



# AIRCRAFT FUELLING AND FUEL INSTALLATION MANAGEMENT

A GUIDE FOR BEST PRACTISE

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# **PART 1 - GUIDELINES FOR AVIATION FUEL QUALITY CONTROL AND OPERATING PROCEDURES FOR PRIVATE AND BUSINESS AIRPORTS IN THE UNITED KINGDOM**

## **1. INTRODUCTION**

- 1.1 Legal Obligations
- 1.2 Definition of a Private and/or Business Airport
- 1.3 Purpose
- 1.4 Staff Responsibilities and Inspection Requirements.

## **2. HEALTH, SAFETY AND ENVIRONMENT**

- 2.1 Management of Health and Safety
- 2.2 Training
- 2.3 Accidents, Incidents and Near Misses – Reporting and Investigation
- 2.4 Emergency Response Procedures
- 2.5 Security
- 2.6 Fuel Spillage
- 2.7 Stock Control

## **3. RECEIVING BULK FUEL SUPPLIES**

- 3.1 Documentation
- 3.2 Pre-Delivery Checks
- 3.3 Records

## **4. SAMPLING AND TESTING**

- 4.1 General
- 4.2 Sampling Intervals
- 4.3 Visual Examination
- 4.4 Sample Containers
- 4.5 Sampling Procedures
- 4.6 Retained Samples

## **5. STORAGE OF FUELS IN BULK**

- 5.1 General
- 5.2 Tanks
- 5.3 Pipe work
- 5.4 Filters
- 5.5 Settling Times
- 5.6 Labelling and Colour Coding
- 5.7 Change of Grade Procedures
- 5.8 Hoses
- 5.9 Laboratory Testing of Fuel Stocks
- 5.10 Records

## **6. AIRCRAFT REFUELLING VEHICLES**

- 6.1 General
- 6.2 Sampling and Purging
- 6.3 Records

## **7. DEFUELLING PROCEDURES**

- 7.1 Defuelling
- 7.2 Records

## **8. BARRELLED SUPPLIES**

- 8.1 Delivery, Handling and Storage
- 8.2 Sampling
- 8.3 Decanting and Dispensing
- 8.4 Records

## **PART 2 – FIRE PREVENTION AND SAFETY MEASURES**

### **1. INTRODUCTION**

### **2. FUELLING OF AIRCRAFT INSIDE HANGARS**

### **3. FUELLING AREA AND FUELLING ZONE**

- 3.1 Fuelling Areas
- 3.2 Fuelling Zone

### **4. PRECAUTIONS PRIOR TO FUELLING**

- 4.1 Aerodrome Fire Service
- 4.2 Fire Extinguishers
- 4.3 Overheated Undercarriage Assemblies
- 4.4 Clear Exit Paths
- 4.5 Bonding and Earthing
- 4.6 Helicopters

### **APPENDIX 1 – GLOSSARY AND ABBREVIATIONS**

### **APPENDIX 2 – EXAMPLES OF RECORD FORMS**

### **APPENDIX 3 – CHECK LIST FOR FUEL HANDLING**

# **PART 1 - GUIDELINES FOR AVIATION FUEL QUALITY CONTROL AND OPERATING PROCEDURES FOR PRIVATE AND BUSINESS AIRPORTS IN THE UNITED KINGDOM**

## **1. INTRODUCTION**

### **1.1 Legal Obligations**

The Air Navigation Order (ANO) at Article 128 places an obligation on aerodrome licensees to produce an Aerodrome Manual that contains all information and instructions as may be necessary to enable operating staff to perform their duties as such, including information and instructions relating to the matters specified in Schedule 13 to that Order.

Schedule 13 requires that, where an aerodrome has facilities for fuel storage, procedures for complying with Article 137 of the Order shall be included within the Aerodrome Manual.

Article 137 requires a person having management of any fuel installation to ensure that fuel received into, and delivered from, that installation is in, and remains in, a state fit for use in aircraft. This Article defines a fuel installation as meaning 'any apparatus or container, including a vehicle, designed, manufactured or adapted for the storage of aviation fuel or for the delivery of such fuel to an aircraft'.

Unlicensed aerodromes where there is a facility for the storage of fuel are not subject to Article 128 but are subject to Article 137.

The ANO requires fuel installation managers to satisfy themselves that:

- a) Fuel received at an installation is fit for use in aircraft;
- b) The installation and the storage and dispensing procedures will not render it unfit;
- c) The fuel storage and delivery system is appropriately labelled;
- d) The fuel should be sampled on delivery into the installation; and
- e) The fuel should be of the correct grade for the installation.

### **1.2 Definition of a Private and/or Business Airport**

For the purposes of this document, a "private and/or business airport" is defined as follows:

- a) There is only one fuel supplier
- b) Aviation fuel is supplied to the location by road transport
- c) The airport fuelling service has a total annual throughput of aviation fuels of less than 5 million litres (1.3m USG)
- d) There are no regular fuel uplifts by scheduled flights of IATA member airlines.

### **1.3 Purpose**

The purpose of this document is to provide a standard set of guidelines which can be used as a reference for the preparation of detailed quality control and fuel handling procedures at the above locations.

## **1.4 Staff Responsibilities and Inspection Requirements**

### **1.4.1 Staff Responsibilities**

Each airport shall have a Designated Person (the Fuel Installation Manager) who is responsible for ensuring that the facility operating procedures conform to acceptable industry standards and to all the relevant requirements of government authorities with respect to safety, training, security, fire prevention, stock control and environmental protection.

The Designated Person shall have overall responsibility for all aspects of the operations under their control, and shall be responsible for ensuring that all operations are carried out in accordance with the agreed procedures, and for compliance with the inspection requirements.

It is the responsibility of the fuel supplying companies to satisfy themselves as to the standards of their supply sources and, if requested, to confirm that the fuel quality is acceptable and that the supply facilities meet recognised industry standards.

Avgas installations will also be licensed and inspected by the Local Petroleum Officer.

### **1.4.2 Inspection Requirements**

There shall be a process to ensure that the location is inspected by suitably qualified personnel, from either the CAA or the fuel supply company, or a suitably qualified maintenance company, at least once every year.

1.4.3 For JAR Ops or future EASA Ops organisations, the Quality Manager or member of his staff or person authorised by the QM should ensure that the above procedures are in place.

## **2. HEALTH, SAFETY AND ENVIRONMENT**

### **2.1 Management of Health and Safety**

#### **Health and Safety at Work Employers Duties**

The Health and Safety at Work etc Act 1974 (HASAWA) is the overarching UK health and safety legislation laying duties on both employers and employees. It places duties on employers and those responsible for places of work to ensure that employees, contractors and other individuals are protected from health and safety risks and dangers arising from work activities.

Employees have a duty under the legislation to take reasonable care of themselves and others who may be affected by their acts or omissions. Employees are required to co-operate with the employer in discharging its statutory duty. As an enabling Act, the legislation describes the general duties on employers and employees and enables specific regulations to be put in place to deal with particular aspects of Health and safety Management.

Although not exhaustive, a significant tranche of legislation known as the six-pack regulations were first introduced in 1992, and are used in regard to health and safety at work:

- **Management of Health and Safety at Work Regulations:**  
Require employers inter alia to assess the risks to which employees are exposed through work activities and to manage those risks so far as reasonably practicable.
- **The Display Screen Equipment Regulations:**  
Display screen regulations extend the risk assessment philosophy to the use of DSE
- **The Manual Handling Operations Regulations:**  
Requires an assessment to be carried out in relation to activities that require pushing, pulling, lifting, and placing down activities and to remove any risk associated with these tasks.
- **Personal Protective Equipment (PPE) at Work Regulations:**  
Again, the provision of PPE should be based on the findings of the risk assessment process. When all risk reduction processes have been explored and no other method of reducing the hazard can be found, the provision of PPE is required and the regulations state that this equipment is provided free of charge and is maintained and inspected.
- **Provision and Use of Work Equipment Regulations:**  
These regulations cover all work equipment from large heavy earth moving equipment down to photocopiers. The regulations require they are in suitable for purpose, maintained and that people are made competent in the use of that work equipment.
- **The Workplace Health, Safety and Welfare Regulations:**  
These regulations relate to the safety and welfare of employees in the workplace, in regard to temperature, lighting, ventilation, and general welfare of the employees while at work. They also cover rest breaks and facilities

provided for these breaks as to washing and eating facilities and are in a clean and maintained manner.

In addition to the above, all aspects of the work activity are covered by Regulations such as the “Electricity at Work Regulations, “Control of Substances Hazardous to Health” and “Dangerous Substances and Explosive Atmospheres”. The foregoing is a summary of legislative requirements and is in no way exhaustive; if in doubt seek help or advice. There is now a comprehensive HSE website which has links to a variety of advisory services.

## **2.2. Training**

- Airport staff shall be thoroughly trained in all operations and procedures which they will be called upon to perform in the course of their duties, and in all actions to be taken in the event of an emergency.
- An employee training record shall be maintained for every employee which indicates:
  - a) For which tasks training has been given and the date of such training
  - b) The signature of the trainer
  - c) An assessment of whether the trainee demonstrated satisfactory understanding of the training
  - d) The signature of the trainee.
- Follow up job observation is to be undertaken, with refresher training if it is found to be necessary.
- Training is to cover routine standard tasks such as sampling, tank and filter draining, etc. and tasks which are specific to a location, such as fuel receipts, tank management etc. The latter tasks must be the subject of specific written procedures, which in the case of a licensed aerodrome should be part of the Aerodrome Manual.

## **2.3 Accidents, Incidents and Near Misses – Reporting and Investigation**

All sites shall have a system for recording accidents, incidents and near misses to ensure that HSE events are documented and lessons learned. The system shall include the reporting of incidents as required by contractual arrangements with the aviation fuel supplier and to the HSE authorities.

Written procedures shall be available for responding to aircraft accidents/incidents. Guidance in their preparation should be provided by the aviation fuel supplier.

Any damage to aircraft caused during a fuelling operation shall be reported immediately to the aircraft representative or pilot.

## **2.4 Emergency Response Procedures**

Airport staff should be able to analyse emergency situations, act in a disciplined manner and apply the correct procedures with confidence, and emergency procedures should be included in their training.

**Note: Fire Prevention Measures are contained in Part 2 of this document.**

## **2.7 Security**

Airport facilities shall be secured to prevent the access of unauthorised people to prevent theft of fuel and equipment, contamination of fuel and the use of equipment for illegal activities. Keys should be removed from unattended vehicles.

## **2.8 Fuel Spillage**

- Spillage and leakage shall be avoided at all times. Any uncontrolled release of product represents a fire hazard as well as an environmental pollutant. Even the smallest of drips from a leaking valve or flange may eventually result in environmental damage unless appropriate action is taken to stop the leak and clean up the affected area. Any testing activity involving the handling of fuel is a potential source of spillage and it is important that care is taken during all product handling procedures to avoid spilling any product.
- In the case of a spillage occurring which measures more than two metres in diameter, the refuelling operative should
  - a) Consider evacuation of the area. It is generally safer upwind and upslope of any fuel spillage
  - b) notify the Aerodrome Fire Service and comply with laid down aerodrome procedures
  - c) Prevent the movement of persons or vehicles into the affected area and ensure that all activities in the vicinity are restricted to reduce the risk of ignition
- If large scale spillage occurs, fuel should not be washed into drains or culverts, and every effort should be made to contain and recover the product. In the event of such contamination occurring accidentally, large scale water flushing should be carried out at once and the local water authorities notified. Absorbent cleaning agents or emulsion compounds may be used to absorb the spilled fuel.
- Contaminated absorbents should be placed in suitable containers and removed to a safe location for disposal. The selection of tools and equipment to be used in removing spillage and the disposal of contaminated materials should have regard to minimising the risk of ignition.

## **2.9 Stock Control**

It is the responsibility of the Designated Person to ensure that the quantities of each grade of fuel received, stored and delivered are accurately measured, recorded and monitored.

### **3. RECEIVING BULK FUEL SUPPLIES**

#### **3.1 Documentation**

- Documentation should clearly state the type of fuel being supplied, and that it complies with the relevant specifications: Jet A1 should comply with Defence Standard 91-91 and Avgas with Defence Standard 91-90. Jet A1 containing Fuel System Icing Inhibitor (FSII or AL48) may also be dispensed: this fuel should comply with Defence Standard 91-87.
- On delivery of fuel, the person in charge of the installation will normally be required by the supplier to endorse the Certificate of Conformity/Release Note to confirm that the grade of fuel is as ordered.

#### **3.2 Pre-Delivery Checks**

- Before the release documentation is accepted and delivery permitted, the person responsible for receiving the fuel should:
  - a) Check that the grade and quantity as shown on the certificate are as ordered, and correspond with the grade of fuel in the receiving tank;
  - b) Examine the seals on the delivery vehicle and ensure that they are intact. Also check the vehicle grade plate indicator.
  - c) Check there is sufficient available capacity in the receiving tank(s) for the quantity of fuel to be received.
  - d) Sample and test the fuel in the receiving tank(s) for the presence of water in accordance with the procedures detailed in section 4. If necessary flush the water drains until a clear and water-free sample is obtained.
  - e) Allow the delivery vehicle to stand on level ground for ten minutes, then draw a sample from the outlet tap of each vehicle compartment from which fuel is to be delivered and check in accordance with the procedures detailed in Section 4.
  - f) Repeat the procedure in paragraph e) above if the sample is unsatisfactory. If a third sample is necessary and this also proves to be unsatisfactory, delivery of the fuel should be refused and the fuel supplier informed.
- Once a satisfactory visual sample and density result (see note below) have been obtained, the vehicle should be bonded to an approved earthing point and discharge of fuel commenced into the selected and correctly grade-plated receiving point. (See Part 2 Section 4 for bonding)

Note: If on delivery it is considered necessary to determine the density of the fuel, then the density should not vary by more than 0.003 kg/litre (when measured at 15°C) from the value quoted on the delivery note.

- On completion of the fuel delivery, record the results of the pre-delivery inspection and sample tests. Also record the quantity and grade of fuel delivered. Examples of record forms are shown in Appendix 3.
- All samples of fuel taken should be retained for a minimum of seven days.

### **3.3 Records**

Records should be kept for a minimum of three years in accordance with EASA Part M of all deliveries both to and from installations. These records should show the results of the actions listed in 3.2 above and include details of the checks and items listed below:

- a) The results of sampling, water drain checks, differential pressure, filter and floating suction head checks.
- b) Details of incoming consignments with cross reference to release notes/certificate of conformity
- c) Receiving tanks contents and water check, settling times and release checks.
- d) Label and retain fuel samples, see Section 4.
- e) Records shall include details of consequential action where an inspection, sampling or test has revealed a defect or deficiency.

## **4. SAMPLING AND TESTING**

### **4.1 General**

- During the handling and storage of aviation fuels, sampling checks will be required to ensure that fuel intended for use is in a fit stage for that purpose.
- Written records confirming that the fuel installation is being kept in a fit state for the storage and dispensing of aviation fuel shall be made after each assessment of the installation or the fuel's suitability. These records shall be preserved by the management of the fuel installation for at least 12 months from the date of assessment. The records shall include details of consequential action where an inspection has revealed a defect or deficiency.
- CAA Inspectors will require to see documentary evidence relating to the qualifications and competence of personnel employed in the management and operation of the fuel installation and the fuelling of aircraft.
- Records of inspections, sampling, test, maintenance, servicing and cleaning of the fuel installation and the aviation fuel held at the aerodrome shall be produced at the request of any person authorised by the CAA or the fuel supplier.
- A sufficient number of representative samples of aviation fuel shall be taken and retained as evidence that the fuel installation is being kept in a state fit for the storage and quality control of aviation fuel so that it will be fit for use in aircraft (see 4.6)

### **4.2 Sampling Intervals**

- Storage tanks should be constructed or adapted so as to allow upper, middle and lower samples to be taken. These samples, taken through the depth of the tank, may be required from time to time for analysis.
- Sampling, in accordance with the procedures detailed in Appendix 3, should be carried out at the following times:
  - a) Each day before the first delivery from the tanks
  - b) Immediately before receipt of fuel into tanks;
  - c) After receipt when the fuel has been allowed to settle for the recommended period
  - d) After prolonged heavy rain or snow.

Note: Line flushing should always be sufficient to ensure that a proper tank sample is obtained.

- After testing for water, the efficacy of the used capsule should be determined by deliberately contaminating it with water or saliva after sampling to ensure that it would have indicated water contamination if any had been present.

### **4.3 Visual Examination**

- Fuel should be considered unfit for use in aircraft if visual examination shows:

- a) The presence of sediment;
  - b) Globules of water;
  - c) Cloudiness;
  - d) A positive reaction to water finding paste, paper or a chemical detector
- The following should serve as a guide to the visual assessment of fuels:
    - a) Colour. Not all Avgas is blue, only Avgas 100LL. Aviation turbine Jet A1 is undyed and can vary in appearance from water white to straw yellow.
    - b) Undissolved water (free water) will appear as droplets on the sides or as bulk water on the bottom of the sample vessel. When suspended water is present the fuel will appear hazed or cloudy.
    - c) Solid matter (particulate matter) generally consists of small amounts of rust, sand, dust, scale etc. suspended in the fuel or settled out on the bottom of the sample vessel.
    - d) The terms 'clear' and 'bright' are independent of the natural colour of the fuel. 'Clear' refers to the absence of sediment or emulsion. 'Bright' refers to the sparkling appearance of fuel free from cloud or haze.

#### **4.4 Sample Containers**

Clean, clear glass jars with wide necks and screw caps should be used for sample examination. Where, in addition, buckets are utilised they should be manufactured from stainless steel. When fuel is drawn into buckets they should be bonded to the fuel line by cable and clip. All sampling equipment should be kept in a scrupulously clean condition.

#### **4.5 Sampling Procedures**

- For Avgas water finding paste applied to the end of a dipstick or dip tape should be used for direct checking of fuel in bulk storage, barrels or fuelling vehicles. Fresh paste must be used for each check and the dipstick allowed to rest on the bottom of the container for a short period of time but not for longer than 10 seconds. Water finding papers can also be used. For Jet A1 water capsules must be used with a sample extracted by syringe.
- Fuel samples from above ground storage tanks and aircraft fuelling vehicles should be drawn from sampling or drain cocks. From buried tanks and barrelled supplies fuel samples should be obtained by using a thief pump.
- Sample size should be sufficient to complete a full and conclusive check of the state of the fuel. As a general guide, when sampling from fuel company delivery vehicles, bulk storage or aircraft fuelling vehicles, at least one litre should be drawn from each compartment. A one litre sample will suffice when checking barrelled fuel supplies.
- Samples should then be checked for colour, sediment, water globules, cloudiness and general cleanliness. Check for free or suspended water by using a water detecting paste or specialised paper. Aviation turbine fuels will require checking by using a chemical water detector. The presence of free or suspended water is indicated by a distinct change in the colour of the paste, paper or detector element.

#### **4.6 Retained Samples**

- Samples should be taken and retained for a minimum of 7 days for the following activities:
  - a) For all deliveries, whether by road tanker or in packages;
  - b) From the bulk tank, vehicle or packed stock each day aircraft refuelling is made
  - c) Whenever samples are taken for laboratory testing.
  
- All samples should be kept cool and stored in suitable containers out of daylight and be labelled with the following information:
  - a) Grade of fuel;
  - b) Reason for sample;
  - c) Date and time of sample;
  - d) Place taken;
  - e) Name of sampling person.

## **5. STORAGE OF FUELS IN BULK**

### **5.1 General**

- All facilities that are used for handling aviation fuel must be fully segregated from other products. Different grades of aviation fuels must also be segregated. Installations should have separate delivery and suction lines.
- The use of protective treatments containing zinc is prohibited for the internal lining of pipelines, storage tanks and any other equipment. Zinc alloys, copper or copper alloys, cadmium plating, galvanised steel and plastic materials should not be used for main piping.

### **5.2 Tanks**

- New tanks should be constructed and installed so as to prevent the ingress of water and dirt and should comply with legislation and the requirements of the local Petroleum Officer. They must also comply with the Oil & Pollution Control Regulations 2005 (as amended).
- Existing tanks may have been in use for many years. When tanks are buried, the manhole chamber/cover should always be kept clean and clear of water.
- Jet A1 storage tanks should have free vent devices. Avgas tanks should have pressure/vacuum relief valves, unless the tank is underground.
- All possible precautions should be taken to avoid the entry of water or dirt into storage tanks. Open ended pipes, hoses and sampling points should be fitted with dust caps, plugs or other suitable protection which should be replaced tightly after use.
- Water should always be withdrawn from the lowest points of tanks. Buried tanks should be provided with a thief pump drawing from the tank sump.
- Samples that have been tested and indicate that the fuel may be contaminated are an indication that the integrity of the installation should be investigated immediately. If frequent evidence of contamination is found the tank should be internally inspected and cleaned.
- A newly lined tank should be inspected one year after the lining is installed to check for soundness and adherence to the tank shell. Defects should be rectified before the tank is refilled.
- It is recommended that all fuel tanks should be coated with a suitable epoxy lining except for stainless steel tanks. A specification for tank linings is available from the fuel suppliers. Tanks made from plastic materials are not acceptable.
- A tank test and/or inspection is required if excessive contamination is found in filters or samples.
- The use of a floating suction fitted with a stainless steel check cable is recommended for the delivery of fuel from storage tanks. Check chains should not be used. Whether fixed or floating systems are used, the suction point should be positioned well clear of the tank sump, and in the case of a fixed suction at least 50 cms clear of the tank bottom.

### 5.3 Pipe work

- To ensure the integrity of fuels it is essential that each grade of fuel is handled in a completely segregated system with no interconnecting lines between pipelines which handle different grades of fuel. Separate input and outlet lines should be provided.
- Drain points should be fitted at all pipeline low points.

### 5.4 Filters

- Avgas installations: Tank input and output lines should be fitted with filters of not less than 80 microns (180 mesh). Also a 5 micron filter should be fitted on the output line. 80 micron filters should be inspected weekly and cleaned if necessary. Damaged filters should be replaced.
- Aviation turbine fuel installations: Tank input lines should be fitted with a 5 micron micro filter, or a filter separator. The output line should also be fitted with a filter separator. Filter separators should have a nominal rating of 5 microns for solid particles and a maximum of 15 parts per million for water.
- All hose ends should be fitted with filters which should be inspected at least once monthly and if necessary, cleaned, repaired or replaced. Excessive contamination of a hose end filter may indicate deterioration of the hose in which case the hose should be replaced.
- Filter separators, filter monitors and micro filters should have the differential pressure (dp) checked weekly. The check should be completed at the maximum possible flow rate and the pressure readings recorded. Filter separator elements should be changed when the dp limit at the rated vessel flow as recommended by the manufacture is reached, or at least annually.
- Where a sudden or significant change of dp from the previously recorded trend is detected, the elements of micro filters or filter separators should be checked. They should also be inspected and replaced if necessary when a significant reduction in flow rate is observed or when a sequence of unsatisfactory drain samples is obtained.
- Where flow rates exceed 1150 litres/min it is recommended that quarterly Millipore colour checks are taken to assess the performance of the filtration equipment.
- When initially filling a filter separator vessel the fuel flow should be regulated to prevent an excessive build up of static electricity.
- Jet A1 is a very good insulator. Jet A1 supplied within the UK contains a static dissipater additive which reduces static electricity hazard. Fuel suppliers will advise whether fuel contains this additive. Suppliers may also provide advice on operating procedures and engineering safeguards which can be adopted to minimise static electricity hazards.
- All filters (monitors and coalescers) should conform to API-1581.

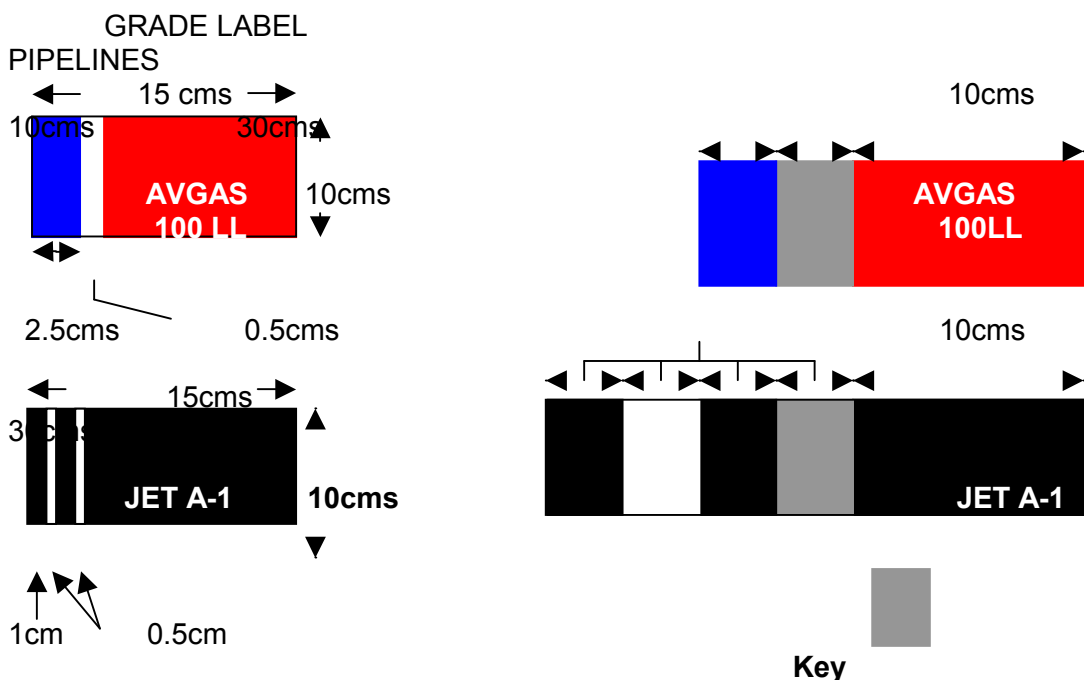
## 5.5 Settling Times

- On completion of delivery, before aviation fuel is dispensed from the receiving tank, fuel should be allowed to settle for a period of time that depends on the grade and depth of fuel in the tank. The settling time is also dependent on the type of tank, filter arrangement and the method by which fuel is drawn from the tanks.
- When discharge of fuel from the delivery vehicle has commenced, no fuel should be dispensed from the receiving tank until adequate settling time has elapsed and the satisfactory completion of the water and fuel cleanliness check carried out in accordance with the procedures detailed in Section 4.
- Horizontal tanks fitted with floating suction devices require a minimum settling time of one hour. Vertical tanks similarly equipped require a settling time of two hours.
- On tanks where floating suction devices are not provided, or where floating suction lines are used but not fitted with the filter arrangements mentioned above, the following minimum settling times, dependent on fuel grade stored, may be required:

Jet A1      3 hours per metre depth or 24 hours, whichever is less;  
 Avgas      90 minutes per metre depth.

## 5.6 Labelling and Colour Coding

All tanks should be labelled and colour coded to identify the grade of fuel they contain. Pipelines should also be similarly labelled and colour coded. If more than one grade of fuel is stocked, the recommended form and dimensions of labelling and colour coding are illustrated in Fig. 1. The overall dimensions of the grade labels should not be less than illustrated, but the dimensions of the coloured segments on both labels and pipelines may be varied provided that the primary indicator colours for the grades (red for Avgas and black for Jet A1) predominate. The grade wording as illustrated should always be used.



## General Pipeline Colour

- As an additional measure to avoid refuelling errors it is recommended that the appropriate grade markings or a band of the appropriate primary grade indicator colour referred to above should be painted on delivery hoses or pipes as close as practicable to the delivery nozzle, but not on the nozzle itself. Any colour coding on the delivery nozzle should be provided by a material which will not flake or separate from the nozzle whilst in general use.
- All aviation fuel containers, including vehicles, should be clearly marked with the grade of fuel they contain. Drums or vehicles containing petroleum spirit should be marked 'Petroleum Spirit' and the words 'Flammable' or 'Highly Flammable' as appropriate. Containers should not be used for any other product or purpose other than that for which they are marked.

## 5.7 Change of Grade Procedures

Change of fuel grade in storage tanks can pose a risk of contamination of the new grade by residues of the previous fuel stored and therefore, where possible, such changes should be avoided. If this is not practicable it is recommended that guidance on the proper procedures should be obtained from the fuel supplier concerned. Additional information on this operation can be found in Defence Standard 91-66.

## 5.8 Hoses

- Hoses shall comply with the requirements of BS EN1361 (2004). New hoses, and hoses previously used in aviation fuel systems, should be checked and before use thoroughly flushed with fuel appropriate to the installation. Hoses that have been used previously for non-aviation fuels should not be used on aviation fuel installations.
- Fuel in delivery hoses should be recirculated if the delivery system has been unused for a period of two days. If a delivery system has been unused for longer than this period, then fuel lying in a hose should not be recirculated or dispensed to aircraft unless a satisfactory sampling check is obtained.
- Hose couplings must be of the clamped type to ensure adequate bonding with the hose. Jubilee type clips must not be used.
- Hoses should be inspected 6 monthly for external damage and replaced if the internal reinforcement is exposed. Hoses **must** be replaced when they are 10 years from date of manufacture.

## 5.9 Laboratory Testing of Fuel Stocks

- Fuel deteriorates with time and prolonged storage may render it unfit for use in aircraft. Therefore the quality of static bulk stocks of aviation fuels should be verified by laboratory tests when:
  - a) Jet A1 has been stored and not added to for a period of twelve months;
  - b) Avgas has been stored and not added to for a period of six months.

- The quality of aviation fuel stored in either a tank commissioned for use from new, or stored in a tank which has been reintroduced to service after cleaning requires verification by laboratory tests
- The companies supplying fuel can provide information on recognised laboratories that can undertake these tests.
- In any event, where the suitability of aviation fuel is in doubt, a full specification test to the relevant Defence Standard may be conducted if a 5 litre sample of the fuel is available. If this is not possible, then sufficient data may be obtained from the results of the following tests, for which a 2.5 litre sample is the minimum required: appearance, density at 15°C, distillation, copper strip corrosion, freezing point, existent gum, flash point, water reaction, electrical conductivity and thermal stability.

#### **5.10 Records**

In addition to the records listed above, a record of tank inspections, tank cleaning and maintenance work should be kept for at least three years.

## **6. AIRCRAFT FUELLING VEHICLES**

### **6.1 General**

- All fuelling vehicle equipment should be constructed of either aluminium alloy, stainless steel or mild steel protected internally with an epoxy lining. Zinc and copper alloys, cadmium plating, galvanised steel or plastic materials are not permitted.
- Grade identification labels of the type illustrated in Section 5.6 should be carried in prominent positions on fuelling vehicles. Fuel inlets and outlets including hoses and nozzles should be marked accordingly.
- Tank compartments, whether lined or unlined, should be kept clean and precautions taken to prevent the entry of contaminants. All open-ended hoses, pipes and sampling points should be fitted with dust caps, plugs or other suitable protection that should be properly replaced after use.
- Tank compartments should be designed so as to drain to a low point sump fitted with a drain line valve. Drain lines should have a constant downward slope with a drain plug fitted at the lowest point overall which will permit complete draining of the tank installation.
- Tank compartments should be drained and inspected internally within a twelve monthly inspection cycle. Cleaning and repair work, when necessary, should be completed during these periodic inspections.
- Where fuelling vehicles draw fuel from aerodrome installations that handle both Jet A1 and Avgas, all line couplings should be grade selective. A fuelling vehicle should carry only one grade of fuel.
- Change of fuel grade in vehicle tanks can pose a risk of contamination of the new grade by residues of the previous fuel carried. Therefore such changes should be avoided. If this is not practicable it is recommended that guidance on the proper procedures should be obtained from the fuel supplier concerned. Additional information on this procedure can be found in Defence Standard 91-66.

### **6.2 Sampling and Purging**

- All fuelling equipment (drain cocks, tank compartments, filter separators, filter monitors, micro filters, gauze filters and air separators) should be purged of water and sediment
  - a) Before the first aircraft refuelling each day;
  - b) After each filling of the vehicle and after defuelling;
  - c) After vehicle washing, prolonged heavy rainfall or snow.
- After a refuelling vehicle has been filled, samples should not be taken until 10 minutes settling time has been allowed. No deliveries either from or into the vehicle should be made until satisfactory samples are obtained. If unsatisfactory samples continue to be obtained, action must be taken to identify and eliminate the cause. Satisfactory samples may be returned to storage.

### **6.3 Records**

Records should be kept of all fuel deliveries both into and from vehicles, together with the results of sampling differential pressure, purging and filter checks.

Results of tank inspections should also be recorded along with a record of all rectification and maintenance work. Details of hose inspections should also be kept.

Records should be kept for a minimum of three years.

## **7. DEFUELLING PROCEDURES**

### **7.1 Defuelling**

- When an aircraft is to be defuelled, whether in total or in part, instructions on the disposal of the fuel should be obtained from the aircraft operator. Fuel must not be returned to aircraft tanks unless satisfactory quality checks are obtained.
- The acceptance of fuel from aircraft into fuelling vehicles or aerodrome storage tanks can introduce the following two hazards to quality:
  - a) Water, other liquid or sediment from the aircraft tanks may be introduced into vehicle or storage tanks;
  - b) Fuel taken from aircraft tanks, and any resultant blend with existing contents of the vehicle or storage tanks, may not meet the appropriate product specification.
- The above mentioned hazards will be avoided by defuelling into an empty fuelling vehicle or an empty storage tank segregated from other parts of the installation. Before defuelling is commenced, samples should be taken from the drain cocks of each aircraft tank involved in the defuelling operation. Unsatisfactory samples do not preclude defuelling but will call for particular attention and thoroughness in the cleaning of vehicles and tank installation after disposal of the fuel.

### **7.2 Records**

Records of all defuelling operations are required. They should include the registration of the aircraft involved, the results of sampling checks and the quantity and grade of fuel drawn. Records should also be made of the fuel disposal.

Records should be kept for a minimum of three years.

## **8. BARRELLED SUPPLIES**

### **8.1 Delivery, Handling and Storage**

- A barrel is generally considered to be a container having a capacity less than 210 litres. Barrels storing aviation fuel should be distinctly coloured according to grade.

Jet A1	Body black with white ends Closure seals should show the grade name in white on a black background
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Avgas 100LL	Body olive drab with red ends.
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- Before acceptance, barrels should be examined for damage and seal integrity. Grade marking and inspector's identification should cross check with details on the delivery note and release certificate.
- Barrels should be stored under cover, clear of the ground and on their sides with both bungs below the liquid level.
- A storage system should be adopted that will use the oldest fuel first, according to batch number and filling date.
- Different grades of fuel should be separated from each other to minimise the risk of fuelling error.
- Batches of Avgas require laboratory testing six months after the filling date with periodic six monthly checks thereafter. For Jet A1 the testing period is every twelve months. After sampling the barrels must be resealed.
- No leaking drum or container should be used for fuelling aircraft.

### **8.2 Sampling**

- Before sampling, check that the seals are intact then stand the barrel on end and wipe clean the area adjacent to the bung. Allow the contents to settle before drawing off the required quantity of fuel.
- Discolouration of the fuel, or the presence of water or dirt in the sample, indicates that the fuel is unfit for aviation use and therefore the barrel must be rejected.

### **8.3 Decanting and Dispensing**

- Fuel should preferably be decanted from barrels into fuelling vehicles or storage by means of a suitable pump and lines fitted with a micro filter or filter separator. Avgas may alternatively be decanted through a funnel fitted with an 80 micron filter. Plastic funnels must not be used.
- When it is necessary to dispense fuel direct from barrel to aircraft, the barrels should be stood on end and the contents allowed to settle for ten minutes before taking samples. Once a satisfactory sample has been obtained fuel may then be dispensed to the aircraft tanks through a suction standpipe designed so that fuel cannot be drawn from below a depth of 75 mm from the barrel bottom.

- Delivery of Avgas or Jet A1 to an aircraft should be via a filter monitor type element or equivalent filter. Additionally, Jet A1 delivery should be through a micro filter or filter separator. Specifications for filters and hoses are given in Section 5.
- After decanting or dispensing fuel, replace barrel caps tightly and reseal.
- After use, drums should not be refilled with fuel intended for aviation purposes. It is recommended that when emptied barrels should be returned to the fuel supplier.

#### **8.4 Records**

Records should be kept of all barrel deliveries, decanting and dispensing of fuel, and sampling checks.

Records should be kept for a minimum of three years.

## PART 2 - FIRE PREVENTION AND SAFETY MEASURES

### 1. INTRODUCTION

- The aerodrome authority, the aircraft operator and the fuelling organisation each have responsibilities in respect of the safety measures to be taken during fuelling operations.
- Much of this guidance will also apply to the fuelling of aircraft on water, and to the precautions to be taken during maintenance of aircraft fuel systems, but supplementary instructions will generally be necessary to provide for these cases.

### 2. FUELLING OF AIRCRAFT INSIDE HANGARS.

- During major servicing of aircraft it may be necessary on occasions to fuel or defuel immobilised aircraft within maintenance hangars. When this becomes necessary it is essential that close supervision is established and maintained throughout the transfer of fuel. In order to reduce fuel vapour levels and to facilitate any required emergency evacuation or response, this operation should be undertaken with the hangar doors open. Fuel lines in use should be routed via the open hangar doors.
- In hangar fuelling procedures should cover the following:
  - a) In hangar fuelling should be restricted to kerosene turbine fuel, i.e. Jet A1
  - b) In the absence of a fixed automatic fire protection system capable of dealing with a fuel fire, the airport or company fire service should standby throughout the transfer of fuel.
  - c) The fuelling vehicle should be positioned outside the hangar
  - d) In order to prevent the automatic venting of aircraft fuel tanks, not more than 25% of the total aircraft fuel tank capacity should be uplifted. Only the minimum amount required to perform the task should be transferred.
  - e) A fuelling overseer should be positioned inside the hangar in full view of the fuelling hose and aircraft, and in a position to communicate immediately with the fuelling vehicle operator.
  - f) A fuelling vehicle operator should be positioned outside the hangar adjacent to the fuelling vehicle controls and in a position to communicate immediately with the fuelling overseer.
  - g) Procedures recommended throughout this publication specifically regarding precautions within the fuelling zone should be strictly adhered to.

Note: The above operations should be permitted only when it is impracticable to fuel/defuel outside the hangar. It should be permitted only for fuel calibrations during major checks or fitment and testing of fuel tank booster pumps, balance pipes, fuel leak tests and other minor assembly work.

It **should not** be permitted for the purposes of tank overspill tests, dump valve tests or normal fuelling of the aircraft. Particular attention is drawn to bonding and earthing requirements.

All fuel hoses should have self-sealing couplings with all couplings (except the direct aircraft connection) outside the hangar. Hose pressure testing records should be available for scrutiny prior to commencement of fuelling/defuelling inside hangars.

### **3. FUELLING AREA AND FUELLING ZONE**

#### **3.1 Fuelling Areas**

- The fuelling of aircraft at an aerodrome should normally be carried out in the open air and should only be carried out in areas approved by the aerodrome authority.
- As a general guide, fuelling areas should be sited to avoid bring fuelling equipment or aircraft fuel tank vents to within 15 metres of any building other than those parts constructed for the purpose of direct loading or unloading of aircraft.

#### **3.2 Fuelling Zone**

- The fuelling zone should be regarded as extending not less than 6 metres radially from the filling and venting points on the aircraft and the fuelling equipment. When defuelling is taking place, the vehicle will be venting and will generate a fuelling zone radiating from the tank vent.
- During fuelling operations air and fuel vapour are displaced from the aircraft fuel tanks. This potentially explosive vapour is expelled via vent points.
- Within the fuelling zone, smoking and the use of naked lights should be prohibited. Operation of mobile phones and the switches on lighting systems of other than intrinsically safe types should be forbidden. Personnel working within the fuelling zone should not carry matches or other means of ignition or wear footwear with exposed iron or steel studs, nails or tips.
- Passengers should not be allowed within the fuelling zone.
- No Smoking signs should be displayed not less than 15 metres from the fuelling equipment and aircraft tank vents.
- APUs which have an exhaust efflux discharging into the fuelling zone should, if required to be in operation during fuelling, be started before filler caps are removed or fuelling connections made.
- If an APU located within the fuelling zone is stopped for any reason it should not be restarted until the flow of fuel has ceased and there is no risk of igniting fuel vapours
- GPUs may be operated provided they are positioned not less than 6 metres from aircraft filling and venting points and other fuelling equipment when in use.
- Equipment with all-metal wheels or metal studded tyres capable of producing sparks should not be moved in the fuelling zone whilst fuelling is in progress.
- All hand torches and inspection lamps and their cable connections used within the fuelling zone should be certified for use in such an environment.
- Vehicle engines should not be left running unnecessarily in the fuelling zones.
- Photograph flash bulbs or electronic flash equipment should not be used within 6 metres of the fuelling equipment or any filling or venting points of the aircraft.

- Aircraft batteries should not be installed or removed nor should battery chargers be connected, operated or disconnected during fuelling.
- Oxygen systems should not be replenished.
- The Aerodrome Authority should issue guidance as to when fuelling operations should be suspended due to the proximity of severe electrical storms.
- Aircraft combustion heaters should not be used.
- Passengers should not remain on board during fuelling operations.
- The main aircraft engine(s) should not be operated (except for helicopter engine(s) as described below).
- All ground equipment such as steps, etc. should be positioned so that the aircraft settling under the fuel load will not impinge on the equipment.
- It is essential that engines and exhaust systems of fuelling vehicles, other vehicles and equipment required to operate in the fuelling zone should be subjected to the most stringent and regular maintenance to eliminate defects which may result in the emission of sparks or flames capable of igniting fuel or fuel vapour.

#### **4. PRECAUTIONS PRIOR TO FUELLING**

##### **4.1 Aerodrome Fire Service**

All personnel involved in the fuelling aircraft should be familiar with the procedure for summoning the Aerodrome Fire Service.

##### **4.2 Fire Extinguishers**

Suitable fire extinguishers should be provided at readily accessible positions, especially on the refuelling vehicles. They should be subject to regular inspection and maintenance and fuelling staff should be instructed in the use of these extinguishers.

##### **4.3 Overheated Undercarriage Assemblies**

The aircraft operator should ensure that when any part of an aircraft undercarriage, e.g. wheels, tyres or brakes appear abnormally hot, the Aerodrome Fire Service is called. Fuelling should not take place until the heat has dissipated and the Fire Officer confirms that it is safe to proceed. Fuelling equipment should not be positioned at an aircraft until the Designated Person is advised that no risk remains.

Note: In checking for high temperatures, care should be taken in approaching the wheels. Approach only from the front and rear, never from the sides.

##### **4.4 Clear Exit Paths**

The refuelling operative should ensure that a clear path is maintained from the aircraft to allow for the quick removal of fuelling vehicles and equipment. Fuelling equipment should be positioned so that there is no requirement for vehicles to

reverse before departure. All vehicles and equipment should be positioned to allow the unobstructed exit of persons from the aircraft in an emergency.

#### **4.5 Bonding and Earthing**

An electrostatic charge may be accumulated on the surface of the aircraft or fuelling vehicle when conditions are favourable. Ensuring that the fuelling vehicle is bonded to the aircraft so that a difference in electrical potential cannot occur between the two can eliminate the hazard of sparking.

- All connections between ground equipment and the aircraft should be made before filler caps are removed and not broken until the filler caps have been replaced.
- The aircraft, fuelling vehicle, hose coupling or nozzle, filters, funnels or any other appliance through which fuel passes, should be effectively bonded to each other throughout the fuelling operation. Connection should be made to designated points or to clean unpainted metal surfaces of the aircraft and fuelling vehicles. Plastic fuel containers, unless specifically designed to have anti static properties, should not be used to transport or move fuel around airports for the purpose of filling aircraft, as the sloshing of fuel can allow electro static charge to build up. Plastic filler funnels or pipes should NEVER be used to guide fuel into aircraft tanks.
- Where appropriate it is recommended that a metal container and funnel is used. If necessary make up a proper bonding device from copper braid bonding wire with PVC coating and heavy duty crocodile clips. The funnel and fuel container must be bonded.

Note: Unless approved bonding points are provided, bonding clamps should never be attached to landing gear or highly stressed components as this may result in serious damage.

- Before the transfer of fuel commences, earthing and bonding should be carried out as follows:
  - a) The aircraft should be effectively bonded to the fuelling equipment. Reliance must not be placed upon conductive hoses for effective bonding and only dedicated clips and wires provided for this specific purpose should be used.
  - b) Prior to over wing fuelling the nozzle of the hose should be bonded to the aircraft structure before removing the tank filler cap.
  - c) When pressure fuelling the mechanical metal-to-metal contact between the aircraft fitting and the nozzle eliminates the need for a separate hose end bonding cable.
  - d) Any cable, clips and plugs for bonding should be maintained in good condition and regularly tested for electrical continuity.
  - e) When fuelling from hand operated equipment including pumping from cans or drums, similar precautions should be taken to bond the pumping equipment, hose nozzle and containers. If funnels are used they should be bonded both to the nozzle of the hose or can and to the aircraft using wires provided for this specific purpose.

## 4.6 Helicopters

- In helicopters, pressure and gravity fuel inlets and fuel tanks are generally very close to the cabin area. Passengers should not remain in the helicopter whilst fuelling is in progress except during ambulance and life saving operations, or when prevailing weather conditions would create significant disembarkation and embarkation risks. If due to the exceptional circumstances, passengers must remain on board during fuelling operations, they are to be briefed to unfasten their seat belts, all main exits must be available for immediate use and the external area adjacent to the exits kept clear. Operators should define those circumstances where it may be suitable after risk assessment to carry out re-fuelling with passengers on board in their Operations Manual and any further hazard controls that they consider necessary.
- Fuelling at onshore sites whilst engines/rotors are running should be considered only to cover urgent circumstances; these may include:
  - a) Ambulance and other emergency missions where time is of the essence;
  - b) When severe weather conditions make it inadvisable to stop engine/rotors;
  - c) Operational requirements at the aircraft commander's discretion
  - d) Circumstances that could require the flight crew to carry out pre-departure checks normally undertaken by an engineer.
- If because of the circumstances described above it is necessary to keep the engines running, extreme care should be exercised and the general guidance covering the Fuelling Zone (see 3.2) should be followed. Helicopter operators should ensure that fuelling companies are provided with appropriate written instructions regarding the aircraft and the required safety measures and emergency procedures to be followed.
- In the severe weather and wind conditions such as experienced on offshore rigs/platforms, it may be necessary to keep helicopter engines running after landing on the helideck to achieve a quick turn-round. Operational reasons may also make it necessary to fuel the helicopter. In such circumstances the commander of the helicopter should be responsible for the overall direction of the fuelling operation, and the operator of the rig/platform should be made aware of the possible hazards, so that they may ensure that their helicopter landing officer fully observes the necessary safety precautions.
- Fuelling with gasoline or fuelling where wide cut turbine fuels not containing anti-static additive are involved should be prohibited whilst engines are running.
- Fuelling with kerosene or wide cut turbine fuels containing anti-static additive should be permitted with engine(s) running only if the exhaust system is higher than the fuel inlet(s) or on the opposite side of the helicopter.

## APPENDIX 1 GLOSSARY & ABBREVIATIONS

For the purposes of this publication the terms below shall have the following associated meanings:

APU	Auxiliary Power Unit
Density Check	This check is frequently made to confirm the correct grade and unchanged quality of fuel stocks by comparison of test results with the value recorded on delivery documentation. Should this comparison, after correction to standard temperature (15°C), differ by more than 0.003 kg/litre, fuel contamination may be present and therefore further investigation should be made before the product is accepted for aviation use.
Fuel	Fuel intended for use in aircraft
Fuelling	Embraces both fuelling and de-fuelling unless otherwise specified
Fuel Equipment	Any device or apparatus or part thereof through which fuel passes when being transferred into or from an aircraft, or between fuel installations
Fuel Installation	Any container or vessel used for the storage of fuel, including a vehicle, designed, manufactured or adapted for this purpose or for the delivery of such fuel to an aircraft or another installation
Fuel Installation Manager	The aerodrome licensee or a person designated by the licensee as being responsible for ensuring and maintaining the quality of fuel received and stored at the aerodrome, and of fuel subsequently delivered to aircraft.
Fuelling Zone	An area that would qualify as a Zone 0 or Zone 1 under Dangerous Substances and Explosive Atmosphere Regulations (DSEAR)
GPU	Ground Power Unit
Incident	Any occurrence that could put personnel or equipment at risk, whether directly or indirectly
Millipore Checks	These are recommended where fuel flow rates exceed 1150 litres/min and therefore may not apply to sites where this document is used. For this test five litres of fuel should be passed through single and double membranes in order to determine colorimetric or gravimetric levels of particulate contaminant.
Wide-cut Fuel	A hydrocarbon mixture that spans the gasoline and kerosene boiling ranges, sometimes known as Jet B or JP-4 and is particularly suited to cold climates e.g. parts of Canada, Alaska and Russia. Also A mixture of gasoline with kerosene where misfuelling has occurred.

## **APPENDIX 2 - EXAMPLES OF RECORD FORMS**

*Companies/Operators should place examples of the forms they use in this appendix or provide a reference to another place where examples may be viewed or obtained*

## **APPENDIX 3 – CHECK LIST FOR FUEL HANDLING**

*(Intended as an aide-memoire for use at installations which are not managed by employees of fuel companies)*

### **1. AVIATION FUEL PURCHASE**

- Purchase orders should specify Jet A1 to comply with specification Defence Standard 91-91 and Avgas 100 LL to comply with specification Defence Standard 91-90. Jet A1 + AL48 to comply with Defence Standard 91/97.
- Delivery of fuel should be accompanied with a Certificate of Conformity (C of C) and a delivery note.

### **2. PRIOR TO RECEIVING FUEL**

- Water check on bottom sample from bulk tank; water drain if necessary
- Check that there is sufficient room in bulk tank to take delivery.

### **3. RECEIVING BULK FUEL SUPPLIES**

- Allow tanker to stand for a minimum of 10 minutes
- Check C of C for correct grade and quantity  
Note: Batch number and test certificate number given on C of C identify the source of the fuel.
- Check all outlets and inlets of tanker for seals and Inspector's number on seal and C of C
- Take sample from each of the compartments and check for water and suspended matter
- Test for density
- Bond vehicle to an approved point
- Check all filters and carry out water drain if necessary. If inlet to bulk storage is fitted with filter separators, check differential pressure immediately after start of discharge of fuel.
- Retain record for predelivery checks, sample checks, quantity and grade of fuel delivered.

### **4. STORAGE OF FUELS IN BULK**

- No fuel should be delivered from a tank after receipt of fuel, until after the specified settling time (see Part 1 – Section 5.5).
- Do water and sediment check of tank bottom or sump after sample line flushing:
  - a) Each day before the first delivery from tank;
  - b) After fuel receipt when the fuel has been allowed to settle for the specific period;
  - c) After prolonged rain or snow.
- After testing for water, the efficacy of the used capsule should be determined by deliberately contaminating it with water or saliva after sampling to ensure that it would have indicated water contamination if any had been present.
- Do water drain daily (or before use) of all filter separators, filter monitors, micro filters and any other drain point on static equipment

- Check buoyancy of floating suction (if applicable) at least weekly.
- Check the dp at maximum flow rate of filter separators, filter monitors and micro filters at least weekly
- Change filter separator elements when the dp reaches 1 bar or after a maximum period of one year
- Change filter monitor elements when dp reaches 1.5 bar, or after a maximum period of one year. If the fuel stored contains FSII (AL48) then change filter monitor elements when the dp reaches 1 bar, or after a maximum period of one year.
- Change micro filter elements when dp reaches 1.5 bar, or after a maximum period of one year.
- Retain records for all receipts, deliveries (including aircraft registration), water drains tanks and filters, differential pressure for at least three years.

## **5. VEHICLE CHECKS**

- Purge water and sediment by sampling checks of drain cocks, t6anker compartments and all filtration equipment:
  - a) Before the first refuelling each day
  - b) After each filling and after defuelling
  - c) After vehicle washing, heavy rainfall or snow.
- Check weekly the differential pressure at maximum flow rate of filter separators, monitors and micro filters. Filter elements should be inspected if there is a sudden change in differential pressure, or sudden change in flow rate, or continuing unsatisfactory drain samples.
- Retain records for all deliveries into and from vehicles, sampling results, filter and dp checks for at least three years.

## **6. CHECKS DURING FUELLING**

- Ensure suitable bonding connections are established before connecting hoses
- Do visual sampling check of fuel downstream of filtration after pumping has commenced.

## **7. DRUM STOCK**

- Do not accept drums/barrels if the seals are broken or leaking or if the drum markings are different from those on the delivery note or C of C.
- Store the barrels on their sides under cover, so that the oldest fuel is used first
- Do sample check before decanting into fuelling vehicles or dispensing into aircraft
- Do not re use drums for aviation fuel.