U.S.Department of Transportation

United States Coast Guard

Marine Safety Center Technical Note

Date: 20 August 1996

SSIC: 16703/Hovercraft
MTN: 02-96

Subj: PLAN REVIEW GUIDANCE FOR HOVERCRAFT

Ref: (a) International Code of Safety for High-Speed Craft (HSC Code), 1995 Edition*
(b) British Hovercraft Safety Requirements (BHSR), Issue 6, Jan 1991**
(c) National Fire Protection Association, National Fire Codes, NFPA 10, Standard for Portable Fire Extinguishers
(d) Underwriters' Laboratory Standard 711, Rating and Testing of Fire Extinguishers
(e) COMDTINST M16000.9, Marine Safety Manual, Volume IV Technical
(f) Navigation and Vessel Inspection Circular (NVIC) 8-87, CH 1, "Notes on Design, Construction, Inspection and Repair of Fiber Reinforced Plastic (FRP) Vessels"
(g) Small Passenger Vessel Inspection and Certification; Interim Final Rule, dated January 10, 1996 (CGD 85-080)

1. PURPOSE: This Marine Technical Note (MTN) consolidates issues addressed during recent reviews of passenger and cargo carrying hovercraft seeking Coast Guard certification for operation on domestic routes. Reviewers and submitters alike found existing regulations and policies lacking when applied to a vehicle more like an aircraft than a ship. This MTN provides general guidance for specific systems. This guidance is intended to ensure a level of safety equivalent to the regulations without adversely affecting the hovercraft's operability.

2. DISCUSSION:

a. A hovercraft or air cushioned vehicle, as defined by reference (a), is a craft such that the whole or significant part of its weight can be supported, whether at rest or in motion, by a continuously generated cushion of air dependent for its effectiveness on the proximity of the surface over which the craft operates.

b. Although the Coast Guard does not have specific regulatory design standards that account for all the unique design, construction, and operating requirements of hovercraft, the Code of Federal Regulations (CFR) applies to such vessels on domestic routes. Where the regulations impose requirements that are impractical, the Marine Safety Center (MSC) may consider alternative design proposals. For hovercraft on

international voyages, the Code for High-Speed Craft (HSC Code) applies. Alternatives, where allowed by the regulations or international standards, should be based on accepted industry standards or established engineering principles and will be considered on a case by case basis.

3. ACTION:

On domestic routes, the submitter may choose to apply the HSC Code or the CFR. Use of the HSC Code is encouraged. Where the submitter intends to apply HSC Code, this must be indicated at the outset of plan review. In order to be effective, the HSC Code must be applied as a system, in its entirety, as stated in reference (g).

For hovercraft reviewed under the CFR, the MSC will consider alternative proposals which provide an equivalent level of safety. The following guidelines are offered to assist the OCMI and submitter, and are applicable to new and existing vessels.

a. Firemain/Fire Protection Equipment: In general, the regulations describe the minimum acceptable requirements for the firemain and fire protection equipment. The MSC recognizes, however, that some hovercraft may operate on routes where fire pumps and similar equipment may be inoperable. The submitter should provide sufficient evidence that such a case exists and that an equivalent level of safety is provided. Information which may be considered includes but is not limited to:

(1) Intended area of operation across ice or land, including ambient operating temperatures.

(2) Comparison to requirements for aircraft carrying similar cargo or passengers.

(3) Restriction to a route which increases the possibility of a safe landing and egress from the craft in case of an emergency.

(4) Adherence to applicable foreign or international standards such as reference (b).

(5) Reduced fire hazards through design such as specially designed fuel cells and piping systems.

(6) Quantitative analysis to show adequate capacity to extinguish a fire based upon anticipated fire loading. References (c) and (d) may be useful in preparation of this analysis.

(7) Required time for passenger and/or crew egress, including time to go from a cushion to displacement mode. If personnel are not allowed on deck while the vessel is on cushion, the time for the necessary shutdowns should also be included.

b. Bilge: The requirements for an installed bilge system may be impractical due to the compartmentation and the operating route of the craft. The MSC may consider designs adhering to an acceptable industry standard. For example, reference (b) identifies an alternative bilge system arrangement that takes into account the vessel configuration while maintaining a level of safety equivalent to the CFR.

c. Fuel: The fuel system on the hovercraft more closely resembles an arrangement found on an aircraft. Accordingly, equivalent industry standards should be applied to address the material/component and fuel tank requirements found in the regulations.

d. Steering/Ride Control: For systems which affect controllability and maneuverability of the craft, the same level of reliability as conventional steering gear should be established. This includes steering gear, power units, control units, indicating and alarm systems, rudder angle indicator systems and steering failure alarm systems as referenced in the CFR. This may be demonstrated by first principles, established standards and/or service history. Each system will be evaluated on a case by case basis.

In general, the materials for the above mentioned systems should meet specifications required by the CFR. Materials that do not comply with accepted specifications will be considered by the Coast Guard on an individual basis.

e. Electrical: In most cases, the applicable regulations found in Title 46 CFR Subchapters T and J are readily applicable to these craft without modification. Any equivalency will be considered on a case by case basis.

f. Structural Fire Protection:

(1) Guidance for hovercraft can be found in section 5.B.12 of reference (e) and section 7.4 of reference (a). All hovercraft carrying passengers should provide structural fire protection which complies with one of these alternatives. Reference (e) requires an analysis of evacuation time and a calculation of necessary structural fire protection between high hazard areas and passenger areas. Specific limitations on the furniture and furnishings are also detailed. Any difficulties in the application of the alternatives of reference (e) may be resolved by consulting the rules of reference (a) which are based upon more modern fire protection engineering principles.

(2) Materials of construction should meet the applicable requirements of reference (a), reference (f), 46 CFR Subchapter H or 46 CFR Subchapter T. The applicable requirements will be dependent upon the compliance path chosen (HSC or CFR) and the determining factors of the vessel (e.g. # of passengers, length, gross tonnage, etc.). The intent is to allow the same materials of construction for hovercraft as are allowed for other vessels in the same service, unless the HSC Code option is chosen thereby allowing the use of non-traditional materials.

g. Noise Levels: Limitation of the noise level should be the same as or better than the requirements of the HSC Code.

h. Stability: Reference (e), section 6.E.21, provides an overview of stability requirements for hovercraft. It briefly describes guidelines for stability compliance in the displacement (water-borne) and non-displacement (cushion-borne) modes.

(1) Displacement Mode: The stability criteria of 46 CFR, Subchapter S is applicable. This criteria varies depending on the vessel length, passenger loading, and vessel use classification. In lieu of an inclining experiment, a deadweight survey with a conservative estimate for vertical center of gravity may be substituted where appropriate. Alternatively, the displacement mode stability requirements of reference (a) or (b) may be substituted, subject to MSC review and approval.

(2) Non-Displacement Mode: References (a) and (b) are the recognized standards that describe stability requirements for hovercraft in the non-displacement mode. Both of these standards require that various proof tests or service trials be conducted in the transient and non-displacement modes to demonstrate operating safety. These trials will normally be witnessed by a Coast Guard inspector, and may indicate the need for operational limitations. In general, these tests should demonstrate the hovercraft's ability to stabilize after a disturbance causing roll, pitch, heave, or any combination thereof, while operating under the worst intended environmental conditions. Procedures for these operational trials are subject to review and approval by the MSC and OCMI.

i. Structures:

(1) References (a) and (b) are the recognized standards that describe structural requirements for hovercraft. We recommend that calculations be submitted to the MSC demonstrating compliance with one of these standards. This greatly reduces the MSC's review time of the vessel's structures and expedites the plan approval process. Alternatively, the vessel's scantlings may be justified as adequate through first principle calculations or experimental testing, subject to MSC review and approval. If first principles are used, the calculations must include relevant loads and calculation methods, and should clearly demonstrate adequate margins of structural safety. Experimental tests of the structure should be under simulated or actual environmental conditions and should represent the worst case loading of the structure. In the case of experimental testing, the tested structures, test conditions, methods, and results shall be clearly defined.

(2) Another option to obtain scantling approval for existing passenger hovercraft is to obtain approval from the cognizant OCMI for the "five year rule" outlined in 46 CFR 177.10-1. This is accomplished by showing that the same vessel, or another vessel built to the same basic scantlings, has been in satisfactory service, insofar as structural adequacy is concerned, under the same or similar operating conditions, for a

period of 5 years or more. The applicability of the "five year rule" will be determined by the OCMI on a case by case basis.

(3) Structural fatigue of marine vessels constructed of aluminum is an industry-wide concern, especially for high speed craft. Hovercraft, by the nature of their "flight" operations, must be built as light as possible. Thus, designers prefer to use high strength aluminum alloys and tend to create designs with narrower margins of structural safety than conventional displacement craft. The result is often a structure that is highly susceptible to fatigue cracking. The increased risk of fatigue is usually countered by frequent and strict inspections of the hull structure. The MSC recommends that a fatigue-life analysis be completed for all hovercraft constructed of aluminum. The analysis should include the projected service life of the vessel, identification of critical and susceptible components, and an owner's inspection schedule detailing inspection frequency and procedures.

j. Operations Manual: An operations manual, when required, will be submitted to and approved by the cognizant Officer in Charge, Marine Inspection (OCMI). The Marine Safety Center will review the technical aspects of the operations manual as requested by the OCMI. The operations manual should be a comprehensive working document that includes all operating procedures (normal and emergency) and clearly defines operating limitations of the hovercraft. Appendix A is a general outline of information that is recommended for inclusion in a typical hovercraft operating manual.

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APPENDIX A

HOVERCRAFT OPERATIONS MANUAL

Operations Manual Guidance: The following is a general outline of information that may be included in a hovercraft operating manual.

I. Vessel Particulars and General Capabilities

- Approved route
- Manning requirements
- Operator Training/Qualifications
- Modes of Operation

II. System and Equipment Descriptions and System Operating Limitations

- Control
- Electrical
- Propulsion
- Fuel
- Fire Fighting
- Lifesaving

III. Loading Instructions and Limitations

- Cargo
- Passengers
- Consumables

IV. Operating Procedures

a) "Flight" Preparations

- Skirt Inspection
- Passenger/Fuel/Cargo Loading for desired trim on cushion
- Propeller/Hull Inspection

b) Over Water Operations

- Sea State Limitations
- Wave Crossing Procedures
- Speed Limitations
- Trim Limitations
- Yaw Limitations
- Maneuvering Procedures

- Procedures to avoid skirt "Tuck Under" and "Plough In"
- Displacement Mode Operation

c) Over Land Operations

- Obstacle Clearance Limitations
- Speed Limitations
- Terrain Relief/Slope Limitations
- Other Terrain Considerations: Snow, Grass, Overgrowth, etc.

d) Over Ice/Icebreaking/Cold Weather Operations

- Limitations and Precautions
- Icing of skirt, propellers, and rudders

e) Night Operations

f) Startup/Shutdown Procedures

g) Mooring/Anchoring/Towing Procedures and Limitations

h) Fueling Procedures

V. Emergency Procedures

- Passenger Safety Orientation
- Fire
- Engine Failure (One or both)
- Emergency Landing
- Rudder Failure
- Abandon Ship

* Reference (a) may be obtained by contacting:

International Maritime Organization
4 Albert Embankment, London SE1 7SR
United Kingdom
TEL: 44(0)171-587 3241

** Reference (b) may be obtained by contacting:

Civil Aviation Authority
Greville House
37 Gratton Road
Cheltenham, England