

ANNEX 8

DEFINITIONS, REQUIREMENTS AND COMPLIANCE CRITERIA RELATED TO OPERATIONAL AND SAFETY PERFORMANCE

This annex applies to all types of craft.

Tests to evaluate operational safety should be conducted on the prototype craft of a new design or of a design incorporating new features which may modify the results of a previous testing. The tests should be carried out to a schedule agreed between the Administration and the manufacturer. Where conditions of service warrant additional testing (e.g. low temperature), the Administration or base port State authorities as appropriate may require further demonstrations. Functional descriptions, technical and system specifications relevant to the understanding and evaluation of craft performance should be available.

The objective of these tests is to provide essential information and guidance to enable the craft to be operated safely under normal and emergency conditions within the design speed and environmental envelope.

The following procedures are outlined as requirements in dealing with verification of craft performance;

1 Performance

1.1 General

- .1 The craft should meet the applicable operational requirements in chapter 17 of this Code and this annex for all extremes of passenger and load configurations for which certification is required. The limiting sea state related to the different modes of operation should be verified by tests and analyses of a craft of the type for which certification is requested.
- .2 Operational control of the craft should be in accordance with procedures established by the applicant for operation in service. Procedures to be established should be start procedure, cruise procedures, normal and emergency stop and manoeuvre procedures.
- .3 The procedures established under .2 should:
 - .1 demonstrate that normal manoeuvres and craft responses to failures are consistent in performance,
 - .2 use methods or devices that are safe and reliable; and

- .3 include allowance for any time lag in the execution of procedures, that may reasonably be expected in service.
- .4 Procedures required by this Annex should be conducted over water of sufficient depth such that craft performance will not be affected.
- .5 Tests should be conducted at minimum practicable weight and additional testing should be conducted at maximum weight sufficient to establish the need for additional restrictions and for testing to examine the effect of weight.

2 Stopping

2.1 This test is to establish the acceleration experienced when stopping the craft in calm water with no passenger load or cargo load during the following conditions:

- .1 normal stop for maximum operational speed,
- .2 emergency stop for maximum operational speed,
- .3 crash stop for maximum operational speed and from any transient mode speed.

2.2 The tests (a) and (b) should document that the accelerations do not exceed level 1 in annex 3 when control levers are used in accordance to written procedures as given in the Craft Operating Manual or in an automatic mode. Should safety level 1 be exceeded during normal stop, control systems should be modified in order to avoid exceedance or passengers should be required to be seated during normal stop. Should safety level 1 be exceeded during emergency stop, then written procedures in the Craft Operating Manual should include detailed information of how to avoid exceedance or control system should be modified to avoid exceedance.

2.3 The test .3 should document that the accelerations do not exceed safety level 2 in annex 3 when control levers of automatic modes are used in a manner which will give the highest accelerations. If level 2 is exceeded then the Craft Operating Manual should include a warning that it is a risk to passengers being injured if crash stop is performed.

2.4 Other tests should be repeated during craft turning to establish the need or otherwise to impose any speed related restrictions during manoeuvres.

3 Cruise Performance

3.1 This test is to establish the craft performance and accelerations experienced during cruise modes with no passenger load or cargo load during the following conditions:

- .1 Normal operation conditions are those in which the craft will safely cruise at any heading while manually operated, auto-pilot assisted

operated or operated with any automatic control system in normal mode; and

- .2 Worst intended conditions, referred to in 1.4.48 of this Code are those in which it should be possible to maintain safe cruise without exceptional piloting skill. However, operations at all headings relative to the wind and sea may not be possible. For type of craft having a higher performance standard in non-displacement mode the performance and accelerations should also be established at displacement mode during operation in worst intended condition.

3.2 Operation levels as defined in 3.1 should be established and documented by full-scale tests in at least two relevant sea conditions and in head, beam and following seas. Test period should at least be 15 minutes. Model tests and mathematical simulations could be used to verify the performance in worst intended conditions.

Limits for normal operation condition should be documented by measurements of craft speed heading to the wave and interpolation of measurements of maximum horizontal accelerations, in accordance with 2.4 of annex 3. Measurement of wave height and period should be made to the maximum extent practicable.

Limits for worst intended condition should be documented by measurements of craft speed, wave height and period, heading to the wave and by root mean square (RMS) values of horizontal accelerations, in accordance with 2.4 of annex 3 and of vertical accelerations close to the craft longitudinal centre of gravity. RMS values could be used for extrapolation of peak values. To obtain the expected peak values related to structural design load and safety levels (1 per 5 - minute exceedance), multiply the RMS values by 3.0 or

$$C = \sqrt{2 \ln N}$$

where N is the number of successive amplitudes within the relevant period.

If not otherwise verified by model test or by mathematical calculations, it might be assumed a linear relation between wave height and accelerations based on measurements in the two sea conditions. Limits for worst intended condition should be documented both related to passenger safety in accordance with, 2.4 of annex 3 and related to the actual structural design load of the craft.

The wave height limitations imposed on the operation of high speed craft are initially based on the critical design condition of the craft at full operational speed.

Tests in this section should be carried out to demonstrate the operational and safety performance of the craft during its normal and emergency condition. A craft should only operate within an envelope which delivers a suitable safety margin at all times.

The Navigation and Communication Branch should be consulted for the initial limitation for a prototype craft of a new design or of a design incorporating new features.

An operator may wish to increase the limitation because they believe that their craft is capable of operating safely in high seas. While the MCA can agree with that in principle, we need to see theoretical and practical evidence. Theoretical evidence can take the form of a statement from a Classification Society, certifying that the craft has been designed and built to operate safely at full operational speed in a particular weather window. The practical evidence will take the form of a series of tests (Heavy Weather Sea Trials), witnessed by an MCA Surveyor.

3.3 The tests and verification process should document the limiting seas for safe operation of the craft:

- .1 in normal operation at maximum operational speed the accelerations should not exceed safety level 1 in annex 3 with an average of 1 per 5-minute period. The Craft Operating Manual should include detailed description of the effects of speed reduction or change of heading to the waves in order to prevent exceedance;
- .2 in the worst intended conditions, with reduced speed as necessary, the accelerations should not exceed safety level 2 in annex 3 with an average of 1 per 5-minute period, nor should any other craft characteristic motion as pitch, roll and yaw exceed levels that could impede the safety of passengers. In worst intended conditions, with reduced speed as necessary, craft should be safely manoeuvrable and provide adequate stability in order that the craft can continue safe operation to the nearest place of refuge, provided caution is exercised in handling. Passengers should be required to be seated when safety level 1 in annex 3 is exceeded; and
- .3 Within the actual structural design load for the craft, with reduced speed and change of heading as necessary.

3.4 Turning and manoeuvrability

The craft should be safely controllable and manoeuvrable during:

- .1 hull-borne operation
- .2 operation in non-displacement mode,
- .3 take-off, landing,
- .4 any intermediate or transition modes, as applicable; and
- .5 berthing operations, as applicable.

4 Effects of Failure Or Malfunction

4.1 General

The limits of safe operation, special handling procedures and any operational restrictions should be examined and developed as a result of full-scale trials conducted by simulating possible equipment failures.

The failures to be examined should be those leading to major or more severe effects as determined from evaluation of the FMEA or similar analysis.

Failures to be examined should be agreed between the craft manufacturer and the Administration and each single failure should be examined in a progressive manner.

4.2 Objects of tests

Examination of each failure should result in:

- .1 determining safe limits of craft operation at the time of failure, beyond which the failure will result in degradation beyond safety level 2;
- .2 determining crew member's actions, if any, to minimise or counter the effect of the failure; and
- .3 determining craft or machinery restrictions to be observed to enable the craft to proceed to a safe haven with the failure present.

4.3 Failures to be examined

Equipment failures should include, but not be limited to, the following:

- .1 total loss of propulsion power;
- .2 total loss of lift power (for ACV and SES);
- .3 total failure of control of one propulsion system;
- .4 involuntary application of full propulsion thrust (positive or negative) on one system;
- .5 failure of control of one directional control system;
- .6 involuntary full deflection of one directional control system;
- .7 failure of control of trim control system;
- .8 involuntary full deflection of one trim control system element; and
- .9 total loss of electrical power.

Failures should be fully representative of service conditions, and should be simulated as accurately as possible in the most critical craft manoeuvre where the failure will have maximum impact.

4.4 "Dead ship" test

In order to establish craft motions and direction of laying to wind and waves, for the purposes of determining the conditions of a craft evacuation, the craft should be stopped and all main machinery shut down for sufficient time that the craft's heading relative to wind and waves has stabilised. This should be carried out on an opportunity basis to establish patterns of the design's "dead ship" behaviour under a variety of wind and sea states.

Dead ship - this is the worst scenario, but the point is not whether it is likely or unlikely to occur. This test is to establish craft motion to determine the condition of the craft during an evacuation scenario and, in case of a black out, the safety of crew and passengers.

Heavy Weather Sea Trials:

This program is to establish the craft performance and accelerations experience during normal operation at the maximum permitted weather condition.

- Each test run should have a duration of at least 20 minutes.
- They could be in any order as required.
- The tests should be planned according to the weather forecast, supported by readings from a Waverider Buoy.
- All tests should be carried out at/around the required Significant Wave height
- No passengers or cargo should be carried.

The following should be monitored and used to evaluate (asses) the tests:

- pitch, roll, heave and yaw
- the cars (one in each end)
- the lashing forces on an HGV (if the craft is intended to carry them)
- the vertical and horizontal acceleration (at the after end of the after passenger space, the forward end of the forward passenger space and at LCG)

The following program of eight tests is proposed.

1. Dead ship
2. Following sea (at half operational speed)
3. Following sea (At full operational speed)
4. Head to sea (" ")
5. 4 points Starboard bow (" ")
6. 4 points Port bow (" ")
7. 4 point on Starboard quarter (" ")
8. 4 point on port quarter (" ")

During the tests, following standards should be maintained:

- *people on board should not be thrown about, meaning that an average person will be able to keep their balance when holding;*
 - *People should not fall out of their seats when not wearing seat belts;*
 - *Vertical acceleration of 1g or more should not be experienced;*
 - *Maximum horizontal acceleration should not exceed 0.20g;*
 - *No object should be thrown about;*
 - *No movement of unlashd cars at each end (stowed as normal for a typical voyage);*
 - *There should be no failure of any machinery or structures; and*
- The craft must maintain a safe cruise without exceptional piloting skill;*

In general - *There should be no risk of injury to people on board during normal and emergency conditions and they should be protected from unfavourable environmental conditions.*

Trial speed - *Tests 3 to 7 of the proposed requirements should be carried out at full operational speed. Please note that operational speed is the speed defined in the HSC Code (90% of the maximum continuous propulsion power for which the craft is certificated at maximum operation weight and in smooth water) and is not the schedule speed. As you know, our explicit Policy is not to accept any speed envelope.*