SPECIFICATION

– for –

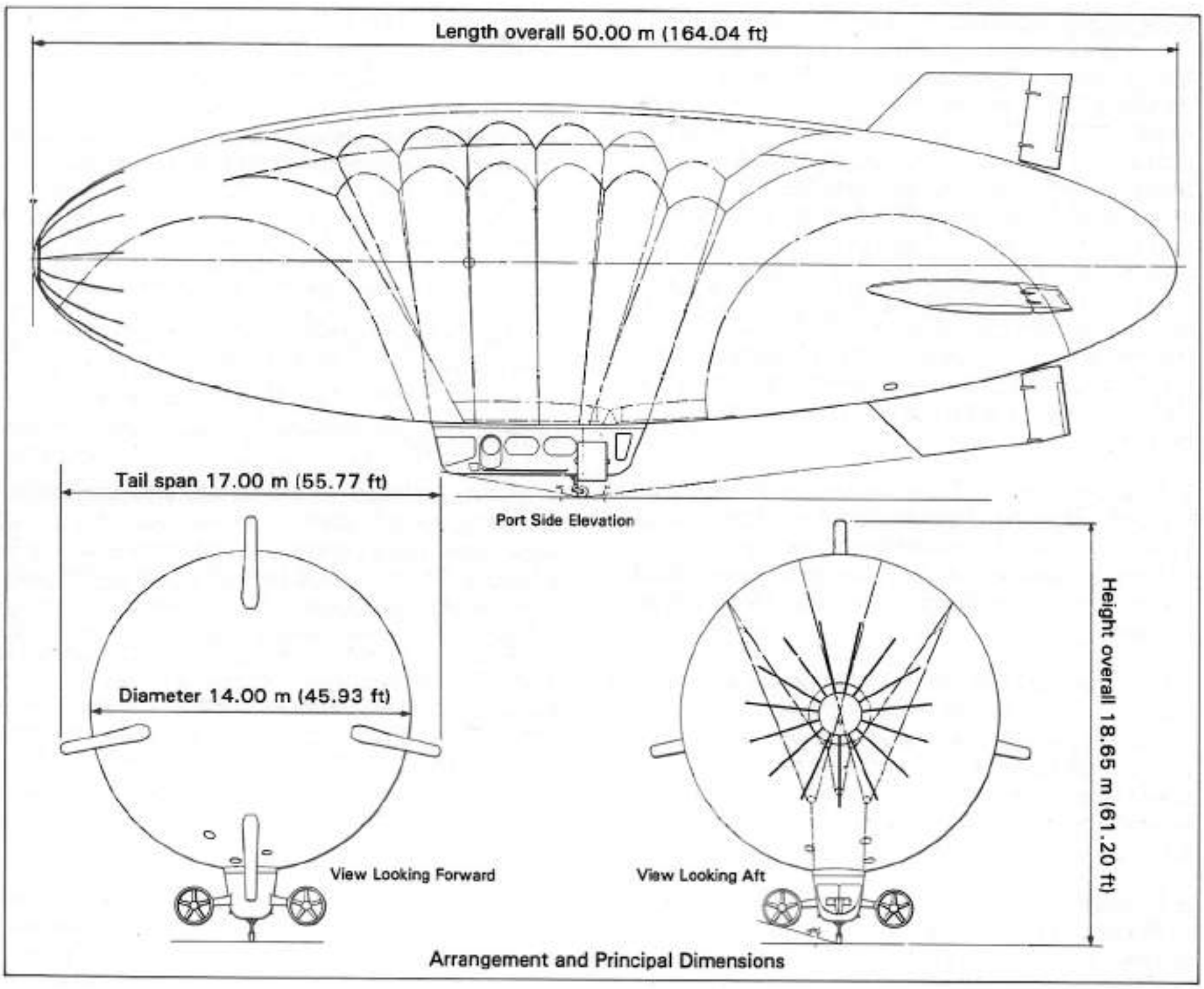
SKYSHIP 500

ASI/L/20 Issue 3
Airship Industries Ltd
April 1983

INDEX

1. GENERAL

This Specification defines the Airship type designated as Skyship 500 and is defined by Master GA drwg. 1214-00-00.



Arrangement and Principal Dimensions

2. PRINCIPAL DIMENSIONS**

Gross Volume	5131 m^3	181,200 ft^3
Length	50.00 m	164.04 ft
Diameter	14.00 m	45.93 ft
Height Overall	18.65 m	61.20 ft
Tail Span	17.00 m	55.77 ft
Ballonet Volume	26% of envelope volume	
L/D Ratio	3.57	
Manufacturers Empty Wt.	3285 kg	3.23 tons
Maximum T/O Weight	5250 kg	5.16 tons

** The data above which defines principal dimensions is based at a nominal envelope pressure of one inch water gauge and will be subject to hull pressure variations and tolerances in the final construction of the Goods due to the nature of the materials involved and the figures given should be construed accordingly.

3. ENVELOPE

3.1 Hull Form: Ellipsoidal configuration – hull form 1214/01/01.

3.2 Ballonets: One forward and one aft of the gondola.

3.3 Valves: The envelope is fitted with six grp/alloy twenty inch Airship Industries valves (Part No ARZ200779); two on the envelope equator, and two per ballonet. Valves are individually adjustable for pressure setting and incorporate a fast rise characteristic providing fully automatic operation under normal operating conditions. A manual opening and closing facility is provided for each valve operable from the flight deck. Maximum discharge rate is 125 cubic metres per minute; pressure differential across valve at 3 inch WG nominal is not greater than ½ inch WG at maximum discharge rate. Valve actuation is via a low pressure pneumatic system.

3.4 Load Curtain: Four parabolic arch fabric load curtains are provided with multiple Kevlar 29 gondola suspension cables and peripheral bolt rope. Gondola suspension is via 12 Kevlar 29 suspension cables and a biased fabric shear collar for horizontal restraint.

3.5 Envelope Materials: To Aerazur Spec. TEP54-1; Laminated material of polyester load carrier with titanium dioxide-loaded (white) polyurethane sprayed outer coating and polyurethane bonded Saran inner gas retention film. Design Spec. for permeability is 1.3 litre/sq metre per 24 hours (AFNOR NF G 37114 at 100 cm WG).

3.6 Ballonet Material: To Aerazur Spec. TEP55-1; Polyamide 66 load-carrier incorporating rip-stop weave: one face polyurethane coating and Saran gas retention film. Design Spec. for permeability is 1.3 litre/sq metre per 24 hours (AFNOR NF G 37114 at 100 cm WG).

3.7 Normal Envelope Operating Pressures: 1"–2¾" WG (depending upon operating conditions).

3.8 Helium Filling/Discharge: Two quick release fittings (ARZ 200920) incorporating non-return valves are provided (one at bow, one inside gondola) for filling, topping up and purifying helium. .

3.9 Inspection Covers: Three polycarbonate inspection covers (23.5 inch nominal aperture dia.) provide access into the envelope whilst inflated (one in each ballonet, one into the hull – located in the gondola). Each aperture is strengthened with a neoprene/aluminium alloy reinforcement ring.

3.10 Emergency Rip System: A cutter type rip system (suitably safeguarded) is provided for emergency deflation purposes.

3.11 Ram Air Supply: A scoop is fitted behind each propulsor to divert ram air into the ballonet duct system. Each scoop can be retracted by means of a pneumatic ram controlled from the flight deck.

3.12 Electrical Fan Air Supply: For low airspeed or large vector angle operations two electric axial fans (Dynamic Air type M8921N-OA) are fitted.

Each fan is individually controllable and can be switched to an automatic mode whereby the ship's pressure is controlled by an adjustable pressure switch.

Maximum combined flow rate provided by both electric fans is 2,000 cubic feet per minute which provides for a 250 ft per minute descent rate.

Automatic flap valves are fitted to ensure correct function of ballonet air supply system with any combination of available air source.

3.13 Emergency Pressure System: In the emergency event only of ballonets becoming full in flight and pressure in the envelope dropping below the safe level, a toggle is provided which when pulled opens twin fabric panels (one in either side of the T-chest) and permits air to be discharged directly into the helium space.

3.14 Colour Scheme: The hull envelope exterior is semi-gloss white polyurethane (this colour is mandatory, being essential to the ultra violet protection of the envelope). A styling line is incorporated along the half height of the envelope and provides a horizontal reference line. Registration letters (as specified by Client) are on the side and upper surface of the hull.

3.15 Tether Points: Strong points are provided on the hull – two at the bow, two forward of the tailfins and one aft – for inflation and emergency tie down purposes. Breaking load (nominal) . . . 1,000 kg.

3.16 Rigging Points: Six are provided around the envelope equator.

4. GONDOLA

4.1 General: The gondola is constructed in accordance with Gondola GA drwg. 1214/02/00.

The flight deck is located at the forward end of the gondola. Whilst the ship is designed for single pilot operation, two pilots' stations are provided to either side of the central instrument console. Twin control yokes (light aircraft console-mounted type) are provided and incorporate vector motor actuator and radio transmit buttons. Single lever type controls (i.e. combined throttle/pitch change lever for each engine) are mounted on the central console plinth. Large transparencies are provided giving excellent visibility.

The main cabin is located in the centre of the gondola and is essentially the payload compartment. It is fitted with a double bottom floor comprising Fibrelam floor panelling and floor support structure bonded to the external Kevlar shell. The centreline floor panels are removable to provide access to the control circuits and aerials beneath.

Large windows are fitted port and starboard. A box structure is built into the rear of the main cabin; water ballast tanks are housed in the outboard ends of the structure and the battery in the centre compartment. A third water ballast tank is housed beneath the engine compartment floor.

The engine room is located at the rear of the gondola and houses the two transversely mounted Porsche engines, each in separate fire resistant containment housings. Hinged titanium panels provide access to the top of the engines for light maintenance and tuning. Access to the bottom of the engines and engine removal is carried out via hatches in the underside of the gondola. An engine lift beam (with two strong points for lifting tackle) is built into the ceiling of the gondola. The rear of the engine room houses the main bag-type fuel tank.

4.2 Principal Dimensions:

Tolerance ± 1%		
Length (overall but less flanges)	9.39 m	30.8 ft
Width (maximum but less flanges)	2.41 m	7.9 ft
Main Cabin Headroom	1.92 m	6.3 ft
Main Cabin Length	4.46 m	14.6 ft

4.3 Structure: Main shell – Kevlar 49/epoxy XD927 two piece wet lay-up moulding, scarph jointed down centreline. Main cabin frame mouldings (one port, one stbd.) of same material. Bulkheads, ceiling, floors profiled from Ciba-Geigy Fibrelam panel (Grades 5, 6 & 7 uni-directional glass fibre 0/90° skins on Nomex honeycomb core).

Fireproof bulkheads (engine compartment) profiled from panel to Spec. No. ASI/L/7 – titanium skins, Nomex honeycomb core impregnated with phenolic foam, core/skin adhesive Redux 319A.

4.4 Transparencies:

Flight Deck – 4 mm acrylic incorporating clear view panels
Main Cabin – 4 mm acrylic

Transparencies are flush mounted being bolted into integral recessed flanges in the Kevlar shell.

4.5 Access Provision: The main access door is located at the forward port end of the main cabin. An emergency exit window is provided in the centre window, port and stbd. An engine room access door is located on the port side at the rear of the gondola.

4.6 Colour Scheme: The gondola is sprayed white acrylic and a styling (horizontal reference) line is painted on the propulsor duct.

5. FLIGHT DECK INSTRUMENTS/AVIONIC DISPLAYS

5.1 P1 Panel:

Altimeter (Encoding)	King	KEA 129-01
Pictorial Navigation Indicator	King	KI 525A
Airspeed Indicator	Smiths Industries	KAB0602W6A/3005
Ballonet Contents	Aldridge	939-1
Envelope Pressure	Revue Thommen	Type 122
ADF Indicator	King	KI 227–01
Vertical Speed Indicator	Aerosonic	30230-0124
Inclinometer	Silva	
Master Caution	Licon	05-63425/80-05063

5.2 Centre Console:

Automatic Direction Finder	King	KR 87
Navigation Receiver	King	KN53
Digital Area Navigation System	King	KNS80
VHF Communications Transceiver Panel	King	KY196 (2 off)
Audio Selector Panel & Amplifier	King	KMA 24H
Weather Radar/Radar V.D.U.	King	KWX 56

5.3 P2 Panel:

Rev. Counter (P & S combined)	Penny and Giles	SL/D17842
Engine Instrument Cluster		
Oil Temp. (for port and stbd. engines *1)	Weston Instruments	SW76-3-405
Oil Pressure (for port and stbd. engines *1)	Weston Instruments	SW76-3-403
Cyl. Head Temp. (for port and stbd. engines *1)	Weston Instruments	SW76-3-406
Fuel Pressure (for port and stbd. engines *1)	Weston Instruments	SW76-3-404
Vector Angle Indicator	Andrews Instruments	
Fuel Gauge (electric)	Weston Instruments	Mod 0832 Form 1 Sub 8666
PNI Slave Unit	King	KA 51A
VOR/LOC Indicator	King	KI 203
Altimeter (standby)	Van Dusen	13-3106-M *2
Transponder	King	KT 78A
Master Caution Light	Licon	05-63425/80-05063
Marker Beacon Receiver	King	KR 21

5.4 Circuit Breaker Port Panel (Eyebrow)

Ammeter	AID	12-1200-2
Voltmeter (digital)	Davtron	Model 450

5.5 Centre Panel (Eyebrow)

Pressure Manometers (standby)		
Forward Ballonet		
Helium		
Aft Ballonet		
Master Warning System Module	Licon/Airship Ind.	1214-06-250
Outside Air Temperature	AID	29-3000
Helium Temperature	AID	29-3000

5.6 Stbd. Panel (Eyebrow)

Manifold Pressure Gauge
Ship Load Gauge

A Marker Beacon Receiver is fitted below the Centre Eyebrow Panel. Prop Pitch Indicators (2) are fitted on the Power Control Module.

5.7 General Notes: All the above equipment is provided with suitable transducers/interface equipment and provided with either internal or pillar type illumination.

*1 Skyship 600 is provided with the following additional engine instruments:
[TBA]

*2 United Instruments Inc

6. AVIONICS

King Silver Crown equipment to full IFR airways fit in accordance with CAA requirements.

Marker Beacon Receiver	KR21
Weather Radar (colour)	KWX56
Audio Console (intercom)	KMA24H
VHF Transceiver (2 off)	KY196
Digital R-Nav System (incl. VOR, DME)	KNS80
VOR (back-up)	KN53
ADF	KR87
Transponder	KT78

7. PROPULSION SYSTEM

7.1 General: The twin Porsche engines are mounted transversely within the gondola, each driving a variable pitch ducted propulsor via transmission shafts and a right angle bevel drive reduction gearbox. Each ducted propulsor is arranged to pivot about the axis of the shaft centreline to provide a vertical thrust capability.

7.2 Propellor: 54 inch diameter Hoffman 5 bladed variable pitch fan HO-V 155 A-R with mechanical pitch change mechanism. Blades are glass epoxy-sheathed wood with aluminium alloy leading edge.

Maximum forward pitch .....
Maximum reverse pitch .....

7.3 Pitch Change System: On each propellor an electric linear actuator (Samariun Cobalt) actuates the pitch change lever mounted on the gearbox. The actuator is signalled by the single lever controls from the flight deck. Provision is made for emergency declutching of the actuators in the event of malfunction of the system permitting the props to return to forward cruise pitch under the influence of the bob weights in the prop hub.

7.4 Gearbox: Westland 90 degree bevel drive type, 19:37 reduction ratio and incorporating mechanical pitch change mechanism.

7.5 Transmission Shafts: Inner and Outboard – manufactured by Westland to AI Spec.

7.6 Power Plant: Twin Porsche 930/01.

General	3 litre, naturally aspirated, single overhead camshaft on each cylinder bank.
Cylinders	6, horizontally opposed.
Carburation	K Jetronic fuel injection incorporating fully automatic mixture and cold starting control up to 9,000 ft.
Cooling	Air cooled via belt driven axial fan; integral oil cooler. Designed for good cooling at zero to low intake velocity.
Lubrication	Dry sump – a separate oil tank is mounted in the propulsor outrigger.
Construction	Die cast aluminium alloy crankcase and cylinder heads with Silumin integral cylinder lining.
Fuel	Motor Gasoline 98 Octane (RON) or Avgas 100 LL.
Take-off Power (5 minutes only)	204 hp at 5900 rpm
Max. Continuous Power	150 hp at 4400 rpm

8. VECTORED THRUST SYSTEM

8.1 General: The ducted fan units are arranged to swivel in the pitch plane (+90 to −120 degrees from horizontal). Each duct is rotated by its own electric vector motor via a self-locking spiroid bevel gear. The vector motors are coupled by a cross shaft system ensuring precise synchronisation of the two ducts and providing a capability of one vector motor driving both ducts in the event of a single vector motor failure. In the event of total failure of the electrical vector system, an emergency hand cranked system is provided at the rear of the main cabin. In the event of jamming of either duct a dog clutch is provided adjacent to the emergency hand cranked system such that the jammed unit can be disengaged and the other unit vectored independently. Vector control is carried out by means of thumb switches built into the pilot's control yokes (P1's control being given priority over P2). Each switch is of "split" design giving protection against contact welding.

8.2 Vector Motors: Nelco 3403T samarium cobalt permanent magnet motors incorporating radio suppression and manufactured in accordance with Spec. No. ASI/L/11.

8.3 Epicyclic Reduction Gear: Each vector motor drives its spiroid bevel gear via a Davall/Desoutter epicyclic reduction gear manufactured in accordance with Spec. No. ASI/L/17.

8.4 Spiroid Bevel Gear: Gear wheel is a 8.25 inch OD 77 teeth two start, steel spiroid bevel and meshes with a steel 1.6 inch O.D. pinion; centre distance 3.00 inch.

8.5 Vector Tube Bearing Assembly: Each vector bearing/vector tube is machined from solid aluminium alloy billet. The bearing tube houses two 7 inch diameter PTFE line bored bearings.

9. ELECTRICAL SYSTEM

9.1 General: 28 volts dc nominal, negative earth.

9.2 Power Generation: Teledyne type. 100 amps at 28 Vdc nominal max output per engine. A remote mounted, trimmable regulator is provided for each generator.

9.3 Battery: Gill G6381E, 28v nom., 48 amp hrs.

9.4 Protection: Circuits are extremely comprehensively protected with circuit breakers and fuses.

10. FUEL SYSTEM

10.1 Main Fuel Tank: A bag-type tank of 120 Imp. gallons capacity is mounted at the extreme rear of the gondola. Filling is via a ¾ inch Avery Hardoll non-return quick connect unit mounted for easy access at the bottom of the tank. Two independent outlets are provided (one for each engine), each with its own fuel cock. Twin vents are fitted, each incorporating flame traps.

10.2 Aux. Fuel Tank Provision: Provision is made for the fitting of two auxiliary fuel tanks (one beneath each outrigger). Fuel is pumped through an electric Bendix pump into the top of the main tank. (A blanked off connector is installed for this purpose.)

10.3 Fuel Lines: ⅜ inch stainless steel tubing and AN connections are used principally in the system.

10.4 Fuel Pumps: Each engine is fed by twin 28 volt dc electric pumps mounted in parallel. A cross feed is provided in the engine room such that both engines can be run off one engine's pump set.

10.5 Fuel Cock Actuation: Four fuel cocks are fitted – one for each of two outlets from the main tank; one for the transfer line between fuel pumps. All are mechanically actuated from the flight deck.

10.6 Fuel Dump: A fuel dump valve is fitted in the base of the main fuel tank actuated pneumatically from the cockpit.

11. ENGINE FIRE EXTINGUISHER SYSTEM

A twin bottle Graviner fire extinguisher system is provided located in the engine room, and incorporates Firewire detection and a two shot facility monitored and controlled from the flight deck.

12. BALLAST SYSTEM

12.1 Water Ballast: 500 kg water ballast capacity is provided in three interconnected tanks mounted towards the rear of the gondola. Tanks are integral with the gondola shell and sealed with PRC compound. Dump valves are mounted (one in each of the two main cabin tanks) with a mean discharge rate of 10 lbs/second each. Actuation is by means of individual Bowden cables from the flight deck.

Filling of the water ballast system is achieved via a quick connect non-return Avery Hardoll ¾ inch coupling mounted in the underside of the gondola. The pilot can control the inflow of water by means of a cock (remotely actuated from flight deck). An indicator mounted in the flight deck (signalled by a load transducer in the undercarriage) provides information to the pilot on the static heaviness of the ship.

12.2 Solid Ballast: Two solid ballast compartments are provided in the main cabin. Each compartment to contain 30 × 10 kg lead shot bags. Hinged hatches are provided externally and internally.

13. UNDERCARRIAGE

A long stroke, twin wheel castoring unit is fitted, directly beneath the airship's centre of gravity. It incorporates a Dowty liquid spring unit incorporating damping. Maximum deflection is 18 inches. A load cell measuring transducer is fitted.

14. TAIL SURFACES

The four tail fins are of all-composite construction and of identical design, (with the exception of the lower fin which is cut away to allow angled climb on take-off) thereby rationalising fabrication and repair. Each fin is of wire braced multi-spar, fail-safe construction. The ribs and spars are profiled from uni-directional glassfibre skinned Nomex honeycomb-cored material. The fins are clad with 2-ply uni-directional glass on the leading edges, remainder of covering in Ceconite. Fins are aerofoil section 8% t/c ratio: maximum thickness 33% chord Span and chord tapered to tip to give single curvature skins. Control surface hinge lines are swept back to make hinge line approximately normal to local airflow. Control surface hingeline is set back to 25% chord. Geared balance tabs are fitted to the rudders and spring tabs to the elevators.

15. EXTERNAL LIGHTING

15.1 All lights are in accordance with BCAR.

15.2 Nav. Lights: One bow is fitted to the nose cone; one stern light is fitted to the envelope, one port and one stbd. light are fitted to the horizontal tailfins.

15.3 Collision Beacons: One on top fin, one under gondola.

15.4 Landing Lights: One fixed on outrigger, one remotely steerable (electrically controlled from flightdeck) mounted under flight deck.

16. DE-ICING EQUIPMENT

The ship is *not* equipped for flying in icing conditions. However, an electrically heated pitot tube is provided. Engine intake de-icing is not required.

17. SAFETY EQUIPMENT

Safety equipment is provided in accordance with BCAR, including:

first aid kit (1)
hand fire extinguishers (2)
axe (1)
lap type seat belts on all seats
trail rope (1)

18. HANDLING LINES

The ship is provided with all necessary handling lines including:

2 bow yaw lines
2 nose pendants (stainless steel) (1 spare)
1 kite line
2 stern quarter lines
1 stern line
1 tail anti-kite line

19. OPTIONAL EQUIPMENT

The Vendors reserve the right to vary the contents of this Specification during the course of construction of the goods provided always that such variations shall not substantially alter the general capability of the vehicle.

THE SECOND SCHEDULE

PERFORMANCE CRITERIA – SKYSHIP 500

1. The performance criteria given below correspond to operating the airship in I.S.A. (International Standard Atmosphere) conditions. They are based on the design maximum weight of 5250 kg not being exceeded.

2. (a) The gross disposable load (as defined in paragraph 4 of this Schedule) capable of being carried to 4000 ft above sea level shall not be less than 1600 kg.
   (b) The minimum endurance of the airship shall be 20 hours with the single tank full (120 Imp. galls) at a height of 3000 ft at a speed of 30 kts EAS (Equivalent Air Speed) in the conditions specified.
   (c) The minimum range of the airship at 3000 ft in still air at 45 kts EAS shall be 350 nm with 120 Imp. galls fuel and a gross disposable load of 1600 kg.
   (d) The airship shall be capable of attaining an altitude of not less than 9000 ft with the conditions specified and with a gross disposable load of not more than 900 kg.
   (e) The maximum level speed under buoyancy conditions of ± 100 kg static heaviness shall be not less than 55 kts EAS at an altitude not greater than 1000 ft.

3. The performance criteria (a) to (e) above shall be demonstrated by flight tests carried out on or before delivery of the airship by a mutually acceptable independent agency, either the British Civil Aviation Authority or the US Federal Aviation Agency and corrected to I.S.A. Conditions.

4. Gross disposable load comprises:
   (a) Flight crew.
   (b) Operational crew or passengers.
   (c) Items such as seats, furnishings, etc.
   (d) Freight.
   (e) Operational role equipment such as AEW Radar, etc.
   (f) Ballast.
   (g) Fuel and oil.

5. NOTES
   (a) The equipment needed to operate the airship, i.e. basic radio/nav. instruments, etc., is included in Manufacturer's Empty Weight.
   (b) The performance data quoted are minima, and range and endurance correspond to zero fuel reserves.