

CHAPTER 4

LIFERAFTS

PART I

INFLATABLE LIFERAFTS (SOLAS)

Section 1

Prototype tests

1 General

1.1 Inflatable liferafts shall comply with the requirements of Schedule 1 and Parts 1 and 2 of Schedule 4 of MSN 1676 (M) as appropriate.

1.2 Proofed fabrics used in the construction of the buoyancy tubes, and floor and canopy should conform to Annex 1, Requirements for proofed fabrics used in the manufacture of inflatable liferafts.

2 Drop

2.1 Each type/size of liferaft operationally packed in its container and containing the equipment pack with which it is to be marketed should be subjected to a minimum of two drop tests.

2.2 The liferaft, in the operationally packed condition, should be suspended and then dropped from a height of 18m into the water. If it is to be stowed at a height greater than 18m, it should be dropped from the height at which it is to be stowed. The free end of the painter should be attached to the point of suspension so that it pays out as the liferaft drops, thus simulating actual conditions.

2.3 The liferaft should be left floating for 30 minutes and then be inflated. The liferaft must inflate the right way up and should be fully inflated within 1 minute. The liferaft should then be lifted from the water and a thorough inspection made for damage to the liferaft, container and contents of the emergency pack.

2.4 Damage to the container is acceptable provided that it does not hazard the liferaft. Minor damage to any item of equipment is acceptable subject to its operational efficiency not being impaired. In particular, damage to tins of water may be accepted provided they do not leak, and damage to sachets of water may be accepted up to a maximum of 2% of the total volume of water. However, for drop tests from heights exceeding 18 metres, leakage from up to 5% of the receptacles may be accepted provided that:

.1 the equipment list for the inflatable liferaft specifies the carriage of 5% excess water or means of desalination adequate to produce an equivalent amount; or

.2 the water receptacles are contained in a waterproof overwrap.

2.5 It should be demonstrated that the container for the equipment pack which is not an integral part of the liferaft should be capable of floating for 30 minutes without damage to any of its contents.

3 Jump

3.1 It should be demonstrated that a person can jump on to the inflated liferaft, with and without the canopy erected, from a height above the floor of at least 4.5 m without damaging the liferaft. The test subject should weigh not less than 75 kg and be wearing hard bottom shoes with smooth soles and no protruding nails. The number of jumps performed should be equal to the total number of persons for which the inflated liferaft is to be approved. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test should be repeated for both sides of the liferaft.

3.2 The jump test may be simulated by dropping a suitable and equivalent mass of not less than 75 kg arranged to impact the liferaft with shoes as described in 3.1.

3.3 There should be no torn fabric, or damage to seams as a result of the test.

4 Weight

The fully packed liferaft container should be weighed to determine its mass. For a throw overboard liferaft deployed without a launching appliance this mass must not exceed 185 kg. The weight test should be performed on the heaviest variation of the liferaft, considering different containers and equipment packs which may be used. If the mass exceeds 185 kg, the different combinations of containers and equipment packs should be weighed to determine which will and which will not exceed 185 kg.

5 Towing

5.1 It should be demonstrated by towing that the fully loaded and equipped liferaft is capable of being satisfactorily towed at speeds of up to 3 knots in calm water. Towing should be by a line attached to the liferaft's towing connection. The sea anchor should be streamed while the liferaft is towed. The liferaft should be towed for a distance of at least 1 km. During the test the force required to tow the liferaft should be measured at speeds of 2 knots and 3 knots and recorded on the type approval certificate.

5.2 During the test at paragraph 5.1 the towing strain should be measured to demonstrate that the painter system provides a safety factor of 3. (See paragraph 7.)

6 Mooring out

The inflated liferaft should be loaded with a mass equal to the mass of the total number of persons for which it is to be approved plus equipment then moored in a location at sea, or in a harbour open to the sea. The liferaft should remain afloat in that location for 30 days. The pressure may be topped up once a day using the manual pump; however during any 24 hour period the liferaft should retain its shape. The liferaft must not sustain any damage that would impair its performance. After this test the liferaft should be subjected to the pressure test prescribed in paragraph 19.

7 Liferaft painter system

7.1 The painter system including its means of attachment to the liferaft should be tensile tested and must have a breaking strain not less than:

- .1 7.5 kN for liferafts accommodating up to 8 persons;
- .2 10.0 kN for liferafts accommodating 9 to 25 persons; and
- .3 15.0 kN for liferafts accommodating more than 25 persons or comply with the requirements of paragraph 5.2, whichever is the greater.

8 Liferaft light

Liferaft lights should be tested in accordance with the requirements of Part V.

9 Loading and seating

The freeboard of the inflated liferaft in the light condition, including its full equipment but no personnel, should be recorded. The freeboard of the liferaft should again be recorded when the number of persons for which the liferaft is to be approved, having an average mass of 75kg and each wearing a lifejacket and an immersion suit, have boarded and are seated. It should be established that all the seated persons have sufficient space and headroom and it should be demonstrated that the various items of equipment can be used within the inflated liferaft in this condition and with the floor inflated. The minimum freeboard, when loaded with the mass of the number of persons for which it is to be approved plus equipment, with the liferaft on an even keel and with the floor not inflated, must be not less than 300 millimetres. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test should be repeated for both sides of the liferaft.

10 Boarding and closing arrangement

The boarding test should be carried out in a swimming pool by a team of not more than 4 persons who should be of mature age and of differing physiques. Preferably they should not be strong swimmers. For this test they should be clothed in shirt and trousers or a boiler suit and should wear approved lifejackets suitable for an adult. They must each swim 100m before reaching the inflated liferaft for the boarding and there must be no rest period between the swim and the boarding attempt. Boarding should be attempted by each person individually with no assistance from other swimmers or persons already in the liferaft. The water should be of a depth sufficient to prevent any external assistance when boarding the liferaft. The arrangements will be considered satisfactory if 3 of the persons board the liferaft unaided and the fourth boards with the assistance of any one of the others. The above mentioned test should be carried out also with persons clothed in immersion suits and lifejackets. After the boarding test, it should be demonstrated by a person clothed in an approved immersion suit that the canopy entrance can be easily and quickly closed in 1 minute and can be easily and quickly opened from inside and outside in 1 minute. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test should be repeated for both sides of the liferaft.

11 Stability

11.1 The number of persons for which the liferaft is to be approved should be accommodated on one side and then at one end and in each case the freeboard should be recorded. Under these conditions there must be a positive freeboard all around the raft so that there is no danger of the liferaft being swamped. Each freeboard measurement should be taken from the waterline to the top surface of the uppermost main buoyancy tube.

11.2 The stability of the inflated liferaft during boarding should be ascertained as follows:

2 persons each wearing approved lifejackets should board the empty liferaft. It should then be demonstrated that the 2 persons in the liferaft can readily assist from the water a third person who is also wearing an approved lifejacket and feigning unconsciousness. The third person must have his back towards the entrance so that he cannot assist the rescuers. It should be demonstrated that the water pockets adequately counteract the upsetting moment and that there is no danger of the liferaft capsizing.

12 Manoeuvrability

It should be demonstrated, with the paddles provided, that the inflated liferaft is capable of being propelled when fully laden in calm conditions over a distance of at least 25m at a minimum speed of ½ knot.

13 Swamp

It should be demonstrated that if the inflated liferaft is fully swamped, it is capable of supporting the number of persons for which it is to be approved and remain seaworthy. The liferaft must not seriously deform in this condition. The swamped inflatable liferaft should be tested in at least 10 waves at least 0.9m high. The waves may be produced by the wake of a boat, or by other acceptable means. During this test self-draining arrangements fitted in the floor of the liferaft are to be closed to prevent the ingress of water. The liferaft must not seriously deform in this condition. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test should be repeated for both sides of the liferaft.

14 Damage

It should be demonstrated that in the event of half of the buoyancy compartments being damaged or failing to inflate, the intact compartment or compartments should support, with positive freeboard over the liferaft's periphery, the number of persons for which the liferaft is to be approved. This can be demonstrated with persons each having a mass of 75 kg and seated in their normal positions, or by an equally distributed mass.

15 Righting

15.1 This test is not required for a canopied reversible liferaft, for this test the liferaft should be inverted so as to simulate inverted inflation.

15.2 The inflatable liferaft should be loaded with its heaviest equipment pack. All of the entrances, ports, and other openings in the liferaft canopy should be open in order to allow the infiltration of water into the canopy when capsized;

15.3 The canopy of the liferaft should then be completely filled with water. Except for an automatically self-righting liferaft, this may be accomplished, if necessary by partially collapsing the canopy support, or alternatively the uninflated liferaft should be flaked out onto the surface of the water upside down and inflation initiated. An automatically self-righting liferaft should self-right in this condition, and should become boardable in the upright position within 1 minute after the start of the test. If the inflatable liferaft, other than an automatically self righting liferaft, does not self-right, it should be allowed to remain in an inverted position for at least 10 minutes before righting is attempted;

15.4 The righting test should be carried out by the same team of persons required for the boarding test similarly clothed and wearing lifejackets and after completing the swim required in paragraph 10. At least one of the persons righting the inflatable liferaft should weigh less than 75 kg. Each person should attempt to right the liferaft unaided. The water should be of sufficient depth to give no external assistance to the swimmers when mounting the inverted liferaft;

15.5 The righting arrangements will be considered satisfactory if each person rights the liferaft unaided. There should be no damage to the structure of the inflatable liferaft, and the equipment pack should remain secured in its place.

16 Canopy closure

To ensure the effectiveness of the canopy closures in preventing water entering the liferaft, the efficiency of the closed entrances should be demonstrated by means of a hose test. The requirement for the hose test is that approximately 2,300 litres of water per minute be directed at and around the entrances through a 64.0 mm hose from a point 3.5 m away and 1.5 m above the level of the buoyancy tubes for a period of 5 minutes. There must be no significant accumulation of water inside the inflated liferaft. Unless the configuration of both sides of a canopied reversible liferaft are identical, this test should be repeated for both sides of the liferaft.

17 Buoyancy of float free liferafts

It should be demonstrated that a liferaft packed in its container which is float free has sufficient inherent buoyancy to inflate the liferaft by means of the actuating line in the event of the ship sinking. The combination of equipment and container should be that which produces the maximum packed weight.

18 Inflation

18.1 A liferaft, packed in its container, should be inflated by pulling the painter and the time recorded:

- .1 for it to become boardable, i.e. when buoyancy tubes are inflated to full shape and diameter;
- .2 for the canopy to be erect; and
- .3 for the liferaft to reach its full operational pressure* when tested in:
 - .1 at an ambient temperature of between 18°C and 20°C;
 - .2 at a temperature of -30°C; and
 - .3 at a temperature of +65°C.

18.2 When inflated in an ambient temperature of between 18°C and 20°C the raft must achieve total inflation in not more than 1 minute. In the case of automatic self-righting liferaft, the liferaft should achieve total inflation and be boardable in the

* The term “operational pressure” has the same meaning as the term “working pressure”, i.e. the pressure determined by the designed reseal pressure of the relief valves, if fitted: except that, if the actual reseal pressure of the relief valves, determined by testing, exceeds the designed reseal pressure by more than 15%, the higher figure should be used.

upright position in not more than 1 minute, regardless of the orientation in which the liferaft inflates. The force requirement to pull the painter and start inflation should not exceed 150 Newtons.

18.3 For the inflation test at -30°C two packed liferafts should be kept at room temperature for at least 24 hours, then placed in a refrigerated chamber at a temperature of -30°C for 24 hours prior to inflation by pulling the painter. Under these conditions each liferaft must reach working pressure in 3 minutes. There must be no seam slippage, cracking or other defect in each liferaft and they should be ready for use after the tests.

18.4 For the inflation test at $+65^{\circ}\text{C}$ the packed liferaft should be kept at room temperature for at least 24 hours, then placed in a heated chamber at a temperature of $+65^{\circ}\text{C}$ for not less than 7 hours prior to inflation by pulling the painter. Under these conditions the gas pressure relief valves must be of sufficient capacity to prevent damage to the liferaft by excess pressure and to prevent the maximum pressure during the inflation from reaching twice the reset pressure of the release valve. There must be no seam slippage, cracking or other defect in the liferaft.

19 Additional tests applicable to automatic self-righting liferafts only

A suitable means should be provided to rotate the liferaft about a longitudinal axis to any angle of heel in calm water and then release it. The liferaft should be fully equipped, with no one on board, with entrances and openings in the as-packed condition and, in the case of an inflatable liferaft, fully inflated. The liferaft should be incrementally rotated to angles of heel up to and including 180° and should be released. After release, the liferaft should always return to the upright position without any assistance. Righting action should be positive and continuous, and complete righting should occur within the time difference between the liferaft reaching boardable shape, as determined by 18.1.1, at ambient temperature, and 1 minute.

20 Pressure

20.1 Each inflatable compartment in the liferaft except the floor should be tested to a pressure equal to three times the working pressure. Each pressure relief valve should be made inoperative, compressed air should be used to inflate the inflatable liferaft and the inflation source removed. The test should continue for at least 30 minutes. The pressure should not decrease by more than 5% as determined without compensating for temperature and atmospheric pressure changes, and there should be no seam slippage, cracking or other defect in the liferaft.

20.2 The measurement of pressure drop due to leakage can be started when it has been assumed that compartment rubber material has completed stretching due to the inflation pressure and stabilised. This test should be conducted after equilibrium condition has been achieved.

21 Seam strength

21.1 It should be demonstrated that sample seams prepared in the same condition as in production, can withstand a test load equal to the minimum specified liferaft fabric tensile strength. Sewn seams on outer canopy fabric shall withstand a test load of at least 70% of the minimum specified fabric tensile strength when tested by the method described in ISO 1421 and by using test samples as shown in figure 4.1 below.

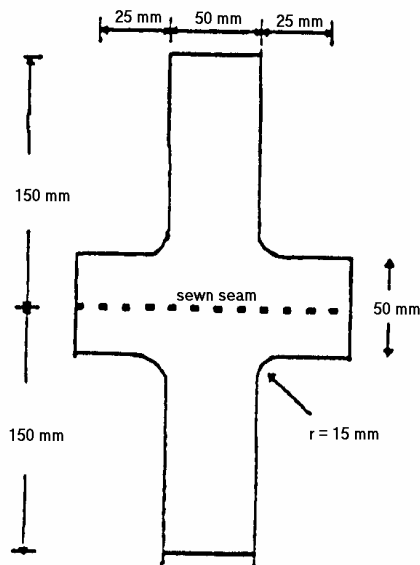


Figure 4.1 Sample specifications for sewn canopy seams

Samples of all types of sewing used in productions shall be tested. Seam construction in both warp and weft direction shall be tested. The test specimens shall be cut out from pre-sewn sample of fabric and no locking of thread ends shall take place.

22 Weld strength

22.1 When tested by the method prescribed below, the load required to initiate failure of the weld should be not less than 175N;

22.2 Specimens should be prepared and tested as given in 22.3.2.3 below:

22.3 Hydrolysis tests should be conducted on sample welded seams where thermoplastic coated materials are to be used. The tests should be conducted as follows:

22.3.1 When tested by the method prescribed below, the weld strength of the sample seam should achieve 125 N/25 mm minimum.

22.3.2 Test method:

- .1 Store the test specimens for 12 weeks over water in a closed container at

93 ± 2°C.

.2 After the conditioning as above, dry the specimens for 1 h at 80 ± 2°C and condition at 20 ± 2°C, 65% RH for 24 h.

.3 Welded test samples should be prepared as follows:

Two samples of fabric 300 mm x 200 mm, cut with the short side parallel to the warp direction, should be superimposed face to back for double coated fabrics, or coated face to coated face for single or asymmetrically coated fabrics. They should be welded with a tool 10 ± 1 mm width of convenient length. 25 mm wide test specimens should be cut transversely to the line of the weld. The test samples should be mounted in a test machine as in ISO 1421. The maximum peel load should be recorded.

23 Wind tunnel

23.1 The MCA should from a range of inflatable liferafts, require one or more rafts to be tested under the following conditions of wind velocity.

23.2 The raft(s) should be in a packed condition with entrances open, but without container or valise, be inflated in a wind velocity of 30 metres per second and should be left in this condition for 10 minutes.

23.3 During the above-mentioned conditions, whenever practicable, the raft(s) should be swung over approximately 30° to starboard, from that position to approximately 30° to port and return to starting position.

23.4 On completion there should be no detachment of the arch support or canopy from the upper buoyancy tube or other damage which affects the efficient function of the raft.

23.5 The raft should then be exposed to the above mentioned wind velocity for 5 minutes in each of the following conditions:

.1 with the entrance to the wind open and the other entrances closed, if there is more than one entrance;

.2 with the entrance to the wind closed and the other entrances open, if there is more than one entrance;

.3 with all entrances closed.

24 Test for self-draining of floors of canopied reversible liferafts and automatically self-righting liferafts

24.1 Water should be pumped into the interior of the liferaft, while it is afloat, at a rate of 2300 litres per minute for 1 minute.

24.2 After the water has been shut off and has drained, there should be no appreciable accumulation of water in the liferaft.

24.3 If a liferaft is divided into separate areas, by thwarts or other means, each such area should be subjected to the test.

25 Emergency packs and their containers - Flotation test

The packed container should, in all conditions, remain secured inside the liferaft. It should be stowed with its opening upwards and should be buoyant when placed in the water for at least 30 minutes without damage to its contents. The line securing the pack should have a factor of safety of three based on the weight of the emergency pack or 1.8 kN whichever is the greater.

Section 2

Additional tests for davit launched inflatable liferafts

1 Strength test of lifting components

The breaking strength of the webbing or rope and the attachments to the inflatable liferaft used for the lifting bridle should be established by tests on 3 separate pieces of each different item. The combined strength of the lifting bridle components must be at least 6 times the mass of the inflatable liferaft when loaded with the number of persons and equipment for which it is to be approved.

2 Impact

The inflated liferaft should be loaded with a mass equal to the number of persons and equipment for which it is to be approved. With the liferaft in a free hanging position it should be pulled laterally to a position so that when released it will strike a rigid vertical surface at a velocity of 3.5 m per second. After this test the inflated liferaft must show no signs of damage which would affect its efficient functioning. The test should be performed so that the cylinder side and the side with the boarding ramp strike the rigid surface. All relief valves should be in the operable condition for this test.

3 Inflated drop

The inflated liferaft, loaded as prescribed in paragraph 2 and suspended from its releasing gear at a height of 3 m above the water, should be released and allowed to fall freely into the water. On completion the liferaft should be examined to ensure that no damage has been sustained which would affect its efficient functioning. All relief valves should be in the operable condition for this test.

4 Abrasion lowering

The inflated liferaft should be loaded with a weight equal to the mass of its heaviest equipment pack and the number of persons for which it is to be approved, the mass of each person being taken as 75 kg. Except for the floor which should not be inflated, the inflatable liferaft should be fully inflated with all relief valves operative. A liferaft should be lowered for a distance of at least 4.5 m in continuous contact against a structure erected to represent the side of a ship having a 20° adverse list. The height of the point from which the hook is suspended should be comparable to that of a shipboard launching appliance. During the test and after its completion, the liferaft should not sustain damage or distortion, or assume a position which would render it unsuitable for its intended purpose.

5 Hook deployment

5.1 A davit launched liferaft should be subjected to a simulated launching test. The lifting ring should be withdrawn from the container, and shackled on to an approved release on the fall of a davit or crane. Bowsing lines should be loosely tied off to cleats on the deck, then the liferaft should be hoisted and positioned outboard, ready for inflation. The painter should be tied off to a strong point, and the raft inflated by withdrawing the painter, giving a sharp pull when tension is felt on the painter line. Inflation should be timed, and the raft bowsed in tightly ready for boarding.

5.2 On completion, and during the deployment, it should be determined that the lifting ring/shackle of the raft is compatible with the release hook on the fall. In addition, it should be confirmed that the bowsing line arrangements, position of the entrance relative to the ship's side and the arrangements for preventing the two halves of the container from dropping into the sea are satisfactory.

6 Davit launched liferaft boarding

A davit launched inflated liferaft should, in addition to the boarding test prescribed in paragraph 10 of Part I Section 1, be subjected to the following test:

The liferaft, should be suspended from a liferaft launching appliance or from a crane with a head sheave of similar height, and bowsed in to the ship's side or simulated ship's side. The liferaft should be boarded by the number of persons for which it is to be approved of average mass 75 kg each wearing a lifejacket. There must be no undue distortion of the liferaft. The bowsing lines should then be

released and the liferaft left hanging for 5 minutes. It should then be lowered to the sea or floor and unloaded. At least 3 tests are required in succession, with the hook of the lowering appliance so positioned that its distance from the ship's side is:

- .1 half the beam of the liferaft + 150 mm;
- .2 half the beam of the liferaft; and
- .3 half the beam of the liferaft -150 mm.

The boarding is to simulate actual shipboard conditions and should be timed and the time recorded.

7 Strength

7.1 It should be demonstrated by an overload test on the liferaft hanging from its centre support that the bridle system has an adequate factor of safety as follows:

- .1 the liferaft should be placed in a temperature of $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for a period of at least 6 hours;
- .2 following this period of conditioning, the liferaft should be suspended from its lifting hook or bridle and the buoyancy chambers (not including an inflatable floor) inflated;
- .3 when fully inflated, and when the relief valves have reseated themselves, all relief valves should be made inoperative;
- .4 the liferaft should then be lowered and loaded with a distributed mass equivalent to 4 times the mass of the number of persons for which it is to be approved and its equipment the mass of each person being taken as 75 kg;
- .5 the liferaft should then be raised and remain suspended for a period of not less than 5 minutes;
- .6 the pressure before and after this test after the weight is removed and while it remains suspended should be recorded;
- .7 any dimensional deflections or distortions of the liferaft during this test should be recorded. During the test and after its completion the inflatable liferaft should remain suitable for its intended use.

7.2 It should be demonstrated, after a period of 24 hours in a cold chamber at a temperature of -30°C , that the liferaft will support a load of 1.1 times the number of persons for which it is approved and its equipment with all relief valves operative. The liferaft should be loaded with the test weight in the refrigerated chamber. The floor should not be inflated. The loaded inflatable liferaft should remain suspended for at least 5 minutes. If the inflatable liferaft must be removed from the chamber in

order to suspend it, the inflatable liferaft should be suspended immediately upon removal from the chamber. During this test and after its completion, the inflatable liferaft should remain suitable for its intended use.

8 Detailed inspection

An inflatable liferaft complete in all respects and in a fully inflated condition should be subjected to a detailed inspection in the manufacturer's works to ensure that all statutory requirements have been fulfilled.

Section 3

Production tests

1 General

1.1 The MCA or Notified Body will make random inspections of manufacturers' premises to ensure that the quality of the inflatable liferafts, materials and associated equipment used in the fully completed liferaft comply with the specification of the approved prototype item. This visit may include witnessing a 10% overload test and pressure test of the buoyancy tube.

1.2 Manufacturers are required to institute a quality control procedure to ensure that the liferaft and/or equipment are produced to the same standard as the prototype approved by the MCA or Notified Body, and to keep records of any production tests carried out in accordance with the MCA's instructions.

1.3 As part of the monitoring process of Nominated and Notified Bodies, appointed by the MCA, a MCA surveyor may make random inspections of the manufacturers' premises to ensure that the appointed Bodies are carrying out their duties in accordance with the Bodies instructions.

2 Liferaft operational inflation

2.1 The MCA or Notified Body surveyor will, at his discretion, select a completed and operationally packed liferaft at random and carry out an operational inflation test on a smooth dry floor or on water, e.g. a swimming pool, as a check on the packing and inflation.

2.2 One out of every 30 liferafts produced should be operationally inflated either in water or on the shop floor; one out of every 60 rafts produced must be operationally inflated in water. The selection of the inflatable liferaft of liferafts for the test should be on a random basis. Personnel fabricating and packing inflatable liferafts should not be made aware of which liferaft will be tested until after the liferaft has been packed in its container. The painter should be pulled from the liferaft using a device to measure the applied force. The force required to pull the painter and start inflation should not exceed 150 N. The inflatable liferaft should break free from its container and attain its design shape and full erection of the canopy support tubes in not more than 1 minute.

2.3 Each liferaft produced should be inspected for defects and dimensional deviations.

2.4 With the relief valves inoperative each liferaft produced should be inflated with air to at least 2.0 times its working pressure. After a settling time of 30 minutes the pressure should be checked and adjusted to 1.5 times the working pressure. After a further 30 minutes the liferaft pressure must not decrease by more than 5 per cent after compensation for temperature and barometric pressure changes. The liferaft must not show signs of seam slippage, hinge slippage or rupture during the test. Following the test, each relief valve should be tested for correct relief and reseal pressure.

2.5 The gas-tight integrity of each inflated compartment of each liferaft produced should be checked by inflating with air to its working pressure. After a settling time of 30 minutes, the pressure should be checked and adjusted to the working pressure as necessary. After 1 hour the pressure must not have decreased by more than 5% after compensation for temperature and barometric pressure changes. More than one compartment may be tested at one time, but adjacent compartments with common pressure barriers should be open to the atmosphere during the test.

2.6 If the insulation of the floor of the liferaft is obtained by inflation, it should be inflated to its designed pressure. After a settling time of 30 minutes the pressure should be checked and adjusted to its design pressure.

2.7 After a further period of 1 hour the pressure must not have decreased by more than 5% uncorrected pressure change. In no case must the floor have suffered damage e.g. failure of reed adhesion.

3 Davit launched liferafts

3.1 Every new davit launched liferaft should satisfactorily undergo a 10% overload test in accordance with the approved drawings or construction specification before the final inflation pressure test. The conditions of the 10% overload suspension test are that:

- .1 the liferaft should be inflated, preferably with air, and stabilised at its working pressure;
- .2 the working pressure should be determined by the reseal of the relief valves. The pressure relief valves should be fully operational;
- .3 the floor of the inflatable liferaft should not be inflated;
- .4 the 10% overload, to be 10% of the mass of the liferaft assembly together with the full complement of equipment and persons calculated at 75kg per person;

.5 the liferaft must be loaded by weights evenly distributed around the floor, and the raft must be lifted completely clear of the ground for at least 5 minutes;

.6 the inflatable liferaft should not sustain damage to its suspension members, their attachments, or any other structural component as a result of this test. The pressure relief valves should maintain the normal working pressure of the buoyancy tubes and their basic shape during suspension; and

.7 when the load is removed the raft must show no sign of damage or permanent strain; in particular, slippage of attachments to the lifting straps.

3.2 Each lifting shackle or ring should be proof tested to 2.2 times the maximum working load.

Section 4

Installation inspection

1 General

1.1 The liferaft should be fitted on board strictly in accordance with the manufacturers' instructions. During installation a check should be made to ensure that:

.1 all temporary lashings used in transportation have been removed;

.2 the drain holes in the bottom of the raft container are clear of any support structure in the cradle stowage;

.3 arrangements are provided in the retaining straps for manual release of the raft; and

.4 the float free facilities are installed strictly in accordance with the manufacturers' instructions.

PART II

INFLATABLE LIFERAFTS (NON SOLAS)

Prototype tests

1 General

All inflatable liferafts (Non SOLAS) shall comply with the requirements of Part 5 of Schedule 4 of MSN 1676 (M) and also with the requirements of Chapter 4, Part I of these Instructions with the exception of the following numbered paragraphs in Part I:

Paragraph 2 Drop

The drop height of 18 metres referred to in paragraph 2.2 may be 6 metres.

Paragraph 18 Inflation

The temperature of -30° C referred to in paragraphs 18.1.3.2 and 18.3 may be -18° C.

PART III

OPEN REVERSIBLE LIFERAFTS (ORL)

Section 1

Prototype tests

1 General

1.1 Open reversible liferafts shall comply with the requirements of Part 4, of Schedule 4 of MSN 1676 (M).

1.2 Proofed fabrics used in the construction of the buoyancy tubes and floor should conform to Annex 1 - Requirements for proofed fabrics used in the manufacture of inflatable liferafts.

2 Drop

2.1 Each type/size of liferaft operationally packed in its container and containing the equipment pack with which it is to be marketed should be subjected to a minimum of two drop tests.

2.2 The liferaft, in the operationally packed condition, should be suspended and then dropped from a height of 10m into the water. If it is to be stowed at a height greater than 10m, it should be dropped from the height at which it is to be stowed. The free end of the painter should be attached to the point of suspension so that it pays out as the liferaft drops, thus simulating actual conditions.

2.3 The liferaft should be left floating for 30 minutes and then be inflated. The liferaft must inflate the right way up and should be fully inflated within 1 minute. The liferaft should then be lifted from the water and a thorough inspection made for damage to the liferaft, container and contents of the emergency pack.

2.4 Damage to the container is acceptable provided that it would not hazard the liferaft. Minor damage to any item of equipment is acceptable subject to its operational efficiency not being impaired.

2.5 It should be demonstrated that a container for the equipment pack which is not an integral part of the liferaft should be capable of floating for 30 minutes without damage to any of its contents.

3 Jump

3.1 It should be demonstrated that a person can jump onto the inflated liferaft, from a height above the floor of at least 4.5 m without damaging the liferaft. The test subject should weigh not less than 75 kg and be wearing hard bottom shoes with smooth soles and no protruding nails. The number of jumps performed should be equal to the total number of persons for which the inflated liferaft is to be approved.

3.2 The jump test may be simulated by dropping a suitable and equivalent mass of not less than 75 kg arranged to impact the liferaft with shoes as described in 3.1.

3.3 There should be no torn fabric, or damage to seams as a result of the test.

4 Weight

The fully packed liferaft container should be weighed to determine its weight which must not exceed 185kg unless suitable means are provided to enable it to be launched without lifting by hand. If the weight exceeds 135kg suitable handles or rungs should be fitted for this purpose.

5 Towing

5.1 It should be demonstrated by towing that the fully loaded and equipped liferaft is capable of being satisfactorily towed at speeds of up to 3 knots in calm water. Towing should be by a line attached to the liferaft's towing connection. The sea anchor should be streamed while the liferaft is towed. The liferaft should be towed for a distance of at least 1 km.

5.2 During the test at paragraph 5.1 the towing strain should be measured to demonstrate that the painter system provides a safety factor of 3. (See paragraph 7.)

6 Mooring out

The inflated liferaft should be loaded with a mass equal to the mass of the total number of persons for which it is to be approved plus equipment then moored in a location at sea, or in a harbour open to the sea. The liferaft should remain afloat in that location for 30 days. The pressure may be topped up once a day using the manual pump; however during any 24 hour period the liferaft should retain its shape. The liferaft must not sustain any damage that would impair its performance. After this test the liferaft should be subjected to the pressure test prescribed in paragraph 19.

7 Liferaft painter system

7.1 The painter system including its means of attachment to the liferaft should be tensile tested and must have a breaking strain not less than:

- .1 7.5 kN for liferafts accommodating up to 8 persons;
- .2 10.0 kN for liferafts accommodating 9 to 25 persons; and
- .3 15.0 kN for liferafts accommodating more than 25 persons;

or comply with the requirements of paragraph 5.2, whichever is the greater.

8 Liferaft light

Liferaft lights should be tested in accordance with the requirements of Part V.

9 Loading and seating

The freeboard of the inflated liferaft in the light condition, including its full equipment but no personnel, should be recorded. The freeboard of the liferaft should again be recorded when the number of persons for which the liferaft is to be approved, having an average mass of 75kg and each wearing a lifejacket, have boarded and are seated. It should be established that all the seated persons have sufficient space and it should be demonstrated that the various items of equipment can be used within the inflated liferaft in this condition. The minimum freeboard, when loaded with the mass of the number of persons for which it is to be approved plus equipment, with the liferaft on an even keel must be not less than 300mm.

10 Boarding

The boarding test should be carried out in a swimming bath by a team of not more than 4 persons who should be of mature age and of differing physiques. Preferably they should not be strong swimmers. For this test they should be clothed in shirt and trousers or a boiler suit and should wear approved lifejackets suitable for an adult. They must each swim 100m before reaching the inflated liferaft for the boarding and there must be no rest period between the swim and the boarding attempt. Boarding should be attempted by each person individually with no assistance from other swimmers or persons already in the liferaft. The water should be of a depth sufficient to prevent any external assistance when boarding the liferaft. The arrangements will be considered satisfactory if 3 of the persons board the liferaft unaided and the fourth boards with the assistance of any one of the others.

11 Stability

11.1 The number of persons for which the liferaft is to be approved should be accommodated on one side and then at one end and in each case the freeboard should be recorded. Under these conditions there must be a positive freeboard all around the raft so that there is no danger of the liferaft being swamped. Each freeboard measurement should be taken from the waterline to the top surface of the uppermost main buoyancy tube.

11.2 The stability of the inflated liferaft during boarding should be ascertained as follows:

2 persons each wearing approved lifejackets should board the empty liferaft. It should then be demonstrated that the 2 persons in the liferaft can readily assist from the water a third person who is also wearing an approved lifejacket and feigning to be unconscious. The third person must have his back towards the entrance so that he cannot assist the rescuers. It should be demonstrated that the water pockets adequately counteract the upsetting moment and that there is no danger of the liferaft capsizing.

12 Manoeuvrability

It should be demonstrated with the paddles provided that the inflated liferaft is capable of being propelled when fully laden in calm conditions over a distance of at least 25m at a minimum speed of ½ knot.

13 Swamp

It should be demonstrated that if the inflated liferaft is fully swamped, it is capable of supporting the number of persons for which it is to be approved and remain seaworthy. The liferaft must not seriously deform in this condition. The swamped inflatable liferaft should be tested in at least 10 waves at least 0.9 metres high. The waves may be produced by the wake of a boat, or by other acceptable means. The liferaft must not seriously deform in this condition.

14 Damage

It should be demonstrated that in the event of half of the buoyancy compartments being damaged or failing to inflate, the intact compartment or compartments should support, with positive freeboard over the liferaft's periphery, the number of persons for which the liferaft is to be approved. This can be demonstrated with persons each having a mass of 75 kg and seated in their normal positions, or by an equally distributed mass.

15 Buoyancy of float free liferafts

It should be demonstrated that a liferaft packed in its container which is float free has sufficient inherent buoyancy to inflate the liferaft by means of the actuating line in the event of the ship sinking. The combination of equipment and container should be that which produces the maximum packed weight.

16 Inflation

16.1 A liferaft, packed in its container, should be inflated by pulling the painter and the time recorded:

- .1 for it to become boardable, i.e. when buoyancy tubes are inflated to full shape and diameter;
- .2 for the canopy to be erect; and
- .3 for the liferaft to reach its full operational pressure* when tested in:
 - .1 at an ambient temperature of between 18°C and 20°C;
 - .2 at a temperature of -18°C; and
 - .3 at a temperature of + 65°C.

16.2 When inflated in an ambient temperature of between 18°C and 20°C the raft must achieve total inflation in not more than 1 minute.

16.3 For the inflation test at -18°C two packed liferafts should be kept at room temperature for at least 24 hours, then placed in a refrigerated chamber at a temperature of -18°C for 24 hours prior to inflation by pulling the painter. Under these conditions each liferaft must reach working pressure in 3 minutes. There must be no seam slippage, cracking or other defect in each liferaft and they should be ready for use after the tests.

* The term "operational pressure" has the same meaning as the term "working pressure", i.e. the pressure determined by the designed reseal pressure of the relief valves, if fitted: except that, if the actual reseal pressure of the relief valves, determined by testing, exceeds the designed reseal pressure by more than 15%, the higher figure should be used.

16.4 For the inflation test at +65°C the packed liferaft should be kept at room temperature for at least 24 hours, then placed in a heated chamber at a temperature of +65°C for not less than 7 hours prior to inflation by pulling the painter. Under these conditions the gas pressure relief valves must be of sufficient capacity to prevent damage to the liferaft by excess pressure and to prevent the maximum pressure during the inflation from reaching twice the reseal pressure of the release valve. There must be no seam slippage, cracking or other defect in the liferaft.

17 Pressure

17.1 Each inflatable compartment in the liferaft except the floor should be tested to a pressure equal to three times the working pressure. Each pressure relief valve should be made inoperative, compressed air should be used to inflate the inflatable liferaft and the inflation source removed. The test should continue for at least 30 minutes. The pressure should not decrease by more than 5% as determined without compensating for temperature and atmospheric pressure changes, and there should be no seam slippage, cracking or other defect in the liferaft.

17.2 The measurement of pressure drop due to leakage can be started when it has been assumed that compartment rubber material has completed stretching due to the inflation pressure and stabilised. This test should be conducted after equilibrium condition has been achieved.

18 Seam strength

It should be demonstrated that sample seams can withstand a test load equal to the liferaft fabric tensile strength.

19 Emergency packs and their containers - Flotation test

The packed container should in all conditions remain secured to the raft. It should be stowed in such a manner that it will remain buoyant when placed in the water for at least 30 minutes without damage to its contents. The line securing the pack should have a factor of safety of three based on the weight of the emergency pack or 1.8 kN whichever is the greater.

20 Detailed inspection

An inflatable liferaft complete in all respects and in fully inflated condition should be subjected to a detailed inspection in the manufacturer's works to ensure that all statutory requirements have been fulfilled.

Section 2 Production tests

1 General

1.1 The MCA or Notified Body will make random inspections of manufacturers' premises on a random basis at least once a year. Each visit will include examination of quality control records, materials and associated equipment used in the fully completed liferaft comply with the specification of the approved prototype item. This visit may include witnessing a pressure test of the buoyancy tubes.

1.2 Manufacturers are required to institute a quality control procedure to ensure that the liferaft and/or equipment are produced to the same standard as the prototype approved by the MCA or and to keep records of any production tests carried out in accordance with the MCA's instructions.

2 Liferaft operational inflation

2.1 The MCA or Notified Body surveyor will, at his discretion, select a completed and operationally packed liferaft at random and carry out an operational inflation test on a smooth dry floor or on water, e.g. a swimming pool, as a check on the packing and inflation.

2.2 One out of every 30 liferafts produced should be operationally inflated either in water or on the shop floor; one out of every 60 rafts produced must be operationally inflated in water. The selection of the inflatable liferaft of liferafts for the test should be on a random basis. Personnel fabricating and packing inflatable liferafts should not be made aware of which liferaft will be tested until after the liferaft has been packed in its container. The painter should be pulled from the liferaft using a device to measure the applied force. The force required to pull the painter and start inflation should not exceed 150 N. The inflatable liferaft should break free from its container and attain its design shape in not more than 1 minute.

2.3 Each liferaft produced should be inspected for defects and dimensional deviations.

2.4 Each liferaft produced should be inflated with air to the lesser of 2.0 times its working pressure or that sufficient to impose a tensile load on the inflatable tube fabric of at least 20% of the minimum required tensile strength. Relief valves should be inoperative for this test. After 30 minutes the liferaft should not show any signs of seam slippage or rupture, nor should the pressure decrease by more than 5%. The measurement of the pressure drop due to the leakage can be started when it has been assumed that the compartment rubber material has completed stretching due to the inflation pressure and stabilised. This test should be conducted after equilibrium condition has been achieved. Following the test each relief valve should be tested for proper relief and reseating pressure.

2.5 The gas-tight integrity of each inflated compartment of each liferaft produced should be checked by inflating with air to its working pressure. After a settling time of 30 minutes, the pressure should be checked and adjusted to the working pressure as necessary. After 1 hour the pressure must not have decreased by more than 5% after compensation for temperature and barometric pressure changes. More than one compartment may be tested at one time, but adjacent compartments with common pressure barriers should be open to the atmosphere during the test.

Section 3

Installation inspection

1 General

1.1 The liferaft should be fitted on board strictly in accordance with the manufacturers' instructions. During installation a check should be made to ensure that:

- .1 all temporary lashings used in transportation have been removed;
- .2 the drain holes in the bottom of the raft container are clear of any support structure in the cradle stowage;
- .3 arrangements are provided in the retaining straps for manual release of the raft; and
- .4 the float free facilities are installed strictly in accordance with the manufacturers' instructions.

PART IV

FLOAT-FREE ARRANGEMENTS

Section 1

Prototype tests

1 General

Float free arrangements shall comply with the requirements of Part 8 of Schedule 4 of MSN 1676 (M).

2 Hydrostatic release units

2.1 A hydrostatic release unit fitted as part of the float free arrangements of a liferaft should be prototype tested. The tests should be carried out on at least 2 units in the sequence listed below and, on completion, the units must continue to function in a satisfactory manner:

- .1 corrosion resistance;
- .2 temperature cycling;
- .3 submergence and manual release;
- .4 strength;
- .5 membrane technical tests; and
- .6 performance

2.2 Corrosion resistance

The hydrostatic release should be exposed to a salt water spray (5% sodium chloride solution) at a temperature of $35^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for 160 hours without interruption. On completion the unit must show no signs of corrosion which could affect its efficient functioning.

2.3 Temperature cycling

2.3.1 The hydrostatic release unit should be alternatively submitted to surrounding temperatures of -30°C and $+65^{\circ}\text{C}$. these alternating half cycles need not follow immediately after each other and the following procedure is acceptable:

- .1 an 8 hour half cycle at 65°C to be completed in one day;
- .2 the units removed from the hot chamber and left exposed under normal room conditions until the next day;
- .3 an 8 hour half cycle at -30°C to be completed in one day;
- .4 the units removed from the cold chamber and left exposed under normal room conditions until the next day;
- .5 repeat the above procedure for a further 9 cycles.

2.3.2 On completion, the release, if designed with a manual release, must be capable of being released manually.

2.4 Submergence and manual release

2.4.1 The hydrostatic release unit submerged in water or a water filled pressure testing tank should, when a buoyant load equal to its designed capacity is applied, release at a depth of between 1.5 and 4 metres. The release unit, on being reset, if designed with a manual release, should be capable of being released manually.

2.4.2 On being opened up for inspection the unit must show no significant signs of corrosion or degradation which could affect its efficient functioning.

2.5 Strength

The hydrostatic release unit, if forming part of the painter system, should be subjected to a tensile load of at least 10 kN for a period of 30 minutes. If the release is to be fitted to a liferaft approved to carry more than 25 persons the tensile load should be increased to 15 kN. On completion, the unit, if designed with a manual release, must be capable of being released manually.

2.6 Membrane material

2.6.1 Two membranes should be tested for resistance to cold and heat as follows:

- .1 Resistance to cold

Temperature	-30° C
Exposure time	30 minutes
Flex testing	180° (stretching both inside and outside face);

- .2 Resistance to heat

Temperature	+ 65° C
Exposure time	7 days

The membranes must show no visible signs of cracking.

2.6.2 Two membranes should be tested for resistance to oil, seawater and detergent as follows:

- .1 Surface resistance to oil

Temperature	+ 18° to 20° C
Type of oil	ASTM Oil No 1 or No 5 or ISO Oil No 1
Exposure time	3 hours on each side

- .2 Resistance to seawater

Two membranes should be immersed in a 5% sodium chloride solution at +18° C to +20° C for a period of 7 days.

- .3 Resistance to detergents

Two membranes should be immersed in a typical ship detergent solution at +18° C to 20° C for a period of 7 days.

The membranes must show no signs of any deterioration.

2.7 Performance

2.7.1 This test should be performed using the smallest and the largest liferafts with which the hydrostatic release unit may be used. If the occupant range between the smallest and largest liferaft exceeds 25 persons then the intermediate size liferaft should also be tested. Place a liferaft horizontally into a rack with its painter and the hydrostatic release unit arranged as fitted on board a ship. Attach sufficient weight to the rack to submerge the raft then lower it into water of depth at least 5m as follows:

- .1 horizontally;
- .2 tilted 45° and then 100° with the hydrostatic release unit at the upper side;
- .3 tilted 45° then 100° with the hydrostatic release unit at the lower side;
- .4 vertically.

2.7.2 Under each of these conditions the hydrostatic release unit must release the liferaft at a depth of not more than 4m.

3 Weak link

3.1 Performance

3.1.1 Using a dynamometer a weak link assembled as fitted in the float free arrangements of a liferaft should be tensile tested until it breaks.

3.1.2 The test should be repeated on a minimum of 5 weak links.

3.1.3 All 5 weak links must break within the limit of 1.8 and 2.6 kN.

Section 2

Production tests

1 General

1.1 The Nominated or Notified Body will make random visits of manufacturers' premises to inspect quality records for production units and to ensure that the quality of the release equipment complies with the specification of the approved prototype. This visit may include witnessing an HRU test, and testing of the weak links using a dynamometer until they break.

1.2 Manufacturers are required to institute a quality control procedure to ensure that all boats are produced to the same standard as the prototype approved by the Nominated or Notified Body and to keep records of any production tests carried out in accordance with the Nominated or Notified Bodies instructions.

1.3 As part of the monitoring process of Nominated and Notified Bodies, appointed by the MCA, a MCA surveyor may make random inspections of the

manufacturers premises to ensure that the appointed Bodies are carrying out their duties in accordance with the Bodies instructions.

2 Hydrostatic release units

2.1 Permanent units requiring annual servicing

2.1.1 On completion of manufacture each hydrostatic release unit should be tested in a pressure tank to check that it is correctly set to release at a depth of between 1.5 and 4 m.

2.1.2 The unit should be reassembled and, if fitted with a manual operation, should be released manually.

2.2 Disposable sealed units

2.2.1 A random sample from each production batch should be tested in a pressure tank on the following scale to ensure that the release units will activate at a depth of between 1.5 and 4 m:

NUMBER IN BATCH	PERCENTAGE TO BE TESTED
100	10
300	6
500	4

2.2.2 If one unit from the sample tested fails to function correctly the whole production batch must be rejected.

3 Weak links

A random sample of not less than 5 weak links from each production batch, assembled as fitted in a ship, should be tested using a dynamometer until they break. If any one of the 5 weak links breaks outside the designed limits of 1.8 to 2.6 kN the whole batch must be rejected.

Section 3

Installation inspection

1 Hydrostatic release unit

1.1 The hydrostatic release unit should be fitted to a liferaft strictly in accordance with the manufacturers' instructions.

1.2 On installation on board a ship it should be checked that:

- .1 the release is not permanently secured to the deck and can be removed for servicing or replacement;

.2 the weak link cannot become part of the painter system until the liferaft has floated free.

PART V

LIFERAFT LIGHTS

1 General

1.1 Internal and external lights should comply with the requirements of Part 9 of Schedule 4 of MSN 1676 (M).

1.2 Details of the prototype and production tests of these lights are contained in Part I of Chapter 12 of these Instructions.

PART VI

GAS INFLATION SYSTEM

Section 1

Prototype tests

1 General

1.1 Gas inflation systems shall comply with the requirements of ISO/CD 15738.

1.2 If the gas used is carbon dioxide, it must conform to the dryness standard of Type 1 Section 1 of BS 4105: 1990. (1995).

1.3 The system should be demonstrated on a MCA or Notified Body approved inflatable liferaft to ensure that a high rate of inflation can be obtained with the gas outlet sufficiently free from icing to permit the achievement of full working pressure within:

- .1 one minute at a temperature of +18°C to 20°C; and
- .2 three minutes at a temperature of -30°C.

1.4 The gas cylinder must be inspected and hydraulically pressure-tested in accordance with the relevant section of BS 5430: (Note Parts 1, 2, 3, 5 and 6 have different years).

2 Gas cylinders

2.1 Gas cylinders should be inspected to ensure that it has been manufactured and tested in accordance with the relevant part of British Standard 5045: (Note Parts 1, 2, 3, 5 and 6 have different years).

2.2 The material used in the manufacture of the gas cylinder should be compatible in a sea water environment with the materials used in the cylinder valve and operating head.

2.3 A cylinder manufactured from aluminium alloy must conform with the relevant part of BS 5045: and only a cylinder valve and operating head made of aluminium alloy should be fitted to this type of cylinder. Before acceptance of these arrangements the complete assembly should be partially immersed in a 3% sodium chloride solution for a period of 18 months, or alternatively be exposed to a salt water spray (5% sodium chloride solution) at a temperature of $35^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for 160 hours without interruption. On completion of either of these tests the gas charge must not have reduced by more than 5% and both the valve and operating head must function in a satisfactory manner.

2.4 The gas cylinder should be visibly inspected to check that the following data has been permanently recorded on the cylinder:

- .1 date of manufacture, serial number and name or mark of manufacturer;
- .2 standard or specification to which it is manufactured;
- .3 date of testing and test pressure;
- .4 tare mass of cylinder and valve; and
- .5 minimum designed water capacity in litres.

3 Gas cylinder valve

3.1 Safety relief test

3.1.1 It should be demonstrated that the safety release on the gas cylinder valve will operate at a pressure between 18 MPa and the test pressure of the cylinder.

3.2 Proof load

3.2.1 The bodies of 6 cylinder valves should be subjected to an internal hydraulic pressure of 28 MPa for a period of 60 seconds.

3.2.2 On completion there must not be any signs of leakage or damage.

$$1\text{MPa} = 145.038/\text{lbs}/\text{in}^2$$
$$28\text{MP} = 4061 \text{ lbs}/\text{in}^2$$

3.3 Temperature cycling

3.3.1 Two gas cylinder valves attached to approved cylinders with a gas capacity of not less than 3.5 kg should be charged with CO₂/N₂ gas, weighed and then

alternately subjected to surrounding temperatures of -30°C and $+65^{\circ}\text{C}$. These alternating exposures need not follow immediately after each other and the following procedure is acceptable:

- .1 an 8 hour exposure at $+65^{\circ}\text{C}$ to be completed in one day;
- .2 specimens removed from the hot chamber and left exposed to ordinary room temperature until the following day;
- .3 an 8 hour exposure at -30°C to be completed the next day;
- .4 specimens removed from the cold chamber and left exposed to ordinary room temperature until the following day;
- .5 the above procedure to be repeated a further 9 times.

3.3.2 On completion the cylinders should be allowed to cool to room temperature before being re-weighed. The loss of weight, if any, must not be greater than 5%.

3.4 Cold

3.4.1 Gas cylinder valves attached to two 3.17 kg charged cylinders, one with CO_2 and the other with CO_2/N_2 , should be placed in a cold chamber at a temperature of -30°C for 3 hours.

3.4.2 On completion the gas must be capable of being completely discharged through a nozzle containing 4 x 3.3 mm diameter holes within the following times:

CO_2 - 20 seconds;
 CO_2/N_2 - 14 seconds.

3.5 Fatigue

3.5.1 Two valve bodies should be hydraulically pressure-cycled internally in a laboratory from 0 to 20 MPa for 33,000 cycles.

3.5.2 On completion the two valve bodies should be subjected to a hydraulic pressure of 40 MPa for a period of 4 minutes.

$20\text{MPa} = 2900 \text{ lbs/in}^2$
 $40\text{MPa} = 5800 \text{ lbs/in}^2$

3.6 Long term leak

3.6.1 Cylinder valves should be fitted to two cylinders charged with not less than 3.175 kg of CO₂/N₂ gas.

3.6.2 The two units should be weighed carefully and then stowed in a secure storage place for a period of 18 months at an ambient temperature of +18°C to 20°C.

3.6.3 On completion of the 18 month period the two units should be re-weighed and the loss of gas charge on each cylinder must not exceed 57 g.

3.7 Impact

3.7.1 One of the gas cylinders and valves used in the long term leak test after being fully discharged of gas should be dropped 9 times from a height of 30 centimetres at an angle of 45° on to a concrete floor covered with hardboard so that the valve receives the full force of the impact.

3.7.2 The test should be repeated with the gas bottle angled in a plane at 90° to the original test.

3.7.3 On completion of the above tests the cylinder should be stood vertically on its base, and allowed to pivot through 90° to strike a steel support 8 centimetres above the base line. The test should be repeated 12 times.

3.7.4 On completion the valve should be carefully examined, if necessary using a flaw detector. There must not be any signs of flaw or fracture.

3.7.5 A gas cylinder of at least 8.165 kg fitted with the cylinder valve should be dropped 3 times from a height of 1.5 metres on to an aluminium sheet so that the valve takes the full force of the impact at an angle of 60° to the sheet.

3.7.6 The aluminium sheet should be removed and test repeated with a single drop on to a concrete floor.

3.7.7 On completion the valve should be removed from the cylinder and carefully examined. There must not be any signs of flaw or fracture.

3.8 Torque

3.8.1 A 3.175 kg CO₂ gas cylinder should be valved and devalved as follows:

- .1 spray valve with ROCOL AS or equivalent dry anti-scuffing lubricant;
- .2 wind PTFE tape around valve cylinder thread on top of the lubricant;
- .3 spray PTFE tape with ROCOL AS or equivalent;

.4 using a valving machine screw valve into gas cylinder with a torque as recommended by the manufacturers of the equipment;

.5 using a de-valving machine unscrew valve from cylinder.

Repeat the above cycle 6 times.

3.8.2 On completion carefully examine the valve threads. There must not be any signs of stripping or damage.

4 Operating head

4.1 Hot

4.1.1 Two operating heads should be placed in a hot chamber at a temperature of +65°C for a period of 2 hours. On removal from the hot chamber the force required to activate the heads should be measured.

4.1.2 The force must not be greater than 100 N.

4.2 Cold

4.2.1 Two operating heads should be placed in a cold chamber at a temperature of -30°C for a period of 2 hours. On removal from the chamber the force required to activate the heads should be measured.

4.2.2 The force must not exceed 150 N.

4.3 Ambient

4.3.1 Two operating heads should be placed in a temperature of 20°C ± 3°C for a period of 2 hours. After this period the force required to activate the heads should be measured.

4.3.2 The force must not exceed 100 N.

4.4 Salt water immersion

4.4.1 Two operating head assemblies each fitted to an approved type of cylinder valve and gas bottle in a 3% salt water solution at an ambient temperature of +18°C to 20°C should be partially submerged for a period of [6] months, or alternatively be exposed to a salt water spray (5% sodium chloride solution) at a temperature of 35°C ± 3°C for 160 hours without interruption. On completion of either of these tests the heads should be carefully examined then the operating mechanism activated.

4.4.2 There should not be any excessive signs of pitting or corrosion and the operating heads must continue to function in a satisfactory manner.

4.5 Impact

4.5.1 The operating head should be attached to an approved type of cylinder valve and placed in a refrigerator for 2 hours at -30°C. On completion, drop the complete assembly from a height of 2 metres on to a solid floor covered with a sheet of blockboard in such a way that the operating head receives the full impact on:

- .1 top of the head;
- .2 side of the head.

4.5.2 The test should be repeated 3 times replacing the valve in the refrigerator between each test to ensure a temperature of -30°C is maintained.

4.5.3 There must be no visible signs of damage to the head and on being activated it must continue to function in a satisfactory manner.

5 High pressure hose assembly

5.1 Hoses used for CO₂/N₂ gas systems

5.1.1 Three hoses at an ambient temperature of +18°C to 20°C should be subjected to an internal pressure until destruction. The pressure at which the hose bursts must not be less than 21 MPa.

$$21 \text{ MPa} = 3045 \text{ lbs/in}^2$$

5.1.2 Three hoses, after being placed in a cold chamber at a temperature of -45°C for a period of 72 hours, should be subjected to an internal pressure until destruction. The pressure at which the hose bursts must not be less than 4.5 Mpa.

$$4.5 \text{ MPa} = 653 \text{ lbs/in}^2$$

5.1.3 Three hoses should be subjected to an internal hydraulic pressure of 12.5 MPa for a period of 60 seconds. During the test the hose and end fittings should be carefully examined and there must not be any signs of leakage, damage or distortion.

$$12.5 \text{ MPa} = 1831 \text{ lbs/in}^2$$

5.1.4 The three hoses used in the hydraulic pressure test after being dried out should be placed in a cold chamber for 2 hours at a temperature of -45°C. Afterwards the hoses should be bent through 180 degrees around a former 50 mm diameter without any signs of cracking or damage. On completion of this test the hoses should be allowed to warm up to room temperature before being subjected

again to the hydraulic test outlined in sub paragraph .3 above to confirm that the hoses are still in a serviceable condition.

5.1.5 The joint between the hose and the end connections should at an ambient temperature of +18°C to 20°C be subjected to an in line loading of 180 kg for a period of 60 seconds. On completion the hose should be carefully examined and must not show any signs of damage or detachment from the end connections.

5.1.6 A hose placed on a solid base should be subjected to a load of 45 kg applied on a bar 25 mm wide resting on the hose at right angles to the bore for a period of 60 seconds. Using a flow meter, flow rates should be taken before and after the test to confirm that there has been no loss of cross sectional area in the bore of the hose.

5.2 Hoses used for compressed air systems

5.2.1 The hoses should be subjected to the tests outlined in paragraphs 5.1, .1 to .6 inclusive.

5.2.2 Three hoses should be subjected an ambient temperature of +18°C to 20°C for a period of 60 seconds to an internal pressure of 2½ times the working pressure of the air in the storage cylinder. The hoses must not show any signs of leakage, distortion, or damage.

6 Valves

6.1 Liferaft tests

6.1.1 Before any valve can be accepted for fitting on a MCA or Notified Body approved inflatable liferaft it must be subjected to and complete in a satisfactory manner the following tests detailed in Part I of this Chapter - Prototype Tests for Inflatable Liferafts:

1. Drop Test (Section 1, para 2);
2. Inflation Test (Section 1, para 18);
3. Pressure Test (Section 1, para 19).

6.2 Workshop

6.2.1 Pressure relief valve

A minimum of 6 valves should be subjected to each test.

6.2.1.1 *Operating pressure and leak*

- (i) A valve should be placed in a test rig in a workshop and an air pressure slowly applied to crack open the valve. The pressure should then be gradually reduced until the valve re-seats, and the valve then covered

with a film of water and examined carefully for a period of not less than 3 minutes to check for airtightness.

(ii) The pressure at which the valve opens and reseats should be recorded and must fall within the designed parameters. There must be no leakage.

6.2.1.2 *Drop*

A valve should be dropped 12 times from a height of 2 metres onto a solid concrete floor. On completion of the drops the valve should be carefully examined and then activated on a test rig. There must be no signs of any damage and the valve must continue to function in a satisfactory manner.

6.2.1.3 *Valve securing*

(i) A valve should be placed in a test rig and subjected for a period of 3 minutes to a tensile force of 1,800 N across the flange in an attempt to separate it from the valve. The valve should be turned through 90 degrees and the test repeated.

(ii) On completion of the test the valve should be examined and must not show any signs of distortion or detachment of the flange from the valve.

(iii) One valve should be tested to destruction and the tensile force required to separate the valve from its surrounding flange recorded.

6.2.1.4 *Pulsating load*

(i) A valve should be mounted on a single inflatable buoyancy tube of an approved six person liferaft. The tube should be inflated until the relief valve blows and the blow off and reseat pressures recorded. A person weighing not less than 75 kg should then step up on to the tube 25 times and on completion then pressure in the tube should be recorded.

(ii) The pressure drop in the tube must not be greater than 10% of the pressure at which the valve re-seated.

6.2.1.5 *Pressure*

(i) Using the inflated tube used in the previous test the relief valve should be plugged and the tube inflated to a pressure 3 times the blow off pressure of the valve. This pressure should be maintained for a period of 5 minutes and the valve carefully examined.

(ii) There must be no damage to the valve or any signs of it being detached from the tube.

6.2.1.6 *Flow*

(i) Using a flow meter and a test rig it should be demonstrated at an ambient temperature of +18°C to 20°C that the valve when fully open is capable of discharging gas at least at the following rates:

PRESSURE	FLOW RATE
0.014 MPa/14 kN/M ²)	1.30 m ³ per minute
0.021 MPa (21 kN/M ²)	1.85 m ³ per minute
0.028 MPa (28 kN/M ²)	2.45 m ³ per minute
0.042 MPa (42 kN/M ²)	3.40 m ³ per minute

6.2.2 Inflate/deflate valve

A minimum of 6 valves should be subjected to each test.

6.2.2.1 *Leak*

(i) A valve should be placed in a test rig in the workshop and a pressure slowly applied to crack open the valve. The valve should be allowed to reseal and an air pressure of 0.014 MPa applied to the back of the valve. The face of the valve should then be covered with a film of water and the valve examined carefully for a period of not less than 5 minutes to check for airtightness. There must be no leakage.

6.2.2.2 *Valve securing*

(i) A valve should be placed in a test rig and be subjected to a tensile force of 1,800 N across the flange in an attempt to separate it from the valve. The force should be applied for not less than 3 minutes then the valve turned through 90 degrees and the test repeated.

(ii) The valve must not be distorted, and there must not be any signs of detachment of the flange from the valve.

(iii) One valve should be tested to destruction and the tensile force required to separate the valve from its surrounding flange recorded.

6.2.2.3 *Drop*

(i) A valve should be dropped 12 times from a height of 2 metres onto a solid concrete floor. On completion of the drops the valve should be carefully examined and then activated on a test rig. There must not be any signs of damage, and the valve must continue to function in a satisfactory manner.

6.2.2.4 *Flow*

(i) Using a flow meter and a test rig it should be demonstrated at an ambient temperature of +18°C to 20°C that the air flow through the valve when fully open at a range of pressures between 0.014 and 0.028 MPa complies with the designed specification of the valve.

6.2.3 Non return/transfer valve

A minimum of 6 valves should be subjected to each test.

6.2.3.1 *Leak test*

(i) A valve should be placed in a test rig in the workshop and an air pressure slowly applied to crack open the valve. The valve should be allowed to reseat and an air pressure of 0.007 MPa applied to the back of the valve. The face of the valve should then be covered with a film of water and examined carefully for a period of not less than 3 minutes to check for airtightness. This test should then be repeated using a pressure of 0.014 MPa.

(ii) There must be no signs of any leakage at either pressure.

6.2.3.2 *Valve securing*

(i) A valve should be placed in a test rig and be subjected to a tensile force of 1,800 N across the flange in an attempt to separate it from the valve. The force should be applied for not less than 3 minutes then the valve turned through 90 degrees and the test repeated.

(ii) The valve must not be distorted and there must not be any signs of detachment of the flange from the valve.

(iii) One valve should be tested to destruction and the tensile force required to separate the valve from its surrounding flange recorded.

6.2.3.3 *Drop*

A valve should be dropped 12 times from a height of 2 metres onto a solid floor covered with a sheet of blockboard. On completion of the drops the valve should be carefully examined and then activated on a test rig. There must be no signs of any damage and the valve must continue to function in a satisfactory manner.

6.2.3.4 *Flow*

Using a flow meter and a test rig it should be demonstrated at an ambient temperature of +18°C to 20°C that the air flow through the valve when fully open at a range of pressure between 0.007 and 0.028 MPa complies with the designed specification of the valve.

6.2.4 Air aspirator valve

- .1 The aspirator should be capable of withstanding all the prototype tests for inflatable liferafts listed in Part 1 of this Chapter without any loss of efficiency, damage or leakage.
- .2 The aspirator must be strong enough to withstand contact with the ship's side during inflation of a liferaft without damage or leakage.
- .3 The valve when subjected to air flow, leak, valve securing and drop tests carried out in a workshop or approved laboratory must conform to the manufacturers' design specification and be suitable for fitting to an inflatable liferaft.

Section 2

Production tests

1 Quality during manufacture

- 1.1 A complete dimensional check against the specification should be made on all items supplied by sub-contractors.
- 1.2 The acceptable quality level for every production batch should be in accordance with the sampling plan table 1 of BS 6001, Part 1:1991 (ISO 2859 - 1:1989) or other equivalent arrangement acceptable to the MCA or Notified Body.
- 1.3 Every valve produced prior to being packaged is to be checked to confirm that the opening and closing pressures fall within the design parameters.
- 1.4 The overall quality control arrangements during production should be to the satisfaction of the MCA or Notified Body. Manufacturers' quality control arrangements approved to Defence Standard AQUAP/1, BS 5750 BS EN ISO 9000: 1994 to BSEN 150 9004: 1994 or other equivalent standards will normally be acceptable.

PART VII

AUTOMATIC RELEASE HOOKS

Section 1 Prototype tests

1 General

1.1 Inflatable liferaft automatic release hooks shall comply with the requirements contained in Part 7, Schedule 4 of MSN 1676 (M).

1.2 The surveyor carrying out the approval tests of the automatic release hooks should be satisfied with the quality control organisation of the manufacturer. The steel used in the construction of the release hooks should be certified by a Classification Society or Government Authority, and approved Test House Test Certificates, in accordance with the requirements of paragraph 2 of Section 2 of this Part, should be supplied with each release gear.

1.3 The following should be submitted to the testing establishment for the prototype testing of the hook:

- .1 two hooks which have been passed for delivery; and
- .2 a functional description of the hook together with any other documents necessary to carry out the tests.

2 Definitions

2.1 In this Section the following definitions apply:

- .1 'Actuating force' means the force required to set the actuating mechanism.
- .2 'Actuating mechanism' means the mechanism which, when operated, allows the liferaft to be released automatically.
- .3 'Automatic release mechanism' means the mechanism which opens the hook automatically to release the liferaft.
- .4 'Hook' means a hook to be used for the launching of liferafts which can be activated to automatically release the liferaft when it is waterborne.
- .5 'Load limit for automatic release' means the minimum load at which the automatic release mechanism opens the hook and automatically and completely releases the liferaft.

.6 'Manual release force' means the force required at the actuating mechanism to release the hook manually.

.7 'Safe working' load means the load for which the hook is to be approved.

.8 'Securing force' means the force required to close the hook manually.

.9 Testing establishment means an establishment accepted by the MCA, Nominated or Notified Body having the equipment and the qualifications necessary for the testing and documentation of liferaft release hooks in accordance with this Section.

3 Corrosion

3.1 Unless every part of a hook is made up of corrosion resistant material, two hooks should be submitted to the corrosion test which should be made in a salt mist chamber in accordance with BS 7479: 1991 (ISO 9227: 1990) for 1000 hours, or an equivalent national standard. Any corrosion effects and other damage to the hooks should be recorded.

3.2 Both hooks should then be subjected five times to the tests required by paragraphs 4.1 to 4.5. One hook should be kept as a spare and for reference.

4 Load

4.1 The hook should be attached to a short wire rope fall, approximately 1.5 m, and loaded with a mass of 10 kg. The weight should be secured and then lifted 1 m. From this position it should be released to perform a free fall before it is abruptly stopped by the wire rope fall. The hook should not release as a result of this test.

4.2 The automatic release hook should be attached to a test load equal to 1.1 times the safe working load, with the actuating mechanism in the locked position. The load should be raised to a height of at least 6 m and then be lowered at a speed of 0.6 m/sec. When the load is 1.5 m above the ground or water surface, the actuating mechanism should be set for automatic release, and the lowering completed. The automatic release hook should release the load when it strikes the ground or water surface. The test should be repeated with a test load equal to 2.2 times the safe working load.

4.3 The automatic release hook should be attached to a test load of 1.1 times its maximum working load using an approved launching appliance. The test load should be lowered at maximum lowering speed through a distance of at least 3 m and stopped by applying the hand brake sharply. This test should be conducted twice, once with the release mechanism set for automatic release, and again with the mechanism set to closed. The release mechanism should not open in either test.

- 4.4 The actuating force should be determined in the following way:
- .1 The hook should be loaded to 0%, 25%, 50%, 75% and 100% of the safe working load of the hook.
 - .2 At each load level the actuating force required at the actuating mechanism should be measured and recorded.
 - .3 The actuating force should be between 150 N and 250 N if the hook is lanyard-operated, or the action required to set the actuating mechanism should be readily performed by a single person without difficulty.
- 4.5 The securing force should be determined with an unloaded hook. The securing force should be less than 120 N. The securing force should be recorded.
- 4.6 The manual release force should be determined in the following way:
- .1 The hook should be loaded with a mass of 150 kg.
 - .2 The actuating mechanism should be set.
 - .3 The force required to release the hook manually should be established and recorded.
 - .4 The manual release force for a mass of 150 kg on the hook should be at least 600 N for lanyard-operated designs. Alternative designs should be demonstrated to the satisfaction of the MCA to provide adequate protection from inadvertent release under load.
- 4.7 The automatic release hook should be attached to a test load equal to the mass of the lightest liferaft for which the automatic release hook is to be approved, with the actuating mechanism in the locked position (i.e. not set for automatic release). The load should then be raised so that it is clear of the ground. The actuating mechanism should be set to automatic release. This should be easily accomplished by a single person and should not release the load.
- 4.8 The hook should be released 100 times without failure by each of its modes of release using the maximum load permitting release for that mode. It should then be disassembled and the parts examined. There should be no evidence of excessive wear on any part.
- 4.9 The hook and its protective saver, if applicable, should be arranged in a cold store at -30°C to simulate operational readiness and loaded with 25 kg. A 3.5 cm thick uniform layer of icing should be built onto it by spraying cold fresh water from angles above 45° from horizontal, with intermittent pauses to let icing form. The hook should then be actuated and as a result release the hold without failure.

4.10 It should be demonstrated that the hook is not damaged as a result of 10 impacts at horizontal speed of 3.5 m/s on to a structure resembling a verticals ship's side. As far as practical all sides of the hook, especially areas with exposed controls, should impact the structure. The hook should not sustain any damage which will interfere with the normal function of the hook.

5 Compatibility of liferaft and release hook

Where automatic release hooks are supplied for use with liferafts of different manufacturers, operational tests with each type and size of lifting/attachment fitting used by the different manufacturers of liferafts should be carried out before the particular combination of liferaft and release hook is accepted by the MCA.

Section 2

Production and operational tests

1 General

When the hooks are made of cast steel acceptable Non-Destructive Tests should be carried out to establish that the material is free from surface or internal flaws.

2 Static load

2.1 Each release hook should be satirically proof tested to 2½ times the safe working load and be provided with a Lloyd's Proving House Test Certificate certifying that it has been so tested. Other nationally approved Proving House Test Certificates may be accepted by the MCA.

2.2 Each release hook should be permanently marked with:

- .1 The manufacturer's name or the approved name of the release hook;
- .2 the date of manufacture;
- .3 the safe working load;
- .4 the number of the Test Certificate required by paragraph 2; and
- .5 clear, concise operating instructions.

3 Operational

Each release hook should be submitted to an operational test with a mass equivalent to the safe working load being applied. The release arrangements should be demonstrated and checked with the liferaft loaded to ensure that the automatic release hook will not release while the load is still being applied.