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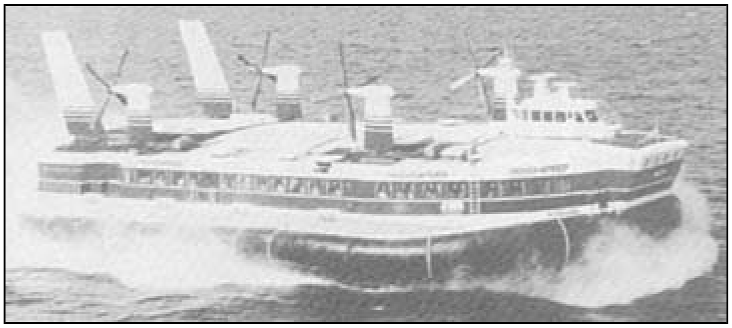
Feature Article

HOVERCRAFT TECHNOLOGY SERIES Part I

More Info On Hovercraft By Mike Terry



SR-N4

All you hovernauts may remember a series of four Hovercraft Technology articles which appeared in this magazine in June, July, September, and October of 1996. Well, after a long holiday, the series is back with a full-page format but on a quarterly basis (every three months).

The intent is to explore hovercraft design principles, operational phenomenon, and amphibious flight characteristics. Remember, R/C hovercraft are about as much fun as R/C helicopters but without the dire consequences of mistakes. The series will present details and specifications of existing operational craft (real machines) that you may wish to scale and scratch-build.

In addition to News Briefs regarding hovercraft model builder activity, a special Hovercraft Design Corner section will outline the basic principles of hovercraft design. This will allow the modeler to design and construct his own hovercraft.

New Briefs

John Jensen of Vancouver, British Columbia, Canada, holds a model of the Canadian Coast Guard search and rescue SR-N6 hovercraft. He is accompanied by Captain John McGrath - Coast Guard Base Commander - standing in front of the real machine.

SR-N6

Real Machines

The largest "commercial" hovercraft in existence is the SR-N4 passenger and car ferry in service across the English Channel.

The specifications are as follows:

Gross weight=375 tons

Length=75 feet

Engines=4 Gas Turbines (4500 HP each)

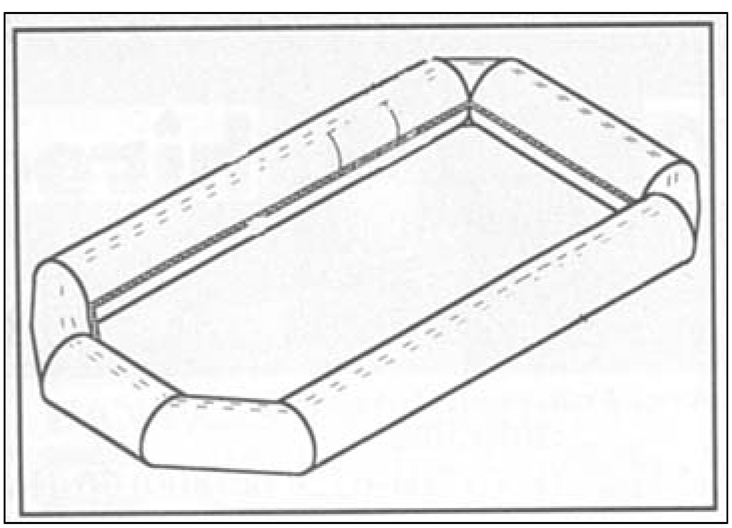
Propellers=4 x 21 foot dia. (steerable)

Speed=50 knots (nominal)

Seal Characteristics

Full-scale hovercraft seal systems (or skirts) come in many shapes, configurations, and arrangements. Seals are the most critical component of a hovercraft vehicle. It is the one component that makes or breaks the operating characteristics.

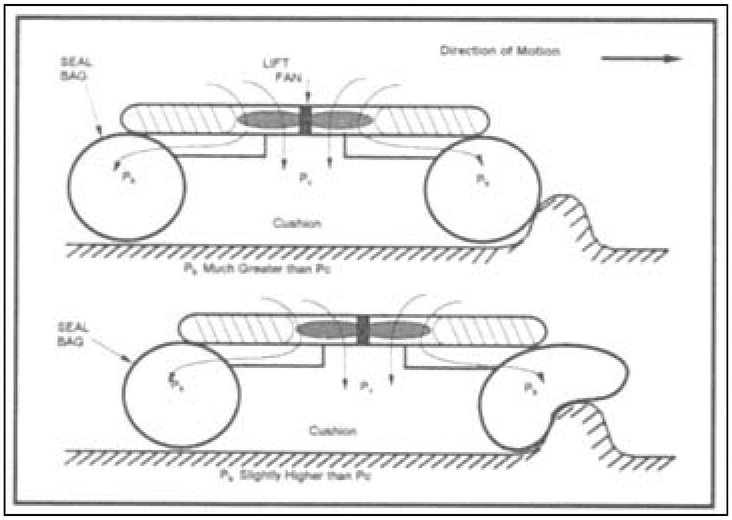
Model hovercraft generally employ fabric tubular seal systems resembling inflated pneumatic tubes with square or sharp corners (Figure 1). However, this is about as far as the resemblance to inner tube goes.



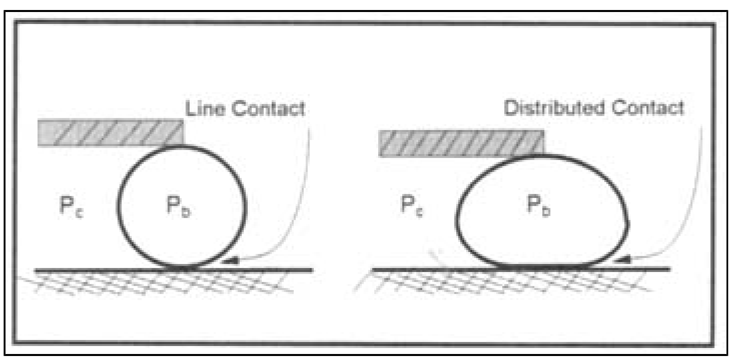
Model "Skirts" Figure 1

A successful model hovercraft is the result of a judicious trade-off between many parameters: material type and thickness, cushion pressure, seal bag pressure, seal height to craft beam ratio, etc. By far the most critical is the bag or internal seal pressure (Pb) and the vehicle cushion pressure (Pc).

The sensitivity of these pressures is significant. When the inflated structure encounters an obstacle, e.g., bumps up against a berm, the high internal bag pressure prevents the seal from "deforming" around and over the object. This leads to high drag forces and hence high propulsion thrust requirements. On the other hand, when the seal internal pressure is low, the bag readily deflects over the obstacle. This, in turn, minimizes drag and propulsion thrust requirements(Figure 2).



Seal Deformability Figure 2



Effect of Pressure on Wear Figure 3

The bag pressure also affects the friction wear at the bag-ground contact zone. With reference to Figure 3 - high seal bag pressures lead to a very narrow contact line and high contact forces. This combination results in increased wear of the seal fabric material.

Low seal bag pressures establish a "footprint" that yields low seal-to-ground contact forces and hence results in low seal material wear. Hence, a rather soft seal bag is desirable and a hard inflated bag is not.

To conclude the discussion on the seal characteristics, we need to reflect on the seal material proper. Full-scale real systems are fabricated from neoprene (rubber) coated nylon.

Normal material thicknesses on a 200-ton hovercraft exceeds 1". In scaling down to model sizes, it is insufficient to simply scale the material thickness. More critically, it is essential to scale the flexibility or compliance of the seals. This necessitates **thinner** model seal materials than would be determined by simple scaling.

By far the most applicable material is lightweight coated rip-stop nylon as used for kites and spinnaker sails; 1/2 oz. or 3/4 oz. nylon works exceptionally well. It is airtight, exhibits excellent wear characteristics, can be sewn, and is very conformable. Other materials that also work well are plastic waste bags. The material can be glued or heat-welded. However, there is a tendency to stretch with pressurization and to snag and tear.

Go to Top of Page