



**NCD SPECIFICATION**

**NCD 4006,      ISSUE-3,      MAR 2014**

**SPECIFICATION FOR GEMINI CRAFT**

**Issuing Authority**

**Integrated Headquarters  
Ministry of Defence (Navy)  
Directorate of Naval Architecture  
D-II Wing, Sena Bhawan  
New Delhi - 110 011**



INTEGRATED HEADQUARTERS  
MINISTRY OF DEFENCE (NAVY)  
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YEAR 2014

REV. No 3

DIRECTORATE OF NAVAL  
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GEMINI CRAFT

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## RECORD OF AMENDMENTS

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### Specification for Gemini Craft

The issue and use of this specification is authorized  
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(ए एम मित्रा) / (AS Mitra)

कमोडोर / Commodore

प्रधान निदेशक नौसेना पोतशिल्प /

Principal Director Naval Architecture

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नौसेना पोतशिल्प निदेशालय / Directorate of Naval Architecture

एकीकृत मुख्यालय / Integrated Headquarters

Ministry of Defence (Navy)

D-II Wing, Sena Bhawan

New Delhi - 110011.

Tele: 011-23010937/23010047

Fax: 011-23010126

Specification for Gemini Craft





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GEMINI CRAFT

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## INTRODUCTION

1. This NCD Specification is sponsored for the Indian Navy, by Principal Director Naval Architecture, Integrated Headquarters, Ministry of Defence (Navy), Sena Bhawan, New Delhi- 110011
2. It is to be applied as required for contracts concerning design and construction of Gemini Craft.
3. If it is found to be technically unsuitable for any particular requirement the Sponsor is to be informed in writing of the circumstances with a copy to the Principal Director, Directorate of Naval Architecture, Integrated Headquarters, Ministry of Defence (Navy), Sena Bhawan, New Delhi-110011
4. Any user of this Specification may propose an amendment to it. Proposals for amendments which are:
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## SPECIFICATION FOR CONSTRUCTION OF GEMINI CRAFT

### SCOPE

1.1. This Specification covers the materials, manufacture, workmanship, quality, tests & trials and packing of the inflatable rubberized Gemini Craft. The description and operation of this craft is enumerated in detail in the succeeding Paragraph of this specification.

1.2. If during the construction it appears that:-

(a) A deviation from the specification or drawing appears desirable,

OR

(b) A characteristic has been omitted or is not sufficiently specified,

OR

(c) A specified characteristic cannot be attained or can be attained with penalties in other directions.

The contractor/builder shall inform IHQ-MOD(N)/DNA immediately of the circumstances together with his proposed alternatives and shall proceed with the alternative only after return approval from IHQ-MOD (Navy) or its representative to this effect.

### 2. FUNCTIONS

2.1. The Gemini Craft shall perform the following tasks at sea and in harbour:

- (a) Diving Operations
- (b) Life boat
- (c) Transport men and material
- (d) Limited Search and Rescue

2.2. The Gemini Craft shall be designed to be seaworthy and carry out functions listed at Para 2.1 with full complement and at speeds (not less than 05 knots commensurate with 25-30HP OBM). The craft shall be stable and should meet static stability requirement specified at Para 18.20 of this Specification.

2.3. The Gemini craft shall be designed to have good manoeuvrability and throttle response throughout its speed range (using 25-30HP OBM) and particularly when coming alongside or breaking away from an underway vessel





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at its full load and complement. Guidance General Arrangement (GA) of the craft is placed at **Appendix A**

### 3. GENERAL DESCRIPTION

3.1 **Principal Dimensions:** The Principle Dimensions of the craft are:-

- (a) Length - Not more than 4700 mm
- (b) Breadth - Not more than 1900 mm
- (c) Dia of Buoyancy Tube - Not less than 450 mm
- (d) Carrying Capacity - 08 - 10 men (80.5 kg per person)
- \* (e) Weight of craft - Not more than 125 kg including floor boards & Accessories (without OBM).

3.2 The craft shall be built of Buoyancy Tube made of Composite Fabric consisting of Hypalon (outer layers) and Neoprene (inner layers) of 1600 Dtex or equivalent, type approved as per ISO 15372:2000 by Classification Society. The bottom floor of the boat shall be made of the same fabric as buoyancy tube. Reinforcement of the boat shall be provided using rubberized strips of Hypalon (outer layer) and Neoprene fabric (inner layer). The stern of the boat formed by a transom shall be made of Marine Plywood on which OBM can be mounted.

### 4. APPROVAL AND INSPECTION BY CLASSIFICATION SOCIETY

4.1 The Craft is to be constructed under the approval of Classification Society in accordance with ISO 6185, Part 3 and the minimum requirements specified in this requirement. Parameters not mentioned in this specification would be in accordance with ISO 6185, Part 3 for inflatable crafts, so as to ensure that the craft meets all functional/material requirement specified in this specification.

4.2 Class approval shall cover following aspects:-

- (a) Design vetting
- (b) Drawing approval
- (c) Material Inspection
- (d) In process Inspections
- (e) Tests & Trials





## 5. CONSTRUCTION DETAILS

### Buoyancy Tube

5.1 The material used for buoyancy tube shall be of Hypalon (outer layers) and Neoprene (inner layers) composite fabric, of 1600 Dtex or equivalent type approved as per ISO 15372:2000 by Classification Society. The Buoyancy Tube shall be divided in to a minimum of 04 air tight compartments by means of baffles/bulk-heads. Each compartment shall be fitted with a combined inflation/deflation valve and two over pressure valve as safety topping-up-valve. The valves shall be made of rubber moulding and plastic nylon material or alternate marine grade material approved by class. The valves should be of reputed make and approved by Classification society for use on inflatable crafts.

5.2 The ends of the tube shall be conical and should terminate in suitably stiffened rubber conical flat ends to take impact loads during coming alongside/lowering. The two legs of the Buoyancy Tube shall be parallel and the width readings at the transom and at midship shall not differ by more than 10mm.

5.3 The tube shall be strong enough to sustain the effects of running whilst coming alongside. The upper layer shall be strong enough to bear the rubbing impact against rough surfaces/ barnacles. In addition, an emergency repair kit with quick drying adhesive and ready use repair patches shall be provided.

5.4 The construction of the Buoyancy Tubes should be in accordance with class approved drawings and production processes.

5.5 The attachment of bulkheads in the buoyancy tube shall be such that each chamber is rendered air tight under specified pressure.

5.6 The seams in the buoyancy chambers shall have an overlap not less than 3cm width and should be pasted with cold glue vulcanisation process or equivalent Class approved process. An additional strip is to be glued at the edge of each panel junction as well as strip inside all assembled parts in order to ensure a perfect water tight preventing from any leakage.

### Inflation/Deflation Valve

5.7 (a) The Inflation/Deflation valve shall combine a high pressure air connection with a deflation valve. The valve assembly shall consist of a light alloy body housing a valve and its associated seat, screwed into a light alloy ring which is bonded to the buoyancy tube. An 'O' ring seal shall ensures water and air tight joint between the body and the ring. The metal disc shaped valve shall be held against the rubber seat by a spring loaded lever. A metal cap screws onto the valve body shall prevent ingress of water or dirt into the valve or buoyancy tube. Each valve shall further





be protected by a rubber cone positioned over the valve assembly and secured by a flap. When the rubber cone shall be lifted and the screw protection cap removed the valve shall be such that it can be opened with a finger for partial or complete deflation of the craft. For rapid deflation the inflation/deflation valve body shall be such that it can be unscrewed and removed from the craft for replacement/repair. Suggested design of Inflation/deflation Valve is provided at **Appendix B**. The valves should be procured from a reputed manufacturer and approved by classification society for use on inflatable crafts.

(b) The valve shall be fitted proud of the buoyancy tube on inner side of the buoyancy tube to enable identification/location in darkness.

(c) The material of inflation/deflation valve fitted on the buoyancy tube shall be of suitable material for marine application.

(d) Alternate design/arrangement for inflation/deflation valves which meet the above functional requirements is acceptable subject to the approval of Classification Society.

#### Safety Topping-up-valve

5.8 (a) The safety valve shall consist of a light alloy body housing a rubber-seated relief valve which is retained on its seat by a flexible disc. If the pressure in the buoyancy tube compartment exceeds the design value the valve shall lift from seat until the pressure drops to preset design value. At this preset design value the flexible disc to automatically reseal on the valve. During topping-up the flexible disc shall act as a non-return valve. Additionally, a rubber plug/plastic cover with a safety cord should be provided, to prevent, to prevent French chalk/dirt from entering the valve. Further the rubber plug should enable use as an emergency stopper for the valve in case the valve is found to be leaking. Recommended design of Safety Topping-up Valve is provided at **Appendix B**. The valves should be approved by classification society for use on inflatable crafts.

(b) The pressure setting of the valve should be such that the valve will not release under momentary increase in the collar pressure due bending of crafts during lowering.

(c) The valve shall be fitted proud of the buoyancy tube on inner side of the buoyancy tube to enable identification/location in darkness.

(d) The material of safety topping-up-valve fitted on the buoyancy tube shall be shall be of suitable material for marine application.





(c) Alternate design/arrangement for Safety Topping Up valves which meet the above functional requirements is acceptable, subject to the approval of Classification Society.

**Floor**

5.9 The floor shall be made of Hypalon (outer layers) and Neoprene (inner layers) composite fabric, of 1600 Dtex or equivalent of type approved as per ISO 15372:2000 by Classification Society. The floor shall be bonded to the underside of the buoyancy tube and attached by a floor retaining strip to the transom board. It shall be strengthened on its underside in way of the keelson by a keelson chafing strip of minimum 16 cms wide fabric. Chafing strips shall also be bonded to the underside at the after ends of the tubes. *21/07/15*

5.10 Special attention shall be paid to the attachment of the floor to the buoyancy tube to ensure that the resulting joint is water tight. Special care is also to be taken that the floor is perfectly taut and smooth and has no puckers, when the craft is assembled and ready for use.

**\* Self Bailers**

5.11 Two self bailers akin to NRV shall be located on the lowermost part of the transom board near the rear end fitment of the keel close to the centre line. The same shall be provided with a flexible flap to overcome pressure on the NRV in following seas. The self bailers shall automatically remove water from the craft at higher speeds. *To use of flap fabric cap to be used.*  
*21/07/15*

**Transom**

5.12 The transom board shall be fitted and securely bonded to the buoyancy tube and the floor so as to provide a water tight joint. The Transom shall be designed for use with 25-30 HP OBM. The transom shall be made of marine plywood of appropriate thickness and to be suitably fitted out with engine mount made of Aluminium alloy plate (IS 737) and chafing patch. The transom shall also be suitably designed to help locate the after end of the keelson. Hypalon coated fabric shall be pasted completely on the surface area of the transom to prevent it from damage as well as loosening from the tube body. Separate strip of suitable size shall be provided on the bottom of the transom to minimize chance of damage. Details regarding craft identification No. etc. shall be engraved on a brass tally fitted on the inner side of the transom on starboard side. Lifting rings, cleat and 'U' bracket shall be provided as per approved drawing.

*M. M. H.*





### Keelson

5.13.1 The keelson shall be provided in three inter-locking sections. It shall be made of High Strength Tempered Anodised Aluminium alloy (IS 737). Suggested arrangement for keelson is provided at **Appendix C**.

5.13.2 The shape of the keel is to ensure that the bow is lifted above the surface of water to ensure better sea keeping ability and to obviate ingress of water from bow wave or splash created when moving at high speed.

### Floor Boards

5.14 The Floor boards shall be made of High Strength Tempered Anodised Aluminium alloy with a non-skid finish. These boards (four/five pieces) shall be connected together to form a rigid platform. Suggested arrangement for Floor Board is provided at **Appendix C**.

### Stowage Pockets

5.15 Minimum One Stowage pockets shall be attached to the buoyancy tube in the forward in board side. The stowage pockets provided shall be capable of holding dynamic weight of 6 Kgs. Holes are to be provided at the bottom of the pocket to drain water (Size 340mm x 280mm x 90mm).

### Rubbing Strips

5.16 Following single piece Rubbing Strips of moulded neoprene rubber of 4" width (where not mentioned) and extending along the entire length shall be attached to the buoyancy tube for the protection of the craft:-

- (a) Bow rubbing strip.
- (b) Outer anti chafing strip 160mm wide on both sides.
- (c) Anti Chafing Strip under Keel.
- (d) Two Beaching Strips under buoyancy tubes
- (e) Chafing patch for coxswain's position
- (f) Chafing patch on Brow in the way of Bow Fair lead

### Carrying Handles

5.17 Minimum Four Carrying handles shall be provided, two on each side and one under the apex of the bow. The handles shall be suitably reinforced to take a weight of 300 kgs. The handles shall be of Moulded Neoprene Rubber bonded to the buoyancy tubes.





### Lifting, Towing Fittings and Securing Arrangements

5.18 Following Lifting and Towing fittings shall be provided. Lifting and Towing fittings shall consist of suitably sized D Shackle of SS AISI 316 (to pass lifting sling and towing rope) securely attached to fabric reinforcing patches bonded to the buoyancy tube.

(a) Towing/ Lifting fittings, forward - One on either side of the craft, below the buoyancy tube at the beginning forward curve in the buoyancy tube. Ring-bolts shall be provided on the transom for lifting.

(b) Towing fittings, aft - One on either side, located on top of the buoyancy tube, shall be used if craft is employed for towing purposes.

(c) Hoisting Lowering Slings. Suitable sling for the Gemini shall be provided for lowering from a Radial davit.

(f) Load Test. The lifting and towing arrangement shall be load tested to 300 Kg.

### Lifting Hooks Aft

5.19 Two hooks of SS AISI 316 shall be provided on transom as lifting arrangement at the aft end of the Gemini Craft.

### Oar Securing Assemblies

5.20 Oars shall be positioned parallel/30° to the vertical when secured inside the inboard side of buoyancy tubes. Adequate securing arrangement shall be provided so that the oars are intact.

### Bellow pumps

5.21 Bellow pump of suitable design shall be provided to inflate the craft in approximately 20 minutes.

### Fabric Fittings

5.22 Patches, doublers, anchorages, etc. shall be made and positioned as shown on the drawing which indicates finished size. Suitable tape/webbing reinforcement shall be used to distribute stresses adequately.

### Polyurethane Cover

5.23 One in number Polyurethane cover shall be provided to protect entire craft from sunlight/weather.



### Lifeline

3.24 Lifeline is to be provided such that the distance between rope loops to waterline is not more than 75 mm

### 6. MATERIAL SPECIFICATIONS

6.1 Material Specification for the various items to be used for construction of Inflatable crafts are as follows:-

(a) The Material Specification for buoyancy tube and floor Hypalon (outer layers) and Neoprene (inner layers) composite fabric of 1600 Dtex or equivalent as per ISO 15372:2000 and type approved by Classification Society.

(b) The Material Specification for Floor Board, Keelson & other fittings is placed at **Appendix-D**

6.2 The material specified shall be strictly adhered to and no deviation is permitted. Materials referred to as approved shall be so approved by the Classification Society in accordance with the requirement specified in this NCD.

6.3 The colour of all exposed surfaces / material shall be light grey shade conforming to RAL 7040. Hidden surfaces are to be of a drab or natural colour.

### Adhesive

6.4 The adhesive shall be Neoprene based contact adhesive of good quality and to be suitable for service in tropical environments as per specification. The adhesive shall consist of a dispersion of polychloroprene in a low boiling point solvent and may have additions of resins to promote building tack. The adhesive shall consist of 2 components, Part 1 and Part 2, Part 1 being the basic neoprene dispersion and part 2, the accelerator (hardener).

6.5 The adhesive should be type approved by Classification Society for use on inflatable and meeting the minimum requirements specified in ISO 6185.

6.6 Alternate adhesive superior in properties are also acceptable subject to type approval of Classification Society as per ISO 6185.





## 7. PRINCIPAL COMPONENTS OF GEMINI CRAFT

7.1 The principal components of the complete assembly are as follows:

### (a) Hull

- (i) Buoyancy tube - Divided in minimum 04 compartments and complete with rubber conical flat ends.
- (ii) Bulkheads - Dividing the buoyancy tube into 4 compartments.
- (iii) Inflation/deflation valves and Safety topping-up-valve - one set per chamber.
- (iv) Transom - fitted with engine mount, anti chaff patch.
- (v) Floor - in proofed fabric
- (vi) Floor retaining strip at transom - 1 No.
- (vii) Keelson chafing strip - 1 No.
- (viii) Aft chaffing strip - 1 No.
- (ix) Keelson locating Blocks - 2 Nos.

### (b) Hull Fittings

- (i) Keelson in 3 interlocking sections - 1 No.
- (ii) Bottom Boards - 1 No.
- (iii) Bow Rubbing strip - 1 No.
- (iv) Side Rubbing strip Aft - 1 set
- (v) Carrying Handles (Patch rubber with handle) - 4 Nos.
- (vi) Lifting Rings on Transom - 2 Nos.
- (vii) SS to AISI - 316 Hook on transom - 2 Nos
- (viii) SS to AISI - 316 "D" rings - 2 Nos
- (ix) Eyelet Brass (No. 28) with washer - 40 Nos.
- (x) Pockets for stowage - 01Nos  
(One for wireless set & one for inflation bellow pump)
- (xi) Floor Board in parts - 01 no. 4 Pcs for Gen. Purpose Gemini,
- (xii) Polygon (Aluminium alloy) - As per offered design
- (xiii) U Channel (Aluminium alloy) - As per offered design
- (xiv) Oars (Shall be light weight not more than 4Kgs and positively buoyant in water)
- (xv) Repair outfit (small) - fabric patches 05, adhesive tube (Dendrite) 500 gm, spanners of required sizes.

### (c) Valises and Store bags

- (i) Valise for Hull - 1 No.
- (ii) Valise for wooden bottom board, keelson and Oars - 1 No.

**Note - 1:** (a) For inflatable craft meant for all ships / establishments, the package be capable of passing through a hole of





82 cms. ± 05 cms in diameter (in this case floor board are to be made of 94 pieces only)

(b) The manufacturer shall mark the relevant diameter and number of floor board pieces on the package and inner side of the transom.

**Note- 2:** List of the contents of each bag shall be placed inside the bag so as to be available when the bag is opened. Each bag shall be marked on the outside with the DS cat No and identification No. of the craft.

**(d) Additional Spares**

- |       |   |   |        |
|-------|---|---|--------|
| (i)   | Inflation/Deflation Valves  | - | 10 Nos |
| (ii)  | Safety Topping up valve   | - | 05 Nos |
| (iii) | Plugs for Water Drain   | - | 04 Nos |
| (iv)  | NRV for Water Drain   | - | 10 Nos |
| (v)   | Tools for assembling Bottom Keel  | - | 01 Set |
| (vi)  | Bellow Inflation Pump   | - | 01 No  |
| (vii) | Patching material with adhesive to repair leak/damage in buoyancy tube. |   |        |

**8. PRODUCTION**

8.1 Manufacturing of the craft should be as per the detailed drawings approved by Classification Society and meeting the requirements mentioned in this specification. The production processes should also be approved and supervised by the Classification Society.

**Packing specification**

8.2 The packing shall be done as follows:

(a) Tube body shall be packed in valise stitched from duck cotton 475gm. This shall be baled from laminated Hessian cloth and packed in wooden box of suitable size.

(b) All other accessories shall be first wrapped and baled with laminate Hessian cloth and then packed in wooden crates of suitable sizes.

**Tolerance**

8.3 General tolerances on all dimensions shall be  $\pm 1.5$  mm unless otherwise specified in this specification or approved by Classification Society. The exceptions to this general limit shall be in respect of stuck-on components,





length of webbing and cordage, and the overall dimensions of components etc; these items shall be given a sliding scale tolerance which increases in accordance with the magnitude of dimensions.

### **PRODUCTION DAMAGES**

8.4 Any Production damage irrespective of size shall be repaired by complete part / panel replacement only. The replacement is to undertaken by the contractor free of charge at the consignee place as soon as possible and in any case not later than 3 months from the date of receipt of intimation.

8.5 No patch repair is permitted on buoyancy tube/ floor. In case of production damages only part/ Panel Replacement shall be permitted.

8.6 Where a part panel replacement is necessary, the following parameters shall apply:

(i) On the buoyancy tubes, not more than one part panel replacement will be permitted on each craft.

(ii) On the floor not more than one part panel replacement will be permitted on each craft.

### **9. RECORDS**

9.1 The builder shall develop and maintain records that demonstrate the effective operation of his quality control system and shall make these records available for review of the Inspecting agency. Inspection records shall include explicit identification of the material, part sub-assembly, equipment, sub-system or system, the nature and number of observations made, the number and type of deficiencies found the quantities approved or rejected and the nature of the corrective action taken, as appropriate. Records shall be retained until disposal is directed by the Inspector. The contractor shall furnish a copy of any record to the Inspector, on request.

### **10. DRAWING & DOCUMENTS.**

10.1 Within one month of placement of order the builder shall submit the design and manufacturing drawings for the approval of the Classification society. Construction of the craft is to commence only after the approval of all drawings by Class. Drawing approval should include approval of Classification Society for component level detailed production drawing required for manufacturing the craft. When a builder is offering Gemini crafts first time to IN, the Classification Society approved GA drawing should be vetted by IHQ, MoD(Navy)/DNA/DSOD prior commencement of production.





10.2 **As Fitted Drawings/Documents.** On successful completion of all tests/trials and prior to the delivery of the specific boat, the Builder shall supply to consignee two sets each of the following as fitted /as made drawings and documents with the craft. (All the drawings shall be to a scale of minimum of 1: 10):-

- 10.2.1 Buoyancy tubes
- 10.2.2 End cones of buoyancy tube
- 10.2.3 Floor and details of joint between floor and buoyancy tubes.
- 10.2.4 Transom with details of joint between transom, floor and buoyancy tube
- 10.2.5 Assembly drawings for keelson and floor board
- 10.2.6 Fitment details of each of fittings:-
  - (a) Inflation/Deflation valves
  - (b) Safety topping valves
  - (c) Self bailers
  - (d) Rubbing Strips
  - (e) Carrying Handle
  - (f) Towing fittings, lifting Hooks
  - (g) OBM attachment drawings illustrating Engine support.
  - (h) Fuel oil/L.O system with storage provisions

10.3 The builder shall also supply soft copy of all the As Fitted /As Made drawings to the consignee.

11. **Photographs.** One soft copy and one enlarged coloured printed copy (A4 size) of the following views as photographed.

11.1 Full stbd. Profile view showing OBM, propeller etc, with boat out of water.

11.2 A view of the bow (out of water).





11.3 Starboard profile of boat in water (preferably looking down on the boat)

11.4 A view on starboard bow (approx. 45° to centre line).

## 12 INSPECTION

12.1 The inspection authority for the boats will be the Classification Society (Any Member of IACS) contracted by the builder. The complete inspection of the craft as mentioned at Para 4 of this specification will be undertaken by Classification Society as per approved QAP. Towards this builder will submit the draft QAP for the approval of Classification Society, within one month of placement of order. The guidance Quality Assurance Plan (QAP) for inspection of the Inflatable crafts is placed at Appendix "C" for reference.

12.2 The cost of conducting tests and the material required for the purpose are to be borne by the builder. The suitable OBM (25- 30 HP) and POL for conducting trials shall be provided by the builder at the site of trials. In case the builder premises does not have sea front, the builder should transport the first craft to suitable location in India (mainland) specified by the order placing authority.

12.3 User Acceptance of First Craft of Every Order. On successful completion and clearance post clearance from Classification Society, the first boat of the every order will be subjected to extensive user trials covering all functional requirements as well as test & trials brought out in this Specification. The trials shall be conducted jointly by Classification Society and Customer nominated team. The trial will be conducted at sea front and the trial team shall be nominated by IHQ-MoD(Navy)/DSOD or Respective Commands/CSOD. Deficiencies observed by the trial team w.r.t the requirements stipulated in this specification should be liquidated by the builder at no extra cost. Subsequent crafts of the order shall be cleared by inspecting agency only after liquidation of all deficiencies observed during user acceptance trials of first craft.

## 13. WARRANTY CLAUSE

13.1 The inflatable crafts supplied shall bear a warranty of the contractor, against defective material, workmanship and performance for a period of 24 months from the date of receipt of the consignment of the stores. During this period if any of the stores supplied found defective the same shall be replaced by the contractor free of charge at the consignee place as soon as possible and in any case not later than 3 months from date of receipt of intimation by the contractor. In addition Inflatable crafts should have manufacturers /builders guarantee for 05 years for the fabric used and 24 months for the adhesion at joints, under normal exploitation.





#### 14. INSPECTION AUTHORITY

14.1 The inspection authority for the boats will be the Classification Society (Any Member of IACS) contracted by the builder.

#### 15. DEFLATION AND DISMANTLING

15.1 When deflated and dismantled the craft and components shall be stowed in four top proofed canvas valises as follows:

(a)	Hull Valise	Hull	
(b)	Valises for wooden	(i)	Keelson - 3 Nos
		(ii)	Bottom board - 4 Nos
		(iii)	Polygon - 2 Nos
		(iv)	U Channel - 1 No
		(v)	Oars - 4 Nos

**Note:** Lists of contents of each shall be kept inside the bag so as to be available when the bag is opened. The list shall be sealed in a polythene envelope.

#### 16. STENCILLING AND MARKING

16.1 The following shall be stencilled in permanent black ink on inner side of the transom starboard side.

BOAT GENERAL PURPOSE .....  
INFLATABLE NO.: .....  
DATE OF SUPPLY: .....  
NAME OF MANUFACTURER : .....  
MAX LOAD CARRYING CAPACITY (KG): .....  
MAX MOTOR RATING (KW): .....  
MAX NO. OF PERSONS: .....  
RECOMMENDED WORKING PRESSURE .....

16.2 The letters shall be of 25 mm (1 inch) high, with a space of three inches clear between the lines.

16.3 Stencil marking with manufacturer's identification craft number and year of manufacture shall be done.

16.4 The following parts shall have the identification of the craft permanently marked on them:-

Bottom boards - Stencil marking to be made.  
Keelson - do  
Oars - do





Storage bags - do-  
Valises - do-

16.5 The stencilling is to be in black ink, waterproof and of a quality non-injurious to the proofed fabric.

**17. PACKING INSTRUCTION**

17.1 The unit shall be suitably packed to the satisfaction of the Inspecting Officer to withstand the hazards of rail / road transit and with a view to avoid any damage during transit and safe arrival at consignee's address.

17.2. **MARKINGS** The packages shall be marked as follows:

- (a) Order No. and date \_\_\_\_\_
- (b) Craft Serial No. \_\_\_\_\_
- (c) Date of Packing / Manufacturer \_\_\_\_\_
- (d) Inspection Notice No. and date \_\_\_\_\_
- (e) Name of Manufacturer \_\_\_\_\_

To: \_\_\_\_\_

\_\_\_\_\_

Gross Weight \_\_\_\_\_

**18. INSPECTION TEST AND TRIALS FOR PROTOTYPE CRAFT**

**Physical and Chemical Tests**

18.1 Fabric and cordages are to be of approved type. If considered necessary, following physical and chemical tests on samples of various types of fabrics, cordages shall be carried out by Classification Society in order to ensure that these conform to the required designed specifications.

**Fabrics**

18.2 Prior to starting manufacture, the manufacturer shall submit samples of the fabric to the Inspecting Officer as follows:

- Buoyancy Fabric Unproofed - 1 Meter long full width
- Buoyancy Fabric Proofed - do-
- Floor Fabric Unproofed - do-
- Floor Fabric Proofed - do-





18.3 The testing of fabric shall be arranged at appropriate defence laboratories by the Inspecting Authority / Inspecting Officer

### **Cordages**

18.4 Test certificates in respect of these items issued by an independent testing authority, where possible or by the manufacturer may be accepted. In case of doubt the purchaser's Inspector may draw samples for testing at the Defence Laboratories.

### **Dimensions**

18.5 The dimensions of the craft shall be measured with the craft inflated and completely rigged. During this test the craft shall be supported on blocks, without the canvas securing straps. The sides of craft shall not touch bear upon the chock blocks.

18.6. The diameter of the buoyancy chambers shall be taken at 3 points along each parallel side. The width shall be measured at the transom and at a point midship. The internal lengths shall be measured between a pump line from inner one of the buoyancy tube to the bottom end of transom along the floor boards.

### **Air Inflation Tests**

18.7 The under mentioned tests shall be carried out of the craft when completed with all fittings. During the tests draughts shall be guarded against and the temperature shall be kept as constant as possible throughout the test.

18.7.1.1 For every 1<sup>0</sup> Centigrade (1degree Fahrenheit) rise above the temperature at commencement of the test, 0.01 Kgs/cm<sup>2</sup> (0.032 PSI or 7/8 inch of water) is subtracted from the final pressure reading and for every 1<sup>0</sup> Centigrade (1 degree Fahrenheit) fall in temperature 0.01 Kgs/cm<sup>2</sup> (0.032 PSI) shall be added to the final pressure reading. If the temperature variation during the period of the test is greater than 2.5 <sup>0</sup> C (50 F) the test is invalid and a further test shall be made under more constant temperature conditions. Accurate thermometer readings shall be taken.





### **Inflation Test**

#### **Preliminary Inflation Tests**

18.8 The whole of the buoyancy tube shall be inflated to 2 PSI (55 inches of water) and left for 30 minutes. The pressure at the end of this test shall not be noted, but craft examined for undue stretch or distortion.

#### **Pressure Test**

18.9 The whole of the buoyancy tube shall be inflated to  $0.14 \text{ kg/cm}^2$  and left for 30 minutes. Fall in pressure corrected for change in temperature shall not to exceed  $0.012 \text{ Kg/cm}^2$ .

#### **Bulkhead Test**

18.10 Each Chamber of the buoyancy tube shall to be inflated to  $0.14 \text{ kg/cm}^2$  with all other chambers remaining deflated and left for 30 minutes. Fall in pressure corrected for change in temperature shall not to exceed  $0.012 \text{ Kg/cm}^2$ .

18.11 The tests stipulated in 18.12 to 18.15 below shall be carried out in calm conditions in smooth water. Service Floor Boards with additional 10 Kg weight shall be used for the tests.

#### **Floataion Test**

18.12 Each craft shall be inflated and assembled complete with keelson and bottom boards. It shall be floated in water. A load of 82.5 Kg shall be distributed evenly over the floor boards and the craft left floating for 2 hours. No leakage of water is to occur. Any defects found at the conclusion of this test shall be made good by the builder.

#### **Free Board**

18.13 The free board of the vessel when floating fully inflated in calm water and loaded with a test load of 825 Kg, shall not be less than  $1/6^{\text{th}}$  the diameter of the main buoyancy tube, forming a side of the vessel, such free board being measured at mid length of the vessel.

#### **Packing**

18.14 The mode of packing in two valises as described in the relevant sections of this specification shall be **successfully demonstrated**. The actual weights of the valises and stores bags shall be checked and recorded.





### Marking

18.15 Markings, weights and dimensions of various items as well as the completely assembled craft shall be recorded and proven to comply with the designed specifications.

### Assembly/ De-assembly

18.16 It shall be proven that the craft can be assembled and de-assembled as per standard procedures.

### Deflation

18.17 Deflation tests shall be carried to prove that the craft can be successfully deflated.

### Lowering and Hoisting Tests

18.18 It shall be proven that the craft is capable of being lowered and hoisted with the dead load of 82.5 kgs to represent the coxswain and with the engine fitted on the transom. In case engine is not available 46 kg weight to represent engine may be used. The craft shall be hoisted up through 1 meter, held in position for 5 minutes, swung through 30° to and fro and then examined for damages.

### Damage Test

18.19 The craft shall be capable of supporting 825 800 kgs with any two alternate compartments deflated.

### Stability in Static conditions

18.20 Following Static Stability Tests shall be carried out on the completed craft.

18.20.1 **Test 1** The boat shall be inflated and assembled complete with Keelson and Bottom boards. It shall be freely floated in water. A load of 825 kg to be distributed evenly over the floor boards (motor and fuel are not be embarked). After satisfactory completion of this, remove the added loading and observe static angle of trim. Where applicable, locate the motor in its operating position. The fuel tank shall be filled, and in cases where the tank is separate from the motor and has no stowage position specified by the manufacturer, it shall be filled and placed as far aft as possible. Observe the new angle of trim of the boat, estimating the change of trim to the nearest 1°. Allow one person having a mass of between 82.5 Kg to embark and seat himself normally at any point on the inflatable hull





chambers. The person shall next take-up successive similar positions around the boundary of the seating area, without leaning outboard of the boat itself. The boat shall not capsize during the above tests. There shall not be more than  $10^{\circ}$  change in the trim angle of the boat following the embarking of the motor and fuel.

18.20.2 **Test 2** The craft equipped with the maximum rated OBM shall not capsize when the maximum permissible number of persons (each of 82.5 kg) move to one side of the boat. The test method shall be as per Clause 6.3.2 of ISO 6185-3

### **Stability: Self-Propelled**

18.21 The tests set out in 18.22 and 18.23 shall be applicable only to boats suitable for motor propulsion and the following general requirements shall be fulfilled for each test:

- (i) The power rating of the motor used shall be the maximum recommended by the manufacturer.
- (ii) The boat shall be inflated to the working pressure.
- (iii) The motor shall be securely clamped to its bearers and the fuel tank appropriately secured within the boat (where separate from the motor). Both motor and fuel tank shall remain so secured throughout the period of the test.
- (iv) The fuel tank shall be filled and the motor started and allowed to become thoroughly warmed before commencement of each test.
- (v) All persons embarked shall be seated.

The minimum water/sea conditions in which these tests are conducted shall be as follows:

- (i) Tests specified in 18.22 in still water or calm sea.
- (ii) Tests specified in 18.23 in short sea conditions with observed/estimated min. wave height of 900mm.

### **Tests In Still Water Condition**

18.22 (a) For the purposes of this test a coxswain only shall be embarked and the boat shall be positioned with its bows pointing into a wind having a strength approximately equal to beau fort scale 3. The motor controls shall then be moved so as to develop maximum ahead thrust on the boat and retained in this position for a period of test of not less than 30 minutes.

- (b) During this period the following requirements shall be met:





- (i) There shall be no bending or twisting of motor bearers likely to lead to premature failure of the means of attachment.
- (ii) There shall be no tendency of the bow to hit in a manner likely to submerge the motor or overturn the boat.

(c) The test described in 18.22(a) shall be repeated but with the maximum number of persons permitted embarked and positioned uniformly within the seating area.

Note: Seating area shall be understood to include all the plan area of the boat within which a person may be expected to position himself during the normal operation of the boat.

(d) At the end of the test period specified in 18.22(c) and without any change in loading, the motor shall be stopped until the speed of the boat has dropped to 0.5 knot or less.

During this period, the following requirements shall be met:-

- (i) There shall be no bending or twisting of motor bearers likely to lead to premature failure of the means of attachment.
  - (ii) There shall be no flooding of water over the stern of the boat except where the boat is designed to be self-draining.
- (e) When moving astern, with the boat loaded as specified in 18.22(a), the following requirements shall be met:

- (i) There shall be no flooding of water over the stern of the boat except where the boat is designed to be self-draining.
- (ii) The boat shall be manoeuvrable.

#### **Tests in waves**

18.23 (a) The boat shall be tested in the manner described below:

- (i) Embark a coxswain only. The period of test shall be not less than 45 min with the motor controls set to develop maximum ahead thrust. During this period the boat shall be kept reasonable dry.
- (ii) The boat shall be headed successively on not less than six different courses of not closer than 30° bearing to each other, commencing with a heading directly into the waves. On each of these courses, a sharp turn to port and starboard shall be made.
- (iii) The boat shall be closely examined at the end of the test period for any structural failure in the form of fracture, tear, etc. On



any part of the hull or boat component such as deck or thwarts, and including any boundary interface such as floor / hull.

Evidence of any of the referred-to structural failures shall be regarded as failure of the boat. Further, the boat shall not overturn.

- (b) The test described in 18.23(a) shall be repeated but with the boat loaded with maximum number of personnel embarked uniformly within seating area. In addition to the requirements of 18.23(a), all hand holds shall be clearly seen during the test.

### Towing Tests

18.24 (a) The boat shall be tested in the manner described below in short sea conditions with observed/estimated minimum wave height of 900 mm.

(b) Embark the maximum number of persons reckoned and position them uniformly within the seated area.

(c) Tow the boat by its towing point at a speed of not less than 4 knots, allowing a tow line length of 3 boat length.

(d) Carryout manoeuvres for not less than 15 min.

(e) The boat shall be closely examined at the end of the test period for any structural failure in the form of fracture, tear etc on any part of the hull or boat component, such as deck or thwarts, and including any boundary interface such as floor/hull.

(f) The point of attachment of the tow line shall remain secure during the period of the test.

(g) Evidence of any of the referred-to structural failures shall be regarded as failure of the boat.

### Righting Test

18.25 The capsized craft shall be capable of being righted by two men with an average weight of 82.5 Kg each. For this test if two men each weighing 82.5 Kg are not available, then 3 men whose total weight does not exceed 250 kgs may be used. During this test, the craft shall be in its light condition with no engine and or other equipments fitted in the craft

### Power Trials

18.26 Power trials with the out board engine shall be conducted and performance curve under various loads shall be prepared and submitted.





### Manoeuvrability

18.27 It shall be proved that the craft loaded with 825 800 kgs (1760 lbs) can be air propelled. The craft shall be turned, brought alongside etc. The test shall be conducted over 30 to 45 minutes and condition of attachment to tube shall be examined for any damage.

### 19. TEST SCHEDULE FOR PRODUCTION CRAFTS

19.1 Fabrics: Clause 18.2 applies

19.2 Cordages: Clause 18.4 applies

19.3 Dimensions: Clause 18.5 applies

19.4 Other Tests: Test prescribed in clauses 18.8 to 18.27 shall be carried out on all crafts.

### 20. COMPLETION

20.1 The craft shall be completed in all respects to the satisfaction of the Inspector. All items of equipment to be checked. The craft shall be assembled on the shop floor and a check is to be carried out that the parts fit properly.

20.2 On completion of all tests and examinations the hull and bottom boards, keelson, etc. shall be packed into their valises to the satisfaction of the Inspecting officer, before dispatch.





**Appendix A**

(NCD 4006, Issue-3, 2014)

**INFLATABLE BUOYANCY TUBE MATERIAL SPECIFICATIONS**

1. The craft shall be made of Hypalon (outer layer) and Neoprene (inner layer) composite fabric.
2. The material shall conform to ISO 15372: 2000. The construction shall consist of basic textile support by a 10 x 10 count High Tenacity Polyester fabric to give basic mechanical properties (tensile and tear strength) covered with four calendared rubber sheets with optimal cohesiveness of rubber to give reliability about air tightness. The outer Hypalon sheet shall give weather resistance (fading and ageing) and chemical resistance. The inner Neoprene sheets shall give high gluability, reliable adhesion and air tightness.
3. The tube shall be made of Hypalon Neoprene material of minimum 1600 Dtex. The material should be type approved by Classification Society. The weight of the tube composite shall be 1500 g/sq.m.
4. Technical specification are as follows :

(a) **Textile Support:**

Type	High Tenacity Polyester
Yarn	1600 Dtex (minimum)
Count	10 x 10

(b) **Coating:**

Outside Coating	Hypalon
Inside Coating	Neoprene
Resistance to Puncture (ASTM D 751/B)	Wrap $\geq$ 500 daN/Sq cm

(d) **Adhesion**

Bostick 2402 Adhesive	} Or equivalent material approved by Classification Society
Bostikurc D Curing Agent	
Bostik 9252 Primer	
Bostik Cleaner/thinner M501	

**Typical Bond Characteristics**

Temperature resistance	from - 40 ° C to + 90 ° C
Water resistance	Good
Oil, Petrol & Kerosene resistance	Good
Acid & Alkali resistance	Good. Virtually unaffected by 5N Sulphuric acid and 5N Sodium Hydroxide
Humidity, resistance	Good, after exposure to 100% RH @ 38° C for 14 days
Ageing	Good



**Appendix B**  
(NCD 4006, Issue 3, 2014)

**THE DETAILS OF OTHER MATERIAL**

Cordage Nylon Braided 12 mm dia BS 1200 kg weight 7000 + 50gm / 100 mtr	IS : 4227
Cordage Nylon Braided 8 mm dia BS 1200 kg weight 4000 + 40gm / 10 0mtr	-Do-
Velcro Hook Tape Fastener OG 25mm Wide (1")	Reputed Make cleared by Class
Velcro Loop Tape Fastener OG 25mm Wide (1")	Reputed Make cleared by Class
Inflation/Deflation valves	-Do-
Top End Rubberised Hemispherical	-Do-
Rubberised patch 'D' Handle	-Do-
'L' type rubber strap	-Do-
Rubberised strips type-I, Size 4.34 mtr x 16cms x 2mm	-Do-
Rubberised strips type-II, Size 3.0mtr x 15 cms x 3mm	-Do-
Rubberised strips type-III, Size 3.62mtr x 8cm x 3mm	-Do-
Rubberised strips type-IV, Size 3.35mtr x 6 cm x 2mm	-Do-
Rubberised strips type-V, Size 1.0mtr x 8cms x 2mm	-Do-
Rubberised strips type-VI, Size 1.1mtr x 4cms x 5mm	-Do-
Set of valves (duck cotton 610 gms)	-Do-
Aluminium's Alloy	IS : 737
Stainless steel (AISI-316 L) rod	IS : 6603
Stainless Steel (AISI-316 L) Plate	IS : 6911
Marine Plywood	IS : 710





**Appendix C**

(NCD 4006, Issue-3, 2014)

**GUIDANCE QUALITY ASSURANCE PLAN**

(To be submitted by manufacturer to Classification Society for Approval)

ITEM :- Inflatable Boat General Purpose (Gemini Craft)  
Specs :- NCD/Gemini Issue - 3, Jan 2014

Sr. No.	Particulars	Types of Checks / Quantum Checks	Specifications	Remarks
1.0	Submission of Class approved Drawings/ Documents	Visual 100%	As per purchase order & NCD/Gemini, Issue -2 / 2009 Clause 10.0	CSHP
2.0	Cardinal Dates Plan	-	-	DR
3.0	Raw Material			
3.1	Hypalon (Outer Layer) & Neoprene (Inner layer)	Review Type Approval Certificate & batch test reports	Clause 5.1, 6.0 and Appendix 'A' (to be Type Approved)	CSHP/ DR
3.2	Bottom Floor of proved fabric	-do-	Clause 5.9 & 5.10	DR
3.3	Adhesive type A	Visual 100%	Clause 6.4 to 6.6	CSHP
3.4	Floor boards		Clause 5.15	DR
3.5	Transom Board, Wooden Keelson, Platform		Clause 5.13 & 5.14	DR
3.6	SS Component	-do-	Clause 6.3 & and Appendix 'B'	CSHP/ DR
3.7	Cordages	-do-	Clause 18.4	DR
3.8	Inflation/deflation valve		Clause 5.7	
3.9	Bellow Pump		Clause 5.23	
3.10	Aluminium Fittings	-do-	Appendix 'B'	DR
3.11	Safety Topping up valve	Visual 100%	Clause 5.8	
3.12	Other materials		Clause 6.0, Appendix 'A'	
4.0	<b>Inspection</b>			
4.1.0	<b>Visual &amp; Weight</b>			



Sr. No.	Particulars	Types of Checks / Quantum Checks	Specifications	Remarks
4.1.1	Construction (Workmanship)	As per Class requirement	Clause 5.0 & 8.0	
4.1.2	Dimensional checks / Tolerance	Physical/ Sample	Clause 3.0, 8.9 & 18.5	W
4.1.3	Weight	Physical 100%	Clause 3.1	
4.2.0	<b>Tests &amp; Trials:</b>			
4.2.1	Air Inflation Test		Clause 18.7	
4.2.2	Preliminary Inflation Test		Clause 18.8	
4.2.3	Pressure Test		Clause 18.9	
4.2.4	Bulk Head Test		Clause 18.10	
4.2.5	Flotation Test		Clause 18.12	
4.2.6	Free Board		Clause 18.13	
4.2.7	Assembly disassembly		Clause 18.16	
4.2.8	Deflation		Clause 18.17	
4.2.9	Lowering and Hoisting test	Physical	Clause 18.18	CSHP/ CHP/ W
4.2.10	Damage Test	100%	Clause 18.19	
4.2.11	Stability in static condition		Clause 18.20	
4.2.12	Stability self propelled		Clause 18.21	
4.2.13	Trials in still water		Clause 18.22	
4.2.14	Trials in Waves		Clause 18.23	
4.2.15	Towing Test		Clause 18.24	
4.2.16	Righting test		Clause 18.25	
4.2.17	Power test		Clause 18.26	
4.2.18	Manoeuvrability		Clause 18.27	
5.0	Marking	Visual 100%	Clause 17.2 and 18.15	W
6.0	Warranty Clause	Certificate to be obtained	Clause 13.0	DR
7.0	Packing/ Completion	Visual 100%	Clause 8.4, 17.0 & 18.14	CHP

W - Witness  
DR - Document Review  
CSHP - Classification Society Hold Point  
CHP - Customer Hold Point

Approved By