Large Yacht Helicopter Refuelling Handbook

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Maritime and Coastguard Agency

HELICOPTER REFUELLING HANDBOOK

Information within this publication is intended to assist yachts with helidecks in meeting their responsibilities, while engaged in trade and operating under the rules of the Red Ensign Group. However, various helicopters and yachts have particular operating characteristics that fall outside the scope of this handbook.

All yachts operating helicopters must have written operating procedures for the helideck in accordance with the International Safety Management Code.

This handbook is intended to be a guide only and not binding. In the interests of clarity, any procedures incorporated within a specific Safety Management System for the helideck should overrule any guidance contained within this handbook. All personnel involved in the aspects of the helicopter operation remain responsible for acting in accordance with relevant national regulations and company instructions.

Note: For ease in reading all terms referring to the personnel contained within this publication are for the male gender. It is understood that male and female personnel are equally capable of conducting the duties contain herein.

HELICOPTER REFUELLING HANDBOOK

SECTION 1 - GENERAL

1.1 Purpose

All personnel who are engaged in the handling and dispensing of aviation fuel must understand that the safety of a helicopter and its passengers depends on their ability to deliver fuel which is free from contamination including water particles. The purpose of this handbook is to offer guidance on the equipment and procedures necessary to achieve this. It should be noted that fuel delivery system manufacturers may impose their own maintenance and operating schedules. In these cases the manufacturer's instructions should be adhered to.

1.2 Personnel Training

The handling of aviation fuel demands great care and attention to detail on the part of personnel involved in order to ensure that the operation is carried out safely and efficiently. The training and assessment of personnel is therefore, of prime importance in order to achieve and maintain the required operational standards and competency.

SECTION 2 - AVIATION FUEL

2.1 Aviation fuel

Fuels used in the aviation industry are different to those fuel oils used to fuel ships machinery. Probably the most widely used of all aviation fuels is Jet A1, a derivative of Jet A (only the freezing point differs). The problem with Jet A1 fuel is that it has a significantly lower flash point than typical marine diesel oil and as such cannot be stored in the same way. Jet A1 has a flash point of about 38 degrees. As with most fuels, the vapour given off by liquid Jet A1 when mixed with air in the ratio of (1%-6% vapour to air), will produce an explosive mixture. If the fuel is at a temperature greater than that of the flash point, combined with a volatile fuel/air mix vapour and a source of ignition, an explosion will occur.
It is also worthy of note at this stage the necessary need for non-contaminated fuel to be delivered to the helicopter. Poor fuel quality will have disastrous results, possibly causing an engine to fail; leading to loss of the helicopter.

2.2 Aviation fuel storage

As can be seen from the above paragraph, storage of a potentially volatile fuel in enclosed spaces at temperatures close to or above its flashpoint can be hazardous. The naval approach, certainly within NATO, is to use a more stable aviation fuel. This fuel is a specially blended kerosene fuel called AVCAT and has a flash point of about 60 degrees, comparable to that of marine diesel oil. Using this fuel virtually eliminates the hazard posed by that of Jet A1; however, this is not a viable option commercially. This means that commercially and in the private sector, that owners and operators will have to accept the significant risks associated with Jet A1 fuel.

2.3 Fuel Specification

The majority of all helicopters use Jet A-1 fuel. Jet A-1 is a kerosene type fuel obtained from a middle distillate of petroleum. It is manufactured to conform to closely defined parameters which embody the most stringent requirements of the following specifications:

Defence Standard 91-9 L Issue 5, (DERD 2494)
IATA Guidance Material
USAASTM D1655-06

2.4 Additives

There are many additives that can be added and for a variety of reasons. Some will contain Static Dissipator Additive. These additives increase the low natural electrical conductivity of jet fuel and thus hasten the dissipation of static electricity generated by the movement of the fuel through fuelling systems, especially filter/water separators and fuel monitors.

The additive used in Jet A-1 is Stadis 450.

In certain circumstances an anti-icing additive may be required. This additive prevents the freezing of water which may be precipitated out of the fuel due to cooling. Two types exist, namely AL48 which is added at the Main Supply Installation and Prist, which comes as an Aerosol and is dispersed into the fuel tank as refuelling is in progress.

Shown below is an example of an anti-ice fuel additive test kit.

2.5 Batching and Testing

In order to trace fuel from the refinery to the point of delivery to aircraft, the process of batching has evolved. A batch is produced as a result of refinery production and testing or any operation which involves the introduction of any new fuel into an existing batch.

2.6 Quality Control

Careful control and documentation is maintained on all Jet A-1 fuel stocks at each stage of movement from the refinery to the customer. At appropriate stages during the handling and storage of aviation fuels, samples will be required for examination in order to detect whether there has been any contamination or deterioration.

2.7 Contamination

Contamination can arise due to the presence of water, dirt, sediment or bacterial growth.

2.7.1 Water

Water is a constant and troublesome cause of contamination. It can be absorbed in solution in the fuel at higher temperatures and, on cooling, is released as free water in the form of droplets which make the fuel become cloudy. Moisture present in the atmosphere, can be drawn into a tank through the vent by tank 'breathing' and the resulting condensation can cause water to collect within the tank. Water must be removed because the droplets can freeze at altitude, causing blockage of the helicopter filters and other components.

2.7.2 Dirt and Sediment

Dirt and sediment must also be removed since solid matter can also cause damage to the helicopter fuel system.

2.7.3 Bacterial Growth

In the presence of water a fungi grows at the water/fuel interface, this can block filters and also give rise to corrosive products.

Because fuel contamination can cause engine failure with potentially disastrous consequences, vigilance on the part of personnel engaged in aviation fuel handling is of paramount importance to remove all traces of water and solid matter.

2.8 Colour Coding

All markings must be in accordance with the American Petroleum Institute (API) requirements.
All tanks, pipelines and fuelling cabinets must be colour coded in order to identify the grade of fuel they contain.

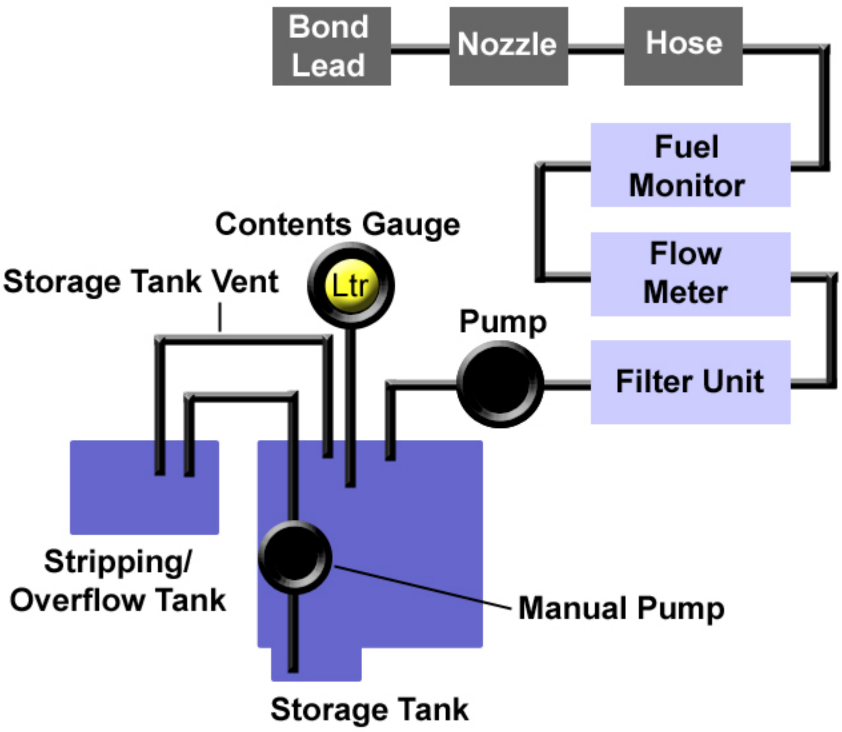
SECTION 3 - BASIC FUELLING SYSTEM

3.1 Fuelling System

A typical arrangement of a fuelling system is shown below. The main components of the system are:

Tanks, pumping units (centrifugal type, either air or electrically driven), filtration and water separation units, filter monitor, metering equipment, fuel delivery hose, hose reel, aircraft fuelling nozzles and bonding equipment.

The fuelling cabinet should be equipped with a pump stop button and a 'deadman' valve to stop flow in an emergency. The inter-connecting pipe work should be of stainless steel.



An example of a simplified, basic refuelling system

3.2 Storage Tanks

Tanks should be constructed in stainless steel or mild steel. If mild steel is used the interior of the tank must be coated with an approved, fuel compatible, epoxy lining.

The bottoms of each type of tank must be provided with a slope of at least 1 in 30 falling to a small sump. The purpose of the sump is to act as a collection point for any accumulated water and solid matter. The sump must therefore, be equipped with a suitable sample/drain line. Tanks should be cylindrical and mounted with an obstacle free centre line slope (no baffles fitted).

Tanks should have jet A-1 grade plates and be stamped with the date of the last inspection and cleaning.

3.3 Delivery Systems

The aim of the delivery system is to transfer fuel from the storage tank to the nozzle, whilst eliminating any contaminants and water. The components of the delivery system can be seen in the diagram of a simple fuel system. The component parts are described in more detail below.

Example of a delivery system

3.3.1 Transfer Pump

An electrical or air driven pump, of either centrifugal or positive displacement type may be used. It is worth considering the benefits of each type, ensuring that it is suitable for the specific application it is intended. The pump should be able to deliver 225 litres per minute under normal flow conditions and with the delivery nozzle shut, 50 psi. It is worthy of note that these are specifications in accordance with the regulations as laid down by the CAA. Other organisations work to different limits, for example, the Royal Navy and Royal Fleet Auxiliary specify that the fuel flow rate should be capable of delivering a minimum of 114 litres per minute. A remote start/stop button should be provided on or close to the flight deck and close to the hose storage. An amber coloured flashing light should be visible from the flight deck whilst the pump is in operation. When considering the design of a fuel system, a suitable pump is one in which is capable of being used in potentially explosive atmospheres i.e. non-sparking (explosion proof).

3.3.2 Filtration Units

Filter units including water separators of suitable size to suit a particular application. Units should be API 1581 5th edition approved. These filters will provide protection down to 1-micron particle size. Also contained within the filter unit should be a sample line, minimum ½ inch diameter, to enable water to be drained from the unit, a differential pressure gauge and an air eliminator.

3.3.4 Flowmeter

A positive displacement type flowmeter calibrated in litres should be fitted.

3.3.5 Fuel Monitor

Should be in-line between the flowmeter and the hose and designed to eliminate any water that is still present. It should be API 1583 approved. Also contained within the filter unit should be a sample line, minimum ½ inch diameter, to enable water to be drained from the unit, a differential pressure gauge and an air eliminator.

3.3.6 Delivery Hose

Aviation hose must meet the requirements of BS3158 1985, Grade 2. Type 'C', which is heavy duty, semi-conducting and has a working pressure of 20 bar (300 psi).

Note: BS 3158 has been superseded by EN 1361 Grade 2, type C.

BS 3158 1985 C will be found stamped on the hoses however, this is being gradually phased out and new hoses may only have EN 13611 or API 1529 stamped on them.

Hoses should be of approved semi-conducting type to EN 1361 or API 1529 (Rubber hoses and hose assemblies for aviation fuel handling). Both of these standards will ensure that the hose is of static dissipating, correct strength etc. The hose should be stored on a reel of sufficient diameter to avoid damage to the hose and should be protected from the elements.

3.3.7 Fuelling Nozzles

Helicopters are equipped with either pressure (Underwing) or gravity (Overwing) fuelling fill points or both. The most common type to be found in the Large Yacht industry is the gravity type.

1. Pressure Fuelling Coupling - There are different types, however, the principle of operation is the same. The components which comprise this coupling are the pressure fuelling nozzle which connects directly to the helicopter fill point, a pressure regulating valve which is set to restrict the pressure into the helicopter fuelling system to 35 psi, a 'quick disconnect' fitting which provides access to a 100 mesh stainless steel cone strainer. A bonding cable and clip is also fitted.

An example of a pressure refuelling nozzle

2. Gravity Fuelling Nozzle - The main features of this type of nozzle are a 'hold open' trigger mechanism, a 100 mesh stainless steel cone strainer and a bonding wire and clip. Because the fuelling couplings have to be interchangeable, the gravity nozzle should be fitted to a length of hose equipped with an adaptor suitable for connection to the pressure fuelling nozzle. The length of hose should be sufficient to ensure that the pressure fuelling nozzle rests on the helideck, so that its weight does not impede the use of the gravity nozzle.

Examples of gravity refuelling nozzles

Both types of nozzle must be provided with dust caps to prevent the ingress of water and dirt. A valve should be provided at the hose-end as an additional precaution in an emergency when using a gravity fuelling nozzle.

For pressure refuelling operations, the nozzle should be fitted with some form of surge control device/regulator limiting to 35 psi. Again, it is worth mentioning that other organisations work to differing limits. The Royal Navy stipulate that the rig is pressure limited to 50 psi but also state a minimum pressure of 20 psi. The nozzle should be protected from the elements.

3.3.8 Bonding Cable

In certain circumstances, when an electrically charged object is brought into contact with another, a momentary spark can occur. This spark is caused by the discharge of static electricity which is generated by friction resulting from the movement of two different substances against one another. Charges, if not effectively earthed, may discharge to adjacent parts and the consequent spark could cause an explosion. By bonding one object to another, the static charges are equalised thereby eliminating the risk of sparking. It is most important therefore, that bonding procedures are strictly followed whenever fuel is being transferred.

A high visibility earthing cable should be fitted that is always to be used to earth the helicopter airframe prior to commencement of any refuelling operation. The cable should be connected to the pipework at one end and a suitable airframe connector at the other. The electrical resistance between the aircraft end and the pipework end should be less than 0.5 ohms. A quick disconnect assembly should be fitted adjacent to the clamp.

Bonding connections must be made to designated points on clean and unpainted metal surfaces and must be the first task before commencing any of the other operations.

3.4 Materials

Certain types of material have a harmful effect on fuel and consequently should not be used when they are in contact with Jet A-1 fuel. These are: Copper and its alloys (e.g. brass, bronze, etc.), Zinc and galvanised material and Cadmium.

3.5 Grade Marking

All units on the fuel system must be clearly grade marked in accordance with American Petroleum Institute (API) requirements.

3.6 Personal Protection

Appropriate PPE including goggles must be worn when conducting refuelling operations.

SECTION 4 - TECHNICAL GUIDANCE (FILTRATION AND WATER SEPARATION)

In addition to fuel settling procedures during storage, filtration and water separation are used to remove solid contaminants and free water from fuel.

4.1 Filter/Water Separators

Filter/water separators

These units remove solids down to1 micron size and free water down to 15 parts per million (ppm).

Filter/water separators must conform to the performance requirements of American Petroleum Institute (API) Bulletin 1581 Group II, Class B.

The main components of the filter/water separator vessel are:

1. The coalescer elements, which perform two functions:
   Microfiltration, the removal of solid matter down to 1 micron size.
   Coalescence (collecting together) of small water droplets into larger drops which fall to the sump of the vessel from where they can be drained off.

2. The separator or stripper element which acts as a second stage of water removal and is manufactured with a Teflon coated screen which repels water. The repelled water also falls to the sump of the vessel.

3. A pressure differential gauge for monitoring the condition of the elements. When the coalescers become clogged with solids, the pressure differential across the vessel increases.

Differential pressure gauge

4. An air eliminator which automatically vents any air entering the vessel.

5. A pressure relief valve.

6. A sump equipped with a drain/sample connection.

4.2 Fuel Monitor

This unit performs a different function to a filter/water separator. It is a one-stage vessel, the elements of which removes solids down to 1 micron and have the ability of absorbing rather than coalescing or repelling water. It has to conform to the requirements of the Institute of Petroleum (IP) Specifications and Qualification Procedures - Aviation Fuel Monitors with Absorbent Type Elements.

The fuel monitor is equipped with a differential pressure gauge, an air eliminator, a pressure relief valve and drain/sample points.

4.3 Routine Checks and Maintenance

4.3.1 Element Change Criteria

Filter elements must be changed when one or more of the following conditions develop:

1. The differential pressure, at maximum rated flow, reaches the following maximum limits: filter/water separators -15 psi (1.03 bar), fuel monitors -22 psi (1.52 bar).

2. If there is a sudden and inexplicable drop or rise in differential pressure.

3. Flow rates fall to unacceptable levels.

4. Inspection shows damaged or contaminated elements.

5. Replace the coalescer elements annually.

(This does not apply to separator stripper elements in filter/water separators which can continue in service provided they are not disarmed).

Filter elements

4.4 Routine Checks

4.4.1 Daily
Before the first fuelling of the day, the filter drain points must be thoroughly flushed, with the pump pressure applied until a water and sediment free sample is obtained. The presence of unusual contaminants in the drain sample must be reported for further investigation. The results of sampling should be recorded (a locally produced form may be used). Unusable samples must be correctly disposed of and not returned to the tank.

4.4.2 Weekly
The maximum differential pressure across the vessel must be read at the maximum operating flow rate and the results recorded.

4.4.3 Yearly
Filter vessels must be opened, inspected and cleaned internally. Replace the elements.

SECTION 5 - ROUTINE INSPECTION & MAINTENANCE

The information contained in this section covers the frequencies and procedures for routine operations and maintenance. Each installation will have a schedule for routine equipment checks based on manufacturers' recommended frequencies. This section is intended to offer guidance. However, some operators do have different maintenance periods based on their own experience. The checklists below are taken from the guidance offered within CAP 437.

5.1 Storage Tanks

5.1.1 Daily Checks

- To maintain the quality of fuel whilst in storage, tanks must be drained on a daily basis to remove water which may have collected at the bottom of the tank.

5.1.2 Six Monthly Checks

- Where fuel remains unused for 6 months a 4 litre sample should be drained and sent to a laboratory for analysis, (Note: if found to be OK thereafter fuel should be subject to the same test on a three monthly basis until replenished or discarded). Alternatively, the fuel is treated as contaminated and rejected.

5.1.3 Annual Checks

Static storage tanks are subject to an annual or biennial inspection depending on the type of tank. If the storage tank is mild steel with a lining then it should be inspected at least once per year, if the tank is stainless steel then a two-year interval between inspections is acceptable. When due for inspection the tank should be drained and vented with the access cover removed. The inspection should include the following:

• Cleanliness.	Clean tank bottom as required.
• Tank internal fittings.	Check condition.
• Lining material (if applicable).	Acetone test (note this check need only be carried out on new or repaired linings).
• Paint condition.	Check for deterioration, especially around the seams.
• Access to tank top fittings.	Check condition of access ladder/platform.
• Inspection hatch.	Check condition of seal.
• Access manhole cover.	Check seal for condition and refit cover securely. Refill tank.

• Floating suction.	Check operation and condition.
• Valves.	Check condition, operation and material.
• Sump/drain line.	Check condition, operation and material.
• Grade identification.	Ensure regulation Jet A-1 markings applied and clearly visible.
• Contents gauge.	Check condition and operation.
• Bonding.	Measure electrical resistance between tank and system pipework.

5.2 Delivery System Checks

The delivery system should nominally be inspected every three months. No system should exceed four months between successive inspections. In addition the system should be subject to daily and weekly checks by fuelling personnel to ensure satisfactory fuel quality.

5.2.1 Daily Checks

The following checks should be carried out each day:

- Microfilter and/or filter/water separator and filter monitor. Drain the fuel from the sump until clear. The sample should be of the correct colour, clear, bright and free from solid matter. The sample should be checked for dissolved water by using a syringe and water detection capsule. Filter vessel and hose end samples should be taken under pump pressure.

- Storage tank. A fuel sample should also be drawn from each compartment of the storage tank (as applicable) and checked for quality as in the paragraph above.

- A sample should also be drawn from the hose end and checked for quality as in the paragraph above.

- These daily checks should be recorded on the ‘daily storage checks’.

NOTE: Fuel samples taken in accordance with the above paragraphs should be retained for at least 7 days to enable them to be analysed in the event of an aircraft accident.

5.2.2 Weekly Checks

The following checks should be carried out each week (in addition to the daily checks specified above):

- Differential pressure gauge. During refuelling the differential pressure gauge reading should be noted and recorded on the filter record sheets.

- Entire system. The system should be checked for leaks and general appearance.

- Tank top fittings. Check to see all are in place, clean and watertight.

- Inlet and outlet couplings. Check caps are in place.

- Hose end strainers. Strainers fitted to fuelling nozzles and fuelling couplings should be inspected and cleaned. If significant quantities of dirt are found, the reason should be established and remedial action taken. During these checks the condition of any seal should be checked for condition and to ensure they are correctly located.

Nozzle strainers

- Floating suction. Should be checked for buoyancy and free movement.

- Aviation delivery hose. The entire length of the hose should be checked visually whilst subjected to system pump pressure. This particular check should be recorded on the hose inspection record.

- Delivery nozzle/coupling. The bonding wire and clip to be checked for general condition, security and electrical continuity (maximum 0.5 ohms).

- Bonding reel. Check for general condition, security and electrical continuity (maximum 0.5 ohms).

The completion of these checks should be recorded on the serviceability report.

5.2.3 Three-monthly Checks

A three-monthly check is the major inspection of the system and should be carried out by an authorised and suitably qualified person. The following check of items to be included will depend on the particular installation and is included as a general guide; additional items may be included as appropriate:

- All filtration units, i.e. decant line, dispenser and monitor filter. Obtain a fuel sample and check for appearance and water presence. Note results of sample check on system records. If bad samples are obtained on this three-monthly check it could indicate the presence of bacteriological growth in the separator. If samples are not good proceed as follows: open the filter vessel and inspect for surfactants, bacteriological presence, mechanical damage and condition of lining (if applicable). Clean out any sediment and carry out a water test on the water stripper.

- Check earth bonding between transit tank and main storage.

- Suction fuel hose and coupling

    1. Ensure outer protective cover is present.
    2. Check hose for damage and leakage.
    3. Check end connections for damage and leakage.
    4. Check correct operation of hose coupling.
    5. Check end cap present.

- Pump unit

    1. Remove, clean and inspect strainers.
    2. If air driven, remove air line lubricator, regulator and water separator units; service as required.

- Hose reel. Ensure reel mechanism operates correctly, grease rewind gears.

- Differential pressure gauge

    1. Check correct operation. (Renew filter element if the differential pressure limit is exceeded.)
    2. Prime the unit and check the operation of the automatic air eliminator. (If manual type is fitted it is recommended that it is replaced with an automatic type.)

- Delivery hose. Carry out a visual check of the hose whilst under system pressure. Look for external damage, soft areas, blistering, leakage and any other signs of weakness. Particular attention should be paid to those sections of the hose within about 45 cm (18 ins) of couplings since these sections are especially prone to deterioration.

- Delivery coupling/nozzle

    1. Check operation to ensure correct lock off and no leakages.
    2. Remove, clean and visually check cone strainers, replace as necessary.
    3. Check earth bonding wire assemblies and bonding clips and pins. Renew if required.
    4. Ensure all dust caps are present and are secured.

NOTE: No lubrication is to be applied to any of the coupling or nozzle parts.

- Main earth bonding

1. On auto rewind, check for correct operation of rewind mechanism, adjust and lubricate as necessary.
2. Carry out a visual check on earth bonding cable and terminal connections, replace if required.
3. Check condition of earth clamp quick disconnect assembly.
4. Carry out continuity check (maximum 0.5 ohms).

5.2.4 Six-Monthly Checks.

Six-monthly checks, as for the three-monthly checks, should be carried out only by an authorised and suitably qualified person. The contents of the six monthly check should include all the elements of the three-monthly checks detailed in the above paragraph above and, in addition, should include the following items:

- All filtration units, i.e. decant line, dispenser and monitor filter

  1. Ensure the unit has the correct fuel grade identification.
  2. Ensure the connecting pipework has the correct fuel grade identification.

- Electrical pump unit (if applicable)

  1. All electrical circuits to be checked by a qualified electrician.
  2. Check gearbox oil level is appropriate.
  3. Lubricate pump bearings.
  4. Check coupling between motor and pump for wear and signs of misalignment.
  5. Refer to pump manufacturer's recommended maintenance schedule for additional items.

- Air-driven pump system (if applicable)

  1. Lubricate air motor bearings.
  2. Lubricate pump bearings.
  3. Check coupling between motor and pump for wear and signs of misalignment.
  4. Refer to pump manufacturer's recommended maintenance schedule for additional items.

- Metering unit

  1. Check operation of automatic air eliminator.
  2. Lubricate the meter register head, drive and calibration gears with manufacturers' recommended lubricant.
  3. Lubricate bearings.
  4. Clean and inspect strainer element.

- Hose reel

  1. Check tension on chain drive and adjust if necessary.

2. Lubricate the bearings.
3. Delivery hose.
4. Ensure the correct couplings are attached to the hose.

5.2.5 Annual Checks.

Annual checks should be carried out by an authorised and suitably qualified third party. The contents of the annual check includes all the items in both the three-monthly and six-monthly and in addition, consists of the following items:

- All filtration units, i.e. transfer, water separator and monitor filters.

1. Remove and discard existing elements and shrouds (see Note below). Clean out vessel. Visually check all areas of lining for signs of deterioration.
2. Carry out water test on separator element if applicable.

NOTE: For vessel installations filter elements should be replaced either annually or, if appropriate, less frequently (e.g. 3 years) in accordance with the original equipment manufacturers (OEM) instructions.

3. Carry out MEK test if applicable.

NOTE: This need only be carried out to check for correct curing when lining is new or has been repaired.

4. Carry out DfT thickness test on vessel interior linings if applicable, (again this is only necessary on new or repaired linings).
5. Apply pinhole detection test if applicable.
6. Fit new elements and shrouds.
7. Fit new gasket and seals.
8. Mark the filter body with the dates of the last filter element change date and the next due date.

- Delivery hose

Ascertain when the hose was fitted from system records. It should be recertified every two years, or earlier if any defects are found which cannot be repaired. The hose will have a ten-year life from date of manufacture.

NOTE: Hoses unused for a period of more than two years are unsuitable for aircraft refuelling.

- Fuel delivery meter

The fuel delivery meter may require calibration; refer to manufacturer's recommendations.

- Pressure Fuelling Nozzle

These nozzles and the associated pressure regulators should be dismantled and overhauled every 12 months. Component wear must be checked against the manufacturers' recommended tolerances and replacement parts fitted if necessary.

- Gravity refuelling Nozzles

Checked and maintained IAW the manufacturers' recommendations.

SECTION 6 - FUEL SAMPLING AND TESTING

At appropriate stages during the handling and storage of aviation fuel, samples will be required for examination in order to detect whether there has been any contamination or deterioration.

6.1 Visual Examination

To be acceptable, fuel should be the correct colour, visually clear, bright and free from solid matter and un-dissolved water at normal ambient temperature. The term 'clear' refers to the absence of sediment or emulsion and 'bright' to the sparkling appearance of the fuel having no cloud or haze. The colour of Jet A-1 fuel varies from water white to straw colour. Un-dissolved water (free water) will appear as droplets on the sides or bulk water on the bottom of the sample jar. It may also appear as a cloud or haze (suspended water).
Solid matter generally consists of small amounts of rust sand, dust etc either suspended in the fuel or settled out on the bottom of the jar.

6.2 Sampling Equipment and Procedures

NOTE: PLASTIC CONTAINERS MUST NOT BE USED FOR SAMPLING DUE TO THE POSSIBILITY OF ACCUMULATED ELECTROSTATIC DISCHARGES.
ALL STAINLESS STEEL CONTAINERS MUST BE CORRECTLY BONDED.

Fuel for visual examination must be drawn at full flush, into scrupulously clean, clear 4 litre capacity glass jars. Examination for solid matter will be enhanced by swirling the sample in the jar to form a vortex, thereby causing any sediment present to be concentrated at the centre where it will be more readily visible. Free water will also appear as large droplets in the bottom of the sample jar.

Testing for dissolved water should be carried out by using a capsule water detector, which changes colour in the presence of water. Suspended water in Jet A-1 fuel at low concentrations will not normally be detectable by eye. See below.

A Syringe and Capsule Water Detector

This equipment consists of a 5 ml syringe with a nozzle to which is fitted a plastic capsule incorporating water sensitive detection paper. Before using, check that the paper in the capsule is a uniform yellow colour and that the expiry date, marked on the bottom of the container tube, has not been exceeded.

The life of capsules is 9 months.

Having removed the capsule from the container, fit it to the syringe without delay and draw 5 ml of fuel into the syringe. The capsule should be examined for any colour change.

If a distinct green colour is evident, it is a positive indication of the presence of water and the problem should be reported/investigated. A capsule should be used only once and then discarded. Because the paper in the capsule is very sensitive to moisture in the atmosphere, the top of the capsule container should be replaced immediately a capsule has been removed.

6.3 Density Determination

Density checks are not carried out afloat.

Density Checks are carried out to determine if any contamination of the fuel has occurred with other fluids by measuring the Density and comparing it with the RS recorded on the Release or Delivery Note. Density determination should be carried out in a portable measuring cylinder; the cylinder should be filled to a predetermined level. The appropriate hydrometer should be carefully inserted into the sample. When the hydrometer is stationary and the eye is level with the top of the liquid, a reading should be taken at the bottom of the meniscus. The temperature of the sample should also be measured. Using the appropriate conversion charts, the observed density should be converted to a reading at 15°C for comparison with the advised density of the consignment. Determined densities should be within 0.003 of the advised figure to be acceptable.

6.4 Retention Samples

Retention samples may be required for analysis in the event of a helicopter accident. For this purpose, the 4 litre sample taken from the hose-end or filter monitor at the completion of a fuelling (see section 8.4) should be retained for twenty four hours. The first good sample of the day from the storage tank in use should be kept for 24 hours.

6.5 Daily Checks

To ensure consistent fuel quality the following checks should be carried out each day:

6.5.1 Microfilter and/or filter/water separator and filter monitor. Drain the fuel from the sump until clear. The sample should be of the correct colour, clear, bright and free from solid matter. The sample should be checked for dissolved water by using a syringe and water detection capsule. Filter vessel and hose end samples should be taken under pump pressure.

6.5.2 Storage tank. A fuel sample should also be drawn from each compartment of the storage tank (as applicable) and checked for quality as in paragraph 6.5.1.

6.5.3 A sample should also be drawn from hose end and checked for quality as in paragraph 6.5.1.

6.5.4 These daily checks should be recorded on the 'daily storage checks'.

Note: Fuel samples taken in accordance with 6.5.2 above should be retained for at least 7 days to enable them to be analysed in the event of an aircraft accident.

6.6 Contamination

If a clear sample cannot be obtained - drain off a further 3 samples and, if still contaminated the fuel must not be used and specialised advice must be obtained.

SECTION 7 - PROCEDURES FOR RECEIPT OF FUEL

7.1 Procedures Prior to Discharge

A sample must be taken from the tank for visual examination and chemical detector test before delivery of fuel to the helideck commences.

7.2 Procedures Prior to Receipt

If the daily checks have not been carried out, the receiving tank should be checked for water by drawing samples from the drain point. Any water found should be removed and the results recorded. The quantity of fuel remaining in the receiving tank should be measured to ensure that sufficient tankage is available and to enable the correct transfer of fuel to be verified after replenishment. The transit tank must be bonded to the deck of the installation before the transfer hose is connected. Fuel being transferred must be pumped through a suitable filter water separator before entering the receiving tank.

SECTION 8- PROCEDURES FOR REFUELLING HELICOPTERS

8.1 General

Hazard: Rotor Blades may dip down to below shoulder height!

The refuelling operation will generally be undertaken by a team of four, comprising the HLO, who will be in overall charge and three Helideck Assistants (HDAs).

Refuelling should only be undertaken with the helicopter engines shut down and the rotors stationary.

Ground power units must not be connected or disconnected while refuelling takes place. A system of simple and clearly understood hand signals should be used for communicating between operators.

8.2 Procedures Prior to Refuelling

The following procedures may be regarded as normal however manning levels may require that some of the duties and responsibilities are shared in a manner other than the ideal set out below:

Ensure that all passengers have disembarked and are clear of the helideck unless (high wind conditions and/or) the helicopter Captain requests that they remain on board. If this occurs they must have their seat belts undone.

The HLO should position himself so that visual contact is maintained between himself, the pilot of the helicopter and the HDAs.

The HDAs should be positioned so that:

HDA/1 is manning the foam monitor/firefighting equipment,
HDA/2 is operating the refuelling nozzle,
HDA/3 is operating the 'deadman' valve and pump controls in the fuelling cabinet.

HDA/2 or 3 should attach the main bonding wire to the bonding point on the helicopter.

HDA/2 and 3 should pullout the refuelling hose and lay the pressure refuelling nozzle on the helideck adjacent to the fill point on the helicopter; or, if the fill point is of the gravity type, the extension hose with trigger nozzle should be connected to the main hose by means of the adaptor.

8.3 Refuelling Procedures

When all is in place to commence refuelling the HDA/3 should start the pump and open the 'deadman' valve.

The HDA/2 must take a 4[1] litre sample from the hose-end nozzle and present it to the pilot for visual examination and chemical detector test (if required by the pilot).

[1] The sample size may be reduced to 1 litre for specific systems by agreement with the aviation inspection body.

After receiving fuel quantities and permission from the pilot to commence refuelling, connect the bonding wire on the pressure nozzle to the helicopter, remove the dust caps from nozzle and helicopter then connect the pressure refuelling nozzle to the helicopter fill point, or, if the fill point is of the gravity type, connect the bonding wire on the trigger nozzle to the helicopter bonding point before removing the dust caps from the nozzle and helicopter.

The HDA/2 should then open the hose-end valve in readiness to commence fuel flow to the helicopter.

Should the HLO or any of the HDAs observe any operational problem or unsafe condition during the refuelling, the HDA/3 must immediately release the 'deadman' valve and stop the pump.

When the refuelling has been completed the hose-end nozzle and valve will be closed by the HDA/2, who will in turn signal to the HDA/3 to release the 'deadman' valve and stop the pump.

8.4 Procedures after Refuelling

On completion of refuelling:

Remove the refuelling nozzle from the helicopter fill point and replace the tank cap. Then remove the bonding wire on the nozzle.

A 4[2] litre sample must be taken from the hose-end or filter monitor. This should be checked visually and with the chemical detector. If the sample reveals any evidence of contamination the helicopter pilot must be informed immediately.

Rewind and stow the refuelling hose.

Disconnect and rewind the main bonding wire.

Record the fuel meter reading and reset the meter to zero.

On completion the refuelling daily log sheet (may be locally produced) should be completed and the signature of the pilot obtained.

[2] The sample size may be reduced to 1 litre for specific systems by agreement with the aviation inspection body.

Appendix 1 Bibliography

1 Relevant Health and Safety at Work Legislation

Provision and Use of Work Equipment Regulations (PUWER)

Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)

Control of Substances Hazardous to Health regulations (COSHH)

Control of Major Accident Hazards (COMAH)

Management of Health and Safety at Work Regulations (MHSWR)

Fire Precautions (Workplace) Regulations (FPR)

2 Guidance Documents for Helicopter Operations

CAP 437 Offshore Helicopter Landing Areas: A Guide to Criteria, Recommended Minimum Standards and Best Practice

Helicopter Operators' 'Operations Manuals' – Offshore sections

Helicopter Landing Officer's Handbook (Offshore Petroleum Industry Training Board)

ICAO Annex 6 Part III, as amended

ICAO Heliport Manual – Doc. 9261 –AN/903/2, CAP 6

3 Appropriate Legislation, Regulations and Directives

Dangerous Substances and Explosive Atmospheres Regulations 2002, including various associated Codes of Practice and Guidance

The Health and Safety at Work etc. Act 1974

Chemical Agents Directive 99/92/EC (ATEX 137)

The Fire Precautions Act 1971

The Control of Substances Hazardous to Health Regulations 2002

The Fire Precautions (Workplace) Regulations 1997

The Control of Lead at Work Regulations 2002

The Confined Spaces Regulations 1997

The Equipment and Protective Systems for Use in Potentially Explosive Atmospheres Regulations 1996 and Amendment 2001

ATEX Product Directive 94/9/Ec OJ l 100

The Provision and Use of Work Equipment Regulations 1998

The Personal Protective Equipment at Work Regulations 1992

The Petroleum (Consolidation) Act 1928

The Safety Representatives and Safety Committees Regulations 1977

The Health and Safety (Consolidation with Employees) Regulations 1996

CAP 168 Licensing of Aerodromes

CAP 393 Air Navigation: The Order and Regulations

CAP 642 Airside Safety Management

CAP 700 Operational Safety Competences

ICAO Airport Planning Manual Parts 1 and 2

ICAO Airport Services Manual Parts 1, 8 and 9

ICAO International Standards and Recommended practices: Aerodromes Annex 14 Vol. 1. Aerodrome Design and Operations

ICAO International Standards and Recommended practices: Aerodromes Annex 14 Vol. 2. Heliports