

Stability and freeboard checks
for
inland waterway hire boats – initial feasibility study

(June 2013)

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1. Introduction and scope

This report provides an initial review of the feasibility of the inland waterway navigation authorities (and/or the Boat Safety Scheme (BSS)) introducing stability and freeboard checks for inland waterway hire boats in light of the recently developed Hire Boat Code.

This report has been researched and compiled by Jonathan Leask of Small Craft Consultancy Ltd and David Fuller of Marine Consultancy Ltd at the request of the BSS Office.

2. The Hire Boat Code – background information

In July 2003 a day-hire boat named BREAKAWAY V capsized on the Norfolk Broads leading to the drowning of one of the occupants. The incident was investigated by the Marine Accident Investigation Branch (MAIB). In summary, their report recommended:

- *Development of a national code of safe practice for boats let for hire on inland waterways and co-ordination of the licensing regimes of local authorities and navigation authorities, including the empowerment of the latter to licence where required.*
- *A review of the international standard on boat stability.*
- *Encouraging boat builders to obtain independent assurance of compliance with the Recreational Craft Directive¹*

The Maritime and Coastguard Agency (MCA) initiated discussion of the recommendations with stakeholders from across the hire-boating industry. It was decided that it would be appropriate for a non-statutory code to be produced jointly by the MCA, the Association of Inland Navigation Authorities (AINA), and the British Marine Federation (BMF) which would set down best practice and be suitable as a basis for licensing by local or navigation authorities.

In June 2009 a draft version (Issue 1) of the Hire Boat Code (HBC) was published by the MCA, BMF and AINA. In September 2009 Issue 1.1 was printed by the BMF (without formal support from MCA and AINA). Issue 1 and Issue 1.1 are for all intents and purposes the same, and Issue 1.1 has been adopted as the focus of this study and report.

The approach adopted in the HBC was based on the foreseeable risks of hire boating activity and recognised the responsibilities that navigation authorities, hire operators and hirers have in ensuring adequate levels of safety. The risk control measures were considered to be reasonably practicable given the level of risk and consistent with established principles of risk management.

The HBC is applicable to 'Power driven boats'² operating in MCA Category A to D waters (loosely interpreted as inland waterways), and which include:

- *Boats providing overnight accommodation and cooking facilities.*
- *Day-hire.*
- *Commercially operated or managed shared use, including time share, where the boat is not wholly owned by her users. Personal water craft are not included.*

The HBC covers:

- The technical standards which apply to the design, construction and maintenance of hire boats (which includes their stability).
- Operational standards, including pre-trip information for hirers and handover procedures and documentation for hirers.
- Change control (boats and areas of operation).
- Record keeping (hire operators and navigation authorities).

This study and report addresses the feasibility of navigation authorities (and/or the BSS) introducing the stability and freeboard requirements, and change control and record keeping measures where applicable to stability and freeboard, as set out in the HBC.

¹ Text shown in *italic* has been copied directly from the HBC.

² Text/terms highlighted in blue are specific Hire Boat Code terms as defined within the Code

3. The Hire Boat Code – stability and freeboard requirements

3.1 General

The BREAKAWAY V accident showed that in certain circumstances of load and distribution the ISO stability standard (BSS EN ISO 12217: 2002) mandated under the RCD could ‘pass’ conditions where stability margins were inadequate. With the support of the MCA and AINA, the BMF commissioned work to investigate the standard and recommend changes to address these issues. The completed work and associated revised stability and freeboard standards have been incorporated into the HBC. In addition, BSS EN ISO 12217 was also amended and republished in 2009 in part to take account of the shortcomings identified by the BREAKAWAY V accident and the subsequent work undertaken by the BMF.

The HBC addresses stability and freeboard at three different levels:

- a. When a boat first enters service as a hire boat its stability and freeboard are tested (either as an individual boat or as part of a [Design Class](#)) to ensure it falls within the specified parameters. Such testing will contribute to the calculation of the maximum number of persons ([Crew Limit](#)) a boat can carry (within the specified stability and freeboard parameters), and where those persons may be distributed around the boat ([Crew Area](#)). Such testing is referred to within the HBC as the Initial Stability Test and Freeboard Test/ing.
- b. To ensure all individual boats continue to meet the requirements during their service life hire operators are required to recheck their freeboard against data obtained during the Initial Stability and Freeboard Tests (the [Datum freeboard](#)) prior to the start of each hire season, and keep on-going records of any changes to the boat which might affect its stability or freeboard (known as [Change control](#)). In the event changes are made to a boat which might affect its stability or freeboard hire operators are required to undertake a Check Stability Test to ensure that, despite the changes, the previously tested stability and freeboard characteristics have not been compromised.
- c. As covered at bullet point a., above, part of the output from the Initial Stability and Freeboard Test/ing is the calculation of how many persons the boat can carry and how those persons may be distributed around the boat. To help ensure a particular boat remains within its specified stability and freeboard parameters during use hire operators are required to market the boat for a given maximum number of persons, and to reference the maximum number of persons the boat can carry, and where they may be distributed by the use of labels affixed onboard the boat, and guidance within boat handover material/procedures.

These three different levels addressing: initial stability and freeboard; on-going in-service stability and freeboard; and, the use of boats by hirers, are explained in more detail below:

3.1.1 Initial Stability and Freeboard Test/ing

Initial Stability and Freeboard testing must be applied to individual boats, or a representative sample of each Design Class. There are two different versions of Initial Stability Test, and one Freeboard Test:

3.1.1.1 General Initial Stability Test

The General Initial Stability Test explores the full limits of a craft’s stability (that it has an adequate righting moment when crew are distributed around the boat and when the contents of onboard tanks are free to move about) and is complicated and time consuming to conduct. The HBC states that this test must only be undertaken by persons competent to do so. To give an idea of what is involved a set of procedures for conducting and recording this test has been included at Appendix A of this report.

The methods used and heeling and freeboard margin measurements obtained should be recorded by the tester. Such recording is important:

- So that the necessary data is available to enable hire operators to undertake annual freeboard checks (see report section 3.1.2.1, below).
- So that the necessary data is available should a Check Stability Test have to be undertaken at a later date (see report section 3.1.2.3, below).
- To enable subsequent verification of the test procedures.

As with all stability and freeboard testing it is the initial setting up of the boat and assembling of equipment and manpower which is time consuming but, for guidance purposes only, it is suggested that the time needed to put one boat through a General Initial Test would be approximately 2.5 hours. However, it may be possible to go on to test 3 to 4 boats in one day.

Once a boat has completed the General Initial Stability test it must be subject to a Freeboard Test (see section 3.1.1.3, below). Boats with a hull length of less than 6m may also be subject to additional testing such as the Gunwhale test, assessment of flotation elements, etc.

3.1.1.2 Simplified Initial Stability Test

The Simplified Initial Stability Test is available for boats which operate on MCA Category A, B or C waters and which are 2.08m beam cruising narrowboats over 10m in length, or unballasted decked Power driven boats over 7m in length and which satisfy the following:

- *maximum height of deck or coachroof on which crew members may sit or stand is less than the maximum hull beam (excluding rubbers), and*
- *maximum number of persons is less than $(L_H \times B^2)/15$, where L_H is the length of hull and B is the maximum hull beam excluding rubbers, both in metres.*

The HBC states that this simplified test may be conducted by suitably competent hire operator staff. To give an idea of what is involved a set of procedures for conducting and recording a simplified test has been included at Appendix B of this report.

The methods used and stability and freeboard measurements obtained should be recorded by the tester. Such recording is important:

- So that the necessary data is available to enable hire operators to undertake annual freeboard checks (see report section 3.1.2.1, below).
- So that the necessary data is available should a Check Stability Test have to be undertaken at a later date (see report section 3.1.2.3, below).
- To enable subsequent verification of the test procedures.

As with all stability and freeboard testing it is the initial setting up of the boat and assembling of equipment and manpower which is time consuming, but for guidance purposes only it is suggested that the general time needed to put one boat through a Simplified Initial Stability Test would be approximately 1.5 hours. However, it may be possible to go on to test 4 to 6 boats in one day.

3.1.1.3 Freeboard Test

After a boat has been subject to an Initial Stability Test it must have its freeboard tested.

The Freeboard Test is undertaken with the boat fully loaded (all tanks full, all equipment onboard, and weights onboard to replicate the maximum number of persons allowed and their luggage).

To give an idea of what is involved a set of procedures for conducting and recording an Freeboard Test has been included at Appendix D of this report. The time needed to put one boat through a Freeboard Test would be approximately 1.5 hours.

3.1.2 On-going in-service stability and freeboard

The HBC sets out the following, additional, tests and monitoring procedures to ensure boats remain within their specified stability and freeboard parameters during their service life:

3.1.2.1 Annual measurement of freeboard

Every boat of a class used by a given hire operator shall have the bow and stern freeboard measured against the Datum freeboard (determined during the Initial Stability and Freeboard Test/ing) prior to every new season. When this check is made the boat shall be in the same loaded condition as when the Initial Stability Test was undertaken.

3.1.2.2 Change control measures

At Section 6 the HBC sets out change control measures to be adopted by hire operators in regard to stability, freeboard and other matters. Hire operators must carefully consider whether any physical changes to a boat could affect its stability and freeboard. A proforma change control form is provided at Appendix 2 of the HBC, as reproduced at Appendix E of this report.

3.1.2.3 Check Stability Test

This test is used to ensure that a particular boat remains compliant with its original Initial Stability Test (whether that was a General Initial Stability Test, or a Simplified Stability Test) and must be undertaken when any of the following apply:

- *After any change of engine type, internal or deckhouse arrangement, or the amount of ballast.*
- *When any permanent weights of more than 3kg/metre of hull length are added or taken off, or any weight is added high up, e.g. adding or altering a mast.*

Check Stability Tests can be carried out by suitably competent hire operator staff. To give an idea of what is involved a set of procedures for conducting and recording a Check Stability Test has been included at Appendix C of this report. However, in summary, a boat must be prepared and loaded to the same parameters as the Initial Stability Test. The total weight of people/weights are then applied and the angle of heel and minimum freeboard measured. If, for the same total weight added, the original heel angle is exceeded by more than 2% or the original freeboard margin is not attained, then the Crew Limit is to be reassessed using the Initial Stability Test.

As with all stability and freeboard testing it is the initial setting up of the boat and assembling of equipment and manpower which is time consuming, but for guidance purposes only it is suggested that the general time needed to put one boat through a Check Stability Test would be approximately 1.5 hours.

3.1.3 Use of boats by hirers

The HBC sets out the following requirements and procedures to endeavour to ensure boats remains within their stability and freeboard parameters when in use:

3.1.3.1 Crew Limit

The maximum number of persons which may be onboard a particular boat or Design Class is determined in a number of different ways, including:

- Overridingly, the maximum number of persons shall not exceed the number of available [Seating Places](#).
- For [Decked Powered Boats](#) the maximum number of persons on the boat, excluding the number permitted on cabin top or side-deck, shall not exceed twice the total plan area (in m²) of cockpits that are either open to the air or equipped with portable means of shelter (sliding tops, canvas covers, etc).
- For [Open Powered Boats](#) the maximum number of persons on the boat shall not exceed twice the total plan area (in m²) of cockpits that are either open to the air or equipped with portable means of shelter (sliding tops, canvas covers, etc).
- The Initial Stability and Freeboard Test/ing.

The total maximum number of crew is to be identified in the hire operator's documentation and on a diagram placed at the main control position of each boat.

Where boats are hired out to groups of young people or groups of mixed ages, the total number of persons permitted onboard may be exceeded provided that the total weight of persons using the boat does not exceed the number permitted by this code multiplied by 75kg.

3.1.3.2 Crew Areas

As part of the Initial Stability and Freeboard Test/ing hire operators must determine where the Crew Areas are for each boat/Design Class of boat. Crew Areas comprise the areas of the boat in which persons may be safely located when the boat is in use, and include all areas where people may stand, walk, sit or lie during normal operation of the boat including internal decks. On some boats it may be limited to the cockpit, but it must always include all of the primary cockpit. The total maximum number of crew (Crew Limit) and the Crew Areas are

to be identified in the hire operator's documentation and on a diagram placed at the main control position of each boat. In addition where points of access are not visible from the control position, they shall be physically marked with "do not access" or "limited access" signs.

When such safety signs are fitted, they shall be placed where they are clearly visible, and shall be made of rigid plate or flexible labels affixed to the craft in such a way that they can only be removed by the use of tools. The size of the symbols and text on the labels is also prescribed.

3.1.3.3 Change control measures

In addition to ensuring that hire operators carefully consider physical changes to particular boats, they are also required to consider operational changes which might affect a boat's stability, freeboard and other matters. For example, poor weather may lead to abnormal wave heights, which might take the environmental conditions outside of assumptions made during the Initial Stability and Freeboard Test/ing. A proforma change control form is provided at Appendix 2 of the HBC, as reproduced at Appendix E of this report.

3.2 CE marked boats

The BREAKAWAY V accident showed that in certain circumstances of load and distribution the ISO stability standard (BSS EN ISO 12217: 2002) mandated under the RCD could 'pass' conditions where stability margins were inadequate. The HBC makes the following references to boats built to the RCD/ISO12217:2002:

Except in relation to freeboard (also known as downflooding height), references to:

- *RCD Design Category C in ISO 12217 shall be taken as applicable to MCA Categories C and D.*
- *RCD Design Category D in ISO 12217 shall be taken as applicable to MCA Categories A and B.*

Even where ISO 12217 is being utilised, the freeboard requirements of section 4 below shall apply to boats assessed using this Code instead of those in ISO 12217.

Therefore a CE marked, Design Category C boat where the stability testing was undertaken in accordance with ISO 12217:2002 may be considered as complying with the stability requirements of the HBC for MCA Category C and D waters, except that in addition its freeboard must be tested separately against the Freeboard Test requirements of the HBC.

And a CE marked, Design Category D boat, where the stability testing was undertaken in accordance with ISO 12217:2002, may be considered as complying with the stability requirements of the HBC for MCA Category A and B waters, except that in addition its freeboard must be tested separately against the Freeboard Test requirements of the HBC.

In such circumstances hire operators must be in possession of the original ISO 12217 stability test data to enable a Check Stability Test to be undertaken.

Note: Issue 1.1 of the HBC was published in September 2009. An amended version of ISO 12217 was also published in 2009 and at this time it is not known whether the relevant requirements in Issue 1.1 of the HBC take account of the 2009 version of ISO 12217.

3.3 Overview of HBC stability and freeboard requirements

The HBC sets out not only an individual boat or Design Class's stability and freeboard parameters, but also how stability and freeboard parameters should be maintained during the boat's service life, and how hire operators should endeavour to ensure hirers keep boats within the specified parameters during use. All of these elements are inextricably linked and must be applied as a whole to ensure the process is meaningful. For example: the benefits in undertaking the Initial Stability and Freeboard Tests would be undermined if a boat did not remain within the original parameters during its service life; and, there would be no benefit in hire operators stipulating Crew Limits and/or Crew Areas if these were not tied back to meaningful Initial Stability and Freeboard Testing.

As touched on at report section 3.1 above, and as covered by the HBC text included at report Appendices A, B, C and D, the stability and freeboard test procedures and requirements are complicated. However, the reality is that they are even more complicated than has been set out so far. Issue 1.1 of the HBC covers Power driven boats, but different types of such craft are subject to different test parameters and different compliance criteria. For example, in addition to all the varied test parameters and compliance criteria already covered in this report the following may, in certain circumstances, also be applicable:

- a. Pontoon boats cannot be operated outside MCA Category A or B waters.
- b. The minimum freeboard requirements may be different for Open Power Boats to Decked Powered Boats.
- c. The minimum freeboard requirements for Open Powered Boats differ depending on whether or not flotation is fitted.
- d. Certain Open Powered Boats must be tested against the requirements of ISO 12213-3.
- e. Certain Open Powered Boats may not operate in MCA Category C or D waters.
- f. Inflatable and rigid inflatable boats must comply with the stability, load capacity, buoyancy, downflooding height, etc requirements of ISO 6185.
- g. On Open Powered Boats under 8m length (approx.) not more than one person should be outside the cockpit and any one time.
- h. On open boats of less than 6m length labels must be affixed warning hirers that the boat is vulnerable to capsize and swamping.
- i. On narrowboats not more than two persons are should be on the roof at any one time, although this figure may be adjusted according to the stability test results.
- j. The maximum number of persons allowed onboard a particular boat shall not exceed the number of available Seating Places.
- k. The maximum number of persons on a boat, excluding the number permitted on cabin top or side-deck, shall not exceed twice the total plan area (in m²) of cockpits that are either open to the air or equipped with portable means of shelter (sliding tops, canvas covers, etc).

The complicated and varied nature of the prescribed test parameters and compliance criteria could make implementation, in a verifiable and meaningful way, difficult for hire operators, especially those with a small number of boats and where the boats fall outside of the Simplified Initial Stability Test.

4. The inland waterways hire fleet – data and statistics

At this time the total number of Power driven hire boats on AINA waterways is not known. The only data currently available has been provided by the Broads Authority, as reproduced below:

Broads Authority

In 2011 the total number of Power driven hire boat was 1,216, which could be subdivided as: Motor cruisers – 920; Day launches – 284; Outboard dinghies – 12.

Canal & River Trust

Information not currently known.

Environment Agency

Information not currently known.

Other AINA members

Information not currently known.

5. The inland waterways hire fleet – existing stability and freeboard requirements

Boat Safety Scheme

Since its inception the Boat Safety Scheme (BSS) requirements for hire boats have included basic freeboard checks. These requirements/checks are included in Part 10 of the 2002 Examination Checking Procedures (ECP) and require examiners to check the minimum down-flooding heights of:

- a. All openings in the hull above the water line;
- b. Self draining cockpits (decks);
- c. Weed hatches.

The measurements are taken from the 'normal laden waterline'. The normal laden waterline can be taken as the observed waterline providing no obvious attempt has been made by the hire operator to 'lighten' the boat.

The existing BSS requirements do not take into consideration crew numbers, luggage or equipment, or onboard tank status, and as such do not require hire operators to prepare the boat in any way before the examiner undertakes his checks.

The existing BSS requirements do not include any stability testing.

Broads Authority

In April 2010 the Broads Authority (BA) implemented the stability and freeboard requirements of the HBC, and as such required all licenced Power driven hire boats to be subject to the Initial Stability and Freeboard Test/ing. How these boats were tested is shown in the table below:

Table 1 – Broads Authority test information		
Boat type	Numbers in 2011	Notes – applicable to the HBC
Motor cruisers	920	Approximately 900 were eligible for the Simplified Initial Stability Test (of which approximately 500 were not tested individually as they were considered part of a Design Class). Approximately 20 were required to be tested under the General Initial Stability Test or were found to be compliant through ISO 12217.
Day launches	284	All were required to be tested under the General Initial Stability Test (of which approximately 200 were not tested individually as they were considered part of a Design Class).
Outboard dinghies	12	Of these were required to be tested under the General Initial Stability Test, although a few may have been new and therefore used ISO 12217.

Since April 2010 the BA has required hire operators, on application, to submit the results of a Loading and Stability Test for each boat or Design Class of boat which they wish to licence.

It took about 2 years for all hire operators to provide evidence of Loading and Stability testing. The data submitted varies from a simple statement from the hire operators that a particular boat is consistent with an existing Design Class, to spreadsheets which contain freeboard measurements and heeling test results. It is understood that no hire operator has submitted a fully documented stability test using the pro-forma test sheets contained in the Code.

No verification has been carried out by the BA other than, where applicable, comparing the Crew Limit against the numbers given in the Design Class data sheets compiled by the BMF. The BA requires the Crew Limit to be shown on the stern of each boat so that their rangers can carry out a rapid comparison of the number people onboard against the Crew Limit.

CE marking is taken as being acceptable for licensing purposes as far as stability and loading are concerned, but where the Crew Limit has been determined using a mass of 75kg, the BA recalculate the figure allowing for a mass of 85kg as is used the HBC and the amended version of ISO 12217-1.

Once the Loading and Stability data has been submitted to the BA, hire operators are required to declare on subsequent licence applications that no modifications have been made which could materially affect the boat's stability.

It is also understood that boat's Risk and Control sheets are examined as part of periodic hire base inspections.

6. Applying the Hire Boat Code stability and freeboard requirements to the inland waterways hire fleet.

6.1 General

The Hire Boat Code was developed by the MCA, BMF, AINA and other interested parties as a direct response to the BREAKAWAY V accident in 2003, which had been caused by inadequate stability and freeboard for the number and weight of people onboard and inappropriate use of the boat by the hirers.

The outcome is a code which addresses a particular boat or Design Class's initial stability and freeboard characteristics, how those compliant characteristics should be maintained during individual boat's service life, and how hire operators should endeavour to ensure hirers use the boat in an appropriate manner.

The main remit for this report was to assess the feasibility of the inland waterway navigation authorities (and/or the BSS) introducing stability and freeboard checks for hire boats. Having reviewed the HBC in detail it is the authors' opinion that the stability and freeboard requirements could reasonably be implemented across the inland waterways Power driven hire boat fleet. However, to do so in a meaningful way would require all the relevant requirements of the HBC to be introduced, and for this to be done in a thorough and verifiable manner. In brief, such an implementation would require:

- a. All in-scope boats to be initial stability and freeboard tested as set out in the HBC (see report section 3.1.1, above);
- b. All hire operators to complete on-going tests and monitoring procedures to ensure boats remain within the specified parameters during their service life (see report section 3.1.2, above);
- c. All hire operators adopt the requirements and procedures to endeavour to ensure boats remain within the specified parameters when in use by hirers (see report section 3.1.3, above).

6.1.2 Initial Stability and Freeboard Testing

Based on the currently available data from the Broads Authority and a general knowledge of the hire fleets on the Thames and canal system, it is estimated that very approximately 75% of boats on the Broads and Thames, and 90% of the boats on the canal system, could be assessed using the Simplified Initial Stability Test (as opposed to the General Initial Stability Test).

However, although the Simplified Initial Stability Test on its own is relatively simply to complete, and the HBC expressly states that it should be within the capability of competent hire operators to conduct themselves, it is envisaged that many hire operators may struggle with the complexities of the overall stability and freeboard test parameters and procedures. In order for stability and freeboard testing to be meaningful measures would need to be put in place to ensure that all boats were tested to the correct parameters.

One way forward would be for BSS examiners to be trained to undertake stability and freeboard testing and for such testing to then be part of the BSS certification process. However, it is considered that training a large body of such examiners would be fraught with initial training, consistency of application and on-going assessment issues, and furthermore the additional costs that such enhanced examinations/tests would place on hire operators may be financially prohibitive.

Alternatively, it would be possible to develop a reasonably simple computer program, based on a widely available platform such as Microsoft Excel to take the hire operators themselves, step by step, through the stability and freeboard testing. Such a program could, as an end result, also produce standard output data/reports.

For example, a hire operator has a 30ft GRP motor cruiser. The hire operator would enter the principal dimensions, waterway category and other basic data into the program and this would then lead them to the correct stability and freeboards tests. The program would then provide them with the necessary information to conduct the tests and the test data would subsequently be entered. The program would then provide standardised test reports for forwarding to navigation authorities, and also advise the hire operators of what information to provide to hirers, and what information to place onboard individual boats, such as Crew Limit and Crew Areas. If all hire operators used the same software it would help to ensure consistency of application and make verification of the procedures and test outcomes relatively simple.

One possible disadvantage of such a system would be that hire operators would be self-certifying on stability and freeboard, but such a standardised test regime would minimise the risks of hire operators undertaking the tests incorrectly. Such a standardised test regime would also make the task of verification and monitoring relatively simple. If standardised test reports had to be submitted by hire operators as part of their licence applications these could be checked and verified by navigation authority staff with relatively little training. As an additional verification tool the navigation authorities could, individually or through the BSS, undertake sample Stability and Freeboard tests on a small number of 'high risk' boats. Such sampling could be undertaken by a very small number of trained persons, whether these be navigation authority staff, or BSS examiners.

6.1.3 On-going in-service stability and freeboard, and use of boats by hirers

As covered in detail at report sections 3.1.2 and 3.1.3 the HBC requires hire operators to:

- a. Ensure Crew Limits are adhered to, and that the maximum number of crew is clearly displayed onboard every boat;
- b. Ensure Crew Areas are clearly identified on every boat;
- c. Check annually the datum freeboard of every boat (to be checked against the freeboard measurements taken during the Initial Stability Test);
- d. Maintain a Change control form.

It is suggested that at each licence renewal hire operators should be required to verify they are complying with these requirements.

In addition, it would be relatively simple for trained navigation authority staff or trained BSS examiners to physically check Office records (Change control forms) and Crew Limit and Crew Area information displayed onboard boats during routine BSS examinations. However, such checks, particularly in regard to Crew Limits and Crew Areas would only be possible/meaningful if the original data was available at the time of the examinations. Realistically, such data would need to be stored electronically for ease of access at the time of the checks, and/or available on standardised reports.

In summary, the Initial Stability and Freeboard tests are the bedrock on which all the operational criteria and subsequent testing is based. Undertaking the initial tests correctly in a verifiable way may take a few hours per boat and be perceived as an initial inconvenience by hire operators, but once completed hire boats could be in service with only annual Datum freeboard tests and relatively minor administrative procedures for the remainder of their service life.

6.3 Applying the HBC stability and freeboard requirements piecemeal

An initial brief for this study and report was to assess whether any individual part/s of the HBC, and in particular the freeboard requirements, could be implemented in isolation, and whether the associated checks could be undertaken by trained BSS examiners.

As already covered in this report, it is the authors' opinion that the stability and freeboard requirements of the HBC must be applied as a whole in order for any one part to be meaningful.

The Initial Stability Tests require boats to be set up in a particular way, which is time consuming to implement. The Freeboard tests require boats to be set up in a different way to the Initial Stability Test, which are again time-consuming to set up. The tests incorporated into the HBC have been developed in such a way as to be the minimum to ensure there is adequate stability when specific Crew Limits are distributed about the boat and the tanks are part full, and that there is adequate freeboard to down-flooding openings when the boat is fully laden, set against the minimum inconvenience to hire boat operators at the time of testing. On an on-going basis the HBC sets out that hire operators must recheck each boat's Datum freeboard prior to each season, but otherwise there is no requirement for any further routine in depth testing. It is the authors' opinion that any additional requirement/s for boats to have their stability rechecked on an on-going routine basis, or the freeboard tested on an on-going basis over and above the annual Datum check, would be an unreasonable burden on hire operators and serve no meaningful purpose.

Routine BSS examinations could be tied in with hire operators undertaking annual Datum freeboard checks but it is considered questionable as to whether there would be any benefit to such. As set out at sections 6.1.2 and 6.1.3 above, it is considered that BSS examiners and/or navigation authority staff routinely checking Change control forms, Crew Limits and Crew Areas would be more meaningful.

7. Hire Boat Code limitations, and outstanding technical issues

The authors have worked through the sections of the Hire Boat Code relating to stability and freeboard and now have an understanding of the methods and requirements of the Code. In their opinion, the code is to some degree a work in progress and they have noted some inconsistencies in content and format. They would like to record the queries listed below:

NB: the list of queries is not exhaustive and it should be noted that the authors have not carried out any practical testing. There may well be further queries once they have put the tests contained in the Code into practice on a range of different craft.

1. MCA categorisation of waters

A narrowboat would only be suitable for use in design category D waters as defined in the Recreational Craft Directive (RCD). This requires the vessel to be capable of operating in significant wave heights up to 0.5m.

In contrast, the Simplified Test in the Hire Boat Code would enable a narrowboat to be operated in MCA category A, B or C waters without further testing. MCA category C allows for significant wave heights up to 1.2m.

2. Freeboard standards and ISO 12217

Appendix 3 clause 2.1(b) says that even where ISO 12217 is being used, the freeboard requirements of section 4 shall apply to boats assessed using this Code instead of those in ISO 12217. Does this apply to ISO 12217:2013?

Where boats have been CE marked using ISO 12217, should the version of the standard which has been used be taken into account?

3. Wind conditions for day boats

Appendix 3 clause 2.1(f) says that day-hire boats unable to satisfy all the requirements for category B, but meeting the requirements for category A, provided that they do so in conditions not exceeding 20kts of wind and significant wave heights of 0.1m.

RCD category D (which is broadly equivalent to MCA category B) wind conditions allow for F4 which is 11-16 knots. Wind force F5 as allowed for in the Code is 17-21 knots. This means that 20 knots of wind is at the upper end of range for F5. Expected wave height for wind force F5 in open water is 2 - 3m.

4. Special provision for young people

Appendix 3 clause 2.1(g) says that where boats are hired out to groups of young people or groups of mixed ages, the total number of persons permitted by the Code may be exceeded provided that the weight of the persons using the boat does not exceed the number permitted by the Code multiplied by 75kg.

Does this mean that the hire operator has to weigh the people going on board because in the author's experience nobody knows their own weight in kg? Should the number of seats available be taken into account to avoid contravening clause 2.1 (d)?

5. Watertight and quick-draining cockpits

Appendix 3 clause 3.2.1(f) says that during the General Initial Stability Test on boats with watertight or quick-draining cockpits, water may enter through the drains when the boat is heeled during the test, provided this drains when the test weights are moved to the centreline.

Are the quick-draining and watertight cockpits as defined by ISO 11812?

6. Simplified Initial Stability Test - down-flooding points

Appendix 3 clause 3.3.1(e) says that on narrowboats the forward door from the bow cockpit is often a critical down-flooding point. In such cases, if the bow cockpit sole is watertight, the down-flooding point is the door sill.

Does the point about the forward door of a narrow boat still apply if the cockpit is quick-draining? i.e if the drains are of the correct size according to ISO 12217:2013, can the coaming be counted as the down-flooding point?

7. Simplified Initial Stability Test - freeboard

Appendix 3 clause 3.3.1(f) refers to decked power-driven boats over 7m in length with permanent ballast weighing less than $Lh^3/7$ kg. This seems to be at variance with the reference in clause 3.3.1(a) to non-ballasted boats.

8. Table 8 – minimum upright freeboard for MCA category A and B waters

Why does the freeboard requirement increase as the beam increases? Apart from for very short boats, the ISO 12217 freeboard requirement for equivalent design category D boats is constant at 400mm.

9. Table 9 - minimum upright freeboard for MCA category A and B waters

Why does the freeboard requirement increase as the beam and length increases? Irrespective of length or beam, all boats sizes are subject to the same significant wave height.

8. Executive summary

8.1 Introduction and scope

This report provides an initial review of the feasibility of the inland waterway navigation authorities (and/or the Boat Safety Scheme (BSS)) introducing stability and freeboard checks for inland waterway hire boats in light of the recently developed Hire Boat Code.

8.2. The Hire Boat Code – background information

In July 2003 a day-hire boat named BREAKAWAY V capsized on the Norfolk Broads leading to the drowning of one of the occupants. The incident was investigated by the Marine Accident Investigation Branch (MAIB). In addition to other matters their report recommended the development of a national code of safe practice for boats let for hire on inland waterways. In response the Maritime and Coastguard Agency (MCA), in conjunction with the British Marine Federation (BMF), the Association of Inland Navigation Authorities (AINA), and other stake holders developed the Hire Boat Code (HBC).

In June 2009 a draft version (Issue 1) of the HBC was published by the MCA, BMF and AINA. In September 2009 Issue 1.1 was printed by the BMF (without formal support from MCA and AINA). Issue 1 and Issue 1.1 are for all intents and purposes the same, and Issue 1.1 has been adopted as the focus of this study and report. The HBC sets down the minimum standards which apply to the design, construction and maintenance of hire boats (including stability and freeboard) and is applicable to Power driven boats operating in MCA Category A to D waters (loosely interpreted as inland waterways).

8.3. The Hire Boat Code – stability and freeboard requirements

The HBC addresses stability and freeboard at three different levels:

a. Initial Stability and Freeboard Test/ing

Initial Stability and Freeboard testing must be applied to individual boats, or a representative sample of each Design Class prior to them entering service as a hire boat. There are two different versions of Initial Stability Test (the General Initial Stability Test and the Simplified Initial Stability Test), and one Freeboard Test. Combined these tests ensure that boats start their service life with compliant stability and freeboard. However, these tests also help to determine safe Crew Limits (the maximum number of persons permitted onboard), and Crew Areas (where onboard a boat crew may be located) in order to help ensure the stability and freeboard parameters are maintained during use.

These tests are complicated and reasonably time consuming to plan and conduct.

b. On-going in-service stability and freeboard

The HBC sets out the following, in-service, tests and monitoring procedures to ensure boats remain within their specified stability and freeboard parameters during their service life:

- i Annual measurement of freeboard (Datum freeboard).
- ii Change control measures. On an on-going basis hire operators must carefully consider, and record, any physical changes to a boat which could affect its stability and/or freeboard.
- iii Check Stability Test. This stability test is used to ensure that a particular boat remains compliant with its original Initial Stability Test and must be undertaken when physical changes have occurred to a boat which could affect its stability and freeboard.

c. In-use measures

The Crew Limits and the Crew Areas are to be identified in the hire operator's documentation and on a diagram placed at the main control position of each boat. In addition where points of access are not visible from the control position, they shall be physically marked with "do not access" or "limited access" signs.

In addition to ensuring that hire operators carefully consider physical changes to particular boats, they are also required to consider operational changes which might affect a boat's stability, freeboard and other matters.

The complicated and varied nature of the prescribed test parameters and compliance criteria could make implementation, in a verifiable and meaningful way, difficult for hire operators, especially those with a small number of boats and where the boats fall outside of the Simplified Initial Stability Test.

8.4. The inland waterways hire fleet – data and statistics

At the time of this initial feasibility report the total number of Power driven hire boats on AINA waterways is not known. The only data currently available has been provided by the Broads Authority - in 2011 the total number of Power driven hire boat was 1,216, which could be subdivided as: Motor cruisers – 920; Day launches – 284; Outboard dinghies – 12.

8.5. The inland waterways hire fleet – existing stability and freeboard requirements

Boat Safety Scheme

Since their inception the Boat Safety Scheme (BSS) requirements for hire boats have included basic freeboard checks, which require examiners to check the minimum down-flooding heights of: all openings in the hull above the water line; self-draining cockpits (decks); and, weed hatches. The BSS requirements do not take into consideration crew numbers, luggage or equipment, or onboard tank status. The existing BSS requirements do not include any stability testing.

Broads Authority

In April 2010 the Broads Authority (BA) implemented, in part, the stability and freeboard requirements of the HBC, and required all licenced Power driven hire boats to be subject to the Initial Stability and Freeboard Tests.

8.6. Applying the Hire Boat Code stability and freeboard requirements to the inland waterways hire fleet.

The main remit for this report was to assess the feasibility of the inland waterway navigation authorities (and/or the BSS) introducing stability and freeboard checks for hire boats.

In summary, it is the authors' opinion that the stability and freeboard requirements of the HBC could reasonably be implemented across the inland waterways Power driven hire boat fleet. However, to do so in a meaningful way would require all the relevant requirements of the HBC (the initial stability and freeboard testing, the on-going in-service stability and freeboard tests and monitoring procedures, and the in-use measures) to be introduced, and for this to be done in a thorough and verifiable manner.

In order for stability and freeboard testing to be meaningful measures would need to be put in place to ensure that all boats were tested to the correct parameters. One way forward would be for BSS examiners to be trained to undertake stability and freeboard testing and for such testing to then be part of the BSS certification process. However, it is considered that training a large body of such examiners would be fraught with initial training, consistency of application and on-going assessment issues, and furthermore the additional costs that such enhanced BSS examinations/tests would place on hire operators may be financially prohibitive.

Alternatively, it would be possible to develop a reasonably simple computer program, based on a widely available platform such as Microsoft Excel to take the hire operators themselves, step by step, through the stability and freeboard testing. Such a program could, as an end result, provide standardised test reports for forwarding to navigation authorities, and also advise the hire operators of what information to provide to hirers, and what information to place onboard individual boats, such as Crew Limits and Crew Areas. If all hire operators used the same software it would help to ensure consistency of application and make verification of the procedures and test outcomes relatively simple.

One possible disadvantage of such a system would be that hire operators would be self-certifying on stability and freeboard, but such a standardised test regime would minimise the risks of hire operators undertaking the tests incorrectly. Such a standardised test regime would also make the task of verification and monitoring relatively simple. If standardised test reports had to be submitted by hire operators as part of their licence applications these could be checked and verified by navigation authority staff with relatively little training. As an additional verification tool the navigation authorities could, individually or through the BSS, undertake sample Stability and Freeboard tests on a small number of 'high risk' boats. Such sampling could be undertaken by a very small number of trained persons, whether these be navigation authority staff, or BSS examiners.

The Initial Stability and Freeboard tests are the bedrock on which all the operational criteria and subsequent testing are based. Undertaking the initial tests correctly in a verifiable way may take a few hours per boat and be perceived as an initial inconvenience by hire operators, but once completed hire boats could be in service with only annual Datum freeboard tests and relatively minor administrative procedures for the remainder of their service life. Routine BSS examinations could be tied in with hire operators undertaking annual Datum freeboard checks but it is considered questionable as to whether there would be any benefit to such. BSS examiners and/or navigation authority staff periodically checking Change control forms, and Crew Limits and Crew Areas information would be more meaningful.

8.7. Hire Boat Code limitations, and outstanding technical issues

In working through the stability and freeboard sections of the HBC the authors have noted a number of inconsistencies in content and format, which indicate that to some degree the code is work in progress. They have also identified a number of technical issues which will need to be resolved if the stability and freeboard requirements are to be adopted by the inland waterway navigation authorities.

General Initial Stability Test Procedure

3.2.1 General

- (a) This procedure applies to the first boat tested of each Design Class that is identical in its class. For details of Check Stability Tests see 3.4.
- (b) Ensure that the bilges of the boat are pumped as dry as practicable and fuel, water and other tanks are between about 25% and 75% full. The boat should be fitted with all normal operating equipment, and outboard motor if appropriate. No personal gear should be on board.
- (c) Record the freeboard on the centreline at both bow and stern, and clearly record the position to which these freeboards have been taken, and whether the boat is in salt or fresh water. These measurements are referred to as the Datum Freeboards.
- (d) Load the boat with all personal effects, stores and baggage to be carried. At least 5kg/person shall be added for open boats, and 20kg/person added for boats with overnight accommodation or for boats used for camping trips.
- (e) All boats must be tested according to 3.2.2 or 3.3 (if applicable). Open power-driven boats of less than 6m L_H shall also be tested according to 3.2.3.
- (f) During the tests, on boats with watertight or quick-draining cockpits, water may enter the cockpit through drains when the boat is heeled during the test, provided this water drains overboard when the test weights are moved to the centreline.
- (g) The freeboard margin is, when the boat is heeled, the vertical height from the waterline to the point at which water could first begin to enter the interior or bilge. Where a hull fitting is connected to a pipe, the highest point of the pipe is the height to be measured. Pipes through which water cannot enter the interior or bilge (eg: exhaust pipes, pipes with non-return valves) can be disregarded.
- (h) During the tests, when measuring the freeboard margin, one outboard engine well penetration fitted with a sealing boot may be disregarded.

3.2.2 Procedure for General Initial Stability Test

- (a) Assemble a group of people up to a total weight of $98n$ kg (where n = number of persons the boat is intended to carry). Record the weight of each person. Alternatively, an 85kg set of test weights may be used instead of each person.

NOTE 85kg includes a margin of 13% to allow for the probability that a group of persons may weigh on average more than 75kg each

Appendix A
General Initial Stability Test Procedures
(Text from Appendix 3 of the HBC)

- (b) For boats in which all parts of the Crew Area are below the sheerline, successive persons shall be placed on board so as to result in the **least freeboard margin** in each case. For all other boats two tests shall be conducted: the first with persons placed so as to result in the **maximum heel angle**. After completion of this, the persons are to be moved to the positions (using the criteria of (g) below) that result in the least freeboard margin. If the measured freeboard does not satisfy Table 5, remove people or sets of test weights until this is achieved, whilst maintaining the most adverse positioning of the remainder³.
- (c) For each test use the following procedure. Where the crew limit is expected to exceed seven persons, up to 25% of the crew limit may be added at each of the first two stages. Successive stages of a physical test should not exceed one person.
- (d) Where people are standing, as far as practicable they should remain upright without exerting much weight on any handholds. When the tester is onboard the boat, he/she should stand on the centreline as close as practicable to the centre of area of the waterplane, so that their presence does not affect the trim, and always stand in the same position when measurements are taken. Their weight may be offset against the mass of carry-on load. Persons measuring freeboards should not be on board the boat being tested.
- (e) Place the first person at the main control position, as far outboard as practical but not closer than 200mm from the outboard edge. Measure the heel angle and freeboard margin (see 3.2.1 (f) and (g)).
- (f) Repeat in the opposite direction of heel unless it is clear from any asymmetry of the boat that the first direction is most onerous, when only this direction need be tested. The most adverse of the two measurements of each parameter made are to be recorded.
- (g) Place an additional person to one side of the Crew Area. The centre of gravity of each person shall be positioned as far to one side as practicable, provided that adjacent people are not placed with their centres-of-gravity closer than 500 mm apart in any direction, or closer than 200 mm from the outboard edge of the Crew Area, except where the deck is less than 400mm wide when practical positions are to be used .
- (h) Measure the heel angle and least freeboard margin. Repeat in the opposite direction of heel unless it is clear from any asymmetry of the boat that one direction is most onerous, when only this direction need be tested. The most adverse of the two measurements made are to be recorded.
- (i) Repeat (e) and (f) for further increments of not more than one person at a time, whilst observing the Hire Operator's definition of Crew Area according to 3.1 (c) and (d). Stop the test when the **first** of the following events happens:
- the minimum heeled freeboard before downflooding is reached according to Table 5, whether over the gunwale or through openings in the topsides
 - the heel angle (degrees) is $11.5 + \frac{(24 - L_H)^3}{520}$, see also Table 6
 - the total mass of people on board reaches $98n$ kg for the desired crew limit n .

³ If all parts of the Crew Area are not below the sheerline, the boat must first be tested by placing successive people so as to create the largest heel angle (on smaller boats this is usually placing them forward). This checks the boat against the danger of capsizing but does not find the worst case regarding downflooding.

However if the test is repeated so that persons are successively placed so as to create the least freeboard margin, they will be placed differently to the first test. Rather than take everyone off the boat and then reload them in different positions, it has been found easier to do the first test and on completion move the people to the positions for minimum freeboard. If the required freeboard is not achieved then people have to be removed until it is.

However if all the people are taken off and the test repeated this time for minimum freeboard margin, it would achieve the same objective. Often minimum freeboard margin occurs on smaller boats when they are placed aft.

Appendix A

General Initial Stability Test Procedures

(Text from Appendix 3 of the HBC)

- the heel angle suddenly increases a large amount for a small increase in heeling moment. This is when the boat is close to a complete loss of residual stability and consequent capsize.

NOTE: The safe loading of a boat may be limited by any of these factors and there is no safe method of determining in advance which is the limiting factor for a given boat. Therefore all need to be considered and the test stopped when the first of them occurs.

Caution: Great caution must be exercised when doing this test because some boats may capsize suddenly. Therefore heeling moments should be increased carefully, especially when approaching the expected Crew Limit. As this point is approached, smaller increments of test weights should be used. In smaller boats it is helpful to attach a capsize preventer rope (eg: from the depressed gunwale to a strong point ashore) provided that this is kept slack enough not to interfere with the test. For larger boats, to give warning of loss of stability, a continuously plotted graph of heel angle against heeling moment (product of the mass of test weights times the distance off the centreline measured parallel to the design waterline) should be used.

Caution: Because of the risk of capsize, sets of test weights should be used instead of persons in any locations from which escape would become hazardous should the boat capsize.

- (j) Of the measurements made according to (c), (e) or (h), the maximum heel angle recorded shall be less than that given in Table 6, and the minimum measured freeboard margin recorded shall exceed the requirement given in Table 5.
- (k) If the test is limited by downflooding over the gunwale, the maximum number of persons allowed is calculated as the maximum actual mass of persons on board, divided by 85kg per person, rounded downwards to the nearest child (or adult).
- (l) If the test is limited by maximum heel angle, loss of stability or downflooding through openings in the topsides, the maximum number of persons allowed is calculated as the maximum actual mass of persons on board, divided by 98kg per person, rounded downwards to the nearest child (or adult).

NOTE: 98kg incorporates a 15% stability margin for persons weighing 85kg each, or 30% for persons weighing 75kg each.

Table 5 — Required minimum freeboard margin

Dimensions in millimetres

MCA Category	Decked Boats	Open Boats with Flotation	Open Boats without Flotation
A	10	10	$53\sqrt{L_H}$
B	40	40	$77\sqrt{L_H}$
C	70	70	$92\sqrt{L_H}$
D	100	100	$104\sqrt{L_H}$

Table 6 — Maximum heel angle for offset load test

L_H (m)	3	4	5	6	7	8	10	12	15	18	21	24
max heel angle (°)	29.3	26.9	24.7	22.7	20.9	19.4	16.8	14.8	12.9	11.9	11.6	11.5

- (m) When the crew limit has been found, return to a loading condition in which between 40% and 60% of the crew limit are on board, positioned as during the test above. Record the weight and positions (lengthwise and athwartships) of each of the people on board, the consequent heeling moment applied, and the measured heel angles and freeboard margins for later comparison with Check Stability Tests conducted in accordance with 3.4.
- (n) Where an open power-driven boat of L_H less than 6m of Category A or B is unable to comply with the test above when using people, it may be retested using a set of test weights totalling $(85 \times L_H / 6)$ kg in respect of each person, in which case the crew limit shall be calculated as in (j) and (k) but using $(85 \times L_H / 6)$ instead of 85 and $(98 \times L_H / 6)$ instead of 98 respectively.

- (o) If the boat passes this revised test, a safety sign as shown in Figure 4 shall be displayed on the boat. The sign shall comply with 3.1 (e) and Table 4.

NOTE The use of water containers instead of metallic test weights will give a less advantageous result.



Figure 4
Dinghy is vulnerable to capsize or swamping

3.2.3 Gunwale Load Test

- (a) This test is only applicable to open powered boats of L_H less than 6m.
- (b) Apply a vertically downwards load of 85kg to the gunwale of the boat without crew at $L_H/2$ forward of the stern. If this load is applied by suspending a test weight in the water, the dry mass of the test weight must be $85d$, where d is a material coefficient as given in Table 7.

NOTE 85 kg includes a margin of 13% to allow for the probability that a person may weigh on average more than 75kg.

Table 7 – Material coefficient

MATERIAL	LEAD	65/35 BRASS	STEEL	CAST IRON	ALUMINIUM
VALUE OF D	1,099	1,138	1,151	1,163	1,612

- (c) If the boat swamps or capsizes under this load, a safety sign as shown in Figure 5 shall be displayed where it is clearly visible when entering the boat. The sign shall comply with 3.1 (e) and Table 4.



Do not sit or stand on the gunwale
 (using ISO 7010 – W001 “General warning”)

Simplified Initial Stability Test (Procedure)

3.3.1 General

- (a) This test is only applicable to boats which operate on MCA Category A, B or C waters and which are 2.08m beam cruising narrowboats over 10m in length, or unballasted decked power-driven boats over 7m in length and which satisfy the following:
- maximum height of deck or coachroof on which crew members may sit or stand is less than the maximum hull beam (excluding rubbers), and
 - maximum number of persons is less than $(L_H \times B^2)/15$, where L_H is the length of hull and B is the maximum hull beam excluding rubbers, both in metres.
- (b) This test may be conducted by suitably competent hire operator staff.
- (c) This procedure applies to the first boat tested of each Design Class that is identical in its class. If in any doubt as to whether the weight of ballast fitted or downflooding openings are the same, first conduct the Check Stability Test to confirm this. For details of Check Stability Tests see 3.4.
- (d) Before conducting Initial Stability Test, prepare the boat in accordance with 3.2.1(b), (c) and (d).

(Ensure that the bilges of the boat are pumped as dry as practicable and fuel, water and other tanks are between about 25% and 75% full. The boat should be fitted with all normal operating equipment, and outboard motor if appropriate. No personal gear should be on board.

Record the freeboard on the centreline at both bow and stern, and clearly record the position to which these freeboards have been taken, and whether the boat is in salt or fresh water. These measurements are referred to as the Datum Freeboards.

Load the boat with all personal effects, stores and baggage to be carried. At least 5kg/person shall be added for open boats, and 20kg/person added for boats with overnight accommodation or for boats used for camping trips.)

- (e) Identify all points in the topsides through which water may flood the interior of the boat (downflooding points). In particular identify those openings with the least height above the waterline. Engine exhausts and pipes fitted with non-return valves can be ignored. For openings piped internally, the critical height is to the highest point reached before downflooding begins. On narrowboats the forward door from the bow cockpit is often critical. In such cases if the bow cockpit sole is watertight, the downflooding point is the door sill.
- (f) For decked power-driven boats over 7m in length and with permanent ballast weighing less than $(L_H^3/7)$ (kg) (L_H in metres), where the minimum upright freeboard to critical downflooding openings when the boat is fully loaded⁴ with the maximum number of persons onboard at 75kg each is greater than that given in Table 8 or 9 below, no further testing is required. In using these tables, boat length should be rounded down, and beam rounded up to the nearest figures tabulated.

*Note: The reduction in freeboard (mm) due to loading with crew and effects can be calculated as:
Reduction in freeboard (mm) = 133 x (number of crew)/($L_H \times B$)*

- (g) All boats not covered by, or failing to pass (f), shall be tested according to 3.3.2.

⁴ As defined in 4.1.2

Appendix B
Simplified Initial Stability Test (Procedures)
(Text from Appendix 3 of the HBC)

Table 8

Minimum Upright Freeboard (mm) for MCA Category A and B Waters

Max Beam excl. rubbers (m)	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5
Min Upright Freeboard to Flooding (mm)	389	412	436	460	484	508	532	555	579

Table 9

Minimum Upright Freeboard (mm) for MCA Category C Waters

Lh (m)	Maximum Beam (m) excl. rubbers								
	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5
7	439	462	486	510	534	558	582	605	629
8	439	462	486	510	534	558	582	605	629
9	439	462	486	510	534	558	582	605	629
10	439	462	486	510	534	558	582	605	629
11	459	462	486	510	534	558	582	605	629
12	484	484	486	510	534	558	582	605	629
13	508	508	508	510	534	558	582	605	629
15	557	557	557	557	557	558	582	605	629
18	630	630	630	630	630	630	630	630	630
24	630	630	630	630	630	630	630	630	630

3.3.2 Simplified Initial Stability Test

The procedure below shall be followed.

- (a) Assemble a group of persons weighing not less than $98n$ (kg), where n is the maximum number of persons the boat is intended to carry. Check their total weight using scales.
- (b) Mark the mid-length of the hull of the boat, excluding bow/stern fittings or rudder.
- (c) Position the group of persons on the side-deck, evenly fore-and-aft about the mid-length, and standing as upright as practicable, holding on lightly if necessary.
- (d) Measure the angle of heel and the vertical freeboard margin to the most critical downflooding points forward and aft. BMF Technical Department can advise simple ways of measuring the heel angle.
- (e) If the angle of heel is less than that given in Table 6 above, and the freeboard margin is more than 150mm for Category A or B waters, or 200mm for Category C waters, the boat has passed.
- (f) If the boat fails to meet these parameters, either:
 - reduce the number of persons and retest, or
 - impose restrictions on the movement of persons on board (as described in 3.1 above), and retest the boat, positioning persons not permitted on side-decks as far to one side as reasonably practical, or
 - conduct the General Initial Stability Test instead.
- (g) If the number of persons has been reduced, the crew limit is the total weight in kg of those finally on board, divided by 98.
- (h) After the maximum number of persons on board has been found, gather data for the Check Stability Test as follows.
- (i) Find the total weight of a group of approximately half the maximum acceptable number of persons that has been found.

Appendix B
Simplified Initial Stability Test (Procedures)
(Text from Appendix 3 of the HBC)

- (j) Repeat the measurements in (d) when this reduced number of persons is positioned on the side-deck evenly about the mid-length, and record the heel angle and freeboard margin fore and aft for comparison with future Check Stability Tests.

Check Stability Test (Procedure)

- (a) This procedure applies to Check Stability Tests only. For details of tests to be applied to the first boat tested of each Design Class see 3.2 or 3.3.
- (b) Before conducting Check Stability Tests, prepare the boat in accordance with 3.2.1(b), (c) and (d).
- (c) Replicate the total weight of people / weights and total heeling moment as recorded for this test during the Initial Stability Test (see 3.2.2(m) or 3.3.2 (i)).

(Ensure that the bilges of the boat are pumped as dry as practicable and fuel, water and other tanks are between about 25% and 75% full. The boat should be fitted with all normal operating equipment, and outboard motor if appropriate. No personal gear should be on board.

Record the freeboard on the centreline at both bow and stern, and clearly record the position to which these freeboards have been taken, and whether the boat is in salt or fresh water. These measurements are referred to as the Datum Freeboards.

Load the boat with all personal effects, stores and baggage to be carried. At least 5kg/person shall be added for open boats, and 20kg/person added for boats with overnight accommodation or for boats used for camping trips.)

- (d) The resulting maximum heel angle and minimum heeled freeboard requirements shall then be compared with those of the initial heeling moment during the Initial Stability Check – see 3.2.2 (m) or 3.3.2(j). If, for the same total mass of persons added, the original heel angle is exceeded by more than 2% or the original freeboard margin is not attained, then the safe Crew Limit is to be reassessed using the Initial Stability Test procedure as 3.2 or 3.3 above (as was originally used for the boat) in its entirety.

Freeboard Requirements (Test Procedure)

4.1 General

- 4.1.1 Freeboard is the least vertical height from the loaded waterline (at design trim and no heel) to any opening in the hull (including the edge of a coaming) that may admit water into the interior or bilge of a boat or a recess. Such openings are called “downflooding openings”.
- 4.1.2 Freeboard shall be measured when the boat is loaded with:
- (a) all normal operating equipment,
 - (b) outboard motor if appropriate,
 - (c) full fuel and water tanks (or weights to make up any missing quantity) but empty sewage or waste tanks,
 - (d) a weight of 75kg for each person to be carried, located in practical positions (ie: on thwarts and seats where appropriate) so as to produce a sensible operating trim, ie: slightly stern down (if practicable).
 - (e) at least 5kg/person allowance for personal effects shall be added for day-hire boats, and 20kg/person be added for boats with overnight accommodation or those used for camping trips.
- 4.1.3 When a boat has no downflooding openings, the minimum freeboard to the main deck shall not be less than 80% of the requirements of 4.2.
- 4.1.4 The requirements given in 4.2, 4.3 and 4.4 apply to all downflooding openings except:
- (a) engine exhausts or other openings that are only connected to watertight systems;
 - (b) openings in the sides of outboard engine wells which are of
 - watertightness degree 2 and having the lowest point of downflooding more than 0.1 m above the loaded waterline, or
 - watertightness degree 3 and having the lowest point of downflooding more than 0.2 m above the loaded waterline and also above the top of the transom in way of the engine mounting, provided that well drain holes are fitted, see Figure 6, or
 - watertightness degree 4 and having the lowest point of downflooding more than 0.2 m above the loaded waterline and also above the top of the transom in way of the engine mounting, provided that well drain holes are fitted, and that the part of the interior or non-quick-draining spaces into which water may be admitted has a length less than $L_H/6$ and from which water up to 0.2 m above the loaded waterline cannot drain into other parts of the interior or non-quick-draining spaces of the boat, see Figure 6.

NOTE: Degrees of watertightness and means of testing are given in ISO 12216.

- 4.1.5 Downflooding openings may exist inboard of the side shell, eg: door sills, hatches, outboard engine trunks, sinks or drains piped to hull fittings.
- 4.1.6 Where the flow of water to a downflooding point inboard of the side shell is restricted by drainage holes, channels or pipes with a total cross-section area of less than 20cm^2 , the freeboard shall be not less than 70% of that required by 4.2 to 4.4 below.

EXAMPLES: Sink drains, cabin doors leading from bow cockpits on narrowboats, bilge pump outlets.

NOTE: It is recommended that doors from bow cockpits on narrowboats (which may be vulnerable to swamping from leaking lock gates) should have a minimum sill height of 75mm above the cockpit sole.

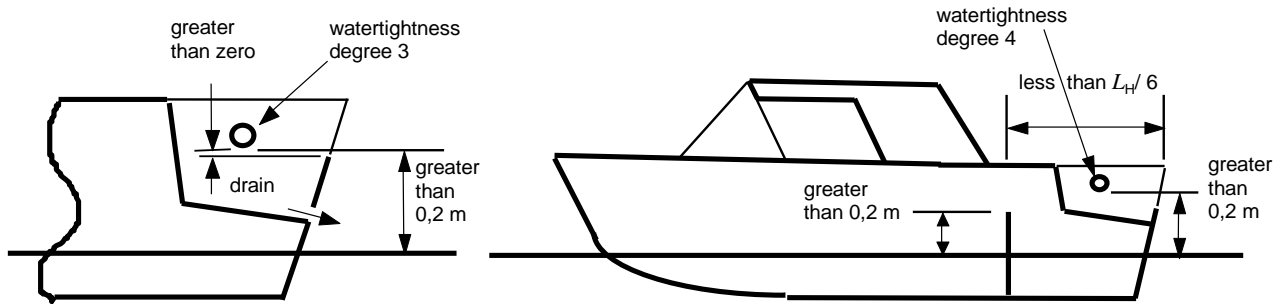


Figure 6 – Openings in Outboard Engine Wells

4.2 Freeboard Requirements for Decked Boats

THE MINIMUM FREEBOARD TO DOWNFLOODING OF DECKED BOATS SHALL EXCEED THE VALUES GIVEN IN TABLE 9.

TABLE 9 – MINIMUM FREEBOARD OF DECKED BOATS
DIMENSIONS IN M

MCA Category	Minimum freeboard (m)		
	L_H less than 7m	$L_H = 7$ to 18m	L_H more than 18m
A	0.250	0.250	0.250
B	0.250	0.250	0.250
C	0.360	$0.0245 \cdot L_H + 0.189$	0.630
D	0.600	$0.0409 \cdot L_H + 0.314$	1.050

4.3 Freeboard Requirements for Open Boats without Flotation

The minimum freeboard to downflooding of all Open Boats not fitted with means of flotation shall exceed the values given in Table 10.

Table 10 – Minimum Freeboard of Open Boats without Flotation

MCA Category	Minimum freeboard (m)
A	0.250
B	0.400
C	0.600

4.4 Freeboard Requirements for Open Boats with Flotation

The minimum freeboard to downflooding of all Open Boats fitted with means of flotation shall exceed the values given in Table 11.

Appendix D
 Freeboard Requirements (Test Procedures)
 (Text from Appendix 3 of the HBC)

Table 11 – Minimum Freeboard of Open Boats with Flotation

DIMENSIONS IN M

MCA Category	Minimum freeboard (m)			
	L_H less than 4m	$L_H = 4$ to 7m	$L_H = 7$ to 18m	L_H more than 18m
A	0.200	$0.0167.L_H + 0.133$	0.250	0.250
B	0.200	$0.0167.L_H + 0.133$	0.250	0.250
C	0.300	0.300	$0.0164.L_H + 0.185$	0.480
D	0.400	0.400	$0.0364.L_H + 0.145$	0.800

Appendix 2 Example of Risk Assessment and Control Form

Hire Boat Company Name

Prepared by: *Dave Brown*

Date: *18th June 2008*

Authorised by: *Harry Smith*

Date: *25th June 2008*

Next Review Date: *31st March 2009*

Boats		
Change¹	Possible Hazard²	Additional Risk Control Measures³
<i>Fitting cabin to open boat.</i>	<i>Reduced stability.</i>	<i>Carry out new Initial Stability Test.</i>
<i>New engine/transmission installation.</i>	<i>Different weights/locations could have adverse effect on trim and stability.</i>	<i>Carry out check stability test. Substantial changes may need a new Initial Stability Test.</i>
	<i>Incorrect or incomplete installation.</i>	<i>Commission surveyor to oversee works and commissioning</i>
<i>Additions or modifications to gas systems.</i>	<i>Gas leaks. Potential for fire/explosion.</i>	<i>Works carried out and inspected by competent person.</i>

Operating Environment		
Change¹	Possible Hazard²	Additional Risk Control Measures³
<i>Restriction to navigation notified by navigation authority - restricted bridge hole due to repair work.</i>	<i>Collision with temporary works.</i>	<i>Include in handover briefings for duration of works.</i>
<i>Strong streams due to water control.</i>	<i>Abnormally strong flows, flow directions and level changes.</i>	<i>Include in handover briefings for as long as necessary. Possibly advise alternatives routes.</i>
<i>Poor weather leading to abnormal wave heights.</i>	<i>Stability question if heights are outside assumptions made in stability assessment.</i>	<i>Check available margins on wave height and restrict operations if necessary.</i>
<i>Operation of boat outside original area.</i>	<i>Risks arising from non-compliance with the Code.</i>	<i>Assess against Code provisions. Identify non-compliance and identify measures required.</i>

Crew/Passengers		
Change¹	Possible Hazard²	Additional Risk Control Measures³
<i>Exceptionally heavy party.</i>	<i>Stability margins reduced.</i>	<i>Do not permit total crew weight to exceed 85kg times number of persons. Re-emphasise handover briefing stability aspects.</i>

Notes

- 1 'Change' includes anything which could introduce a hazard outside the scope of the Code, or require substantial alteration to measures already introduced.
- 2 What could happen as a result of the change.
- 3 The measures judged necessary to deal with the hazard.