SKYCRUISE SWITZERLAND

DOCUMENT 5

OPERATION & MAINTENANCE

An overview of the requirements for operation and maintenance

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5. Operation & Maintenance

Introduction.....48

5.1 Scheduled Maintenance.....48

5.2 Hangarage.....50

5.3 Helium replenishment and purification.....51

5.3.1 Replenishment.....51

5.3.2 Purification.....51

5.4 Ground Support Equipment.....52

5.4.1 Mooring Masts.....52

5.4.2 Refuelling.....54

5.4.3 External Power.....54

5.4.4. Personnel Transportation.....54

5.4.5. Vehicles.....55

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INTRODUCTION

The Skyship non-rigid airship is an all-composite construction using modern manufacturing materials and techniques. It is specifically designed to be a low maintenance vehicle, which is achieved by the assembly methods and materials, as well as the benign flight environment characteristics of modern non-rigid airships. Whereas fixed or rotary wing aircraft are subject to fatigue due to the inevitable vibrations and stresses of dynamic flight, the airship is not, nor is it subject to corrosion. These two factors are fundamental to the airship maintenance concept, and are reflected in the low maintenance requirements, as exemplified by the ratio of maintenance man hours to flight hours of approximately 0.8:1 (comparison: helicopter 28:1!).

5.1 SCHEDULED MAINTENANCE

The Skyship maintenance schedule was originally developed in strict accordance with the UK Civil Aviation Authority guidelines. The Skyship 600 Series airships are the only non-rigid airships in the world to currently hold an internationally recognised Certificate of Airworthiness in the Public Transport category. To support this high level of certification, approved inspection and maintenance cycles have been formalised and are published in the Approved Maintenance Schedule:

ENGINE MAINTENANCE CYCLES				
Cycle	**Description**	**Location**	**Frequency**	**Man/Maint. Hrs.**
Engine 150"	Inspection / Service	Field	150 hrs	8 hrs
Engine 300"	Inspection / Service	Field	300hrs	8 hrs
Engine 750"	Engine change	Field	750 hrs	24 hrs

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MAJOR COMPONENT REPLACEMENT CYCLES				
Component	**Number**	**Location**	**Frequency**	**Man/Maint. Hrs.**
Engine	2	Field	750 hrs	24
Main gearbox	2	Field	2000 hrs	16
Prop. Actuator	2	Field	1000 hrs	2
Vector motor	2	Field	1000 hrs	4
Vector gearbox	2	Field	2000 hrs	4
Ignition unit	2	Field	1000 hrs	1
Undercarriage liquid spring	1	Field	1000 hrs	3
Propellers	2	Field	1500 hrs	6
Fuel pumps	4	Field	800 hrs	4
Envelope	1	Hangar	on inspection*	*

* Envelope replacement cycles are heavily dependent upon airship utilisation, local climactic and environmental considerations and whether the airship is hangar based. Replacement is decided in carried out on an "on inspection" basis at intervals of approximately ten to twelve years, if not stored when out of operation. Replacement, which normally can be done in two working weeks, should be scheduled to coincide with an airship's annual hangar maintenance period.

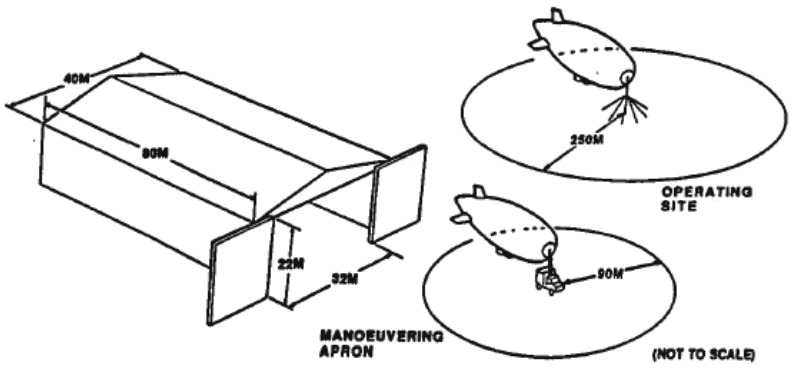
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AIRFRAME MAINTENANCE CYCLES				
Cycle	**Description**	**Location**	**Frequency**	**Man/Maint. Hrs.**
Check "A"	Preflight	Field	once daily	0.5 hrs
Check "B"	Inspection	Field	100 hrs.	8 hrs
Check "C1"	Inspection	Hangar / field	6 monthly	1000 hrs
Check "C2"	Close Inspection	Hangar	12 monthly	2500 hrs

5.2 HANGARAGE

The Skyship maintenance cycle normally requires the vehicle to be grounded for approximately three weeks once every twelve months. The "C2" cycle check involves a detailed inspection of the flight controls, including the removal of control surfaces. All other scheduled maintenance checks are carried out in the field. In addition to the annual inspection, there may be other occasional hangarage requirements, for example to replace advertising banners (one week at C1 inspections), to carry out a major customer related modification, to change mission fit or during severe weather.

Since the airship does not require the support of conventional airport infrastructure (runways, etc.), hangarage need not be limited to purpose-built aircraft hangars at airports. Other non-aviation related structures can also serve as temporary airship hangars, such as disused factories, warehouses or shipyard sheds. Even general purpose rapid construction structures can meet the minimum dimensional requirements for suitability as airship hangers (see figure). These can be of a variety of designs: pre-fabricated flat on the ground, complete with services, wiring and lighting, then raised using a wire tensioning system, or a fabric-covered metal frame design forming a semi-permanent structure; steel-reinforced sprayed concrete shell buildings, 'blow-up' military shelters, etc.



In addition to purpose-built airship hangars, most large civil international airports and many military or government airfields have hangars of a size suitable for 600 series airships. Many of these facilities have been used very successfully for both initial assembly and subsequent scheduled maintenance.

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5.3 HELIUM REPLENISHMENT & PURIFICATION

5.3.1 Replenishment

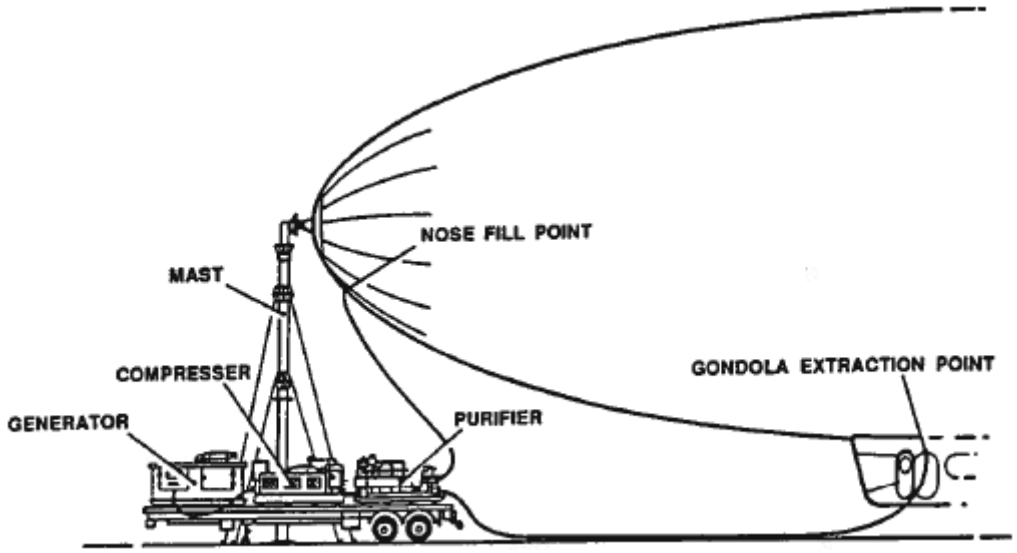
The laminate construction used in the manufacture of the Skyship envelope provides high resistance to permeation by contaminant gases and excellent helium retention properties. Helium loss rates are typically in the order of 1% per month, so only occasional replenishment is required. The helium replenishment process is straightforward, the necessary hoses and hose couplings are supplied with standard ground support equipment and the procedure is carried out in the field. Helium is available worldwide through commercial contractors.

5.3.2 Purification

All airships experience a gradual decline in helium purity. The Skyship envelope is particularly resistant to atmospheric contamination, with the average helium purity decreasing by approximately 2% per year. In order to maintain maximum utilisation of the airship and the availability of optimum disposable lift, periodic helium purification may be required - typically once a year.

This process is also carried out in the field. The airship is connected to a helium purification unit during scheduled downtime to minimise disruption to flight operations. Such a unit can be leased or purchased depending on the maintenance support option selected.

These skid-mounted units are easily transported by pallet, container or lorry bed and are completely self-contained. They work by extracting contaminated helium from the airship and passing it at high pressure through a membrane filtration system which separates the helium from the contaminant gases before returning it to the airship at high purity (99%)..



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5.4 GROUND SUPPORT EQUIPMENT

Skyships can operate within the existing aviation infrastructure as an airship requires no external operational support in its day-to-day operation. All normal day and night flight programmes can be carried out from airfields or greenfield sites with no additional facilities other than those provided with the Skyship. These consist of an airship mooring mast and support, an airship refuelling facility and a ground power supply.

5.4.1 Mooring mast

The mooring mast can take three forms:

a) Mobile Mast

The mast truck is a fully customised road vehicle, ideal for mobile operations where sites change from day to day. Once on site, the mast can be erected ready for use in two minutes. It then takes about half an hour for the support crew to anchor it to the ground for additional support. The latter can be done while the airship is attached. The mast can be lowered and packed for transport in a similar time. A further advantage of the Master is its ability to manoeuvre the airship on the ground while it is attached (for example, to enter/exit a hangar or to operate in confined spaces).



Mobile Mast while hangering-out a Skyship 600

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b) Tripod Mast

The Tripod Mast provides a lesser degree of manoeuvrability and is ideally suited to fixed base operations where several airships may need to be moved around an operational area and/or in and out of hangars. This type of mast is towed by a suitable vehicle and is not normally roadworthy or easy to assemble/disassemble.



Tripod Mast for manoeuvring Skyship in the hangar

c) Exped Mast

The third type of mast, known as an 'Expeditionary Mast' or simply 'Exped', is a three piece aluminium tube construction that is flanged together to form the mast, then hoisted and secured by staked guys. This type of mast is easy to transport once dismantled. The assembly/disassembly time is approximately forty minutes. It is standard operating procedure, and strongly recommended to prospective operators, that each airship is equipped with a main mast, which may be one of the three forms mentioned above, and a spare mast, which would normally be an Exped mast.



Exped Mast ready to receive Skyship

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5.4.2 Refuelling facility

The Skyship can be refuelled using a truck-towed bowser, a road-going fuel truck with an integral fuel tank, or a drum. In each case, the pressurised pumping system can be actuated mechanically or by hand. Drums or small towed browsers are suitable for fixed-base operations. A small self-contained refuelling truck is usually used in mobile operations, subject to local legislation and certification for such transport. See also section 4.4.5/3 for fuel trailer information.)



5.4.3 Ground power supply

An external electrical supply is required whenever the airship is on the mast. This supply is to power the airship's internal automatic pressure control system as well as ancillary services such as site lighting, power tools, crew facilities etc. A portable generator is normally used or a "Constavolt" converter if network-power is available, both items are included in the Ground Support Equipment. Additional / backup standard portable fuel generators may be desirable. The mast truck e.g. as used by Skycruise Switzerland on its mobile operations has an integral generator.

5.4.4 Personnel transportation

Conventional transportation may be required for ground crew, engineering, and flight crew personnel depending on the nature of the proposed operation.

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5.4.5 Vehicles

A full road-going mobile operation would typically be supported by seven or eight vehicles.:

1) Mast truck

See also 4.4.1 /a for an example of a mast-truck as used for Skyship operations.



2) Towing vehicle(s) (Jeep or Landrover or Landcruiser type)

These vehicles are used for towing fuel and expedited trailers, as well as for general purposes. It is convenient to have one of them equipped with a small bridge.



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3) Fuel Trailer

Transporting fuel is most convenient using a double-walled special trailer, such as the one pictured below, which has a capacity of 1000 litres. Many countries impose limits on road transport, but these restrictions are not overly burdensome..



4) Exped Mast Trailer

see pictures in 5.4.1 / c above, but any low-bed trailer is convenient.

5) Engineering truck

A standard van can be used to set up a small mobile workshop for servicing the Skyship. It is recommended to transport a standard set of spares with the Engineering truck, especially when away from the home-base.



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6) Passenger / Ground Crew Bus

he vehicle is used to transport passengers from the reception site to the airship. It is also required for transporting the ground crew on the road..



7) Minivan

A minivan is suitable for transporting personnel or material with additional requirements.

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