by Barnes Brinkcraft using the same hull. The builder's operating experience of the hull with the *Brinklet* and *Picnic* craft was, therefore, not an appropriate demonstration of compliance with the stability elements of the RCD. In particular, the addition of the sloping foredeck, which extended above the gunwale of the original hull for about half of the boat's length, was an area passengers could potentially occupy, regardless of the builder's intention to restrict its use. Because this was not taken into account, the boat's maximum capacity was determined on the basis of the number of seats available alone, and the possible need to restrict people on the foredeck to preserve stability, as well as personal safety, was not considered.

The builder had extensive practical experience of sailing and building a variety of craft, but little training or knowledge in stability or theoretical boat design. Although stability data could have been obtained by using the methods within the draft stability standard, or by inclining the vessel, these were unfamiliar to the builder. With his operating experience of the *Brinklet* and *Picnic* as the way of showing compliance with the RCD, it was understandable that he did not consider calculation or extensive testing necessary. It is probable that his approach would not have been markedly different from that of his peers in similar companies.

2.4 FITNESS FOR PURPOSE

No boat is unsinkable, but all boats should be made as safe as possible by minimising risk in relation to their intended purpose. People hiring boats on UK inland waterways require no knowledge, experience, or relevant qualification regarding their operation, and it is reasonable to expect that hire boat operators adopt safety measures to take account of the potentially unconventional actions of customers. It is sensible that such measures include a considered assessment of a boat's maximum capacity to allow safe operation in all foreseen conditions, other than deliberate misuse.

It is acknowledged that hire boat operators can do little about their customers deliberately misusing boats let for hire. For example, they are unable to prevent additional people being taken on board once a boat is out of sight from the boat yard, or to stop deliberate attempts to make a boat unstable. However, a clear distinction must be made between deliberate misuse and misuse through ignorance.

Barnes Brinkcraft expected its *Breakaway* customers to remain mainly in the cockpit area, where sufficient seating was provided for the maximum numbers allowed. However, it was highly unlikely that any group of ten people would have stayed seated within the confines of the cockpit area for a substantial period. There is a natural tendency to move around for comfort and to facilitate social interaction. In a party which includes adults and children (particularly teenagers), a tendency to separate into two or more spatially separated groups is natural, and on a warm, sunny day, it is not surprising that the younger members of the group were attracted to the foredeck. In this case, the movement of people forward, which allowed their weight to be concentrated to starboard of the centreline, was the result of predictable social behaviour and ignorance of the potential consequences, not deliberate misuse. The rocking of the vessel could be interpreted as deliberate misuse, but this was stopped by the intervention of an adult before the capsizing occurred.

The ladder providing access to the foredeck of the *Breakaway* was a physical indication that such access was sanctioned. In the absence of any warning signs, the stipulation in the briefing to hirers, that access should be restricted to two people at a time, was unlikely to be universally effective, and, in practice, might well have been honoured more in the breach than the observance. Barnes Brinkcraft's expectation that its customers would only use the seating available was, therefore, optimistic, and the boat's suitability to safely carry ten passengers with regard to comfort, habitability, and the space available was questionable. A more realistic consideration of the space requirements of individuals, and their likely movements, might have led to a more conservative decision regarding the boat's maximum loading.

Barnes Brinkcraft was aware of instances of the deliberate rocking by groups sited outside the normal seating, but these probably re-enforced its positive opinion of the boat's stability, rather than caused it to question the appropriateness of the space available.

2.5 ADEQUACY OF THE BRIEFING

It is not certain whether the day boat hire manager briefed the restriction on the number of people on the foredeck or offered buoyancy aids before *Breakaway 5* left Barnes Brinkcraft. He was very busy that day and was only on board for a few minutes. He had, however, undertaken the procedure many times, and had developed a set routine.

If buoyancy aids were offered, the manager could not have made more than a token effort to persuade the lead hirer of their benefits when he first arrived. It is possible that had buoyancy aids been offered to the entire group, the deceased might have taken one. She was not a strong swimmer, and had worn one during previous trips on a hire boat. It is impossible to predict, however, whether the wearing of a buoyancy aid would have resulted in a different outcome, particularly as the deceased was trapped under the up-turned boat.

If the restriction on the foredeck was included in the handover procedure, it is evident that the manager did not make all of the party aware of it. Also being unaware himself of the stability implications of people spreading to the foredeck, it is unlikely that the importance of the restriction would have been emphasised. If the manager did brief the restriction, it was one of many covered at a quick pace, and did not register with any of the hiring party.

As the manager demonstrated a concern for safety, by obtaining qualifications as a Boat Safety Examiner and Assessor of Boat Safety Examiners, it is very unlikely that his approach to the safety aspects of hiring boats to the public was inferior to that of his peers in similar companies. In a day boat hire operation involving many boats, even where a company has a responsible attitude to the hiring operation, there is, inevitably, pressure to get customers out on the water as quickly as possible. Customers do not want to waste valuable time, and the company will have the pressure of other boats to attend to. Therefore, Barnes Brinkcraft was likely to have been typical of most boat hire firms in the small amount of time devoted to briefing customers, its differentiation between day boat and cruise hire with regard to the information provided, and the limited effort made when offering buoyancy aids.

The importance of the need to properly brief customers before a boat is let for hire has been recognised by the hire boat industry, and, in 2000, BMF produced a 'Guide to Hire Boat Handover Procedures' on behalf of APCO. The guide was intended for use by operators providing holiday hire boats for short breaks or longer cruises, rather than day or shorter periods of hire. The provision of relevant information regarding a boat's safe operation is essential, regardless of the duration of hire. So the time and effort required to ensure customers are aware of this information must be commensurate with the complexity of the operation of a vessel, not the limited time available.

2.6 ABSENCE OF AN INDEPENDENT ASSESSMENT

2.6.1 Conformity with the RCD

Barnes Brinkcraft's assessment of the maximum number of people to be carried was not questioned because Module A (*Internal Production Control*) of the RCD did not require a notified body to verify the vessel's conformity with the Directive's prescribed essential requirements.

Also, on entering service, responsibility for monitoring the boat's conformity in this respect lay with the Trading Standards Department of Norfolk County Council, which could have taken action against Barnes Brinkcraft if it considered the company to be in breach of its obligations under the Recreational Craft Regulations. This department was highly unlikely to uncover the flaws in the determination of the *Breakaway's* maximum loading, or the irregularities in its technical documentation, because of its lack of expertise, and its reactive nature. Its inability to inspect boats and associated technical data during visits meant that the department would only have been aware of a problem with the *Breakaway* craft had a customer complained to them about the craft's safety. As the vessels were let for hire rather than put on sale, it is not surprising that given the probable inexperience of the majority of people hiring day boats, the difficulty in assessing boat stability, and the absence of scrutiny normally expected from a discerning purchaser, no complaints were forthcoming.

Even had the capsizing of *Breakaway 5* triggered enquiries from the Trading Standards Department regarding its safety or conformity with the RCD, the Norfolk County Council would not have had the expertise readily available to make any meaningful assessment. To provide a proactive and an effective reactive means of enforcement of vessels' conformity with the RCD, local trading standards departments would need to have appropriate expertise available.

2.6.2 The Norfolk Broads

On the Norfolk Broads, the regulation of hire craft is totally voluntary, and Barnes Brinkcraft had taken a number of positive measures intended to guard the safety of its customers. These included: its adoption of a prescribed handover procedure; the availability of buoyancy aids; its compliance in spirit with the requirements of the Boat Safety Scheme; and its regular maintenance and boat servicing schedules.

However, no independent checks are made on hire boats to verify their safe operation or fitness for purpose, and no licensing regime is in effect. North Norfolk District Council does not exercise its statutory power to issue licences with conditions, and the Broads Authority is not empowered to do so. Also, although the district council's powers under the HSWA (enforcement) regulations apply to hire companies' shore-side activities, they do not extend to the hire craft themselves.

2.6.3 Consequences

The *Breakaway* was a markedly differing style to its forerunners. Accordingly, it is difficult to see how scrutiny of the boat by a suitably qualified person could have failed to question the validity of the previous experience of the hull, the optimistic expectation that customers would remain in the seats provided, and the irregularities in the boat's technical and owner's manuals, when considering its fitness for purpose. The lack of a requirement for such scrutiny was a significant omission.

2.7 THE SAFETY OF HIRE BOATS WITHIN THE UK

2.7.1 Licensing

Any person hiring a boat within the UK has the right to expect that the boat provided will be safe to use, and be properly instructed in how to use it. The situation on the Norfolk Broads illustrates that this is not necessarily the case, and it is evident that the lack of independent assessment or regulatory control is not confined to this area alone.

The management of the inland waterways is a complex web of numerous authorities, empowered to varying degrees by different legislation. Intent to regulate hire boats on these waters has been in evidence since the Public Health Amendments Act of 1907, but such regulation has never been consistent either in terms of the conditions set, or the geographical areas in which it has been applied.

Scope exists, in some inland waters of the UK, for boats to be hired to the public by companies which are not required to, or choose not to, apply appropriate safety measures. Such companies can potentially operate without the knowledge of local authorities, since there is no requirement for trading standards, or departments responsible to the enforcement of the HSWA, to be informed on start up. Even where conditions of licensing are imposed, there is no guarantee that such conditions are effective in ensuring a hire boat's safe operation. For example, none are known to require vessels to conform to a particular stability standard.

2.7.2 A national standard

The safety record of the hire boat industry within the UK has generally been good, and many craft in operation have been well tried and tested in their role. The disparate nature of independent checks made on hire craft across the UK, and the potential pitfalls of the RCD, however, suggest that accidents similar to *Breakaway 5* and *Sandpiper* are possible in the future.

Initiatives already undertaken to improve safety on inland waters, such as the Boat Safety Scheme, the conditions of licensing of hire boats set by some local authorities, and the measures taken by hire boat operators themselves, have

been positive steps. But, because of the complex and fragmented nature of the management of inland waterways, these measures have not been applied uniformly across the UK, and in any case, they do not include specific stability requirements.

There is no doubt that public safety would benefit from all hire craft operations being independently assessed in accordance with a common standard or code of practice. Such a standard must include all aspects of hire boats' operations, including the core issues highlighted in this and the *Sandpiper* investigations, namely: fitness for purpose with regard to stability and numbers borne; the content and conduct of the handover procedure; and the provision of lifesaving equipment. Much of this could be achieved by adding to the good practice already exercised voluntarily by many hire companies, including Barnes Brinkcraft, and that imposed through conditions of licensing and via the Boat Safety Scheme. However, any common standard or code of practice will need to take into account the varying types of pleasure craft let for hire, and the waters on which they operate.

2.7.3 Role of the MCA

The MCA is the body primarily charged with the regulation of the safety of vessels on inland waterways, and, given its expertise and positive influence in many other areas of maritime commercial activity, a greater involvement in the safety of operation of craft let for hire would be of benefit. It is best placed to determine the content of a code of practice or a national standard for hire boats. It is also well placed to decide how to overcome the diverse legislation and powers which have a bearing, to ensure that such a code of practice can be universally applied.

2.8 HARMONISED STANDARDS

2.8.1 Stability

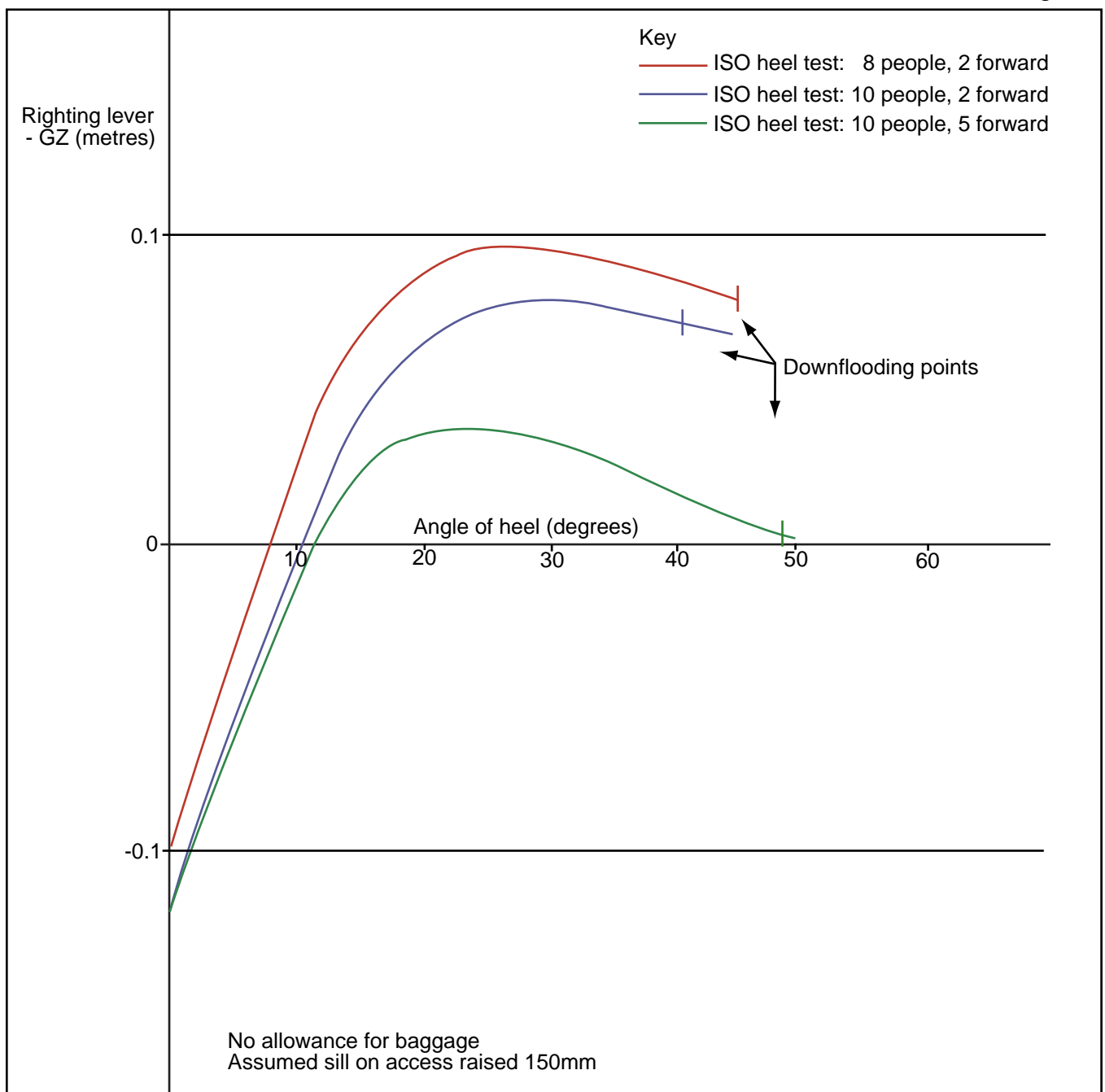
Tests have shown that, had the stability of the *Breakaway* been checked on build, using the methods within the draft of the later harmonised ISO 12217-1, the maximum capacity determined by the builder would have remained permissible. Moreover, it would have allowed the same number without a restriction being placed on the use of the foredeck. As the boat capsized on 19 July as a result of the offset loading of her passengers, this raises concern regarding the usefulness of the standard in this case.

The offset load test used in ISO 12217-1, which is similar in principle and scope to heel tests used by the MCA in its codes of practice, is intended to ensure that the angle of heel achieved with the maximum recommended number of people on board remains within predetermined limits based upon a vessel's length. In this case, the predetermined maximum angle of heel with ten people offset from the centreline was 18.63°. **Annex H** shows that the actual angle of heel

achieved to port was 11.7°, which was well within the prescribed limit. However, although the test provides a degree of heel at which a vessel will remain stable, it does not provide an overall assessment of the vessel's stability, or an indication of the actual angle at which stability vanishes.

Although the angle of heel achieved during the test was permissible, the area below the GZ curve produced from the *Breakaway's* condition during the offset load test (five people on the foredeck and five in the cockpit) (**Figure 7**) indicates that only a small amount of stability remained. This stability can soon be diminished by several factors, such as the weights of the passengers being

Figure 7



Breakaway GZ curves - test conditions

greater than allowed for, and the positions of the passengers being more extreme than expected, both of which contributed to *Breakaway 5's* capsize. The methodology of the standard does not allow a margin of safety to allow for such possible variations, for the possible differences in the interpretation of the conduct of the offset test, or any dynamic effects when a vessel is underway. If it did, more confidence could be placed in its validity in all cases.

2.8.2 Weight

The total weight of the group of ten was 845kg. As the international standard for determining the maximum capacity of a boat (ISO14946) assumes an average adult weight of 75kg, the group was nearly 100kg heavier than the total weight used in the offset load test conducted on 24 October 2003. This represents an additional 1.25 people. Statistical data for the UK population, supplied by QinetiQ, can be used to provide a basis on which to estimate the probability of such a large total weight being achieved. This data is shown in **Figure 8**.

Figure 8: Table Showing Probability of Achieving Large Total Weight

Random sample			probability	probability	95th %ile*
Males	Females	mean total weight (kg)	>750kg	>845kg	(kg)
5	5	732.3	>0.27	<0.0001	780
10	0	797.5	>0.87	<0.13	865
0	10	667.0	>0.02	<0.0001	736

*The 95th percentile is the weight above which 1 in 20 samples would fall.

It is evident that, although this hiring party appears to represent an extreme case for a mixed party of men, women, adults, and children, even allowing for their relatedness, to reach the overall weight of 845kg, it had at least a 27% probability of exceeding 750kg.

Also, if parties of adult men are common, the risk of a total party weight reaching extreme values is significant. Such a party has at least an 87% probability of exceeding a total weight of 750kg, and a 13% probability of exceeding 845kg. This casts doubt on the validity of the stability calculations and tests used to determine maximum capacities, which use the 75kg per person as a standard.

If anything, it would be prudent to over-estimate the assumed weight of people when determining maximum capacities, particularly for hire craft. This would allow a margin of safety when hiring to groups of varying and unknown weights. Otherwise, the stability criteria established using the notional 75kg per person would potentially be invalidated unless operators took the impractical and undoubtedly unpopular step of determining the total weight of each hire party.

2.9 PROBLEMS WITH THE RCD

2.9.1 Additional requirements

In areas where licensing conditions are applied, or the Boat Safety Scheme has been adopted, authorities have, to date, been advised not to place requirements on new vessels over and above the essential requirements of the RCD. This is because additional requirements cannot require modifications to craft conforming with the Directive, which includes the maximum number of people the builder, or notified body, has determined can be carried.

Yet it is evident from this accident that a declaration of conformity with the requirements of the RCD is not a guarantee that the essential requirements of the RCD have been met, nor is it a guarantee of a vessel's fitness for purpose as a hire boat. The potential flaws in self-certification, and the harmonised stability standard, are of particular concern. The RCD is primarily a trade directive, and although the introduction of safety criteria, via its Essential Safety Requirements, is likely to have contributed to the safer design and construction of recreational craft, it cannot be allowed to be a barrier to the maintenance or improvement of the safe operation of hire craft, or any other vessel.

2.9.2 Understanding

Although introduced in 1996, the RCD had only been mandatory for 2 years when the *Breakaways* were built. The document itself is open to interpretation, and it is reported that despite considerable publicity during its implementation and industry-led information campaigns, many small boat builders did not, and still do not, fully understand how to put its requirements into practice. The irregularities in the boat's technical and owner's manuals, and the failure to affix a builder's plate, are possibly symptomatic of this.

Recognising the difficulty that small boat builders experience when interpreting and applying the requirements of the RCD, and the potential pitfalls in its self-certification process, the BMF is working on two schemes. The first is an RCD management system incorporating the harmonised ISO standards and a step-by-step guide, which is intended to give boat builders a clearer picture of what they are supposed to do and how. The second is the Blue Riband scheme, the concept of which is to ensure the quality of boats British Waterways sells through its marinas by third party inspection. Both schemes are positive measures, but because the BMF's efforts will probably fall short of companies outside its membership, the potential for self-certificated boats not to meet the essential requirements of the RCD is likely to remain.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES

The following are the safety issues identified by the investigation. They are not listed in any order of priority.

1. The results of the tests and calculations conducted by the MAIB show that *Breakaway 5* capsized because of the weight and distribution of the people on board. [2.2]
2. The capsize of *Breakaway 5* on a calm inland waterway showed that it did not have sufficient stability considering its design category and the builder's maximum recommended load. [2.3]
3. The builder's operating experience of the hull with the *Brinklet* and *Picnic* craft was not an appropriate demonstration of compliance with the stability elements of the RCD. [2.3]
4. The builder's chosen method of showing compliance with the RCD was understandable, and his approach would not have been markedly different from that of his peers in similar companies. [2.3]
5. The concentration of people forward and to starboard on board *Breakaway 5* was the result of predictable social behaviour and ignorance of the potential consequences, not deliberate misuse. [2.4]
6. An expectation that passengers would only use the seating available was optimistic, and the boat's suitability to safely carry ten passengers with regard to comfort, habitability, and the space available was questionable. [2.4]
7. It is possible that had buoyancy aids been offered to the entire group, the deceased might have taken one. It is impossible to predict, however, whether the wearing of a buoyancy aid would have resulted in a different outcome, particularly as the deceased was trapped under the upturned boat. [2.5]
8. If the restriction of the numbers of people on the foredeck was included in the briefing, it was one of many items covered, at a quick pace and without emphasis, and did not register with any of the hiring party. [2.5]
9. Barnes Brinkcraft was likely to have been typical of most boat hire firms in the small amount of time devoted to briefing customers, its differentiation between day and cruise hire with regard to the information provided, and the limited effort made when offering buoyancy aids. [2.5]

10. The Trading Standards Department of Norfolk County Council was highly unlikely to uncover the flaws in the determination of the *Breakaway's* maximum loading because of its lack of expertise and reactive nature. To provide a proactive and an effective reactive means of enforcement of vessels' conformity with the RCD, local trading standards would need to be better resourced. [2.6.1]
11. No independent checks were made on the boat to verify its safe operation or fitness for purpose, and no licensing regime is in effect. North Norfolk District Council did not exercise its statutory power to issue licences with conditions, and the Broads Authority was not empowered to do so. Also, although the district council's powers under the HSWA (enforcement) regulations applied to hire companies' shore-side activities, they did not extend to the hire craft themselves. [2.6.2]
12. The absence of any requirement for an independent evaluation of the *Breakaway's* fitness for use as a day hire boat was a significant omission. [2.6.3]
13. Scope exists, in some inland waters of the UK, for boats to be hired to the public by companies which are not required to, or choose not to, apply appropriate safety measures. [2.7.1]
14. There is no doubt that public safety would benefit from all hire craft operations being independently assessed in accordance with a common standard or code of practice. [2.7.2]
15. As a *Breakaway* boat passed the offset load test conducted in accordance with ISO 12217-1, but *Breakaway 5* capsized a result of the offset loading of its passengers, concern exists regarding the usefulness of the standard in this case. [2.8.1]
16. The offset test within ISO 12217-1, which is similar in principle and scope to heel tests used by the MCA in its codes of practice, determines a degree of heel at which a vessel will remain stable, it does not provide an overall assessment of the vessel's stability or an indication of the actual angle at which stability vanishes. It also does not allow any margin of safety for potential extreme conditions, for possible differences in the interpretation of its conduct, or any dynamic effects when a vessel is underway. [2.8.1]
17. A group of adult men has at least an 87% probability of exceeding a total weight of 750kg, and a 13% probability of exceeding 845kg. This casts doubt on the validity of the stability calculations and tests used to determine maximum capacities, which use 75kg per person as a standard. [2.8.2]

18. The RCD is primarily a trade directive, and although the introduction of safety criteria, via its Essential Safety Requirements, is likely to have contributed to the safer design and construction of recreational craft, it cannot be allowed to be a barrier to the maintenance or improvement of the safe operation of hire craft, or any other vessel. [2.9.1]
19. Despite industry-led efforts to improve knowledge of the requirements of the RCD among small boat builders, the potential for self-certified boats not to meet the essential requirements of the RCD is likely to remain. [2.9.2]

SECTION 4 - ACTION TAKEN

The MAIB published a Safety Bulletin on 22 August 2003, which was distributed to the hire boat industry via the BMF, and also to all local authorities. A copy of the bulletin is at **Annex L**. The safety recommendations made in the bulletin are:

1. Ensure that on completion of build, or any modification altering a vessel's stability characteristics, the consequences of such changes has been determined through calculation and testing by a suitably qualified person before the vessel is put into service.
2. Allow an adequate safety margin when determining the maximum number of passengers a boat is authorised to carry, taking into account the potential inexperience and weights of the persons hiring a boat, and the worst case effects of uneven weight distribution.
3. Ensure that handover procedures and briefs to persons hiring a boat be comprehensive, and include the dangers of uneven weight distribution, particularly on raised decks.

The MAIB is considering methods to improve the reporting of accidents on inland waterways which will be incorporated in the next revision of the current accident reporting regulations.

Barnes Brinkcraft has taken the following actions:

- Following the testing of a *Breakaway* in accordance with ISO 12217-1, the maximum number of people carried has been reduced to eight.
- The restriction of access to the foredeck has been given greater emphasis during handovers.
- Signs, informing customers of the restricted access to the foredeck, have been placed in the *Breakaway* craft.
- All customers are invited to sign a boat acceptance certificate (**Annex B**) before taking a boat on hire.
- Stated its intention to modify the hull to comply with the requirements of ISO 12217-1 with regard to downflooding height.
- Stated its intention to seek the advice of an independent party when assessing a vessel's compliance with the RCD.

The **MCA** intends to include, from 1 January 2004, the following note on Passenger Safety Certificates for Class III – VI(A) passenger vessels:

“The passenger numbers recorded on the certificate are based on an average mass of 75kg per person including hand baggage. Where this figure is significantly exceeded an appropriate risk assessment should be carried out, based on the likely effect on the stability of the vessel and escape/evacuation arrangements. If necessary passenger numbers carried should be reduced. The appropriate load line markings shall not be submerged.”

SECTION 5 - RECOMMENDATIONS

Unless already undertaken by other authorised authorities, **local authorities** are recommended to:

2004/122 Assume responsibility for ensuring that hire boats operate safely within their area of interest by arranging the introduction of licensing regimes supported by the inspection of hire craft by competent bodies.

To support this, **the MCA** is recommended to:

2004/123 Form and chair a working group of key interested parties including inland navigation authorities, local authorities, and the hire boat industry, to draw on current best practice to:

- a. Agree on how licensing regimes operated by inland navigation and local authorities can be co-ordinated to ensure full coverage of the UK inland waterways, and to seek the empowerment of appropriate inland navigation authorities to license if required.
- b. Develop within 15 months, a national code of safe practice for boats let for hire on inland waterways, to include, as a minimum, requirements for hire boat construction, stability, fitness for purpose, life saving equipment, and handover procedures.
- c. Liaise with the DTI to clarify the impact of the requirements of the RCD on any national code of practice and licensing requirements for pleasure craft let for hire, and provide ongoing advice to the DTI regarding deficiencies and areas of concern in this respect.

The **British Standards Institution** is recommended to:

2004/124 Propose to the International Standards Organisation, that ISO 12217 Parts 1 and 3 should be reviewed with the intention of introducing a margin of safety within the methodology of its offset load test, and take into account the probability of a person's weight exceeding 75kg.

The **MCA and British Standards Institution** are jointly recommended to:

2004/125 &
2004/126 Raise with IMO and ISO respectively, the validity of the use of 75kg to represent a person's mass when determining criteria and limits based on the weights of individuals.

The **MCA** is also recommended to:

2004/127 Review the stability tests currently required within all its codes of practice for small craft with a view to introducing a margin of safety in their methodology, and to take into account the probability of a person's weight exceeding 75kg.

The **BMF** is recommended to:

2004/128 Encourage boat builders to arrange for an independent competent audit of their methods used to certify a boat's conformity with the essential requirements of the RCD.

The **DTI** is recommended to:

2004/129 Re-examine the methods used to raise the awareness of the RCD among small boat builders, and to improve their understanding of the means of demonstrating compliance with its Essential Safety Requirements.

2004/130 Ensure that relevant local authority Trading Standards Departments are aware of their responsibilities as enforcement authorities with regard to the application of the Recreational Craft Regulations.

**Marine Accident Investigation Branch
February 2004**

Barnes Brinkcraft *Handover Procedures Guide for Employees*

HANDOVER PROCEDURE - Guide for Employees

1 fendoff per eye 3 ropes 2 rhond anchors
1 dropweight & rope 1 lifebuoy 1/2 fire extinguishers

Show the location of the above equipment and how to use it.

Offer buoyancy aids and instruct how to use them.

Offer adequate instruction with this craft in relation to:

1. Handling, manoeuvring and mooring.
2. Safety precautions to be taken when moving about on deck and approaching bridges.

(ie Daylaunches no more than 2 persons on foredeck of boat)

3. The use of gas appliances, and the need for adequate ventilation when in use.

Our responsibilities to the environment, wildlife and other river users particularly;

- a. Observing speed limits for safety and to avoid the danger of bank erosion.

ie 3mph to main river, 4 mph thereafter - show this on rev counter and point out sticker on dash

indicating speeds - comfortable walking pace.

- b. Keeping out of reeds and avoiding shallow water.
- c. Disposal of rubbish
- d. Keeping noise down.
- e. Acting and navigating responsibly at all times (including NOT navigating at night.)

Barnes Brinkcraft Boat Acceptance Certificate

BOAT ACCEPTANCE CERTIFICATE

BOAT _____ SKIPPER _____ DATE _____

YOUR TRIAL RUN IS WITH: _____

The following deck gear is on board:

1 fendoff per eye 3 ropes 2 Rhond anchors 1 boathook
1 dropweight & rope 1 lifebuoy 1 mop fire extinguishers

I have been shown the location of the above equipment and how to use it.
We have been offered buoyancy aids for our party and been advised to use them.
I acknowledge that I accept responsibility for this craft and have received adequate instructions,
in particular with reference to:

1. Handling, manoeuvring and mooring.
2. Safety precautions to be taken when moving about on deck and approaching bridges.
3. The use of gas appliances, and the need for adequate ventilation when in use.
4. Engine maintenance, including checking weed filter(s), header tank and sump oil.
5. Boat Maintenance, including checking water and fuel, the importance of not allowing the tank level to fall below quarter full. (Customer is liable for call outs due to craft running out of diesel)

Our responsibilities to the environment, wildlife and other river users particularly:

- a. Observing speed limits for safety and to avoid the danger of bank erosion.
- b. Keeping out of reeds and avoiding shallow water. (Customer is liable for call out costs due to running aground)
- c. Disposal of rubbish.
- d. Keeping noise down.
- e. Acting and navigating responsibly at all times (including NOT navigating at night).

I confirm that to the best of my knowledge I am satisfied with the condition of the craft, her inventory and mechanical performance and feel confident to handle her. We understand and appreciate the advice given in our Holiday handbook and in the Skipper's handbook provided on board. I acknowledge that I am welcome to return (or phone) for further instruction if necessary.

PLEASE ENJOY YOUR HOLIDAY WITH US.

SIGNED _____ DATE _____

DEPOSIT RECEIPT & RECORD

1. DEPOSIT RECEIPT and RECORD

Security _____			
Security Surcharge _____			
Fuel Deposit (Covers Litres) _____			
TOTAL DEPOSITS _____			
Add: Reimbursements (if any) _____			£
2. DAMAGE RETENTIONS (security deposits only) _____			
Fuel			
Amount used @ _____			
Cleaning Charge: (we reserve the right to charge for craft left dirty) _____			
Late Return Charge _____			
Excess Fuel Charge _____			
TOTAL RETENTIONS			£
3. AMOUNT REFUNDED (by cheque)			£

The craft should be vacated by: _____

I CERTIFY:

That the craft has not been involved in any accident whilst in my charge, neither have we suffered any structural damage or loss of equipment except as listed below.

Please note: Our craft are valuable assets, only ACCIDENTAL damage is covered by the 'Damage Waiver'

You are liable for any wilful or negligent damage.

DAMAGE/LOSS _____

Breakaway 5 technical manual - stability information

Integrity and Structure Requirements

Structure (ESR 3.1)

NOTE 6

The craft has been designed for inshore voyages where conditions up to, and including, wind force 5, and significant wave heights up to, and including 1.5 metres, may be experienced.

The craft is classified as being Category D as set out in the Recreational Craft Directive.

Stability and Freeboard (ESR 3.2)

NOTE 7

The Notified Body Practical Test of this boat was based on

ISO CD 12217 - Part 1-WD7 - Small Craft- Stability and Buoyancy- Non Sailing Boats

Crew Limited: 10 Persons
Maximum Load 1750 Kgs

The boat is not susceptible to swamping
The stability category is:

Down Flooding Height:

A practical test of down flooding height has been carried out with results as under:

	Crew to Port	Crew to Starboard
Boat at design trim		Stability & Freeboard
Crew as far forward as possible		Max Speed 5 Knots
Crew as far aft as possible		Stability maintained @ all speeds with people mass in extreme areas
Maximum down flooding height (Which is within minimum requirement of 0.48 metres)		*Please only 2 persons allowed on foredeck whilst boat is in motion
Offset Load		Fore & Aft Port & Starboard
Heeling practical test with 6 crew:		6 years of operating this hull shape has established this
Heel to port	15 degrees	
Heel to stbd	15 degrees	
(Maximum permitted heel angle is 21.31 degrees)		
Downflooding Angle		
Downflooding angle is	degrees	
Within limit of	degrees	

Breakaway 5 technical manual - builder's plate

TECHNICAL MANUAL

Hull Identification No. (ESR 2.1)

NOTE 1

The hull identification No. is: GB BBB BB 005D100

This number complies with ISO 10087.95 and is glassed on to the hull in the hanging locker.

Builder's Plate (ESR 2.2)

A black plate is screwed to the bulkhead by the helmsman position.
The plate complies with ESR 2.2 and reads

NOTE 2

<hr/>		
CE		
International Boatbuilding Training College		
B		
Recommended Persons	10 X 75kg	750kg
Additional Load Capacity		<u>1000 kg</u>
Recommended Maximum Load		<u>1750kg</u>
<hr/>		

Protection from falling overboard and means of reboarding (ESR 2.3)

NOTE 3

REF: ISO/DIS 15085

Slip resistance

All working deck areas are slip resistant in accordance with sec 7.1

Means of reboarding

In accordance with sec 16 & ISO 8666

A handhold is provided to give reboarding access from the bathing platform

Breakaway 5 owner's manual - maximum capacity

Design Category

This craft has been assigned to Category D with a crew limit of 12 in accordance with ISO 12217- Small Craft - Stability and Buoyancy - Methods of assessment and categorisation.

In accordance with ISO 12217, the category assigned to this boat is considered to render it suitable for operation in significant waveheights up to 1.5 meters and mean windspeeds up to 4 (Beaufort Force) subject to many factors including the following:

- The training, skill and experience of the skipper and crew
- The standard of design and construction of the hull fittings and equipment
- The standard of maintenance of the hull, fittings and equipment
- The environmental conditions of the operating area

Owners and operators should be aware that the stability of a boat may be substantially reduced by increase in topweight (e.g. by fitting additional equipment to masts or superstructure) and that the category quoted above only relates to the boat condition used for assessment.

Owners and operators should be aware that the stability of a boat is substantially reduced by the presence of loose fluids or weights within the hull. Care should therefore be taken to minimise water in the bilges.

In rough weather, when a risk of swamping exists, operators should close hatches, lockers and doorways giving access below decks.

Operators should note that the stability may be affected when towing, being towed, or when lifting heavy weights using a davit or boom. Caution should be exercised.

Inclining test report - summary

Breakaway 5 – Inclining test report

Date and time: Mid-day on Tuesday 29 July 2003

Place: River Bure, Wroxham (to the north east of Norwich).

Weather: Dry, overcast, with a light wind from roughly the south west.

Mooring: The berth where the inclining was undertaken was in a sheltered position and the surface of the water was calm. The vessel was arranged bow into wind. The bow line was taught sometimes as the light wind blew. Lines were also rigged from each quarter; these lines were held by an MAIB Inspector ashore to ensure that they stayed slack during the inclining. The battens were not marked when there were slight gusts of wind. Marks were only made when the pendulums were steady.

Those present: Richard Barwick MAIB (aft pendulum)
Ken Arnott Murray Fenton (Fwd pendulum)
Tony Brown MAIB (Port quarter line)
Graham Inseal MAIB (Stbd. quarter line)

Hydrostatics:

Waterline fwd: 0.84m vertically down from the underside of the fender at the stem.

Waterline aft: 0.04m vertically down from the underside of the fender at the stern.

Draft fwd: 0.266m

Draft aft: 0.842m

Mean draft: 0.554m

Trim: 0.576m (by stern)

Specific gravity: 1.01

From hydrostatics

Disp. = 2.909t KMT = 1.794m LCB = 3.999m VCB = 0.469m

GMT = 0.790

VCG = KMT – GMT = 1.794 – 0.790 = 1.004m
(Free surface negligible)

LCG = LCB - [(Actual trim/LBP) x (VCG – VCB)]
= 3.999 - [(0.576/6.57) x (1.004 - 0.469)] = 3.952m

As inclined: Disp. = 2.909t LCG = 3.952m VCG = 1.004m

Summary of the offset load test conducted on 22 August 2003

22nd. August, 2003.

“BREAKAWAY”

10 Person Cabin Cruiser

The test was conducted with the craft afloat, in a fully loaded displacement condition, with fuel and water tanks full.

The weather during the test was fine and clear, with a light breeze and, at all stages through the test, the mooring ropes were slack and the craft clear of any obstruction.

Weights used - 24 x 25 Kg. + 2 persons = 10 persons

One person (Surveyor) remained amidships, representing the Helmsman.

24 x 25 Kg. weights + One person arraigned on Port side:-

Pendulum Shift = 300 mm.

30 x 25 Kg. weights + One Person arraigned on Starboard side:-

Pendulum shift = 275 mm.

Length of pendulum used = 1140 mm.

Taking maximum pendulum shift of 300 mm.

$$\tan \phi = \frac{300}{1140} = 0.2632$$

$$\begin{aligned} \text{Maximum Angle of Heel } \phi &= 14^{\circ} 45' \\ &= 16.75^{\circ} \end{aligned}$$

$$\text{Maximum Permissible Angle of Heel} = 19.4^{\circ}$$

The craft is within the parameters of the Off Set-Load Test as set down by the Standard

—OOO—

Report of the stability test conducted on 24 October 2003

REPORT ON STABILITY TEST OF BARNES BREAKAWAY Reg No. 763F IN ACCORDANCE WITH ISO 12217-1

Introduction

This test was conducted on Friday 24th October 2003 at the Barnes Brinkcraft Boatyard in Wroxham, Norfolk. Representatives of the Broads Authority and the Marine Accident Investigation Branch witnessed the tests.

The boat has an open cockpit and enclosed cabin containing toilet, galley and two berths. As the boat does not have a quick-draining cockpit in accordance with ISO 11812 and does not conform to the definition of "two-thirds covered", it was assessed using Option 6 in Table 2.

Condition of the Boat

The boat was in a protected under-cover berth.

The fuel tank was 40% full and has an approximate capacity of 150 litres.

The freshwater tank was 25% full and has an approximate capacity of 120 litres.

The black water (sewage) tank was 50% full and has an approximate capacity of 140 litres.

Thirty 56lb (25.4kg) standard weights were loaded to represent ten persons on board.

During the tests the author was also on board, whose weight (82kg) approximately represented the balance of the mass of full fuel and fresh water if the black water tank were to be empty. This therefore represents the loaded displacement condition.

It was considered to be conservative to retain the free-surface effect of the tanks during the test, as the Standard is not specific on this point.

Downflooding Height

The critical downflooding opening is the stern opening from the swim platform into the cockpit (offset to port).

With the boat upright, and the test weights disposed to represent two persons on the foredeck, two by the helm and six in the main cockpit, the measured freeboard to the stern access opening was 0.250m. This is 0.150m less than the required height for Design Category D, which is 0.400m.

To comply with ISO 12217-1 the sill of the stern access should be raised by not less than 150mm.

Offset Load Test

This was tested with two configurations, two persons and five persons on the foredeck.

Unless a plate is attached to the boat stipulating that no more than two persons should occupy the foredeck, the boat would have to be assessed with the full number considered by the Standard. It is understood that the builder will be fitting such a warning plate to each of these boats.

Annex B of ISO 12217-1 was applied. The boat was assessed as having three levels, and thus the method of B.3.2 was employed.

The boat was measured and the following data obtained:

Level	Crew Area (m ²)	Max Breadth (m)
foredeck	2.880	1.63
helm area	1.075	1.56
main cockpit	3.504	2.08

Completed Worksheets for both crew placement configurations are appended, showing that the following heeling moments were to be applied:

two persons on foredeck	heeling moment = 3611.1 N-m = 368.3 kg-m
five persons on foredeck	heeling moment = 3512.7 N-m = 358.2 kg-m

These moments were applied by shifting the test weights off the centreline of the boat. The maximum permitted heel angle (based on $L_H = 6.7\text{m}$) equals 18.63° .

The results are summarised below:

TWO PERSONS FORWARD	measured	required
heel angle	10.1° to port	$< 18.63^\circ$
	10.6° to stbd	$< 18.63^\circ$
residual downflooding height	0.150m to port	$\geq 0.181\text{m}$
	0.255m to stbd	$\geq 0.181\text{m}$
FIVE PERSONS FORWARD	measured	required
heel angle	11.7° to port	$< 18.63^\circ$
residual downflooding height	0.215m to port	$\geq 0.181\text{m}$

(the boat was only tested to port)

The vessel passes on heel angle but fails on residual downflooding height. If the sill to the stern access opening is raised by 150mm the boat would pass the residual downflooding height requirement.

Conclusion

If the sill to the stern access opening is raised by not less than 150mm the boat would pass the downflooding height and offset load test requirements of ISO 12217-1 for Design Category D with a Crew Limit of ten persons.

Alternatively the vessel could be given a Crew Limit of eight persons and a carry-on load of 150kg permitted.

TWO PERSONS FORWARD

ISO 12217-1 CALCULATION WORKSHEET No. 3 OFFSET-LOAD TEST

Calculation of heeling moment for boats with not more than one level:

item	Symbol	unit	value	ref.
Plan area for movement of crew	A_C	m ²		B.3.1 a)
Crew density = $CL/4A_C$	CD	m ⁻²		B.3.1 a)
Maximum breadth of Crew area	B_C	m		B.3.1 b)
Crew heeling moment — if $CD \geq 0,5 = 314A_C B_C$ — if $CD < 0,5 = 314CL \cdot B_C(1 - CD)$	M_C	N·m		B.3.1 b)

Calculation of heeling moment for boats with more than one level:

	crew area	number of crew	crew density	crew area maximum breadth	crew heeling moment	ref.
symbol	A_C	N	CD	B_C	M_C	
units	m ²	—	m ⁻²	m	N·m	
level		$\leq 2A_C$	$= N/4A_C$ $\leq 0,5$		calc. as in table above	Annex B
highest level	2.880	2	0.174	1.630	845.5	B.3.2 a) + b)
next highest level	1.075	2	0.465	1.560	524.1	B.3.2 c) + d)
next highest level	3.504	6	0.428	2.080	2241.5	B.3.2 e) + f)
next highest level						B.3.2 g)
total of values of $N = CL =$		10	total of values of $M_C =$		3611.1	B.3.2 g) + h)

Compliance with requirement:

item	Symbol	unit	value	ref.
Equivalent moment in kg·m for test = $M_C/9,806$		kg·m	368.3	
Angle of heel with M_C applied	ϕ_0	degrees	10.1° P 10.6° S	6.2
Max. angle of heel allowed = $10 + \frac{(24 - L_H)^3}{600}$	$\phi_{0(R)}$	degrees	18.63°	6.2
PASS/FAIL?			PASS	

In addition, for boats using options 5 and 6:

requirement:	Cat. C > $0,11\sqrt{L_H}$	Cat. D > $0,07\sqrt{L_H}$	value	ref.
least height to waterline (m)		0.181	0.150 P 0.255 S	6.2 a) + b)
Design category given:			FAIL	

FIVE PERSONS FORWARD

ISO 12217-1 CALCULATION WORKSHEET No. 3 OFFSET-LOAD TEST

Calculation of heeling moment for boats with not more than one level:

item	Symbol	unit	value	ref.
Plan area for movement of crew	A_C	m ²		B.3.1 a)
Crew density = $CL/4A_C$	CD	m ⁻²		B.3.1 a)
Maximum breadth of Crew area	B_C	m		B.3.1 b)
Crew heeling moment — if $CD \geq 0,5 = 314A_C B_C$ — if $CD < 0,5 = 314CL \cdot B_C(1 - CD)$	M_C	N-m		B.3.1 b)

Calculation of heeling moment for boats with more than one level:

	crew area	number of crew	crew density	crew area maximum breadth	crew heeling moment	ref.
symbol	A_C	N	CD	B_C	M_C	
units	m ²	—	m ⁻²	m	N-m	
level		$\geq 2A_C$	$= N/4A_C$ $\geq 0,5$		calc. as in table above	Annex B
highest level	2.880	5	0.434	1.630	1448.5	B.3.2 a) + b)
next highest level	1.075	2	0.465	1.560	524.1	B.3.2 c) + d)
next highest level	3.504	3	0.214	2.080	1540.1	B.3.2 e) + f)
next highest level						B.3.2 g)
total of values of $N = CL =$		10	total of values of $M_C =$		3512.7	B.3.2 g) + h)

Compliance with requirement:

item	Symbol	unit	value	ref.
Equivalent moment in kg-m for test = $M_C/9,806$		kg-m	358.2	
Angle of heel with M_C applied	ϕ_0	degrees	11.7° P	6.2
Max. angle of heel allowed = $10 + \frac{(24 - L_H)^3}{600}$	$\phi_{0(R)}$	degrees	18.63°	6.2
PASS/FAIL?			PASS	

In addition, for boats using options 5 and 6:

requirement:	Cat. C $> 0,11\sqrt{L_H}$	Cat. D $> 0,07\sqrt{L_H}$	value	ref.
least height to waterline (m)		0.181	0.215	6.2 a) + b)
Design category given:			D	

Section 94 of the Public Health Acts Amendment Act 1907

SECTION 94 OF THE PUBLIC HEALTH ACTS AMENDMENT ACT 1907

1. The local authority may grant upon such terms and conditions as they may think fit licences for pleasure boats and pleasure vessels to be let for hire or to be used for carrying passengers for hire, and (persons in charge of or navigating) such boats and vessels, and may charge (for each type of licence) such annual fee as appears to them to be appropriate.
2. Any such licences may be granted for such period as the local authority may think fit, and may be suspended or revoked by the local authority whenever they shall deem such suspension or revocation to be necessary or desirable in the interests of the public; provided that the existence of the power to suspend or revoke the licence shall be plainly set forth in the licence itself.
3. No person shall let for hire any pleasure boat or pleasure vessel not so licensed or at any time during the suspension of the licence for the boat or vessel, nor shall any person carry or permit to be carried passengers for hire in any pleasure boat or vessel unless,
 - a. the boat or vessel is so licensed and the licence is not suspended; and
 - b. the person in charge of the boat or vessel and any other person navigating it is so licensed and his licence is not suspended and the conditions of his licence are complied with.
4. A licence under this section shall not be required for any boat or vessel duly licensed by or under any regulations of the Marine & Coastguard Agency (or for a person in charge of or navigating such a boat or vessel).
5. No person shall carry or permit to be carried in any pleasure boat or pleasure vessel a greater number of passengers for hire than shall be specified in the licence applying to such boat or vessel, and every owner of any such boat or vessel shall, before permitting the same to be used for carrying passengers for hire, paint or cause to be painted, in letters and figures not less than one inch in height and three-quarters of an inch in breadth, on a conspicuous part of the said boat or vessel, his own name and also the number of persons which it is licensed to carry, in the form "Licensed to carry persons".
6. Every person who shall act in contravention of the provisions of this section shall for each offence be liable to a penalty not exceeding (level 3 on the standard scale) (but a person shall not be guilty of an offence under this sub-section by reason of a failure to comply with such conditions as are mentioned in sub-section (3) (b) of this section if it is shown that there is a reasonable excuse for the failure).
7. Any person deeming himself aggrieved by the withholding, suspension, or revocation of any licence under the provisions of this section may appeal to a petty sessional court held after the expiration of two clear days after such withholding, suspension, or revocation: provided that the person so aggrieved shall give twenty-four hours' written notice of such appeal, and the ground thereof, to the clerk, and the court shall have power to make such order as they see fit and to award costs, such costs to be recoverable summarily as a civil debt.
8. No licence under this section shall be required in respect of pleasure boats and pleasure vessels on any canal owned or managed by the British Waterways Board.
9. In sub-section (1) and (3) of this section "let for hire" means let for hire to the public.

UK Statutory and Non-Statutory Navigation Authorities

UK Statutory and Non-Statutory Navigation Authorities

British Waterways
Waterways Ireland
Environment Agency
Bristol City Docks
Lower Avon Nav Trust
Upper Avon Nav Trust
Basingstoke Canal Authority
East Riding of Yorkshire Council
Manchester Ship Canal Company
Bude Canal Trust
River Cam Conservancy
Chelmer and Blackwater Navigation Ltd
Colchester Borough Council
Chester City Council
Driffield Navigation Ltd
Droitwich Canal Trust
Exeter City Council
City of York Council
Devon County Council
Associated British Ports
Hull City Council
Port of Medway Authority
Mersey Docks and Harbour Co
Middle Level Commissioners
Neath Canal Navigation
Port Tennant Canal Navigation
The Broads Authority
Sedgemoor District Council
Rochdale Canal Company
The Waterways Trust
Sleaford Navigation Trust
The Company of Proprietors (Stroudwater)
Tees Barrage Ltd
Tees and Hartlepool Port Authority
Port of London Authority
Wansbeck District Council
National Trust
Lake District National park
South Lakeland District Council
Witham and Fourth District Internal Drainage Board
Loch Lomond Regional Park Authority

Examples of Conditions of Licensing imposed by British Waterways

Examples of Conditions of Licensing imposed by British Waterways

- The boat must comply with the Boat Safety Scheme standards and have a Boat Safety Certificate or a correctly completed declaration of conformity with the EEC Recreational Craft Directive.
- The boat must be covered by an insurance policy, which covers at least third party liabilities of at least one million pounds.
- The boat must be fit for navigation on any waterway where it is intended to be used.

Specific conditions also apply to leisure business craft. These include:

- Each time any person uses the boat, it must be ensured they are capable of using it safely by:
 - (a) provide adequate and appropriate coaching in:
 - (i) safe methods of navigating the waterways including operating the locks
 - (ii) the operation and care of the boat and its equipment (including safety equipment)
 - (b) provide on the boat and draw attention to:
 - (i) The Boaters Handbook (published by the Association of Inland Navigations Authorities)
 - (ii) Other relevant publications about the local waterway
 - (iii) Emergency contact details
- Offer to all passengers and users of the boat free use of properly maintained buoyancy aids or lifejackets.

MAIB Safety Bulletin 2/2003

MAIB SAFETY BULLETIN 2/2003

Capsize of the motor hire cruiser

Breakaway V

on the River Bure, Norfolk

19 July 2003

Issued August 2003

MAIB

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on the River Bure, Norfolk

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This document, containing Safety Recommendations, has been produced for marine safety purposes only on the basis of information available to date.

The Merchant Shipping (Accident Reporting and Investigation) Regulations 1999 provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

The Marine Accident Investigation Branch (MAIB) is carrying out an investigation of the capsizing of the motor hire cruiser *Breakaway V* on 19 July 2003. The MAIB will publish a full report on completion of the investigation.

Towards the end of a day's cruising on the Norfolk Broads, *Breakaway V* capsized and inverted, trapping two of her ten occupants in the upturned hull. One of the two persons trapped subsequently died.

A handwritten signature in black ink, reading "Stephen Meyer". The signature is written in a cursive style with a long horizontal stroke at the bottom.

Stephen Meyer
Chief Inspector of Marine Accidents

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<http://www.dft.gov.uk>

SAFETY RECOMMENDATIONS

Background

Breakaway V was a 6.77m day hire motor cruiser built and operated by Barnes Brinkcraft Ltd, Wroxham, Norfolk. It was based upon a traditional open boat hull form, which had been modified, and to which a 'sports cruiser' type superstructure had been added. The boat's maximum capacity was ten persons, which had been based on the boat's seating arrangements. No in-depth stability tests were considered necessary because two other types of craft based on the same hull form had been operated safely by the builder since 1996.

On 19 July 2003, a group of ten persons hired the boat for the afternoon. When returning to Wroxham, the boat capsized to starboard and inverted without warning. Two of the party were trapped underneath. Rescue services managed to cut into the upturned hull but tragically, one of the trapped persons had died.

The MAIB conducted an inclining test on another *Breakaway* boat on 29 July 2003, initial analysis of which indicated that *Breakaway V* capsized because of the loading and distribution of the ten persons on board at the time. The total weight of these persons was about 845Kg, and they were distributed primarily forward and starboard of the centreline. Six of the party were located on the raised forward deck, which because of its height, had a considerable destabilising influence.

The MAIB considers that this tragic accident highlights the importance of stability calculations and tests on build or following major modifications to vessels, and the need to allow an adequate safety margin when determining the maximum number of persons a boat can carry.

Safety Recommendations

All bodies and authorities responsible for the licensing of pleasure vessels let for hire, and all hire boat operators are recommended to:

1. Ensure that on completion of build or any modification altering a vessel's stability characteristics, the consequences of such changes has been determined through calculation and testing by a suitably qualified person before the vessel is put into service.
2. Allow an adequate safety margin when determining the maximum number of passengers a boat is authorised to carry, taking into account the potential inexperience and weights of the persons hiring a boat, and the worst-case effects of uneven weight distribution.
3. Ensure that handover procedures and briefs to persons hiring a boat be comprehensive, and include the dangers of uneven weight distribution, particularly on raised decks.