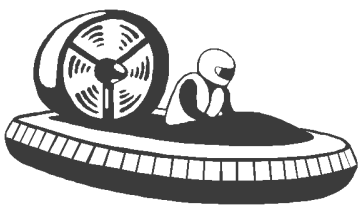
CONSTRUCTION REGULATIONS
FOR
CRUISING HOVERCRAFT

EFFECTIVE
November 2003



Hovercraft Club of Great Britain
The National Organisation for Light Hovercraft

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CONTENTS

1.0 INTRODUCTION

1.1 General

A. These regulations cover the construction of a Cruising Hovercraft, with a maximum dry weight of 1000kg and a maximum seating capacity of 12 persons, which is designed for recreation and leisure use only and excludes any use for commercial operation or hire or reward.

B. They have been prepared by the Hovercraft Club of GB (HCGB) based upon the experience of its members in manufacture and operation of Cruising hovercraft since 1966. The regulations reflect the necessary good engineering practice in the construction of Cruising hovercraft.

C. A Hovercraft which does not comply with these regulations will not be issued with a Craft Registration document or a Certificate of Compliance, without which the craft will not be permitted to enter any event organised by the HCGB or any of its affiliated organisations.

D. Throughout this document a number of special terms and acronyms are used, the meanings of which are explained in Appendix - B.

1.2 Purpose of these Regulations

A. The purpose of these regulations is to ensure that cruising hovercraft are designed, constructed, operated and maintained in such a way as to prevent, so far as can be foreseen, the occurrence of incidents. Should an incident occur, these rules are to ensure its effects are minimised as far as possible both to persons and property.

1.3 Interpretation

A. These regulations are not intended as a manual of Hovercraft Design but, wherever practical, examples of methods that meet these regulations are included. Alternative practices which provide an equivalent level of safety may be accepted at the discretion of the HCGB Recreational Scrutineers.

B. Mandatory clauses are denoted by 'shall' or 'must', whereas recommended but not mandatory practice is denoted by 'should' or 'may'.

C. It is implicit in the regulations expressed qualitatively (e.g.: 'readily visible', 'adequately tested' etc.) that the Chairman of the HCGB Recreational Scrutineers Committee will adjudicate in cases where doubt of compliance exists.

1.4 Implementation of the Regulations

A. These regulations are brought into operation by the body of the HCGB Recreational Scrutineers, who **will inspect the craft for compliance in order to issue a Registration Document. The craft will also be checked for compliance before operation at every HCGB authorized event. It is the ultimate responsibility of the owner and driver to ensure that the craft fully complies with these regulations.**

B. Where a craft owner operates a craft alone or outside an organised event, it is their responsibility to inspect their craft for compliance with these regulations. Failure to maintain compliance will invalidate the craft Certificate of Compliance for the period of non-compliance. In addition any operating insurance provided by the HCGB will be invalid during any period of non-compliance.

C. The HCGB reserves the right to amend any regulation herein in the light of practical application. Amendments to these rules will come into force immediately following sanction by the HCGB Council and the publication of an announcement in the official journal of the HCGB.

D. The HCGB may grant special exemption from these rules for non-complying 'Historic Craft' for purposes and conditions to be defined by the HCGB Recreational Scrutineering Committee for each case.

1.5 Appeals Procedure

A. In the case of an operator disagreeing with the ruling of a Recreational Scrutineer, he/she may appeal as follows:

   a. Submit a complaint in writing to the Recreational Scrutineering Committee with a copy to the Scrutineer concerned

   b. If a grievance still exists, submit a complaint, with a deposit of £20, to the Council of the HCGB.

B. The appeal will be considered by HCGB Council at its next scheduled meeting or one specially convened. Both complainant and Scrutineer will be expected to attend this meeting. Council will judge the case, taking whatever additional technical or legal advice is considered necessary. Council's decision will be final.

C. In the case that legal or other professional advice need be taken, the cost of such consultancy will be required to be paid by the complainant, whatever the outcome of the dispute.

1.6 Compliance

A. Compliance with these regulations shall be established by calculation, testing or other evidence to the satisfaction of the HCGB Recreational Scrutineer. An example of the 'other evidence' may be a certificate of compliance from an HCGB approved component manufacturer.

B. Where an applicant proposes to use a proprietary component in a manner other than that provided for in its manufacturer's certificate, then compliance shall be demonstrated to the HCGB or its agents.

C. Where a requirement is not susceptible to quantitative proof of testing, compliance must be established to the satisfaction of the Recreational Scrutineer, by inspection at part-built stage of the craft, by reference to precedent, or by reference to good engineering practice.

D. Since it is not possible to prescribe regulations to cover every detail that designers may introduce, the Recreational Scrutineer may reserve the right to with-hold approval of a craft or part thereof, if in his opinion, such a craft or part thereof is unsafe even though it complies with the letter of these regulations.

1.7 General Design Regulations

A. All connecting elements essential to safe operation of the vehicle shall be provided with adequate means of locking against loosening from vibration, rotation and torque, or flexure of the craft structure.

B. All personnel shall be positively protected from contact with rotating components, surfaces with temperatures exceeding 70^{o} C, live electrical circuits and sharp edges or corners.

C. Services essential for personnel safety shall be operational at all times during operation, independent of the functioning of the main power unit(s).

D. Adequate access shall be provided to all parts of the craft requiring periodic inspection.

2.0 CRAFT STRUCTURE

2.1 General

A. The structure of the craft shall have adequate strength to withstand all load cases as defined in section 2.2, in either cushion borne or floating/static mode as appropriate, in such a manner that structural deformations occurring will not interfere with the safe operation of the craft.

B. The stiffness of the craft structure shall be such that any vibrations due to prime movers or rotating equipment, or flexure of the structure due to dynamic loads, will not affect the safe functioning of the craft or machinery.

C. Power plants shall be able to be re-started from cold with the craft floating in the maximum design environment without external assistance.

D All craft shall be fitted with handling points adequate for manhandling of the craft itself and for grasping by personnel overboard in water, and pulling during recovery.

E A minimum of one handling point at the front and rear of each side of the craft shall be fitted.

F Craft shall be fitted with a towing eye, or equivalent, at the bow of sufficient strength to pull a disabled craft ashore.

2.2 Strength of Structure

A. The structure of the craft shall have adequate strength to withstand loads encountered under all conditions of operation.

Each load case shall be determined by the design limits specified by the designer to the HCGB in advance of inspection. For guidance an approach to design limits and margins is given in Appendix - C & D of these regulations.

B. Inflatable structures forming a part or whole of the Hovercraft primary structure shall conform to Ref. RP.4. (Appendix A)

2.3 Crashworthiness

A. The craft shall be designed so as to minimise the risk of injury to the occupants in the event of a collision.

B. All major components and items of equipment shall be attached to the craft primary structure with arrangements sufficient to withstand inertia forces in any direction.

C. All rotating machinery and frames shall have adequate mountings of a fail safe design.

D. Craft structure comprising cabin roof or roll bar(s) or roof framework shall deform little enough in a rollover to enable safe escape via removable windows from the craft in upturned condition over a solid surface. Safety glass shall be used for glazing of craft windscreen for enclosed cabin craft.

E. Interior surfaces and edges within the cockpit and cabin areas shall be designed to minimise injury to occupants in the event of a collision.

F. The exterior periphery of the craft shall be constructed so that any sharp edges or corners are protected by bumpers or crushable material.

G Enclosed craft shall have arrangements for rapid egress of crew and passengers in the event of an overturn on land or water. Push-out panels or similar shall be designed with due regard to the disorientation due to craft inversion. It shall be possible to open or secure any exit door from inside or outside the compartment by a robust, rapid and obvious mechanism.

2.4 Buoyancy

A. The craft shall have buoyancy providing at least 110% of the maximum design operating weight when afloat in fresh water. All buoyant portions for which credit is taken shall be sealed. All compartments shall be inspectable.

B. The craft shall have sufficient freeboard such that water will not flood into any of the craft open areas when freely rolling at least +/- 10^{o} or pitching +/- 5^{o} in calm water due to moving about of the occupants. For design purposes a margin of 150mm minimum above the roll or pitch waterline for hard body freeboard, is recommended.

C. Special note should be taken of designs having internal air ducting to segmented skirts. All ducted areas should be designed to allow water to freely drain out when hovering.

D. The intact floating stability of the craft shall be such that when floating in calm water, normal movement of the occupants will not endanger safety.

E. The craft shall remain afloat in the case of either of the following:

a. Any one air filled buoyancy compartment, for which credit for the design buoyancy is claimed. becoming punctured

b. When capsized, or at an angle other than upright as in normal operation.

The definition of remaining afloat shall be that in the worst case of the craft capsizing or being total flooding, the craft will not sink and will be capable of supporting occupants who are in the water.

F. The outer surface of the hull shall be configured so as to provide a planing surface with a dihedral of 10^{o} to 35^{o}, in the case that the skirt should totally collapse on one side, front, or rear of the craft at the maximum operating speed in still air over land or water. The planing surfaces shall be present over a depth of not less than that defined by the skirt outer and inner hull attachment points. The top 25% of the surface height may be perforated for the provision of skirt air feed holes. (Certain larger designs may be exempt from this regulation)

2.5 Power Transmission

A. All transmission components shall be constructed, arranged within the craft and protected as necessary, to ensure their safe functioning at all times within the craft operational envelope of gross weight, environmental conditions and maximum speed.

B. The possibility of failure of a given power unit, transmission or support system shall be considered. In any such case, the system shall fail safe and not endanger the craft or crew.

C. Craft designed with multiple thrust power plants should have the capability to navigate safely to a point on the shoreline at least five nautical miles away from the incident in the event of a power plant failure, in the design maximum environment.

D. Each power unit fitted shall be able to operate independently.

E. Air intakes with filters shall be designed for safe continuous operation for at least 12 hours without cleaning.

F. Exhaust systems shall be designed to safely disperse exhaust to free atmosphere.

G. Mountings and connections between main machinery and primary structure, and between main machinery and rotating assemblies, shall be positively locked. Such mountings and connections shall be designed in order that failure of 25% of the mountings or connections will not lead to any subsequent failure, or endanger the safe operation of the craft.

3.0 ROTATING ASSEMBLIES

3.1 General

All rotating assemblies shall be designed and operated such as to preclude as far as possible failure during the normal operating life of the assembly.

3.2 Fans and Propellers

3.2.1 Fan Systems

A. A number of proprietary axial and centrifugal fans are available and suitable for use on cruising hovercraft. The use of these fans is to be limited to a combination of rotational speed and diameter giving blade tip speed of less than that shown in Table 3V

TYPE	MAXIMUM TIP SPEED	
	m/sec	ft/sec
MULTIWING TYPE 3	137	450
TRUFLO (NYLON)	160	524
MULTIWING TYPE Z	168	550
MULTIWING TYPE 2,3 (GLASS FILLED NYLON BLADE)	168	550

Table 3V

Note: Proprietary centrifugal fans shall not be run at speeds exceeding manufacturer's recommended design. Non-certificated fans shall not exceed 85 m/s tip speed.

B Propulsion systems designed for tip speeds in excess of 137 m/sec are likely to produce noise levels in excess of 84 dBA at 25m distance. A maximum design tip speed of 122 m/sec is recommended to be used for this reason where practical. Where maximum power results in tip speeds greater than 122 m/sec, the fitting of a rev counter is recommended, a marker being attached to indicate the speed at which 122 m/sec fan tip speed is exceeded.

C. Table 3W indicates the fan speed in RPM for the limiting tip speeds, based on the recommended limit of 122 m/sec for normal cruising operation, 137 m/sec for design maximum and 168 m/sec which is the absolute limit for Multiwing Z and Nylon blade fans.

Diameter (m)	TIP SPEED		
	122 m/sec RPM	137 m/sec RPM	168 m/sec RPM
0.50	4660	5233	6417
0.60	3833	4360	5,348
0.65	3585	4025	4936
0.70	3329	3738	4584
0.75	3107	3489	4278
0.80	2913	3271	4011
0.85	2741	3078	3775
0.90	2589	2907	3565
0.95	2453	2754	3377
1.00	2330	2616	3208
1.10	2118	2379	2917
1.20	1942	2180	2674
1.30	1792	2013	2468
1.40	1664	1869	2292
1.50	1553	1744	2139

Table 3W

3.2.2 Propeller Systems

A. Wherever possible it is recommended that reliable commercial units (with a test certificate) are used. If it is essential to home-produce a propeller or fan, the material should be very carefully selected and if possible tested for tensile strength.

B. Wooden blades shall be laminated and be continuous through the hub. It is very important to provide adequate blade cross section in the region of the blade root. Glass fibre should be avoided as it is unreliable for propellers, even when laid up under carefully controlled conditions.

C. On no account shall cast materials (aluminium, resin etc.) be used. If accurate materials and stressing data is not provided, then maximum permissible tip speed shall be 200 m/sec (656 ft/sec) for normal operation, with the exception of centrifugal fans.

3.2.3 Overspeed Conditions

A. The normal operating rotational fan speed for craft with more than one fan unit driven from a single engine must allow for the overspeed of the remaining unit(s), resulting from a single failure in any part of the system, the limiting stress shall not exceed the limits, as shown in Table 3X

FAILURE	OVERSPEED
1 from 2	30%
1 from 3	15%
2 from 3	50%

Table 3X

3.2.4 Positive Locking Systems

A. Inspectable positive locking devices: wire, split pins, locking washers, stiff nuts or Nyloc type nuts; shall be used on all threads employed in the rotating assembly and its mounting structure, where loosening might cause dangerous misalignment. There shall be two exposed threads clear of any nut type locking device. Anaerobic adhesive, will not normally be deemed adequate as it is not Inspectable.

3.3 Guarding of Rotating Assemblies

3.3.1 General

A. All rotating assemblies shall be guarded in such a way that under all operating conditions no part of a person or his clothing may enter the space swept by the rotating assembly, or force the guards or the duct structure into that space whether the person be:

a. in collision with the Hovercraft
b. manhandling the Hovercraft
c. operating the Hovercraft

B. No guard should extend beyond the edge of the main hull structure. This edge is defined by a vertical line extending upwards from the hull outside gunwale (outer hard structure point) when the craft is sat on level ground on its landing pads or skids. Local extensions to the hull shall not be considered part of the craft main hull.

3.3.2 Fans and Propellers

A. Fans and propellers must have a minimum guarded area at the intake, around the periphery and at the discharge side of the unit, to the following standards:

a. The INLET SIDE of all fans or propellers must be guarded to the standard as described in section (B) below.

b. The PERIPHERY of the volume swept by the fan or propeller must be surrounded by a guard (duct) extending at least 126mm (5”) forward and 250mm (10“) aft of the swept volume, to avoid fingers gripping the edge of the guard from contacting the blades.

c. Special care shall be taken to provide adequate guarding at the exit area from a fan or propeller. There shall be no open areas greater than 300mm diameter (12”) aft of the fan or propeller swept volume. Guarding may be provided in the form of rudder(s), elevator(s), duct support framework, fan centre bodies or flow straightening vanes, or wire mesh conforming to the strength regulations of section (C) below.

B. The guarding of fans may be provided in the form of wire mesh, wire rod, tubular metal framing, and/or solid wall ducting. Where wire mesh is used to form a guard, the mesh sizes shown in Table 3Y shall be the maximum acceptable:

Distance from rotating device Swept volume	Maximum mesh dimension
< 150mm (6 inches)	12mm (0.5 inches)
< 800mm (32 inches)	50mm (2.0 inches)
> 800mm (32 inches)	300mm (12.0 inches)

Table 3Y

C. No guard (duct) or structure shall deflect into the swept volume of the rotating device when a force of 440 newton (45kg~100lbs.) is applied over an area of 90mm^2 at any point of the guard. This is to prevent failure of the rotor, or injury to a third part in the case of a person falling onto the guard and taking the impact on one hand.

D Guards shall be adequately mounted around their periphery to withstand a pull load of 350 newton (36kg~80lbs) in any direction. . **The gap between the edge rim of the guard and the fan duct shall be no more than 15mm.**

E. All fan and propeller guarding shall be designed to contain so far as is possible, failed blades or blade pieces caused by collision or ingestion of foreign objects.

a. **Fans:** Polypropylene blade materials tend to break into many pieces, whilst Nylon or Delrin blades tend to fail at the blade root or break into larger pieces. Minimum thickness of GRP ducting over an area 100mm forward and aft of the centreline of the rotor swept volume, shall be four layers of 450g/m^2 chopped strand mat, for a maximum tip speed of 137m/sec. Where tip is >137m/sec, duct ,reinforcement shall be added consisting of two additional layers of 450g/m^2 chopped strand mat. The addition of stronger materials such as woven rovings, Kevlar or wire mesh within the laminate is highly recommended.

b. **Propellers with Mesh Guards :** Where propellers are guarded by wire and tube mesh cage(s), the propellers shall be guarded by mesh to the sizes as in Table 3Y The guard shall be of sufficient strength to contain a blade component comprising the outer two thirds of a single blade, ejected in any direction from directly ahead to 45^o aft from the propeller swept disc at a rotational speed corresponding to the application of maximum engine power, plus a margin of 10% of engine power.

c. **Ducted Propellers :** Where propellers are guarded by a duct system with mesh guarding at the inlet, the duct shall have metal plate or heavy gauge wire mesh reinforcement over an area 100mm (4") both forward and aft of the propeller swept volume. The reinforced duct shall be of sufficient strength to contain a blade component in the manner described above. The duct outlet may require mesh guarding to contain a blade component as described above.

3.3.3 Transmission Shafts

A. A fail-safe device shall be fitted to all transmission shafts transmitting more than 20bhp (14.84kw) per shaft, in order to prevent shaft 'flailing' in consequence of bearing or bearing housing failure. Suitable flail guard devices include a suitably sized metal strap over pedestal bearing housings or suitably sized plates with a clearance hole around the shaft to act as a temporary plain bearing, and limit shaft movement. Such flail guards should be securely attached to a substantial part of the transmission mounting frame in order that the shaft movement will not cause failure in the guard itself.

B. All rotating components shall be guarded by containment inside a closed space (engine compartment, fan centre-body, engine or component solid cover) or by wire mesh guarding to the regulations described above.

3.3.4 Failure Conditions

A. It should be noted that the regulations described above DO NOT require that the guarding shall remain undamaged in failure conditions. The requirement is for containment of rotating components. Gross deformation of the guard structure is acceptable, though the designer should bear in mind that in such a case the craft is likely to be disabled beyond the ability for local field repair to a safe condition.

4.0 SYSTEMS AND CONTROLS

4.1 General

A. All systems and controls shall be designed to be safe in operation and, where possible, fail-safe when stopped or released by the operator.

B. The designer should keep in mind the environment in which the controls and systems will operate. Systems should be protected against dampness, salt water, sand ingress, vibration and relative movement of craft substructures.

C. Where necessary, marine grade or marinised equipment should be specified. Systems not able to be protected against salt water or sand ingress should be designed for regular inspection, maintenance and replacement.

D The driver should have adequate 360^{o} unrestricted vision directly, or by means of mirrors.

4.2 Aerodynamic Control Surfaces

A. Aerodynamic control surfaces may be of two types:

a. **Fixed Surfaces :** providing aerodynamic stabilising forces while in operation, which are fixed or able to be moved (trimmed) when the craft is stopped such as fixed elevators, fins or fan straightener vanes.

b. **Moving Surfaces :** providing aerodynamic control forces such as rudders, controllable elevators or elevons.

B. Fixed surfaces and associated control systems shall be attached to the craft in a secure manner to maintain position under the design maximum air speed over the device.

C Moving surfaces and associated control systems shall be attached to the craft structure with arrangements sufficient to maintain them securely in position under the maximum design airspeed over the device, at the position of maximum control force generation.

4.3 Engine and Associated Controls

A. Open cockpit craft with a fixed throttle must have a lanyard type ignition kill switch fitted to the thrust engine (s)

B Manually operated control systems should be designed with adequate safety margins.

C. Power operated control systems shall provide equivalent effort to that in section 4.3B and shall be designed to have the same proof and ultimate design factors.

D. Power operated control systems shall fail-safe in such a manner as not to endanger the craft in operation.

E. Control cables, chains, torque tubes and push rods should have an adequate safety margin against the applied loads.

F. All primary controls shall be capable of operation by the driver when in the normal driving position, with sufficient ease and smoothness of operation to permit the proper performance of their function.

G. Primary controls shall be so grouped, arranged and identified and have directions of operation such as to prevent the possibility of confusion or inadvertent operation.

H. Full movement of every control shall be possible when the driver is in position while wearing appropriate protective clothing and safety equipment.

I. Skirt shift mechanisms shall be considered a primary control mechanism and be subject to that compliance.

4.4 Ballast Transfer Systems

A. All tanks, containers, pipelines, structure and equipment shall be designed to comply with the strength regulations of the vehicle as described in section 2.0.

B. Ballast transfer systems utilising petrol as the medium shall not be allowed. Diesel transfer is allowed but must conform with the regulations of section 4.8.

C. Ballast transfer pipelines shall be designed to minimise the possibility of leakage.

D. Ballast tanks shall be baffled to prevent slopping when part full.

4.5 Fuel Systems

A. All tanks, containers, pipelines, structure and equipment shall be designed to comply with the strength regulations of the vehicle as described in section 2.0 and the fire safety regulations of section 4.8.

B. Fillers to all tanks or containers shall be identified and should be outside the area occupied by passengers or crew in an enclosed craft.

C. Vents and drains shall be so arranged that they will not become obstructed by debris or otherwise create a hazard.

D. Fuel tanks should be sufficiently baffled to prevent slopping of fuel while the craft is in operation.

E. Fuel tanks shall be fuel tight against the operating conditions of the craft whilst providing for fuel expansion due to temperature changes, prevent siphoning of fuel through vents and minimise entry of water through fillers. Fuel tanks should be capable of drainage to a completely empty condition.

F. Fuel supply systems should have a shut-off valve clearly marked in an easily accessible position for emergency operation.

G. Fuel tanks and supply lines shall be so located that, in the event of a leak occurring, the escaping fuel is prevented so far as possible, from making contact with any of the hot parts (e.g.: engine, exhaust pipe etc.), or electrical circuits of the craft.

H No fuel vents shall pass through or be contained in an area occupied by passengers in an enclosed cockpit craft.

4.6 Electrical Systems

A. Electrical systems shall be designed and installed in such a manner as to be fail-safe in operation.

B. Running lights and a flashing yellow beacon must be fitted to craft over 4.57m (15ft)

C. It shall be possible for the driver of the craft to switch off power to all electrical systems whilst seated in the driving seat and in addition (if those systems are separate), cut off main and auxiliary power plant ignition in a positive manner.

D. Battery power supplies should in addition have a separate circuit breaker in a clearly accessible position and marked by an 80mm sided RED equilateral triangle bounded with a white border 10mm wide or an International Lightning Strike Symbol.

E. Engines shall have adequate Radio Frequency (RF) suppression fitted, as required by common law in the United Kingdom. It should be noted that RF suppression relates particularly to ignition systems, including spark plug leads and caps and coils. condensers. Suppressed plug caps are available as are low emission leads or RF chokes for leads, in most car parts stores.

F Any battery capable of being charged in-situ shall be vented to atmosphere.

G Any electrical generator or alternator supplying power to craft electrical systems should have a power failure indication.

H All metallic components and piping shall be earthed and bonded where appropriate to prevent accumulation of static charges.

4.7 Instrumentation

A. Instrumentation fitted to the craft shall be at least the minimum needed to enable safe operation of the craft, bearing in mind the craft size and complexity of systems fitted.

B. Instrumentation shall conform to the regulations of section 4.6A.

C. Communications equipment should be fitted appropriate to craft operations and as advised in the *Safety at Sea* booklet. (see Ref. RP.5 Appendix A).

D. Radio and radar equipment if fitted, shall comply with current regulations.

4.8 Fire Control Systems

4.8.1 Design Safety

A. The design of craft shall be such as to minimise the risk of fire occurring.

B. Fire hazard zones should have permanently fitted remotely operated fire extinguishing systems, when the volume of the area is greater than 2 m^3 (70 ft^3).

C. Fire hazard zones should be designed so that in the event of a leak fuel or lubricating oil cannot make direct contact with any hot parts, exhaust pipes or electrical system components (motors, pumps, wiring, switches etc.) when the craft is in the upright position or rotated to a minimum of 30^o about any axis (roll or pitch).

D. Fuel lines of PVC or other plastics which degrade over time shall be replaced annually.

E. The parts of a craft within 50mm (2") of hot parts shall be non-flammable or fire inhibiting material.

F. Hot parts shall have an adequate supply of cooling water or air to maintain a steady design temperature during all normal operations.

G Except in the case of open cockpit craft, the passenger compartment must be separated from the engine compartment by a fire resistant bulkhead.

4.8.2 Fire Extinguishing Systems

A. All craft should be equipped with a dry powder fire extinguisher of at least 1kg discharge weight carried within the cabin/cockpit, in a readily accessible and safely retained position. Craft of greater than 300kg dry weight shall carry an extinguisher of at least 2kg discharge weight or the equivalent in two extinguishers. A controllable discharge system is preferable. Water filled fire extinguishers are not permissible.

NOTE The powder in a dry powder extinguishers has a tendency to settle unless the extinguisher is vigorously shaken regularly.

B. Craft having permanently fitted fire extinguishing systems shall have units containing a minimum charge of 1kg/m^3 of enclosed fire hazard zone volume.

C. Fire hazard enclosed zones not fitted with permanent extinguishers shall have readily accessible aperture(s) for the purpose of efficiently extinguishing a fire.

4.9 Noise Level Regulations

A. External noise level measured at a distance of 25m and height of 1.2m above flat, open grass land shall not be greater than 84dBA.

B. Internal noise level at the driver's normal head position should not be greater than 105dBA. Levels higher than this can cause permanent hearing damage. It is recommended that the noise level at driver's head be kept below 100dBA.

C. Noise measurements should be made at maximum power of lift and propulsion systems.

5.0 SKIRT DESIGN AND ATTACHMENT

5.1 Stability

A. The skirt system shall be such as to ensure adequate stability when hovering under all operating conditions. Adequate stability is defined as follows:

a. For the craft trimmed level in a static hovering condition, the skirt shall provide sufficient righting moments in the conditions of maximum design speed and maximum design environment of wind and waves or hard surface so as to prevent unnecessary plough-in.

b. The righting moment generated by the skirt system in pitch and roll shall steadily increase at a linear or greater rate with rotation, to the point that the hull contacts ground or water.

5.2 Hard Structure Clearance

A. Hard structure clearance should not exceed 12.5% of hard structure width (Hard Structure Width/8) unless it can be demonstrated that both dynamic and static stability characteristics are adequate, by calculation and/or trials in accordance with section 5.1.

5.3 Cushion Pressure Design

A. In order to avoid collapse of the skirt system at high speed, the pressure in the skirt or the cushion area itself should be not less than the dynamic air pressure.

5.4 Construction and Materials

A. Skirt material should be coated, woven material with high resistance to ripping in any direction and of sufficient weight (thickness) so that its operating life before replacement should be significantly greater than the maximum duration of a single operation. (A recommended absolute minimum is 12 hours operation)

B. Skirt construction by riveting, gluing and sewing shall be such that all connections, bonds and seams are stronger than the single thickness base material.

C. Attachments of the skirt to the hull shall be of sufficient strength that no damage is caused to the hull attachment if the skirt material is ripped or snagged with sufficient force to break the skirt connecting device.

D. Attention should be paid to the configuration of seams on a bag or loop so that rips will be stopped by the seams rather than guided by them.

E. Skirt attachments shall be designed to withstand the loading due to skid stops on land.

5.5 Operational Damage

A. The craft shall maintain stability sufficient to prevent capsize in the event that any part of the skirt should collapse and be dragged back by the water surface during operation at a maximum operational speed in any direction.

B. The skirt should be designed so that damage to any part or area of the skirt will not cause other parts or areas of the skirt to fail as a direct consequence.

C In the design and construction of skirts consideration should be given to the problems associated with:

i) Scooping that may induce excessive loads in skirt materials or attachments

ii) Drainage of water collected when floating off-cushion or in normal operation.

iii) The need to avoid excessive skirt bounce

6.0 CRAFT CERTIFICATION

A The Craft Registration Document will define the limiting conditions in which a craft may be operated.

B Recreational Scrutineers are authorised to prevent further craft operation and withdraw the Certificate of Compliance if in their opinion the craft is no longer safe.

C. The craft registration number shall be clearly displayed on the craft hull using numerals not less than 50mm in height.

D. The Recreational Scrutineers reserve the right to call for a trial demonstration of craft characteristics of freeboard, stability, control, emergency stopping and performance.

APPENDIX A

RELATED PUBLICATIONS

RP.1	Title:	Construction Regulations for a Racing Hovercraft
	Ref. No:	HC 134
	Issued by:	Hovercraft Club of Great Britain
RP.2	Title:	Racing Hovercraft Competition Regulations
	Ref. No:	HC 115
	Issued by:	Hovercraft Club of Great Britain
RP.3	Title:	Guidelines for Cruising Hovercraft Usage
	Ref. No:	HC
	Issued by:	Hovercraft Club of Great Britain
RP.4	Title:	British Standard Specification for Inflatable Boats
	Ref. No:	BS MA16: 1971
	Issued by:	British Standards Institute
RP.5	Title:	Safety at Sea
	Issued by:	HM Coastguard Marine Safety Agency Buy, Spring Place 105 Commercial Road Southampton SO15 1EG
RP6	Title:	Glass Reinforced Plastic Boat Building
	Ref. No:	Technical Booklet No. 43 by A. McInnes and W. L. Hobbs
	Issued by:	Lloyds Register of Shipping, London, England
RP7	Title	A code of practice for safety in the design, construction & operation of small Hovercraft
	Issued by	British Small Hovercraft Manufacturers Association.
	Supplied by	Hovercraft Club of GB.
RP8	Title:	Hovercraft: Constructor's Guide (also on CD Rom)
	Ref. No:	HC 113 0906535-55-7 (Feb 2002)
	Issued by	Hovercraft Club of Great Britain.

APPENDIX - B

DEFINITION OF TERMS

APPLICANT	Person applying for approval of a Cruising hovercraft or any part thereof under HCGB rules
APPROVAL	Acceptance by HCGB or its agents as suitable for a particular purpose
BHSR	British Hovercraft Safety Regulations (of the MCA)
CERTIFICATE OF COMPLIANCE	Certificate issued by the HCGB for an approved Hovercraft
CONNECTING ELEMENTS	Bolts and nuts, rivets, pop rivets, huck bolts, nails wire
CRAFT	A Cruising hovercraft
DESIGN MARGIN	A margin of safety against the design condition. For example a margin of 10% of calculated weight to give the design craft weight for calculation of the required buoyancy
DIHEDRAL	Angle between planing surface of craft and operating surface
HCGB	Hovercraft Club of Great Britain
HOVERCRAFT REGISTRATION DOCUMENTATION	Document issued by the HCGB on certification of a Hovercraft for use in the UK.
MAX. OPERATING WEIGHT	Maximum weight at which the craft is to operate under design conditions, including all exclusions under dry weight
MCA	Maritime Coastguard Agency
PITCH	Angle of rotation about the transverse axis (bow up or down)
PRIMARY COMPONENTS	Major components of the craft whose failure would endanger the safety of the craft its occupants or any third party
PRIME MOVER	Engines, pumps and electrical motors
RACING CRAFT	Craft design specifically for racing or operating in protected environments only.

ROLL	Angle of rotation about the craft longitudinal axis (port or starboard up or down)
ROTATING EQUIPMENT	Fans, drive shafts, belts and pulleys, drive couplings and chains and sprockets
SITE	Any defined area where craft may be operated, stored or worked upon, including ancillary places such as spectators enclosures, car parks, offices, etc.
UNLADEN WEIGHT	Weight of craft ready to use, excluding fuel, occupants, baggage, cargo, stores, buoyant life saving equipment, portable emergency equipment and non-permanent ballast.

APPENDIX - C

TYPICAL DESIGN LIMITS

1.0 Material Stresses

A. Typical properties of materials which may be used for Hovercraft design values are as follows:

MATERIAL	TENSILE STRESS(N/mm^2)	SHEAR STRESS(N/mm^2)
CARBON STEEL	350	150
ALUMINIUM HP 30	108	175
GRP (csm)	035	170
PLYWOOD	014	117

B. These values are for guidance only. They are appropriate design values for non-fatigue type stresses. Where there is vibration and possible fatigue, then the material strength above should be divided by 2.2 to give a design value for steel and aluminium, and divided by 4.0 for GRP or plywood. British Standards give detailed specifications for all these materials and designers will find comprehensive data in BSI documents. Further advice on application to specific designs may be obtained from HCGB Recreational Scrutineers.

2.0 General

A. Design of a Hovercraft will involve estimating the weights of various components in order to determine the loads applied to the structure and then estimating the local pressures at support points, or the buoyancy distribution of the floating craft.

B. It is important to remember to apply a factor of 1.1 to all major masses during the design process. When estimating buoyancy it is advisable to use water density of 1000 (fresh water) and to be careful not to overestimate the buoyancy volume of the craft as freeboard is also determined by the buoyancy.

C. When considering the craft standing on three points, the local pressure applied by this case will probably determine the required floor thickness. A rule of thumb which may be applied for craft within these rules, of typical hull geometry currently used, would be minimum thickness 6mm for plywood bottom, 3mm for GRP and approximately 1.5mm (16SWG) for aluminium. Such thickness will avoid punching holes in the bottom. It should be noted that the use of dish type landing pads, landing strakes or runners (stiffeners or GRP D rope) will both stiffen the floor panel and help further prevent punching damage.

APPENDIX - D

OPERATIONAL DESIGN LOAD LIMITS

The structural loading requirements shall be complied with for all practical weights up to the specified Maximum Normal Operating Weight and with specified most adverse weight distributions.

All practical cases should be considered together with any reasonable combinations and others particular to the type of craft or its operation. The following list includes most cases:

Water impact	Loads arising from wave impacts that are likely to occur in any conditions up to the Emergency Environmental condition, or from plough-in up to the specified maximum operating speeds over calm water
Parking Loads	Loads in the structure due to parking on uneven ground, or loads tending to puncture the hull bottom due to rocks or pebbles.
Flotation Loads	Loads arising when craft is floated off-cushion in waves up to the Emergency Environmental height.
Towing & mooring loads	Loads arising from towing from the specified towing point at any speed up to the specified towing speed in conditions up to the Emergency Environmental, or from mooring in the specified manner under these conditions.
Floor and Deck Loads	Loads arising from the presence of passengers. In conditions up to the emergency environmental when sudden lift failure occurs over land or water, or when parked or moored, as appropriate.
Slinging or jacking loads	Loads arising when the craft at its laden weight is suspended freely from its specified slinging points, or it is supported at its specific jacking points
Machinery and Equipment Loads	Loads arising from any adverse combination of operating conditions (torque, inertia, gyroscopic couples etc) including those due to changing conditions and in particular due to sudden stopping of rotating assemblies
Collision loads	Machinery and equipment shall, as far as is possible, be located so that if they break loose or the surrounding structure deforms in a collision they should not, as far as can be foreseen, endanger the occupants, nullify facilities provided for use in emergencies (exits, fire extinguishers, flotation etc) or further hazard the craft..
Manoeuvre loads	Loads arising from the most severe movement of the controls at any speed up to the specified maximum in calm conditions.
Wind and Gusts	Loads arising from relative airspeed associated with specific extreme wind and gust conditions when the craft is operating at its specified maximum speed

To allow for the uncertainties in the prediction of the ‘limit’ loads arising from the loading cases, variation in the strength of materials used and the quality of construction, a suitable margin must be provided between the stress levels arising in the material due to these ‘limit’ loads and the Ultimate Allowable Stress capability of the material.

Where fluctuating loads occur, such as in rotating assemblies and skirt attachments, the possibility of “fatigue” failure within the specific life of the component must be remote.

The application of the ‘Limit Loads’ shall not result in elastic or permanent deformations which would interfere with the safe operation of the craft.

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