



Marine Safety Center Technical Note

MTN 02-96, CH 1
16703/Hovercraft
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MARINE SAFETY CENTER TECHNICAL NOTE (MTN) 02-96, CH-1

Subj: PLAN REVIEW GUIDANCE FOR HOVERCRAFT

- Ref:
- (a) International Code of Safety for High Speed Craft (HSC Code), 2008 Edition
 - (b) British Hovercraft Safety Requirements (BHSR), Issue 6, January 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) Marine Safety Manual, Vol. IV
 - (f) Navigation and Vessel Inspection Circular (NVIC) 8-87, CH 1, "Notes on the Design, Construction, Inspection and Repair of Fiber Reinforced Plastic (FRP) Vessels"
 - (g) Title 46 CFR Subchapter T - Small Passenger Vessels (Under 100 Gross Tons)

1. Purpose: This MTN provides guidance on the design and construction of Coast Guard certificated hovercraft operating on domestic routes.
2. Summary of Changes: Change 1 of this MTN clarifies approving authorities and alternate design standard acceptance.
3. Applicability: The guidelines provided in this MTN apply to all U.S. flag hovercraft restricted to domestic routes. Hovercraft operating on international voyages must meet the requirements of reference (a). The Coast Guard has accepted compliance with reference (a) as an equivalent to the requirements of 46 Code of Federal Regulations (CFR) Subchapters T and K (paragraph 5.a. of Navigation and Inspection Circular (NVIC) 6-99). Alternative standards, where allowed by the CFR or reference (a), should be based on accepted industry standards or established engineering principles and will be considered on a case by case basis.
4. 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. If applied, the HSC Code must be applied in its entirety, as a complete set of comprehensive requirements, as stated in reference (a).

5. **Action:** Submitters electing to comply with the equivalent regulatory scheme of reference (a) must clearly indicate so at the outset of plan review. The following guidelines provide amplifying details on potential equivalent arrangements to applicable U.S. safety regulations for these unique vessels:
- a. **Fire main/Fire Protection Equipment:** In general, the regulations describe the minimum acceptable requirements for the fire main and fire protection equipment. However, we recognize that some modes of hovercraft operation may render fire pumps and similar equipment inoperable. The submitter should provide sufficient evidence that an equivalent level of safety is provided if the fire pump cannot take suction in all modes of operation. 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 of the fire protection system to extinguish a fire based upon anticipated fire loading. References (c) and (d) may be useful in preparation of this analysis; and,
 - (7) Required time for passenger and/or crew egress, including time to go from 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 regulatory standards.
 - c. **Fuel:** We recognize that hovercraft fuel systems may closely resemble arrangements found on aircraft. In cases where compliance with references (a) and (b) is not practicable, the submitter may propose compliance with an acceptable alternative standard. Submitters must demonstrate that the proposed standard provides an equivalent level of safety to that provided by the CFR and references (a) and (b).

- 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 systems listed in paragraphs 5.a through 5.d above should meet the specifications required by the CFR. Materials that do not comply with accepted specifications will be considered on an individual basis.

- e. **Electrical:** In most cases, the regulations found in Title 46 CFR Subchapters T and J can be applied to these craft without modification. Any proposed alternatives 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.
- (2) The 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 (reference (a) or domestic regulations) and the determining factors of the vessel (e.g. number 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 reference (a) 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 reference (a).

- h. **Stability:** Section 6.E.21 of Reference (e), provides an overview of stability requirements for hovercraft. It briefly describes guidelines for stability compliance in the displacement (waterborne) and non-displacement (cushion) modes. Passengers shall have an assumed weight per passenger as defined in 46 CFR 170.090 (d)(1) when showing compliance with any applicable stability criteria of references (a), (b), or the CFR.

- (1) Displacement Mode: The stability criteria of 46 CFR, Subchapter S applies. These criteria vary 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 approval by the OCMI. The OCMI may request a technical review of the procedures from the MSC.

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 adequacy of the vessel's scantlings may be demonstrated 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 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 177.310. Approval using this method requires that the owner "demonstrate that the vessel or another vessel approximating the same size, power, and displacement, has been built to such scantlings and has been in satisfactory service insofar as structural adequacy is concerned for a period of at least 5 years." 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 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 OCMI. The MSC 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. Enclosure (1) provides a general outline of information that is recommended for inclusion in a typical hovercraft operating manual.
6. Disclaimer: While the guidance contained in this document may assist the industry, the public, the Coast Guard, and other Federal and State agencies in applying statutory and regulatory requirements, this guidance is not a substitute for the applicable legal requirements, nor is it in itself a regulation. It is not intended to, nor does it impose legally binding requirements on any party, including the Coast Guard, other Federal agencies, the States, or the regulated community.



R. C. COMPHER

Encl: (1) OUTLINE OF SUGGESTED TOPICS FOR HOVERCRAFT OPERATIONS MANUAL

SUGGESTED TOPICS FOR HOVERCRAFT OPERATIONS MANUAL

- I. Vessel Particulars and General Capabilities
 - a. Approved route
 - b. Manning requirements
 - c. Operator Training/Qualifications
 - d. Modes of Operation
- II. System and Equipment Descriptions and System Operating Limitations
 - a. Control
 - b. Electrical
 - c. Propulsion
 - d. Fuel
 - e. Fire Fighting
 - f. Lifesaving
- III. Loading Instructions and Limitations
 - a. Cargo
 - b. Passengers
 - c. Consumables
- IV. Operating Procedures
 - a. "Flight" Preparations
 - i. Skirt Inspection
 - ii. Passenger/Fuel/Cargo Loading for desired trim on cushion
 - iii. Propeller/Hull Inspection
 - b. Over Water Operations
 - i. Sea State Limitations
 - ii. Wave Crossing Procedures
 - iii. Speed Limitations
 - iv. Trim Limitations
 - v. Yaw Limitations
 - vi. Maneuvering Procedures
 - vii. Procedures to avoid skirt "Tuck Under" and "Plough In"
 - viii. Displacement Mode Operation
 - c. Over Land Operations
 - i. Obstacle Clearance Limitations
 - ii. Speed Limitations
 - iii. Terrain Relief/Slope Limitations
 - iv. Other Terrain Considerations: Snow, Grass, Overgrowth, etc.
 - d. Over Ice/Icebreaking/Cold Weather Operations
 - i. Limitations and Precautions
 - ii. 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
 - a. Passenger Safety Orientation

- b. Fire
- c. Engine Failure (One or both)
- d. Emergency Landing
- e. Rudder Failure
- f. Abandon Ship