

# Vortex

Design & Construction in Composites  
Hovercraft Manufacture  
Mould and pattern work  
Bespoke engineering services

## SERVICES

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### Vortex 7+



The Vortex 7+ is a twin engined craft with all engineering power plants placed at the rear of the craft. The 2 rows of seating can easily be removed for carrying a wide range of cargo; More than enough room for 2 stretchers and attendants. Whilst the design weight is 700kg we know from previous experience of our other craft that this is a 'safe' under estimation / calculation.

Final payload is dependant on craft specification and what extras are added to the craft, pilot with 600kg of payload should be considered as the minimum.

The pilot (driver) sits well up front and high and is in an ideal position to see the beach, rock, ramp etc for easy slow speed manoeuvrability, this position also allows for good control of the craft when at speed.

The use of 2 engines, lift and thrust, means that the craft can manoeuvre much more easily at slow speed than an integrated craft and provided better wave handling when at sea. These engines have been selected for their reliability and longevity, basic maintenance of these power units is simple and requires minimum technical competency. The whole design concept

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of the craft is to keep it simple and reliable. The fans are set up to run as slow as possible and with quality engine silencing the intention is to get the noise levels as low as possible we expect to be well inside the current 85dba @ 25m currently recommended for vehicles like these.

The segment skirt with high pressure loop skirt at front and rear is the best design solution for a craft of this size, giving excellent ride quality as well as durability and stability; the replaceable fingers ensure that down time is kept to a minimum. Hard structure clearance will be around 300mm; this can be increased if service demands dictate. The inflatable side bodies with their separate sealed buoyancy chambers ensure that not only is the craft buoyant, but there is a flexible outer structure when hitting / knocking against hard objects. Should the craft be left on water and the air chambers go flat for some reason, the 0.5cum of buoyancy foam (around the engine / fan areas) ensure that the craft is safe. By using inflatable side bodies it ensure that towing the craft is easy and will fit a standard shipping container, the 2.25m towing width is well within the limits of a standard car and would not require a multi-purpose vehicle (4\*4 etc).

Whilst the final internal design layout is not fixed, it is possible to add 2 extra seats either side and slightly further back to the pilot should the customer require. We can offer a wide range of extras from navigational aides to communications systems, however most customers prefer to fit their own so that the equipments matches units that are already in service, in this case we can provide suitable electrical and physical connections. Depending on final engine choice air conditioning can also be offered.



<b>Pilot (operator)</b>	1
<b>Number of passengers</b>	7-8 (depending on weight)
<b>Hull Details</b>	
Length	6.8m
Width for trailing / loading	2.26m
Height (off hover)	2.05m
Weight (depends on final spec)	Approx 750kg
Length (on hover)	7.0
Width (on hover)	2.95m
Height (on hover)	2.35m
Max Design Payload (depends on final spec)	500 – 800kg
<b>Buoyancy</b>	
Polystyrene and polyurethane	0.5cum (480kg)
Multi-cambered air cells 6 off 0.3cum (300kg) each	1.8cum (1800kg)
<b>Lift System</b>	
Fan dia	1 * 750mm
Toyota 1.0 FI petrol engine	50hp @4000rpm
Hascon H series	1 off 9 / 9 @ 35deg
<b>Thrust System</b>	
Fan dia	1250mm
Toyota 1.0 EFI petrol engine	80bhp@6500rpm
Hascon BS series (5Z)	8 / 16 @ 45deg
Toyota 1.0 Turbo Charged petrol engine	120hp@4200rpm
Hascon BS series (5Z)	12/ 16 @ 45deg
<b>Control Surfaces</b>	
Rudders	4
<b>Elevators</b>	1
<b>Skirt</b>	
High pressure loop	650gr/m <sup>2</sup>
Segments	420gr/m <sup>2</sup>
<b>Nominal cruising speed</b>	70kph
<b>Standard equipment</b>	
Navigation beacon	
Engine temperature gauge	2
Engine tachometers	2
Oil warning lights	2
Battery Meter	2
Hour Meters	1
Mooring ropes	
12v power outlets	3
Dry powder fire extinguisher (1kg)	2
First aid kit	1
Batteries	2
Petrol Fuel Tank	1 * 90lt
Operation time under normal cruising conditions	6 hours +

## Detailed Specification

### **Hull construction**

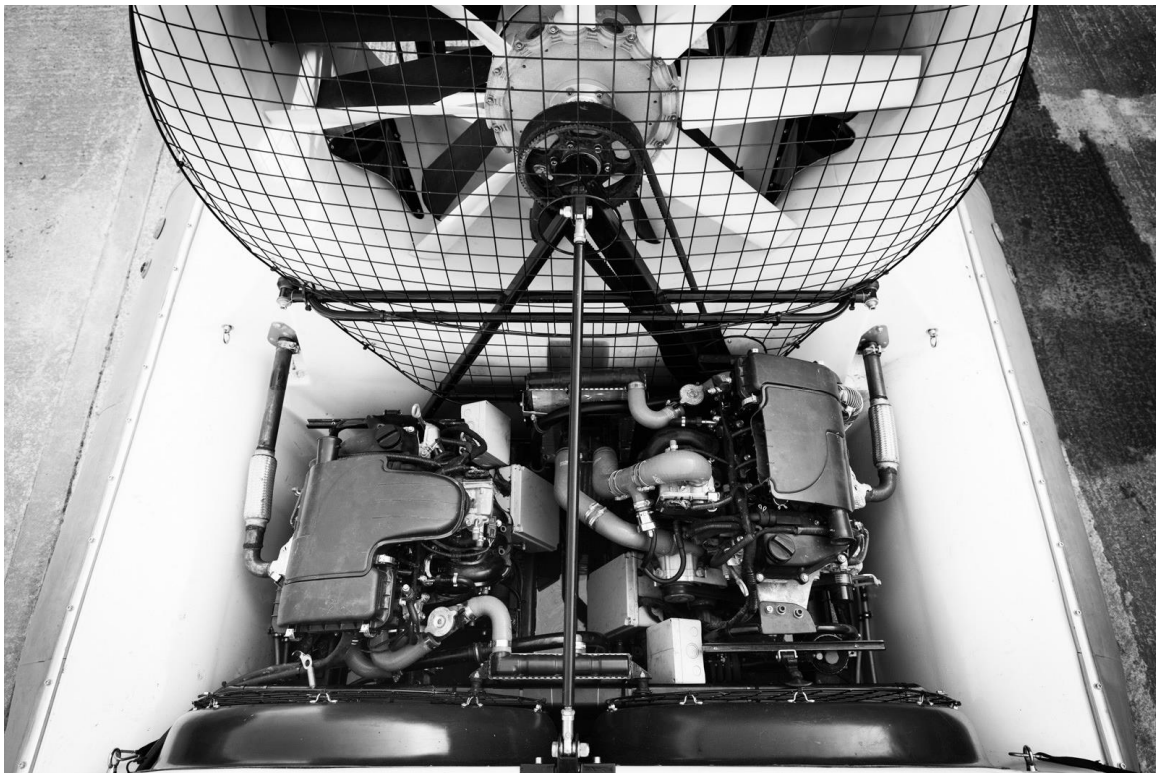
- Full composite construction, most areas are made up of a 3 layer system, 450grm CSM, 265grm Diolen (hybrid woven cloth) 300grm CSM. Polyester resin is used making repairs in the field easy.
- Addition layers of Kevlar (255grm) are sandwiched to provide additional support in high stress areas, ie engine mounting points and load mount fixings
- Foam cores also increase panel stiffness in non stress areas.
- Underneath, the floor has an additional layer of 12mm end grain balsa wood (as used in power boat construction) this produces a very hard wearing, puncture resistant floor surface
- 8 off HDPE (high density polyethylene) landing pads are bolted to the floor; these are sacrificial items and are easily replaced at major service intervals. These landing pads enable the craft to operate on strong abrasion surfaces such as airport runways.
- Unlike many other hovercraft, any part of our craft can be walked on, even the rear duct.



### **Engine and Transmission**

- The thrust power unit is an 80hp Toyota engine. This K1 series engine 1000cc, 3 cylinder unit is supplied to our specification by Toyota engine developments. This includes an ECU system programmed to match our fan installation.
- The lift power unit is an 45hp Toyota engine (de-rated K1 series engine 1000cc, 3 cylinder unit)
- The engines are rubber mounted on a welded steel engine cradle

- The fans are produced by Hascon in Italy, we are their UK distributors for their products.
- The power transmission coupling system is provided by Centa Transmissions of Germany
- The HTD drive reduction system is designed by Vortex Services and produced by Megadyne of Italy
- The fan frames are fabricated from mild steel, heat treated welded tube, not stainless steel. As a company we have found that a welded stainless frame does not stand up to the loads that the frame is subjected to over a long period of use; age hardened stress cracks are formed in welded steel structures.
- The fan frames are plated and powder coated for long life.
- The fan guards are also plated and powder coated.
- Photograph below show the engine bay, with the 2 engines installed. This photo was taken standing on the cabin roof (engines covers have been removed)



### **Controls and Instrumentation**

- The main controls are focused around the steering wheel.
- The engine throttle levers are mounted to the left of the steering wheel.
- Hovercraft trim control is provided by 2 sealed push buttons on the middle of the steering wheel.
- All instrumentation and other controls are grouped around the driving position.



### **Seating and Operation**

- The standard seating arrangement is 2 rows of 3 seats for passengers
- Up front there is the pilots seat plus 2 additional seats if needed for crew
- For other operational environments we can offer 2 rows of back to back bench seats mounted down the length of the craft. This arrangement would be better for rescue scenarios when there is no cabin roof allowing for greater side access.

### **Skirt system**

- The skirt system that we use on this craft is of the industry standard loop and segment skirt.
- This type of skirt uses a loop (or bag) that is fitted to the top of the hull and to the underneath lower edge of the planning surface.
- To this loop is attached individual skirt segments (sometimes called finger). There are some 120 of small segments, and it is the lower tip of these that supports the craft when on lift.
- These segments are bolted to the loop using 3 nylon bolts, and are fastened to the lower part of the loop using plastic cable ties.
- The skirt system is so efficient that the craft will continue to operate even with 5% of these segments missing. On craft that use full depth segments ie no loop, the loss of even one segment reduces the ability of the craft to operate safely.
- The loop is made from very heavy duty 650grm PVC coated nylon, a similar material that is found on inflatable rib boats.
- The segments are made from a high quality 6oz nylon base cloth coated with 2oz of Hyperlon. This material is made specially for us.

## Service and maintenance

- The craft was design to enable easy servicing and maintenance by personnel that have no previous experience of hovercraft.

- The engines being a standard small car engine is very cost effective to maintain

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- The drive and transmission uses standard bearings and belts that are readily available almost anywhere in the World.

- Whilst Vortex Services maintain a stock of replacement skirt segments these could easily be made locally with material supplied by Vortex.

- The only specialised components are the fan and pulley assemblies which have been designed for long life and these are always available off the shelf form Vortex.



**Vortex 7+ under construction**





Keith Smallwood  
Vortex Services (Hovercraft) Ltd

**Please note:-**

The above specification is based on good, engineering and design practice. The design philosophy is based on more than 40 years designing hovercraft of all types, there are design restraints involved with hovercraft design, the key points are detailed below.

*The foot print area of a hovercraft defines its load carrying capabilities, this 'load' not only refers to what it can carry but also the craft's structural weight (all up weight). Lift fan systems used on small and medium hovercraft (< 10m long) are limited to producing pressure equivalent to 22lbs sq foot, so a craft of 18' \* 8' would only be able to lift a craft weighing 1.29tons all up weight. The Vortex 7 has a theoretical maximum weight limit of 2.05tons. However running fans producing 22lbs of force is not efficient or reliable so at Vortex we limit our design figures to 15lb so giving a much truer all up weight of 1.4tons. 650 – 700kg hull weight and 700kg of load.*

*It is also worth noting that for stability in operation the width to length ratio should be 0.5 / 0.6 to 1. It can easily be seen that as a craft gets larger, and so has the capability for a much higher load, the weight of the hull structure / engines etc also increases.*

