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DOCUMENT No:

GSS-P34 v1.5.3

Hovercraft Specification Sheet

November 2009

Customer: Draft Sales Specifications for "Customer"
Design: *Pioneer Mk3*
Hull No: P34-xxx

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General Description

The Pioneer Mk3 hovercraft is an amphibious hovercraft designed to carry up to 25 passengers or 2.5 tonnes payload + 1 crew. The air-conditioned cabin provides comfortable seating and good visibility for the passengers and crew. The Pioneer Mk3 is powered by two Steyr M16 engines of 160kW each and will cruise comfortably at up to 40 knots on water and at higher speeds on hard surfaces such as ice.

The Pioneer Mk3 follows the well proven format of the very successful Surveyor and Pioneer series of designs introduced 1986 and incorporates many incremental improvements, resulting in an outstanding new design.

Construction is in accordance with Australian USL, British Hovercraft Safety Requirements (BHSR), Transport Canada (TP5579), Lloyds SSC rules, IMO HSC Code and other class requirements.

Technical Details Table

Dimensions	When Hovering	Hull Survey Measure	For Transporting
Length	12,150mm	11,500 mm	11,500 mm
Width	5,700 mm	4,500 mm	4,500 mm
Height	2,810 mm	810 mm (bottom to skirt top)	2,260 mm
Cockpit length		5700 mm	
Cockpit width		2500 mm (inside @ bottom of windows)	
Cabin Internal Height (centre)		1770 mm (floor to ceiling on craft centre-line)	
Cushion height		690 mm	
Isolated obstacle clearance		600mm	
Wave height clearance		1100 mm	

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Maximum recommend speed (for safety)	100 km/hr (54 kts) on smooth ice 74 km/hr (40 kts) on smooth water 37 km/hr (20 kts) on land
Economical cruising speed	50 to 74 km/hr (27 to 40 kts) on smooth water
Max wind speed (heavy)	37 km/hr gusting to 46 km/hr (20 kts gusting to 25 kts)
Max wind speed (light)	46km/hr gusting to 55 km/hr (25 kts gusting to 30 kts)
Cabin	The cabin incorporates laminated glass windscreen and side windows. The cabin doors are top hinged and may be removed easily.
Climate Control	Four air-conditioners of approximately 50,000 BTU/h in total provide ample cooling in ambient temperatures up to 40°C. Heating available through same units using engine coolant heat to provide warmth with ambient temperatures down to -30°C.
Seating (According to Survey)	Total = 1 crew plus 25 passengers. UES 'Technoseat' membrane seating.
Payload (Normal) (for a water-start)	25 persons plus equipment or 3,200 kg (includes fuel, ballast, safety equipment and passengers).
Overload Payload	Up to 3,700 kg (reduced performance & good conditions).
Empty weight	4,300 kg as equipped for passenger transit.
Engines	2 x Steyr M16 Turbo Diesel. 2 x 160kW @ 3800 rpm.
Fuel capacity	2 x 30 litres in run tanks plus 2 x 300 litres (max) in the ballast tanks (normal max is 360 litres but max of 660 litres can be carried). All fuel including ballast is useable.
Hull construction	Vacuum moulded using Vinylester resin, non-woven E-glass fabrics and Corecell® foam core. Under-hull Urethane landing pads for abrasion protection.
Skirt type	Pressurised bag tapered from front to back with larger sections at the front for improved wave clearance. All fingers are separate and detachable.
Thrust system	2 x pitch controllable (and reversing) propellers of 1400mm diameter x 5 blades. Blades made from Carbon fibre and Epoxy resin with Urethane coating. Hubs CNC machined from high tensile aluminium.
Thrust transmission	Industrial rated components of toothed belts, shafts and self-aligning bearings. An automatic clutch is incorporated for smooth engine starting and stopping and to allow engine idle without the prop turning for safety of bystanders.
Lift System	1-mixed flow type fan direct coupled to a hydraulic motor. Very efficient and quiet.
Lift Transmission	Hydrostatic. 2 x pumps. One mounted to each engine providing oil to the lift fan motor. The lift fan speed is automatically controlled to a constant pre-set speed regardless of the changing speed of the main engine.
Steering	By power assisted rudders fitted behind thrust ducts.
Pitch control	By power assisted elevators fitted behind thrust ducts.
Roll control	By differential action of the elevators.

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Controls	Programmable Logic Control System (PLC) in duplex provides logical and simple linking of the pilot input controls to the craft systems. Engine speed and propeller pitch control are controlled by a pair of levers to left of driver. Steering, Pitch and Roll are controlled by a single joystick to the right of the driver. All dynamic and often used controls may be operated by the driver without moving his hands from the primary controls. All PLC control and monitoring systems designed and installed in accordance with class rules.
Electrical System	Nominal 24-volt system. Battery charging by 2 x 28-volt, 100-amp alternators. One fitted to each engine. There are two banks of batteries for starting and one additional radio battery. All circuits wired and protected in compliance with codes utilizing BEP Contour Zone™ (CZone) networked power control and monitoring system fully compliant with NMEA 2000® enabling integrated craft control and navigation.
Pumping	Double acting manual bilge pump with manifold to each compartment, strum boxes and non-return valves. One electric pump 7570 l/h (2000 gph) in the cabin, Port side. One electric pump 7570 l/h (2000 gph in the engine room, Starboard side. Two electric pumps of 5678 l/h (1500 gph) in luggage compartments each side. Two electric pumps of 1893 l/h (500 gph) in stairwalls each side.
Fire Fighting	Fixed HFC-227ea type fire extinguisher to the engine room. Portable HFC-227ea type extinguisher recessed into the cockpit sidewall.
Navigation & Communications Options (Standard)	Standard equipment includes a 70 mm compass and a marine scanning VHF transceiver and matching antenna. Customer to supply any special communications or navigation equipment.

Technical Details, Descriptions

Classification

Classification may be carried out according to Australian Uniform Shipping Laws, "Class 1C". The build construction does not change but a charge will be made if the government certificate is required. Advice at the start of the building is required so we can organise the government inspectors. Classification costs are additional to contract amount and will be charged 'at cost' +15% as received by the examining authorities.

Hull and Superstructure

The hull is moulded with reinforcement from Vinylester resin and non-woven E-glass fibreglass reinforcements and Corecell® cores for increased panel stiffness. This method of construction is lightweight while retaining excellent strength and stiffness. Thermal and sound isolation properties are excellent for this construction system. All laminating is conducted within an air-conditioned ISO 9001 certified environment with active quality control procedures to ensure the highest quality. The hull construction complies with or exceeds the Australian U.S.L., BHSR, Transport Canada (TP5579), Lloyds SSC rules, IMO HSC Code and other international survey society requirements. Seat fixing strong points are moulded directly into the floor. Under-hull moulded Urethane landing pads are fitted for hull protection.

Four lifting 'Chain Plates' are mounted through the deck and internally strengthened. A towing eye

is fitted to the stern. There are 8x cleats mounted to the deck (separate to lifting eyes) plus 4x recessed 'hooks' providing more than ample attachment points for mooring, towing and lifting.

Cabin

The cabin sides and ceiling are finished in fire retardant fabric to owner choice. The floor is in gelcoat finish or covered with heavy duty vinyl to customer choice.

The two large doors are top hinged and open 'gull-wing' style. Fold out steps are fitted to each gangway. The steps and the doors may optionally be fitted with pneumatic openers enabling open and shut operation from the driver position.

Glazing:

All windows are custom manufactured from laminated safety glass. The front screen and front quarter windows have wipers and washers fitted (total of 5). All glazing is bonded with polyurethane adhesive sealant.

Seating:

The seats are UES Technoseat style with medium backs, rear mounted brochure holders, under-mounted life jacket containers and easily replaceable covers with hard wearing fire retardant fabric to owner choice. Total seating capacity is variable, 1-crew plus 25-passengers without toilet module fitted or 1-crew plus 24-passengers with the optional toilet module fitted.

A bilge pump is fitted into a recess at the rear of the cockpit for water removal. A large diameter (38mm) 'drain-bung' is also fitted in the rear floor area to facilitate washing out of the cabin.

Engines

Power is provided by two units of Steyr M16 Turbo Intercooled diesel engines. These engines produce ample power of 160kW each and are organised for complete redundancy enabling the Pioneer to return to base whilst operating on only one engine. All controls, transmission, fuel, cooling, exhaust, power generation and auxiliary systems are duplicated for complete redundancy.

Exhaust Systems

The engines exhausts are ducted through extremely quiet 'Cowl' type mufflers and eject to the rear via the radiator cooling air discharge ducting. This arrangement keeps the exhaust gasses enclosed in the radiator exhaust air-stream until it is well clear of the craft bodywork, thereby reducing the craft cleaning requirements. All exhaust pipe work is manufactured from Stainless Steel and thermally lagged for safety.

Propellers

There are two in-flight pitch adjustable ducted propellers of 1400mm diameter X 5 blades. The propeller blades are precision moulded from Carbon-Fibre and Epoxy resin and are post-cured at high temperature to obtain consistent high tensile strength. The propellers provide full in-flight pitch control and reversing. The pitching mechanism is controller by the operator through the PLC to ensure the optimum angle relationship to the engine speed thus ensuring the best of performance and economy whilst protecting the engines from overloading. Manual over-ride with priority to engine speed or pitch angle is available. Emergency 'get you home' manual setting is also available. Mode may be selected between 'Synchronised' (for economy and cruising) or 'Differential' (for manoeuvring).

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Propulsion Transmission System
Automatic clutches are fitted in primary drives. The clutches automatically dis-engage engines at idle speed to stop the propellers. This provides added safety for by-standers and also reduces shock loading on the transmission during engine starting and stopping. Toothed belts provide positive power transmission from the engine shaft to the propeller shaft. The propeller shaft is firmly supported by self-aligning bearing units within the transmission housing. All transmission components are power rated well above the maximum engine output.

Lift Fan
The 'Mixed Flow' lift fan was designed and developed specifically for this hovercraft and provides maximum efficiency and minimum noise along with large performance reserves while running at a relatively slow speed. The lift fan is moulded from Epoxy resin and Carbon fibre and the fan stator blades are moulded from epoxy resin and glass fibre.

Lift Fan Transmission
The lift fan is supported on an elastomerically mounted bearing system to further reduce noise and is directly driven by a hydraulic motor. The hydraulic motor is provided by oil from the pumps mounted on the engines. The pumps are of the variable displacement type and are controlled automatically by the PLC to a pre-set pressure which keeps the lift fans running at constant output independently of the engines speed. The pre-set speed may be varied at any time by the pilot for different operating modes. This is a unique system which is easily controlled and allows efficient use of available power by applying only what is necessary to meet lifting requirements and leaving all other available power for thrust.

Apart from the single fan motor, all other parts of the hydraulic system are duplicated and able to operate alone, thus providing the best possible redundancy of operation. Full lift power is available via either pump alone, even in the event of one engine failure. Two pumps together have a relatively easy task leading to long component life.

All hydraulic filtration to 3 µm and cooling is suitable for tropical (+40^{o}C) to arctic (-35^{o}C) operation in salt water and dusty conditions.

Skirt
The skirt is a fully pressurised tapered bag and finger system. The bag pressure is higher than the cushion pressure and is regulated by control orifices in the bag inner membrane. This system is well proven to be the most stable and dynamically efficient skirt system available for amphibious hovercraft today. The skirt is CNC cut for consistent and exact fitting to the hull.

The skirt bag is manufactured from Urethane coated Nylon fabric. Urethane is extremely tough and with high abrasion resistance. All joints are R.F. welded for exceptional strength. Urethanes have good low temperature flexibility (down to -35 °C) and are suitable for use in very cold areas. Colour is normally black but many colours optionally available. The skirt fingers are manufactured from neoprene coated nylon, only black colour is available.

Controls
The controls are simple and easily managed. Turning, Pitching and Rolling the Pioneer is easily accomplished by a single joystick mounted to the pilot's seat. The speed of each engine and the pitch angle of the respective propeller are jointly controlled by a single lever, in similar fashion to

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the typical boat engine speed lever…

- Lever to central position is engine idle and no pitch to the propeller.
- Move the lever forward increases both engine speed and propeller pitch until the combination arrives at the most economical cruising point. Further forward movement of the lever increases engine speed and reduces pitch angle to provide maximum thrust.
- The same lever moved to the rear of the central position repeats the same sequence but with the propeller angle going into reverse pitch.

The system has two levers, one for each engine and propeller combination. The operation of the lever is selectable from 4 standard programs…

1. Automatic and Independent. Operation as described above but with the Port and Starb'd sides independent of each other. This will allow forward thrust on one side and reverse thrust on the other side. Most suitable for manoeuvring.
2. Automatic and Synchronised. Similar to above but with both engines and propellers in synchronisation. Most suitable for cruising.
3. Manual – Engine priority. When switched to this mode the levers control only the engine speed. Propellers stay at the last set point. Useful for running engines through speed range with the propellers set to neutral pitch.
4. Manual – Propeller priority. When switched to this model the levers control only the propeller pitch angle. The engines stay at the last set speed. Useful for manoeuvring.

All primary controls and most secondary controls are linked through the Programmable Logic Controllers (PLC's). This arrangement provides the most comprehensive set of controls possible whilst at the same time providing a very simple operator interface. Additionally the PLC system provides warning, protection and logging systems that would be impossible otherwise. The complete PLC system, power supplies and controls are duplicated to provide redundancy and compliance with class rules. The PLC system is made up of internationally available and well recognised industrial components such as Rexroth, Siemens, Omron, SMC etc.

Instrumentation and Indicators

Display on the console

Hydraulic System

Main Loop Pressure	0 – 240 Bar (0 – 3480 PSI)
Fan speed and Power	Selectable display between System Pressure, Fan Speed or Fan Power.
Charge Pressure	0 – 3 Bar (0 - 44 PSI)
Main Loop Temperature	0 °C to 120 °C (32 F to 250 F)
Warnings	Low Charge Pressure. Low Oil Level. High Oil temperature. Filter Contamination.

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Thrust Engines

Tachometers	0 – 4000 RPM selectable display
Oil Pressure	0 – 500 kPa (0 - 80 PSI)
Coolant Temperature	48 °C to 116 °C (120 F to 240 F)
Fuel Pressure	0 – 500 kPa (0 - 80 PSI)
Fuel Temperature	0 °C to 120 °C (32 F to 248 F)
Exhaust Gas Temperature	0 °C to 1000 °C (32 F to 1832 F)
Manifold Boost Pressure	0 – 2 Bar (0 - 30 PSI)
Warnings	Low oil pressure. High engine temp. Low water level. Engine overload. Engine overspeed.

Other Instrumentation

Fuel contents Port side	Empty to Full
Fuel contents Starb'd side	Empty to Full
Fuel ballast Forward	Empty to Full
Fuel Ballast Rear	Empty to Full
Fuel System Warnings	Low Fuel Port side. Low Fuel Starboard side. Filter clogging Port side. Filter clogging Stb'd side.
Batteries Management (indicated separately for each battery bank).	Battery Switch Position. Battery Volts. Battery Temperature. Battery Remaining Power. Charge/Load Rate. Condition report (for unstable cells).
Cab Bilge Pump	Indicator light
Engine Room Bilge Pump	Indicator light
Water alarm in engine room	Indicator light
Alternators	Charging indicator light
Compass	70 mm illuminated card
General Indicators	Mode for Engine Speed and Propeller Pitch. Engines Power Percentage. Propellers Pitch Angle. Rudders Angle. Elevators Angle. Doors not closed. Doors locked open. Air Compressors running.

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	Compressed air reservoir pressure. Air-Conditioning run. Air-Conditioners' fan speed. Cabin set temperature. Cabin actual temperature.

Electrical System

System voltage is nominally 24 volts DC. The normal voltage range is 21 volts to 28 volts. Each engine has a 100-amp alternator charging one dedicated bank of batteries per engine.

Batteries

Each engine has one starting battery bank compromised of two 12 volt batteries in series to provide the nominal 24 volts for the starting system. All batteries are connected and fused through remotely operated BEP isolators according to class rules. An additional remotely controlled isolator provides parallel connection of the port and stb'd battery banks for the emergency starting of either engine.

An additional 12 volt emergency radio battery is provided and charged from either starting battery bank.

An automatic battery control system manages the batteries and reports through the ModBus to the PLC control system to provide information and warnings of condition, voltage and temperature. This prevents over-charging, discharge beyond pre-set limits, over-temperature and warns of impending battery fault conditions such as a failing cell.

Protection

Circuit breakers, PLC controls and fuses are installed according to class rules. All electrical cable is marine type tinned copper multi-strand cable with V95°C (or better) low halogen insulation. All terminations in exposed areas are crimped and covered with heat shrinking and hot-melt insulation for corrosion protection. Exposed cable runs are protected in conduits. Circuits are clearly marked with an engraved switch panel and a matching circuit diagram in the operating manual.

Lighting

All navigation lights comply with IMO recommendations. In addition a flashing orange beacon is mounted atop the thrust cabin according to the British CAA requirements for hovercraft.

Inside the cabin is a low powered work light with selectable white or red light for map reading. Main cabin lighting is provided by dimmable LED strip lighting. Entrance and steps are illuminated by LED lights. Beside the cabin doors are 15 Amp power outlets suitable for connecting a high-powered spotlight or other auxiliary device.

A directionally adjustable spot light is optionally mounted to the roof.

Fuel Ballast System

There are two fuel tanks in the ballast system, each of approximately 300 litres. One mounted in the bow area and one mounted in the stern area. Normal fuel ballast load is 150 to 250 litres which is moved fore and aft as required by a pair of high-flow, compressed air operated fuel transfer pumps. This relieves the dynamic control surfaces of static trimming load and increases the overall craft efficiency.

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Fuel System

Fuel Type is Diesel, automotive standard.

There are four fuel tanks in total, two in the ballast system and two in the engine supply part. As fuel is transferred between the ballast tanks, it 'tops-up' the running tanks with each transfer or at any other time as required. This allows good utilisation of the fuel and good fuel reserves without too much 'dead-weight'. The 'running tanks' are of 30 litres capacity for each engine and allow more than one hour of safe operation after all ballast load is depleted.

Normally the maximum fuel load would be 360 litres in total but this can be 'pressed-up' to 660 litres for exceptionally long duration in special circumstances.

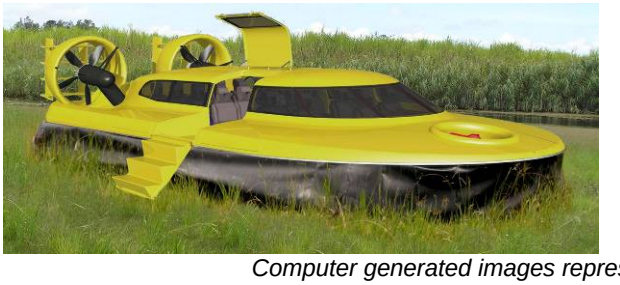
The fuel tanks are formed by flexible bladders mounted inside compartments. All fuel piping (apart from short flexible elements near the engine) is of stainless steel pipe. A safety shut off valve is mounted near each tank. Comprehensive fuel/water separators and filters are fitted for reliable supply of the fuel to each engine. Ultrasonic sensors constantly check the fuel reserves and report to the PLC which can either automatically manage the fuel or simply report status to the hovercraft operator.

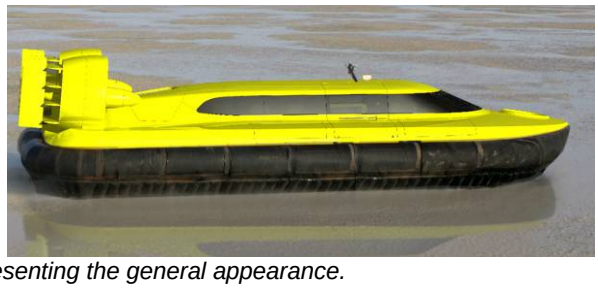
Fire Safety

A fire detection heat sensor is mounted in the engine room and connected to an alarm at the control position. The engine room is fitted with a fixed chemical smothering system that can be activated from the cabin. Additional portable extinguishers are mounted inside the cabin. Areas of the engine room that are affected by radiant heat are shielded by stainless steel heat shields. The exhaust system is lagged and shielded to reduce heat radiation and increase safety. The bulkhead to the cabin is insulated and fire rated.

Lifting

There are four lifting attachment points protruding from the deck upper surface enabling connection with cranes and other lifting tackle. A portable gantry is optionally available.





Computer generated images representing the general appearance.

NB: The above specifications pertaining to performance are based on a properly trimmed and maintained craft with a competent operator. These specifications are subject to change as improvements are made and should only be used as a guide unless specifically annexed to a build contract and signed by all parties to that contract. Specifications may also be varied from time to time by agreement between the parties involved. This document is based upon pre-production specifications of November 2009.

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