

# Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-Airfield Storage Terminals

API RECOMMENDED PRACTICE 1595  
SECOND EDITION, OCTOBER 2012



AMERICAN PETROLEUM INSTITUTE



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**Downstream Segment**

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## Foreword

This recommended practice has been prepared by the API Aviation Technical Services Subcommittee with technical participation and feedback from other industry stakeholders, and is intended to provide guidance on the minimum equipment standards and operating procedures for the receipt, storage of aviation fuels at pre-airfield distribution terminals, located directly upstream of an airport, and its shipment directly via a grade dedicated pipeline, marine vessel (barge or ship) or road/rail transport to an airport.

This publication is intended to provide recommendations for safe practice, rather than set rigid guidelines. Users of this publication shall be aware that due consideration shall be given to the effect of any unusual or abnormal circumstance, on which it is not possible to generalize within the scope of this publication. Specialist advice shall be sought in these cases.

The guidance contained in this publication is primarily intended for civil aviation fuel handling operations. However, many of the practices and procedures are suitable for military pre-airfield storage terminals.

In addition, in some areas local or national statutory regulations also apply. This publication is intended to be complementary to these established controls and practices.

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Suggested revisions are invited and should be submitted to the Standards and Publications Department, API, 1220 L Street, NW, Washington, DC 20005, [standards@api.org](mailto:standards@api.org).

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# Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-Airfield Storage Terminals

## 1 Scope and Purpose

This recommended practice (RP) contains basic requirements for the design, construction, operation, and maintenance of pre-airfield storage terminals located directly upstream of the airport, hereafter referred to as “pre-airfield storage terminals.”

Mandatory requirements in this standard are designated by the word “shall.” Recommendations are designated by the word “should.” Optional items are designated by the word “may.” This standard incorporates by reference a number of other standards and recommended practices that need to be referred. The distinction between mandatory, recommended, and optional provisions in the referenced documents is not changed by nature of their reference in this standard.

The values stated for this standard are in U.S. Customary units.

## 2 References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 652, *Lining of Aboveground Petroleum Storage Tank Bottoms*

API Recommended Practice 1543 *Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport*

API Recommended Practice 2003, *Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents*

API Publication 2013, *Cleaning Mobile Tanks in Flammable or Combustible Liquid Service*

API Standard 2610, *Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities*

EI HM 50 <sup>1</sup>, *Guidelines for the Cleaning of Tanks and Lines for Marine Tank Vessels Carrying Petroleum and Refined Products*

EI Standard 1542 <sup>2</sup>, *Identification Markings for Dedicated Aviation Fuel Manufacturing and Distribution Facilities, Airport Storage and Mobile Fuelling Equipment*

EI Specification 1581, *Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators*

EI Specification 1583, *Specifications and Qualification Procedures for Aviation Fuel Filter Monitors with Absorbent Type Elements*

EI Specification 1590, *Specifications and Qualification Procedures for Aviation Fuel Microfilters*

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<sup>1</sup> Energy Institute, 61 New Cavendish Street, London W1G 7AR, UK, [www.energyinst.org.uk](http://www.energyinst.org.uk).

<sup>2</sup> Energy Institute, 61 New Cavendish Street, London W1G 7AR, UK, [www.energyinst.org.uk](http://www.energyinst.org.uk).

### 3 Terms and Definitions

For the purposes of this document, the following definitions apply.

#### 3.1

##### **Pre-Airfield Storage Terminal**

A facility equipped with receipt pipelines and /or docks, storage tanks, filtration, pumps, valves and pipelines for shipping aviation product directly to an airport either by pipeline, marine vessel or road or rail transport.

#### 3.2

##### **MOC**

Systems shall be established for each pre-airfield distribution terminal to review potential health, safety, and environmental considerations resulting from proposed additions, modifications or other changes that may periodically occur at a terminal. The following changes should be properly managed by identifying and reviewing them before implementation:

- material or products handled,
- equipment used or installed,
- operations and procedures.

The system should ensure that designs and operating procedures are reviewed before implementation and should be revised, as appropriate, with the intent of minimizing adverse effects on safety of the community, environment and workforce. Minimum requirements for specific terminals are identified in OPS RSPA 49 *CFR* 195 or OSHA 29 *CFR* 1910.119

#### 3.3

##### **ullage**

The height from the product level in a storage vessel to a datum point on the tank roof or gauging point.

#### 3.4

##### **segregated**

Provision made so that tanks are positively isolated for product quality control. The inlet and outlet to each tank, as well as other possible piping connections to other grades of products shall be fitted with either:

- A double block and bleed (DBB) valve arrangement (either using a single DBB valve, or using two valves with a drain arrangement in a pipe spool between them); or
- A removable distance piece; or
- A spectacle blind.

#### 3.5

##### **dedicated**

Tankage, piping, valves, filters, etc. that are only used to handle one grade of aviation product.

#### 3.6

##### **flowing line sample**

When a storage tank is fitted with a sump recovery tank provision shall be installed to take a sample in a glass jar, stainless steel bucket or closed sampling system from the piping between the storage tank the recovery tank while product is flowing and to visually examine it for water and particulate and traces of red dye. This test is to check that the sump is free of water and particulate which an accumulated sample in the recovery tank can not give you.

-----

### 3.7

#### **release certificate (RC)**

This document supports any transfer of product, confirming compliance with the relevant specification(s), and contains at least the following information:

- Date and time of transfer;
- Grade of fuel;
- Batch number and batch API Gravity at 60 °F (density at 15 °C) of the product in the tank(s) from which it originated. If more than one batch is being included in any shipment then the quantity from each batch is required to be stated on the release document.

NOTE 15 °C is the internationally accepted temperature, but some areas are required to use 20 °C (68 °F).

## 4 General

### 4.1 Nonapplicability and Retroactivity

This recommended practice is intended to provide guidance on the minimum equipment standards and operating procedures for the receipt and storage of aviation fuels at pre-airfield storage terminals, located directly upstream of an airport, and its shipment directly via a grade-dedicated pipeline, marine vessel (barge or ship), or road/rail transport to an airport. This RP does not address in-transit or breakout storage upstream of the pre-airfield storage terminal.

The design and construction provisions of this standard are intended for application at new facilities. Application of the design and construction provisions of this standard to facilities, equipment, structures, or installations that are already in place, that are in the process of construction or that are installed before the date of this publication should be evaluated when circumstances merit. Such an evaluation should consider the site-specific circumstances and detailed accounting for both the potential and tolerance for risk, existing conditions at the installation, and overall benefit for applying the required design and construction provisions.

The operation, sampling, testing, and maintenance provisions in the various sections of this standard shall apply to both new and existing installations.

### 4.2 Management Responsibility and Accountability

The management of pre-airfield storage terminals is responsible for ensuring that the facility design and operation conform to acceptable industry standards and the appropriate legislative regulations with respect to health, safety, environmental protection, and security are applied.

The operating procedures for pre-airfield storage terminals shall be maintained in a manual or handbook that is readily available for reference by staff. It is desirable that conformance to agreed-upon procedures be tied in to a recommended quality assurance system like the one outlined below.

Any change to operating procedures or physical equipment changes (unless replacing like with like) to the existing pre-airfield facilities shall be supported by a management of change (MOC) process with appropriate risk assessments/hazard reviews performed by trained and experienced staff.

### 4.3 Quality Assurance System

#### 4.3.1 General

The potential consequences of a failure to supply the correct, on-specification product to aircraft are such that it is essential for each organization to have an effective quality assurance system, which shall be designed to ensure the following:

- the provision and maintenance of appropriate facilities and equipment for the safe and uncontaminated delivery of aviation fuels to the airfield fuel storage facility;
- an auditable documentary record demonstrating the correct handling of aviation product at the pre-airfield storage terminal.

#### 4.3.2 Product Quality Assurance Organization

Each pre-airfield storage terminal shall have a product quality assurance organization. The specific details of such an organization may be varied according to the nature of the operating unit. The organization shall have individuals nominated to carry out the following roles; nomenclature may vary according to local requirements. At each level of the structure, records shall be kept of the responsible individuals in the succeeding level together with details of training received.

##### 4.3.2.1 Site Product Quality Manager

At each site that stores or handles aviation fuels there shall be a nominated site product quality manager responsible for the efficient operation of the quality assurance system at that site. At pre-airfield storage terminals, this role would usually be taken by the pre-airfield storage terminal manager (or operations manager of a large facility).

The Site Product Quality Manager shall be accountable for:

- the implementation of correct quality control procedures,
- the maintenance of satisfactory documentation,
- the release of product only of satisfactory quality,
- the training of all staff at the site who are nominated as Product Quality Inspectors.

##### 4.3.2.2 Product Quality Inspectors

All staff whose duties include tasks critical to the quality assurance system shall be fully trained in such tasks and nominated as approved Product Quality Inspectors. Such tasks include, but may not be limited to, the following:

- checking that the documentation on incoming consignments is correct and that it corresponds to the transport/container concerned;
- visually inspecting and conducting control checks and online sampling from pipelines and dock lines (color membrane filtration test, MSEP, flash point, API, color, free water, as applicable) on incoming material, including checking seals on vehicles, if present;
- product discharge into storage;
- loading of material, including control checks on marine vessels/road or rail transports/containers and pipelines, unless these tasks are performed by non-pre-airfield terminal staff (i.e. independent inspectors, road transport

operators), to ensure that they are clean and uncontaminated and online sampling from pipelines, loading racks, and dock lines (color membrane filtration, MSEF, flash point, API, color, free water tests) unless these tasks are performed by non-pre-airfield terminal staff;

- sampling of aviation fuels;
- maintaining appropriate records of inventory/quality/equipment checks.

## 5 Sampling

### 5.1 General

At appropriate stages during the handling and storage of aviation fuels at pre-airfield terminals, fuel samples will be required for laboratory and/or visual examination to check the quality of the fuel.

### 5.2 Sampling

Sampling shall be undertaken by competent, trained personnel using clearly defined procedures and appropriate apparatus to ensure that the sample obtained is truly representative of the material from which it has been drawn. Sampling shall be in accordance with the latest requirements of the following procedures or their equivalent:

- a) Local, state, and national measurement standards;
- b) ASTM D4057, *Standard Practice for Manual Sampling of Petroleum and Petroleum Products*;
- c) *API Manual of Petroleum Measurement Standards (MPMS) Chapter 8, Sampling*.

For detailed sampling procedures not covered herein, reference shall be made to the aforementioned publications.

#### 5.2.1 Basic Requirements

- a) Before sampling, the sampling apparatus (including ropes or cords to suspend the sampler or other ancillary equipment) and containers shall be dry and free of any contaminating substance. All metal sampling gear shall be constructed from non-spark-generating materials.
- b) Sample containers shall conform to the requirements listed in 5.2.3.
- c) The operator carrying out the sampling shall have hands free from any contaminating material. Clean gloves impervious to aviation fuels shall be worn to protect the operator from any health hazards.
- d) Sampling points for drain samples shall be fitted with dust caps, chained to the sample connection, and the sampling pipes shall be of a material unaffected by the product and not susceptible to oxidation/corrosion (i.e. stainless steel or other suitable material). Sampling points shall be covered by dust caps at all times except while a sample is being drawn.
- e) During sampling operations, the material being sampled shall be protected, as far as possible, from the effects of rain, sun, blown dust, etc. Sample containers shall be securely closed immediately after the sample has been taken.
- f) It is important that samples are truly representative of the material being sampled. Samples from tanks shall be taken from a gauge hatch or other suitable opening that gives unrestricted access to the bulk of the liquid or from a suitably designed piped sampling system.

- g) Prior to sampling, apparatus for sampling liquids including the sample container shall be flushed and rinsed at least three times thoroughly with the product to be sampled and allowed to drain before use. An alternate method is filling the can with product to be sampled and allowing the can to soak for 24 hours then disposing of the fuel prior to taking the sample to be tested.

This requirement shall not apply when such flushing and rinsing would nullify the purpose for which the sample is being obtained or by the nature of the material being sampled, e.g. drain samples for water and dirt content.

- h) If it is suspected that a sample or set of samples is not fully representative, a further sample or set of samples shall be taken.
- i) Samples for laboratory testing shall be free from dirt and water except in the case of samples specifically taken to determine the presence of such contaminants.
- j) No sample container shall be completely filled with liquid. The ullage space required for certain samples and testing can be found in ASTM D4057 or API *MPMS* Ch. 8.
- k) Records shall be maintained of all samples taken. Sample containers shall be clearly labeled for identification and sealed immediately after sampling. The following information shall be available as appropriate, either on the label or on associated documentation.

Sample No:	Date:	Time:
Taken By:	Sample Type:	Tank:
Batch No.:	Grade:	Vehicle/Vessel:
Test Required:	Sample Quantity:	Quantity in Tank or Represented:

- l) When samples are required from levels in a tank or bulk container, the order of sampling shall be from the top downward.
- m) Samples of materials that could be affected by light or heat shall be stored in a cool, dark place.
- n) When a sample of aviation gasoline is taken for laboratory analysis, especially at high ambient temperatures, care must be taken immediately after sampling and during sample transport. aviation gasoline samples must remain cool and protected from direct sunlight to avoid the loss of light ends. It is also recommended that aviation gasoline samples be taken in containers protected from direct light. The sample shall, if at all possible, be taken directly into the container, and not transferred from sampler to container. The container shall be examined closely for leaks, so as to avoid the loss of light ends through the cap sealing material.

### 5.2.2 Sampling Terminology

The most common sample types used in aviation fuel handling are as follows.

- a) Bottom Sample:

A sample obtained from the material on the bottom surface of the tank or container at its lowest point.

- b) Drain Line Sample:

Samples obtained from the water draw-off or drain point of a storage or vehicle tank or filter body.

- c) Line Sample:

A sample obtained from a line sampling point, preferably drawn while the product is flowing.



d) Lower Sample:

A sample obtained from the middle point of the lower third of the tank contents.

e) Middle Sample:

A sample obtained from the middle point of the tank contents.

f) Multiple-Tank Composite Sample (Ships, Barges, etc.):

A mixture of individual composite samples from the several compartments each of which contains the same grade of product. The mixture is blended in proportion to the volume of product in each compartment.

g) Retention Sample:

A sample taken and stored in a retention sample container for the purpose of laboratory analysis at a later date in the event that the quality of the original product needs to be verified.

h) Single-Tank Composite Sample:

A sample obtained by blending upper, middle and lower samples. For a vertical tank of uniform cross section, the blend consists of equal parts of the three samples.

i) Upper Sample:

A sample obtained from the middle point of the upper third of the tank contents.

j) Top Sample:

A sample obtained from just below the surface of the liquid in the tank.

k) All Level Samples:

A sample obtained by submerging a stopped beaker or bottle to a point as near as possible to the draw-off level, then opening the sampler and raising it at a rate such that it is approximately  $\frac{3}{4}$  full as it emerges from the liquid.

### 5.2.3 Sample Containers

a) Laboratory Sample Containers:

Metal containers that are internally lined with an epoxy coating suitable for aviation fuels shall be used for the carriage/storage of samples for laboratory testing (see ASTM D4306). One (1) quart and 1 U.S. gallon sample container shall be used for Jet A/A1 and 1 or 5 U.S. gallons for aviation gasoline. These shall be suitable for air transport when used with the associated transit packaging materials.

b) Field Sample Containers:

- 1) Clear glass jars of one (1) quart minimum capacity with wide necks and screw caps shall be used for product examination in accordance with the visual check procedure. These shall be kept in an outer protective wire cage to facilitate easier handling. Sample bottles may be removed from the wire cage to enhance the visual check performed on the sample.

or

2) Stainless steel buckets, which shall be internally coated with white porcelain or epoxy and equipped with a bonding cable and clip.

c) Retention Sample Containers:

Laboratory sample containers as described in 2.2.3 a) shall be used for containing product for retention purposes. If necessary, the product can then be transported by air without the need to be transferred to another container, eliminating the associated potential for contamination.

d) Packaging for Air Transport:

Containers for the transport of samples by air shall be of an International Civil Aviation Organization (ICAO) approved design and shall be dispatched in accordance with the latest edition of the ICAO *Technical Instructions for the Safe Transportation of Dangerous Goods by Air*.

#### 5.2.4 Aviation Fuels

The aviation fuels covered by this recommended practice are summarized in the two tables below. These list the major specifications in use together with the usual nomenclature for the products concerned.

#### 5.2.5 Aviation Turbine Fuels (Jet Fuels)

Fuel Grade Name	Description	Specification
Jet A	Kerosene type fuel Freezing point –40 °C maximum Flash point 38°C minimum	ASTM D1655
Jet A	Kerosene type fuel Freezing point –47 °C maximum Flash point 38 °C minimum	ASTM D1655
Jet A/A-1/FSII	Kerosene type fuel Freezing point (see above) Flash point 38°C minimum containing 0.1 % to 0.15 % DiEGME	ASTM D1655
JP-8	Kerosene type fuel Freezing point –47 °C maximum Flash point 38 °C minimum containing 0.1 % to 0.15 % DiEGME and approved CI/LI additive	MIL-DTL-83133 (U.S.)

#### 5.2.6 Aviation Gasoline

Fuel Grade Name	Description	Specification
Aviation Gasoline 80	Gasoline with maximum 0.14gPb/l, dyed RED	ASTM D910
Aviation Gasoline 100	Gasoline with maximum 0.85gPb/l, dyed GREEN	ASTM D910
Aviation Gasoline 100LL	Gasoline with maximum 0.56gPb/l, dyed BLUE	ASTM D910
Aviation Gasoline 91	Gasoline with maximum 0.56gPb/l, dyed BROWN	ASTM D910
Aviation Gasoline 100VLL	Gasoline with maximum 0.45gPb/l, dyed BLUE	ASTM D910

Aviation gasolines (Avgas) are identified in specification by their minimum antiknock engine ratings. Two ratings are established out: a “lean mixture” and a “rich mixture” rating. The full description of the grade uses both numbers, e.g. Avgas 100; the lower (lean mixture) rating is used for the shortened grade name as above.

The use of an incorrect grade can have serious results in terms of engine performance and aircraft safety. In order to differentiate between grades, dyes are added to the fuels in accordance with an internationally agreed-upon color code to impart a distinctive color.

[paragraph deleted]

## 5.3 Sampling and Testing

### 5.3.1 Release Certificates

#### 5.3.1.1 Release Certificate

This document supports any transfer of product and contains at least the following information:

- date and time of loading,
- grade of fuel,
- batch number and batch API Gravity (at 60°F) of the product in the tank from which it originated,
- certification that a representative sample has passed a visual check.

The release certificate shall be dated and signed by an authorized representative of the issuing pre-airfield storage terminals (see Annexes A, B, and C for example documents).

### 5.3.2 Test Requirements

#### 5.3.2.1 Visual Check

A visual check is conducted to confirm the acceptability of products where the grade is known and no cross-grade contamination is possible. To be acceptable, fuel shall be of the correct color and be visually clear, bright and free from particulate solid matter and undissolved water at normal ambient temperature. Samples for a visual check shall be drawn into clean, clear-glass jars, closed sampling devices (utilizing a transparent collection container) or a stainless steel bucket shall be manufactured with internally coated white porcelain, or other suitable material, and equipped with a bonding cable and clip.

The results of the visual check shall be judged as follows:

- *Color*—The various grades of aviation gasoline are dyed to aid recognition, while the color of aviation turbine fuels may vary from water white to straw color. When potential contamination from red dyed nonaviation fuels during receipt is possible, use a stainless steel bucket, which shall be internally coated with white porcelain or epoxy and equipped with a bonding cable and clip. (If there is a dispute if red dye contamination has occurred, then use the referee visual test method for determination, which is contained in the Boeing Service Letter, dated 22 November 1996, “Aircraft Use of Dyed Fuels.”)
- *Clear and bright*—The term “clear” refers to the absence of sediment or emulsion. The term “bright” refers to the sparkling appearance of the fuel having no cloud or haze. These terms are independent of the fuel’s natural color.
- *Solid matter*—Solid (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 container. (Acceptable standards will vary according to the point at which the sample has been drawn. A few specks of dirt are often found in samples

drawn from the sumps of unlined tanks and transports and unlined pipe low points, and these do not constitute a test failure.) Sampling through unlined carbon steel tank gauge pipes can be the cause of high particulate, which is not representative of the fuel. Consideration of this shall be taken when obtaining samples from the storage tank.

- *Undissolved water*—Undissolved water (free water) will appear as droplets on the sides or bulk water on the bottom of the sample container. It may also appear as a cloud or haze (suspended water).

The visual check, especially the examination for solid (particulate) matter, is best carried out by swirling the sample in the container to form a vortex. Any solid (particulate) matter and water droplets will tend to concentrate at the center of the vortex.

### 5.3.2.2 Control Check

This is a visual check plus fuel API Gravity determination. This check is frequently made to confirm the correct grade and unchanged quality of fuel stocks by comparison of the result of the API Gravity determination with the relevant batch API Gravity. If the temperature corrected API Gravity differs by more than 0.7 API degrees, a possibility of contamination exists and the matter shall be investigated further before the product is accepted for aviation use. It may be necessary to carry out further testing before such acceptance can be given.

### 5.3.2.3 Chemical Water Detector

This test is the recommended method for the detection of small concentrations of suspended water in jet fuel.

A number of methods exist for the detection of suspended water at low concentrations, e.g. the Velcon Hydrokit, Shell Water Detector, and the Gammon Aqua-Glo (ASTM D3420).

### 5.3.2.4 Membrane Filtration Tests (Gravimetric and Colorimetric)

These tests (often referred to as “color membrane filtration test”) shall be carried out and evaluated in accordance with test methods ASTM D2276/EI 216.

### 5.3.2.5 Conductivity Test

This test shall be carried out in accordance with procedures set out in ASTM.

### 5.3.2.6 Soak Test

Soak testing is carried out after construction work on a fuel system to ensure that there are no potential fuel contaminants present in the form of solvents from coatings/linings, welding flux, valve grease, or other general debris. Such contaminants are unlikely to affect the bulk properties of the fuel so only limited testing is carried out using the tests most sensitive to contamination.

At the end of the soak period, representative samples are taken from the fuel system being commissioned and a selection of laboratory tests are carried out to determine the quality of the fuel used in the soak test. The fuel properties tested shall be compared with the specification limits for the grade of fuel used and with the presoak test results for the fuel used in the soak test. If there is any doubt that the test certificate results are representative of the fuel used, it is recommended that the retention (presoak) sample is analyzed in parallel with the postsoak sample. A successful result requires that all tested properties are within the specification limits and within the tolerance limits established for recertification. If any test result does not fully comply with the applicable specification or falls outside the allowable variances, the product shall be resampled and retested. If the fuel is found to be unsuitable for use, then the reason shall be investigated and the fuel removed (and downgraded to nonaviation use or disposed of), the system refilled with on-specification fuel and the soak test repeated until a satisfactory result is obtained. The relevant fuel supplier shall be contacted for advice in the event of any problems with the soak test. The laboratory tests include those in Table 1.

**Table 1—Laboratory Tests**

	Jet Fuels	Avgas	Test Method	
			ASTM	IP
Appearance	X	X	D4176	
Existent Gum	X	X	D381	540
Water Reaction		X	D1094	289
MSEP	X		D3948	
Conductivity	X		D2624	274
Saybolt Color	X		D156	
Thermal Stability (JFTOT)	X		D3241	323
Distillation	X	X	D86/D2887	123/406
Flash Point	X		D56	170

**Summary**

Table 2 and the accompanying notes provide a summary of the soak test requirements for storage tanks, piping, and ancillary equipment.

**Table 2—Summary of Soak Test Requirements**

	Storage Tanks			Pipelines	Ancillary Equipment	
	Fully Lined	Partially Lined	Unlined	Supply	Pumps, Valves, Meters, etc.	Filter Vessels
Duration	Four days (Note 1) (seven days max)	Four days (seven days max)	Four days (seven days max)	Four days (seven days max)	(Note 2)	
Minimum Fuel Volume	Enough product to cover the floating or fixed suction and the receipt nozzle to allow circulation of product without pump cavitation	Normal fill level <sup>a</sup>	Normal fill level <sup>b</sup>	Fill lines completely		
Lab Testing	Jet fuel: Appearance, existent gum, MSEP, conductivity, Saybolt, JFTOT, distillation, flash Avgas: Appearance, existent gum, water reaction, distillation					
Sample Volume	Jet fuel: 5 liters or 1 U.S. gallon Avgas: 5 liters or 1 U.S. gallon (20 liters or 5 U.S. gallons required for a full specification test)					

<sup>a</sup> Normal fill level is recommended however by agreement, soaking may be limited to the lined surfaces and roughly similar area of the unlined tank wall.

<sup>b</sup> Normal fill level is recommended however by agreement, soaking may be limited to a depth of one meter. This would be a severe test due to the relatively high surface to fuel volume ratio.

— *Hoses*—Fuel shall be drained after the 8 hour soak period and visually inspected for appearance, discoloring, and solid matter.

NOTE 1 The four day soak period applies to equipment (fully, partially or unlined storage tanks, pipelines, ancillary equipment, and vehicles) where the lining material used is an approved epoxy (EI 1541) and is covered by a 10 year joint material and applications warranty from the manufacturer. Use of equipment where the lining material is not a fuel supplier approved epoxy and is not covered by a 10 year material and application warranty shall be subject to approval by the fuel supplier prior to use. Additional sampling and testing may be imposed to mitigate the potential risks of using an unapproved lining.

NOTE 2 Newly installed ancillary equipment (e.g. pumps, filter vessels, valves, pit valves, control valves, meters, sense tubing, water drain lines, etc.) should be soak tested during the system-wide soak test. Replacement or repaired equipment is not typically soak tested prior to use since the ratio of total surface area to fuel volume is very small diluting any contaminants below harmful levels. However, it is important to confirm that the replacement or repaired equipment does not contain detrimental materials, e.g. preservative oil or rust inhibitor coatings, which could contaminate the fuel and render it unfit for use. As a general rule, if new lining material is applied to an existing tank or pipe then soak testing shall be undertaken if the new lining material covers more than 5 % of the tank's coated surface area or surface area of existing piping. Participants may agree on different criteria depending on local circumstances.

### 5.3.2.7 Recertification Test

#### Recertification Test Certificate (RTC)

Where aviation product is transferred to an installation under circumstances which could in any way allow the possibility of contamination, then before further use or transfer, recertification is necessary. Recertification testing is carried out to verify that the quality of the aviation fuel concerned has not changed and remains within the specification limits, e.g. after transportation in ocean tankers or multiproduct pipelines, etc. The RTC (see Annex A) shall be dated and signed by an authorized representative of the laboratory carrying out the testing. The results of all recertification tests shall be checked to confirm that:

- the specification limits are met, and
- no significant changes have occurred in any of the properties.

The results of such tests shall be compared to the expected calculated results from a weighted average of the previous tank recertification and the receiving batches RQC or COA as well as reviewed for compliance with the specification limits. If any test results indicate that the sample does not comply with applicable specifications or is outside the allowable variance, the product shall be immediately quarantined and remain under quarantine until further testing has established that the quality is acceptable for aviation use. If more than three new batches are received into a tank, the comparison becomes difficult and possibly meaningless, and therefore the contents of the tank shall be tested against all the requirements of the specification.

If the incoming product is not accompanied by an RQC or COA or one is not available, then full COA laboratory testing is required to verify that the fuel is still within the limits of the fuel specification. In this case the amount and usage of approved additives in the fuel is unknown.

Any further additization should be performed in a manner consistent with the relevant specifications (ASTM D1655, ASTM D910).

### 5.3.2.8 Hydrometers and Thermometers

Hydrometers and thermometers used for API Gravity (or density) quality control checks shall meet the requirements of the relevant standards:

- hydrometers—ASTM E100 or ISO 649-1,
- thermometers—ASTM E1 or EI Appendix A,
- thermo hydrometers for Jet A/A-1 designated ASTM 255H and 55HL,
- thermo hydrometers for aviation gasoline designated ASTM 258H and 58HL,
- Anton Paar DMA 35N handheld densitometer (intrinsically safe model).

Hydrometers and thermometers must not be left in direct sunlight or near heating appliances. Hydrometers shall be stored vertically.

Before each use, hydrometers shall be carefully examined to ensure the following.

- a) The etched line on the hydrometer stem corresponds to the arrow (or line) at the top of the paper scale. A fingernail can be used to detect the etched line position.
- b) The weighting material has not dislodged. This would cause the hydrometer to float in a nonvertical plane.

- c) The glass is intact.
- d) The scale markings are legible.

Before each use, a thermometer shall be visually inspected to confirm that there are no gas bubbles trapped, or separation of the liquid column in the mercury column or the bulb, the mercury column is unbroken, and there are no mercury globules above the top level of the mercury column. The thermometer's scale markings shall be clearly visible.

If a measurement of temperature or API Gravity is suspected of being inaccurate, the accuracy of the thermometer and hydrometer shall be checked. These checks shall be carried out by means of one of the following options:

- a) transporting to laboratory or a central point,
- b) holding a reference set of instruments on site or at a number of "hub" sites,
- c) using a standard API Gravity reference fluid held at each site or sent to each site from a central point or a laboratory,
- d) avoiding the need to recalibrate by disposal and repurchase before recalibration becomes due,
- e) checking against other instruments in service (most operations will have more than one of each).

## **6 Pre-Airfield Storage Terminals Equipment Design**

### **6.1 General**

The observance of certain fundamental practices in the design, construction, and commissioning of facilities used for the storage, handling, and transport of aviation fuels is considered essential to ensure that health and safety of staff, environmental protection, and product quality are maintained.

#### **6.1.1 Segregation of Aviation Fuels**

All facilities utilized for handling aviation fuels shall be fully grade segregated (grade separated) and shall also provide segregation between batched (aviation product in storage that has been assigned a unique batch number and has been subject to a recertification test) and unbatched (aviation product in storage that has not been assigned a unique batch number and/or has been subject to a recertification test) product. This requirement may be relaxed only in the case of pipework upstream of aviation fuel storage tanks used for the receipt of multiple products from ships/barges or pipelines, and then only provided the system is so designed to facilitate the detection and appropriate downgrading of product interfaces.

#### **6.1.2 Materials of Construction**

The choice of construction materials is an important factor, particularly in the case of aviation turbine fuel systems, where product thermal stability can be degraded by the presence of very low concentrations of copper or by finely divided particulate matter.

The use of copper or copper alloys shall be eliminated wherever possible by the use of alternative materials such as stainless steel or aluminum. Zinc and cadmium are two other metals that adversely affect product quality. Zinc-rich (galvanized) coatings, cadmium alloys, and cadmium plating shall not be used for applications in contact with aviation fuels.

Pipework, vessels and tanks shall be fabricated from either carbon steel, internally epoxy-lined carbon steel, or from stainless steel.

## 6.2 Tankage

### 6.2.1 Working Capacity

The number and size of aboveground tanks (underground tanks require specialist advice not covered in this recommended practice) shall be sufficient to provide adequate working capacity to deal with peak demands of each product grade handled, with due allowance for settling, testing, and tank cleaning requirements. Allowance shall also be made for the reliability of the method of supply, batch volumes, and delivery frequency.

### 6.2.2 Vertical Tanks

- a) Newly constructed vertical tanks shall be fixed-roof type with a downward sloping conical floor (slope shall be 1:30) to a central drain sump. Where lap welds are used in floor construction they shall be designed such that the laps do not impede the flow of water to the drain sump.
- b) Existing vertical tanks in aviation grade service or existing tanks being converted to aviation grade product shall be inspected to ensure existing sumps are located in the low point(s) of the tank to ensure water/sediment removal via the tank water drain(s).
- c) Existing vertical tanks in aviation grade service or existing tanks being converted to aviation grade product where a replacement double bottom is to be installed shall be designed with the maximum slope mechanically allowed for the design (not greater than 1:30) and low point sump(s) installed in the low point(s) of the tank to ensure water/sediment removal via the tank water drain(s).

### 6.2.3 Horizontal Tanks

Horizontal tanks shall be installed on foundations that will ensure maintenance of a minimum 1:50 positive slope to a drain sump at the lower end.

### 6.2.4 Tank Lining

- ▮ All new vertical tanks, existing aviation grade vertical tanks having new bottoms installed, or existing tanks being converted to aviation service shall have at least the floor and first (bottom) 3 ft of the walls internally coated per API 652 meeting performance requirements of API 1541. This shall preferably be white or light colored to aid inspection. All new horizontal and small vertical (less than or equal to 30,000 U.S. gallons) shall be coated internally throughout.

### 6.2.5 Tank Fittings

#### a) Vents:

##### i) Jet Fuel Tank

All jet fuel tanks shall be free vented unless local legislation specifies that pressure/vacuum valves (P&V) shall be used. All vents shall have screens to prevent the ingress of contaminants.

##### ii) Aviation Gasoline Tanks

The vents of all horizontal and small vertical aviation gasoline tanks shall be fitted with P&V valves. Large vertical tanks shall be equipped with an internal floating pan/blanket and a fixed cone roof.



**b) Sumps, Drain Lines, and Sampling Systems:**

A low point sump with a drain line and a suitable valve for draining water and sediment shall be installed in all tanks. The drain line shall preferably be a nonrusting material, selected to avoid galvanic action created by dissimilar metals (i.e. stainless steel lines shall only be used in internally lined storage tanks and internally/externally coated mild steel in unlined tanks) of approximately 2 inches in diameter and fitted with an inline sampling valve.

In the case of aboveground tanks, the drain line shall lead to one of the following tank sump drain systems.

- i) A large capacity stainless steel, aluminum or internally lined carbon steel sample sump recovery tank, provided with a quick acting valve at entry, a cone down bottom with a drain valve, and a suitable motor driven return system back into the tank through a separate return line. The sump recovery tank shall be at least 50 U.S. gallons capacity. The lid shall be removable to view the contents of the sump recovery tank. There will be instances where it will need to be significantly larger depending on, for example, the storage tank size or mode of delivery of product to the storage tank. The design shall ensure that it is not possible for water to accumulate in the drain lines (where it could freeze and prevent draining in cold weather conditions).
- ii) A filtration system that operates at a flow rate equivalent to draining the tank sump into a sump recovery tank as described in Item i) above. The system will send removed water from the tank sump to a disposal system and return clean and dry fuel to the tank through a separate return line. Provisions shall be designed into the system to allow visual examination of the fuel, both before and after filtration.
- iii) A system that will allow safe and efficient draining of the storage tank through the sump that allows visual examination of the sumped fuel throughout the draining process.

Provisions shall be made in any of the three systems described above for taking a flowing line sample from the tank drain between the tank and the sample receiving system. The running sample shall be taken into an open container (such as a glass jar or stainless steel bucket, which shall be internally coated with white porcelain or epoxy and equipped with a bonding cable and clip) or a suitable closed circuit sampler using a transparent collection container. A pipe site flow indicator (site glass) shall not be used for this purpose.

**c) Manholes/Gauging and Sampling Hatches:**

Sufficient manholes shall be provided to facilitate entry for gas freeing, inspection, and cleaning. Provision shall also be made for representative samples to be drawn at all product depths. Fill connections and gauge openings shall be provided with tightly fitting covers to prevent entry of water and/or solid contaminants and evaporative loss.

**d) Inlet and Outlet Connections and Floating Suctions:**

All tanks shall be fitted with separate inlet and outlet pipe work. This is to ensure that only fully batched product is dispensed from storage for delivery to the airport.

For all aviation fuels the outlet should be via a floating suction arm with a minimum clearance between the arm inlet opening and tank floor plates of 9 in. or the diameter of the arm inlet, whichever is less, but in no case must the clearance be less than 4 in. or the manufacturer's recommendation. A simple buoyancy check device (check cables or position indicators) shall be fitted to the floating suction. Restraining wires shall be used to prevent the unit from rising above an angle of approximately 70 degrees to the horizontal or hitting the tank roof structure.

If no floating suction is provided, the inlet to the suction shall be placed at a suitable height above the tank floor. In a vertical tank this shall be 16 inches. In all cases where a floating suction is not present, the suction point shall be turned up from the bottom so as to not draw fuel from the bottom of the storage tank.

e) Positive Segregation:

Provision shall be made so that tanks can be positively segregated for product quality control purposes. The inlet and outlet to each tank in multiaviation tank storage terminals and the inlet (or at some other location on the segregated receipt line to the single storage tank) in single tank storage terminals shall be fitted with either:

- a “double block and bleed (DBB)” valve arrangement (either using a single DBB valve, or using two valves with a drain arrangement in a pipe spool between them);
- a removable distance piece (pipe spool and blind flanges); or
- a spade or spectacle blind.

NOTE These requirements are set for quality control purposes to isolate the tank from uncertified or nonaviation products; separate arrangements approved by an authorized person will be made to make the tank safe for any personnel entry into the tank.

f) Overfill Protection:

Storage tanks shall have provision for overfill protection using two independent sensors as per API 2610.

g) Tank Signs:

All tanks shall be prominently numbered and clearly marked with the grade stored as described in API 1542 and provisions made for the dates of the last cleanliness inspection and tank cleaning (see 10.7) to be added. Aviation gasoline tanks and tanks that have in the past contained leaded product shall be permanently marked with suitable signs to that effect.

h) Water Bottoms:

The carrying of water bottoms is not permitted in aviation product tanks. In an emergency, due to a real or suspected tank bottom leak, a water bottom may be used only to allow for time to remove the aviation product from the storage tank in a timely manner so the tank can be repaired.

### 6.2.6 Tank Dike/Dike/Bunds

Guidance can be found in API 2610.

## 6.3 Pipelines (Used for the Transfer of Fuel to an Airport or Another Pre-Airfield Distribution Terminal)

### 6.3.1 Integrity Measures

For all pipelines, the following integrity measures shall be provided.

- For all buried pipelines a means of isolating the pipe section(s) and performing a pressure (leak) test(s) shall be provided. For longer (cross-country or feeder) pipelines, an automatic leak detection system shall also be provided.
- Wherever practicable, all pipelines shall be designed to accommodate cleaning or “intelligent” pigs.

### 6.3.2 Links with the Receiving Pre-Airfield Storage Terminals

Where a pipeline supplies tankage in pre-airfield storage terminals, the interface between the two shall be arranged to ensure the integrity of both. For instance, the following measures shall be considered:

- interface pressures and change of pressure ratings for components, such as filtration equipment;
- relief of thermal and surge pressures;
- facilities to collect product discharged for thermal or pressure relief systems and cloudy fuel arising from pipe pigging;
- automatic shutdown of the pipeline in the event of a tank high-high level, or if an emergency stop button is activated;
- information on the total flow rate and volume of fuel received during a transfer (especially if from more than one source at the same time).

## 6.4 Pipework Within the Pre-Airfield Storage Terminals

### 6.4.1 Separation and Segregation of Aviation Fuels

Except for pipework upstream of aviation fuel tankage used for discharge of mixed cargoes, coastal/inland waterway vessels, or for receipts from multiproduct pipelines, each grade of aviation fuel shall be handled in a grade-separated system or grade-segregated system, with no interconnecting lines between pipelines handling different products. Pipelines that handle tested and untested products shall be capable of providing positive segregation between tested and untested product.

Receipt system grade separation and batch segregation shall be achieved by “positive segregation,” meaning in conjunction with designated operational procedures:

- an approved DBB valve arrangement (either using a single DBB valve, or using two valves with a drain arrangement in a pipe spool between them);
- a removable distance piece (pipe spool and blind flanges); or
- a spade or spectacle blind.

NOTE These requirements are set for quality control purposes; separate arrangements approved by an authorized person will be made for maintenance isolation.

### 6.4.2 Piping Low Point Drains

Long pipelines should install low point drains at points where water/particulates can accumulate.

## 6.5 Tank Recirculation Piping

The advantage of recirculation piping, which allows product to be pumped from the storage tank through a filtration train (if wet or dirty fuel is expected) or through a fuel additive system to meet customer requirements, should be reviewed to see if it offers advantages during design or modification of a site.

## 6.6 Static Relaxation Design Considerations

Static relaxation shall be incorporated into the loading terminal design as outlined in API 2003.

## 6.7 Fuel System Additive Systems

Fuel system additive systems shall be designed to automatically dispense the additive at the desired dosage. The additive system shall be designed to shut down the loading if over or underdosage is encountered. The fuel system additive systems shall inject the additive after all filtration vessels in the loading line [see also 15.11.2 d)]. The amount of additive shall be recorded on the release or other delivery documentation.

## 6.8 Loading Couplings/Swivels for Road/Rail Transports

### a) Couplings:

Bottom loading into road/rail transports of all aviation grade fuels is preferred through an API 4-in. coupling.

When necessary, top loading shall only be performed under cover to avoid weather hazards and contamination associated with top loading from entering a road/rail transport. Other design considerations are addressed in API 2003.

### b) Swivels and Loading Hoses:

Pipe work fittings such as swivels used on loading hoses shall be self-lubricating and under no circumstances shall these be fitted with grease nipples or similar devices into which grease or oils can be injected and consequently contaminate the fuel due to seal leakage. Existing loading arm swivels may be lightly greased by hand when the swivel is disassembled in accordance with the manufacturer's instructions provided that the packing seal/diaphragm to prevent grease from contacting the fuel is intact.

## 6.9 Filtration

### 6.9.1 Receipt Points

Inlet filtration at receipt points is not often installed due to extremely high flow rates during pipeline or marine vessel receipts. However, it is recommended that inlet filtration of an EI 1581 qualified filter water separator for jet fuel and an EI 1581 qualified filter water separator or 5 micron EI 1590 qualified microfilters for aviation gasoline be installed for truck transport/rail receipt points.

### 6.9.2 Discharge Points

Outlet filtration from a pre-airfield distribution terminal to a pipeline leading to an airport, a dock cargo line loading marine vessels for delivery of fuel to an airport, or a road/rail transport loading rack shall consist of the following.

- *Jet fuel*—An EI 1581 qualified filter water separator shall be installed. The installation of clay filtration elements/vessels is highly recommended where surfactants may be an issue coming from multiproduct pipeline or nondedicated marine vessels. EI 1590 qualified microfiltration is recommended where additional particulate protection is required. If significant water is expected, the installation of a single-stage coalescer (i.e. "Hay pack" or similar unit) located upstream of all other filtration should be considered.
- *Aviation gasoline*—An EI 1581 qualified filter/water separator, EI 1583 qualified monitor, or 5 micron EI 1590 qualified microfilters shall be installed.

There is a risk of internal fire or explosion if product is pumped into a filter vessel that contains air. Therefore, automatic air eliminators shall be installed on all filter/water separator vessels (except small single-element vessels). The operation of such air eliminators requires the discharge piping to be open at all times when the vessel is in service. Any isolation valves in the air elimination discharge system shall be wire sealed in the open position during normal operations. The discharge pipework from the eliminator shall be arranged such that any product escaping is

returned to a recovery system. Where necessary, soft-seat nonreturn valves (check valves) shall be installed in the air eliminator to prevent filter/water separator vessels draining down into storage where there is a chance the filter vessel might drain down allowing air to enter the vessel.

A water defense system should be installed (as described in EI 1581) that would shut flow down or set off an alarm may be fitted to all filter water separators.

All filter and strainer vessels shall have a drain connection at the lowest point of each chamber. The main sump drain shall be fitted with a valve permitting regular check samples to be conveniently taken. The drain sample shall be taken into an open container (such as a glass jar or stainless steel bucket, which shall be internally coated with white porcelain or epoxy and equipped with a bonding cable and clip) or a suitable closed circuit sampler utilizing a transparent collection container. A pipe sight flow indicator (sight glass) shall not be used for this purpose.

All filters shall have a thermal relief valve, which vents to a recovery tank and shall never be closed off while the filter is in operation.

Except for mesh strainers, all filters shall be equipped with direct reading differential pressure gauges to indicate pressure loss across the vessel. A means shall be available to verify the proper operation of the differential pressure gauge in accordance with manufacturers' procedures (e.g. for piston type gauges a deflection test apparatus).

All filter vessels shall be equipped with a membrane filtration sample probe and adapters for performing a filter membrane test and arranged so membrane tests can be performed before and after each filter vessel.

## **6.10 Paved Areas, Drainage, Oil Water Separators, and Spill Collection Tanks**

Guidance can be found in API 2610.

## **6.11 Emergency Shutdown (ESD), Level Alarm, and Fire Alarm Systems**

Guidance can be found in API 2610.

## **6.12 Cathodic Protection**

Guidance can be found in API 2610.

## **6.13 Grade Markings**

All piping work and valves on receipt and loading systems shall be clearly marked in accordance with EI 1542. The product name and color coding, and flow directional arrows shall be indicated.

# **7 Receipt Procedures**

## **7.1 Receipt—General**

Aviation fuels shall only be received through clean product pipelines. It is preferable that each grade of aviation fuel be received through its own segregated line. Where this is not the case, jet fuels should be received through lines reserved for middle distillates and aviation gasoline through lines reserved for gasolines.

Wherever possible product-to-product pumping shall be adopted, without the introduction of water to separate products or to clear lines handling aviation fuels. If lines handling aviation fuels have to be left full of water, it shall not be sea water but shall be fresh or suitably treated water.

Procedures for receiving multiproduct cargoes or pipeline receipts shall be clearly defined and rigorously followed to ensure that interface contamination is minimized. All grade interfaces, both leading and trailing, shall be diverted into nonaviation storage or slop tanks. Wherever possible, aviation fuels shall not be left in multiproduct lines between receipts.

One or more tanks shall be segregated for receipt of product, checked for water, and any water drained off before receipt. More than one vessel may be discharged into the same tank.

Product receipt tanks shall in all cases be quarantined after receipt until testing has been completed and the tank has been released for issue.

## 7.2 Receipt by Pipeline

During receipt of aviation product, samples shall be drawn from the incoming pipeline at the receiving pre-airfield storage terminal. As a minimum, samples shall be drawn at the commencement and the end of the transfer. Control check testing shall be conducted to ensure product integrity. In the case that a transfer consists of more than one batch, then an additional control check shall be carried out at the time of the arrival of each batch. For large batch receipts (in excess of 25,000 bbl), the frequency of sampling should be increased (i.e. sampling every four hours). The samples shall be taken as close as practicable to the receiving tank. A color membrane filtration test shall be performed on the commencement sample of each pipeline receipt. This color membrane filtration test will advise the pre-airfield storage terminal of the particulate level of fuel being received and of potential issues in filtering out to the airport as well as to allow trending of receipts for possible further investigation and corrective action.

If any of the samples fail any control check then the receipt shall be quarantined and the problem investigated. Delivery to the airport aviation storage shall only be resumed after clearance has been given by the site products quality manager of the pre-airfield storage terminals.

Recertification testing shall be carried out after receipt of product from a multiproduct pipeline.

Although not typically controlled by the distribution terminal, unless it is the marine vessel unloading dock line, the following recommendation for the order of preference for leading petroleum product grades so as to limit the degradation of aviation fuels due to interface commingling or tailback shall be one of the following products, listed in order of preference.

- *Jet fuels*—Middle distillates, light distillates, motor gasoline. Jet fuel shall not be led by products with dyes. (See Note 1, Note 2, and Note 3.)
- *Aviation gasoline*—Motor gasoline shall always be the leading and the trailing grade. (See Note 2 and Note 3.)

NOTE 1 Motor gasoline transported in pipelines handling jet fuels shall be free of detergent type additives.

NOTE 2 The additives used in leading and trailing products shall be carefully considered as to what additional precautions shall be required to prevent their inadvertent mixing with aviation fuels. When new additives are to be used in nonaviation fuels an MOC process shall be used to determine any additional safeguards needed to preserve the aviation fuels during shipment. Pipeline corrosion inhibitors shall not be added to aviation fuels. If incoming grades of nonaviation product contains drag reducing additive (DRA), the DRA injection shall be stopped two hours before and not resumed until two hours after the expected aviation grade fuel has passed the injection point.

NOTE 3 Jet fuel and aviation gasoline shall never be led by black oils, thermally unstable product or fuels containing surfactant type additives.

## 7.3 Receipt by Ocean Tanker, Coastal/Inland Waterway Vessel

In addition to the above mentioned quality documentation, all other appropriate documentation and particularly the bill of lading shall be checked and found to be in order before commencing discharge procedures.

The inventory of each vessel compartment shall be checked.

If the inventory of any compartment differs by more than 0.2 % for jet fuel or 0.1 % for aviation gasoline from the inventory when the vessel compartments were loaded, leakage and possible contamination are indicated and the matter shall be investigated. If the investigation does not yield a satisfactory answer, the product shall not be unloaded until a composite sample is drawn from each affected compartment and a recertification test carried out. If satisfactory, the product may then be discharged.

If contamination is not suspected, a one quart middle or all level sample shall be drawn from each compartment and a control check carried out before accepting the product for discharge. For jet fuels, it is also good practice to carry out a flash point determination. If results from these tests are not within reproducibility allowances of the test method, the matter shall be investigated. If the investigation does not yield a satisfactory answer, the product shall not be unloaded until a composite sample is drawn from each affected compartment and a recertification test carried out. If satisfactory, the product may then be discharged.

If the product contains static dissipater additive (SDA), then the conductivity of the samples shall also be determined. If the conductivity does not meet product specifications, then additional SDA may be added. The conductivity results and any additive addition shall be recorded along with the final results to establish that the product is suitable for receipt.

Each vessel compartment shall be checked for free water and the results recorded. If water in substantial quantities is found in any compartment, the master of the vessel shall be promptly informed. The terminal shall have established contingency plans agreed upon in advance to address the handling of excess water and insuring it is not introduced into the aviation product.

A 1 U.S. gallon multiple-tank composite retention sample shall be drawn made up from a middle or all level sample from each compartment. This composite sample shall be taken in an approved retention sample container, labeled and sealed in the presence of the ship's responsible officer. The sample shall be retained at the pre-airfield storage terminals until at least one month after complete exhaustion of the relevant batch.

Supply arrangements shall avoid wherever possible the use of ships or coastal vessels with copper or copper alloy heating coils in any of the compartments used for the transport of jet fuels. Ships with other types of heating coils shall be pressure tested prior to charter/loading to assure the integrity of the coils.

All ships or coastal vessels shall be checked where practicable after discharge for the presence of such heating coils and, if any are found in compartments used for the transport of jet fuel (or if there is any doubt), a thermal stability test shall be added to the recertification test requirements.

During receipt of aviation product, samples shall be drawn from the incoming dock pipeline at the receiving pre-airfield storage terminals at the commencement, middle and end of the transfer and control check testing carried out at each stage. For large batch ship/barge receipts (in excess of 25,000 bbl) then additional frequency of sampling shall be established (i.e. sampling every four hours). The samples shall be taken as close as practicable to the receiving tank. A color membrane filtration test shall be performed on the commencement sample of each jet fuel receipt. If results from the color membrane test exceed a 4 rating (wet) the matter shall be investigated and additional color membrane tests performed. The receipt may continue while the investigation is proceeding.

#### **7.4 Receipt by Road or Rail Tank Car**

The seals (if present), release certificate, and grade plates shall be checked on arrival.

Drain samples shall be drawn from each compartment and a control check carried out. Up to three compartments may be combined for the API Gravity determination. This API Gravity determination shall be compared with the API Gravity of the originating batch as shown on the release certificate. If a difference of more than 0.7 API is found, a

possibility of contamination exists and the matter shall be investigated further before the product is accepted for aviation use.

If water and/or sediment are present in significant quantities (more than 2 quarts), the product shall be allowed to settle for 10 minutes; then a fresh sample is taken. This process shall continue until clean, water-free samples are obtained before continuing with receipt. Failure to achieve such clear samples after withdrawal of a reasonable quantity from any one compartment shall be reported promptly to the supply source and the vehicle quarantined awaiting the results of an investigation.

Whenever possible, a vehicle tank shall be dedicated to the transportation of one grade of aviation fuel.

Only one grade of fuel shall be carried at one time.

Vehicle discharge operations shall, at all times, be supervised by pre-airfield storage terminals staff.

## **8 Fuel Quality Control**

### **8.1 Segregation of Aviation Fuels**

For quality control and safety purposes, it is vital to ensure that aviation fuels are not contaminated with any other products, and also that tested product released for use is not mixed with untested product. The following means are used to ensure such contamination does not occur.

#### **8.1.1 Segregation**

This term refers to a physical barrier that prevents nonaviation grades from entering aviation fuel systems, intermixing of different aviation fuels, or the entry of untested product into systems containing quality cleared product. Segregation is usually achieved by means such as the following.

- Completely separate pipework and tankage, with no connections to any other pipework system. This is the safest and, therefore, the preferred method.
- Isolation using spectacle blinds.
- Isolation using a double block and bleed valve arrangement.

#### **8.1.2 Dedicated Transport**

This term refers to any vessel or vehicle in continual service carrying the same grade of aviation fuel.

#### **8.1.3 Grade Selectivity**

This refers to the practice (often used in conjunction with dedicated vehicles) of fitting specially designed connections to transport, receipt and delivery facilities. These connections are unique to a specific aviation fuel grade and cannot be cross-connected to standard connections used for nonaviation grades.

## **8.2 Settling**

After product has been received into storage tanks and the tank positively segregated, a “settling” status indicator shall be positioned at the outlet valve or otherwise indicated in the tankage electronic control system, until product release is approved.



The stock shall be quarantined and a batch number allocated. Where positive segregation is required, and this is achieved by means of a double block and bleed valve arrangement, and where the bleed valve is kept closed for environmental reasons, routine checks shall be carried out as in 9.1.6. If the bleed valve(s) indicate that one of the block valve(s) is leaking or has been opened in error, then possible contamination of the new batch shall be assumed and appropriate action taken.

The normal settling periods shall be as follows.

- *Jet fuels*—One hour per foot depth of fuel or 24 hours, whichever is less.
- *Aviation gasoline*—Five minutes per foot depth of fuel.

However, where fast turnaround of product is essential, and the tanks are provided with outlet filtration and a floating suction, a two hour minimum settling time is allowed for jet fuel and 45 minutes for aviation gasoline.

At the end of the settling period, any water that has collected at the bottom of the tank shall be drained off.

## 8.3 Testing

### 8.3.1 Sampling and Testing

After a 30 minute minimum settling time, upper, middle and lower samples shall be drawn for the control check. Visual checks are conducted to confirm the product is free of suspended water and particulate contamination and sample. API Gravity is performed to check that the tank is not layered/stratified. If the product passes these preliminary checks, samples for laboratory testing may be taken.

If the product contains suspended water and particulate matter, a further settling period shall be allowed before a new set of samples are taken for a repeat control check.

Where aviation product is transferred to a pre-airfield storage terminal under circumstances that could in any way allow for the possibility of contamination, then before further use or transfer, recertification testing is necessary. The appropriate recertification test certificate shall be dated and signed by an authorized representative of the laboratory carrying out the testing. For laboratory recertification testing a set of upper, middle, and lower samples shall be combined into a single-tank composite sample. The samples used for API Gravity determination shall not be included in the composite sample. Samples taken for inclusion into the composite sample may be drawn at the same time as the control check samples.

### 8.3.2 Tank Layering/Stratification

Where a control check identifies an API Gravity difference of greater than 0.7 API degrees between any of the upper, middle and lower samples then the tank shall be considered to be “layered or stratified.” In such instances current and previous batch densities shall be reviewed to determine if the tank layering is likely to have been caused by inadequate mixing of batches. Additionally, the upper, middle and lower samples drawn from the tank shall be forwarded to the laboratory in separate containers for the following tests.

- *Jet fuels*—API Gravity, flash point, initial boiling point, distillation end point.
- *Aviation gasoline*—API Gravity, RVP, octane rating (lean mixture), distillation end point.

Where the results from these tests clearly show that layering has not resulted from contamination, the remaining recertification tests may be completed on a composite sample. Any indication from the above tests of contamination shall be reviewed with appropriate experts.

### 8.3.3 Conductivity (for Jet Fuel Containing Static Dissipator Additive)

The conductivity of fuels containing SDA shall be measured on completion of settling, preferably on a middle sample or at midpoint level.

If the conductivity is outside the specification limits, steps shall be taken to increase the additive concentration where conductivity is below the specification minimum, or to dilute with undoped fuel where the conductivity exceeds the specification maximum.

The results of conductivity tests, along with the quantity of static dissipater added, where applicable, shall be recorded.

## 8.4 Release

Aviation fuels shall only be released for delivery from pre-airfield storage terminals if the following procedures have been satisfactorily completed:

- a) settling period,
- b) draining of any significant volumes of water,
- c) conductivity test (if required),
- d) laboratory testing (if appropriate).

Once completed, the "settling" sign shall be removed and replaced with a sign indicating that the product is available for delivery, such as "Released" or "On Issue."

Sample tank release certificate is attached in Annex B, Annex C, and Annex D.

## 9 Storage Procedures

### 9.1 Routine Checks

#### 9.1.1 Draining

Tanks shall be kept free from water by routine draining. The sample quantity drawn shall exceed the capacity of the drain line, which shall be labeled on a point near the line, and the draining shall be carried out under full flow conditions. Where a tank sump drain system is used, a flowing line sample shall be performed [see 3.2.5 b)] to insure that the sump is free of water and particulate in addition to observing the amount of water and particulate observed in the sump recovery tank.

Water draining shall be carried out as follows.

- a) Immediately before release.
- b) After release, daily before the first issue of the day. Draining shall be carried out daily. Longer intervals shall only be adopted after extensive experience has shown that no water accumulates but shall not be less frequent than weekly.

If water drain lines are found to be frozen, it shall be reported in the daily log and sumps rechecked periodically until flow is possible.

Routine tank drain samples showing microbiological growth may indicate that tank cleaning is required (see 9.1.7).

Treatment of tank microbiological problems by shock treating with biocide additives is not an acceptable method of control.

### **9.1.2 Floating Suctions**

The buoyancy of floating suction shall be checked at least monthly on cone roof tanks and tanks equipped with internal floating roofs where the floating suction is not physically attached to the roof.

The monthly floating suction check cannot be performed on tanks equipped with internal floating roofs in which the floating suction is physically attached to the floating roof. In this case an internal inspection shall be performed every three years to verify that the floating suction is serviceable.

### **9.1.3 Swing Arms**

Where swing arms are fitted, the correct positioning of swing arm suction shall be checked each day that deliveries are made.

### **9.1.4 Conductivity**

The conductivity of fuels containing an SDA shall be checked monthly.

### **9.1.5 Testing of Static Stock and Occasional Use Piping**

A periodic test shall be carried out on all grades of aviation fuels remaining in storage over a specific time: (six months for jet fuel and three months for aviation gasoline) after the date of the last replenishment. This testing shall be repeated at six-month intervals until the stock is replenished.

If the periodic test results are unsatisfactory, the tank shall be quarantined until the matter is resolved. Tanks need not be quarantined while awaiting periodic test results.

Piping, such as storage tank recirculation lines or tank transfer lines that are left unused longer than three months, shall be flushed back to storage. If the line contains fuel that has not been recertified, then if flushed back to an aviation grade storage tank, the tank shall be recertified after the transfer prior to being released for use. To reduce the need for additional recertification, the flushing can take place after receipt of fuel into the tank and recertified with the recent receipt.

### **9.1.6 Double Block and Bleed Valve Arrangement**

Where storage tanks are fitted with a double block and bleed valve arrangement and positive segregation is required, the two block valves (or single double block and bleed valve) shall be closed after receipt of product.

The bleed valve between the two block valves shall be opened to drain the pipe between the two block and bleed valves into a suitable container. The bleed valve on the single double block and bleed valve shall be opened to check the valve integrity with a suitable container available to catch any discharge. Recommend draining the bleed valve before and after each receipt or at a minimum quarterly on DBB valves segregating different products (i.e. at the pipeline receipt manifold) and yearly on dedicated lines.

[paragraph deleted]

These checks shall be recorded.

If a significant quantity of product is found during a check of a bleed valve between two block valves, or if there is a continuous flow of product indicating product is bypassing at least one of the block valves (or the double block and bleed valve seals), the appropriate measures, including additional product sampling and testing, shall be taken to ensure that the quality of the product is satisfactory before the batch is released.

### 9.1.7 Six-Month Microbiological Tank Bottom Check

Pre-airfield storage terminal operators shall perform a test for microbiological contamination, which shall be carried out on all grades of aviation fuels on a bottom sample from each tank.

Specialist advice shall be obtained to determine the most applicable test and what constitutes acceptable and unacceptable results. Additional guidance on the subject of microbiological contamination can be found in the ASTM Manual 47, *Fuel and Fuel System Microbiology: Fundamentals, Diagnosis and Contamination Control* and the Energy Institute (EI) document *Guidelines for the Investigation of the Microbial Content of Petroleum Fuels and for the Implementation of Avoidance and Remedial Strategies*.

This testing shall be repeated at six-month intervals. If the test results are unsatisfactory, the cause of the unsatisfactory results shall be investigated. Cleaning of the tank may be one result.

Treatment of tank microbiological problems by shock treating with biocide additives is not an acceptable method of control.

## 9.2 Change of Grade in Storage Tanks

When changing product grade in storage tanks, an MOC process shall be used to develop a plan to address all risks and required modifications.

When converting nonaviation product tanks to aviation product tanks the observance of certain fundamental practices in the design, construction and commissioning of facilities used for the storage, handling and transport of aviation fuels outlined in Section 6 is considered essential to ensure that health and safety of staff, environmental protection, and product quality are maintained.

In addition, the following points shall be considered.

- The design and area classification for the tank(s), dike/bund, and associated facilities, such as venting arrangements, instrumentation, electrical equipment, fire protection, etc., shall be checked to confirm their suitability for the grade of product to be stored, especially if a Class I product is being stored in facilities previously used to store a Class II product.
- Ground product storage tanks shall be drained down, gas freed, entered, and thoroughly cleaned before being commissioned on aviation fuel. Tanks shall also be cleaned when transferred from one grade of aviation fuel to another. The changing of jet fuel grades between JP-8, Jet-A, and Jet-A1 shall be drained down and flushed when changing from JP-8 to Jet-A or Jet-A1 with the new product to be used. Tanks and facilities that have been used for black oils or chemicals shall not be used for aviation fuels.
- Associated pipelines, pumps, strainers and filters shall be drained down and then flushed with three times line contents. Flushing shall be downgraded. Some pipe work and valve modifications may be necessary to achieve positive segregation.
- Chemical cleaning fluids shall not be used.
- All filter/water separators, filter monitors, clay filters, or microfilter elements, where used, shall be changed.
- Color coding and grade marking shall be changed.

- Selective couplings, where used, shall be changed.
- Issues shall not be made until a satisfactory recertification test is performed on a composite sample taken from the tank, along with a sample taken from the end of the delivery system.
- Particular care shall be exercised to ensure that full safety precautions are taken if the tank has contained leaded product.
- After any change of grade has been made the tank shall be filled and a recertification test performed. Once the quality has been deemed satisfactory, the tank can be released.
- Special decontamination procedures may be needed to address special concerns with previous products.

## 10 Delivery Procedures

### 10.1 Documentation

All transfers of product from pre-airfield storage terminals shall be supported by a release certificate.

### 10.2 Product Release Procedure

Product shall only be released for delivery from pre-airfield storage terminals from stock that has been fully settled and satisfactorily tested. Tanks shall be clearly identified "Released" or "On Issue."

### 10.3 Product Transfer

#### 10.3.1 General

Prior to road and rail loading or transfer by pipeline, the issuing tank shall be checked for free water per 9.1.1. Loading rack filter vessel sumps shall be drained of any water or particulate, with the filter vessel under pressure, and the results of the visual check recorded. These checks shall be made daily (every 24 hour period) when equipment is operational; they are not required on following loadings that day unless a different issuing tank is used. Longer intervals of drainage, to address short term unmanned operations (weekends, holidays), of no longer than three consecutive days may be undertaken if the following is met:

- 1) the storage tank(s) being used to supply the filter(s) are equipped with floating suction(s) or have the inlet suction at least 16 in. off the tank bottom and turned up from the bottom,
- 2) there is a 12-month history on negligible water or dirt observed in the filter sump,
- 3) the filter/water separators are equipped with water slug defense mechanisms that will shut down flow,
- 4) all microfilters and filter/water separators are equipped with an automatic means to shut down flow if the maximum differential pressure is exceeded.

A monthly colorimetric membrane filtration test shall be performed downstream of all filtration, preferable as close to the road or road transport loading point as possible to monitor the effectiveness of the filtration equipment.

#### 10.3.2 Loadings of Road/Rail Cars

- Before loading road or rail cars, the tank/compartments of these shall be checked (i.e. each tank compartment drained to verify it is empty and clean) to ensure that they are clean and free of water. If not satisfactory, steps shall be taken to clean/dry out the tank/compartments. *For grade dedicated road tankers that are bottom loaded*

*via grade selective couplings, this inspection needs to be performed once during the start of each day on that road tanker.* Grade selectivity may be satisfied by electronic means which provides a secure method to load only the correct grade of product into a road or rail transport.

- During loading, especially if it is raining, appropriate precautions shall be taken to avoid the ingress of water.
- After loading, all tanks/compartments of road and rail vehicles shall be sampled and checked for the presence of water and particulates from the low point drain or tank compartment bottom loading line. If the sample(s) are not clear and bright, additional sampling shall be done until clear and bright samples are obtained. Only after clear, water-free samples are obtained may the vehicle be released. A sample from the first jet fuel road or rail car for a particular day or subsequent to a change in shipping tanks shall be drawn from the road or rail car and the API Gravity determined. A sample from all aviation gasoline loads shall be drawn from the road or rail car and the API Gravity determined. For multicompartment tanks all compartments shall be tested; however, composite sample(s) may be taken from groups of up to three compartments to reduce the total number of tests. If the API Gravity(ies) differs by more than 0.7 API degrees from the API Gravity of the issuing tank contents, the matter shall be investigated and the vehicle kept in the facility pending resolution.
- Before dispatch, all filling and discharge connections, gauge hatches, and sampling valves shall be capped, secured, and sealed.
- Each vehicle shall have grade indicator plates or U.S. Department of Transportation (DOT) fuel ID placard positioned near the discharge connections.
- Hoses carried on vehicles shall be protected by dust caps or plugs when not in use.
- Vehicle loading operations shall be supervised at all times by pre-airfield terminal staff, independent inspector, or road truck driver.
- A release certificate shall be issued for each road/rail car indicating the above checks were performed by an authorized and trained person (pre-airfield staff, independent inspector, or road transport driver). The release certificate is in addition to the bill of lading, meter ticket (or measurement documentation) and recertification test reports (if applicable) issued with each road/rail car.
- If additives are injected into the fuel when loading the car, then some control system shall be in place (1) to monitor [e.g. before and after meter reading or a postloading refractometer test when injecting fuel system icing inhibitor (FSII)] the amount of additive and that injection is at approved levels and (2) to have a means of shutting down the loading or preventing the delivery of the car if over-or-under injection is found.

### 10.3.3 Marine Vessels

- Before loading marine vessels, the compartments, piping systems and pump arrangements shall be checked to ensure that they are clean and free of water. The vessel shall also meet the requirements in 7.3.
- Whenever possible, dedicated vessels shall be used. For nondedicated vessels, care must be taken to establish that only compatible products have previously been carried. Details of the previous cargoes and the date and cleaning procedure applied shall be included in the information supplied to the terminal. Refer to the EI HM 50 Guidelines for the cleaning of tanks and lines for marine tank vessels carrying petroleum and refined products.
- During product loading, samples shall be drawn from the pipeline at a point as close to the ship as possible for a control check. As a minimum, line samples shall be drawn at the commencement of loading and immediately before the end of pumping. A sample shall be taken after the new product passes the sampling point.
- For nondedicated vessels or where loading is via nonsegregated shore loading lines, loading shall be stopped after filling to approximately 1 ft to 2 ft level in each cargo tank; a ship middle or running composite sample shall

be prepared and specific properties checked and compared to the RQC/COA of the product being loaded. Appropriate level of investigation for contamination shall follow if the changes between the properties checked vary beyond tolerances.

- During loading, especially if it is raining, appropriate precautions shall be taken to avoid the ingress of water.
- After loading, all compartments shall be sampled and checked for the presence of water and contaminants.
- For nondedicated vessels, a multitank middle or all level sample shall be prepared for recertification test to confirm the condition of the product on board the vessel. The recertification test analysis shall not delay the departure of the vessel. However, the results of the test shall be made available to the supplying terminal within 12 hours, and to both the supplying and receiving locations before the vessel may be discharged.
- Before dispatch, all filling and discharge connections, gauge hatches and sampling valves shall be capped, secured and sealed.
- Vessel loading operations shall be supervised at all times by pre-airfield terminal staff.
- A release certificate shall be issued for each vessel indicating the above checks were performed by an authorized and trained person (pre-airfield staff). The release certificate is in addition to the bill of lading, meter ticket (or measurement documentation), and recertification test reports (if applicable) issued with each vessel.

#### 10.3.4 Pipeline Shipments

Prior to pipeline shipments, filter vessels sumps shall be drained of any water or particulate, with the filter vessel under pressure, and the results of the visual check recorded. Control checks should be conducted to verify quality of batch at commencement, middle, and end of transfer and when changing shipping tanks.

#### 10.3.5 Transloading of Aviation Product Rail Cars

Transloading may take the following forms.

- A *loaded* rail car used as temporary storage of aviation fuel at a rail siding. The aviation fuel stored in the rail car is off loaded into road trucks for shipment to an airport.
- An *empty* rail car placed at a rail siding and road trucks used to deliver aviation fuel to the rail car. The rail car then transports the aviation fuel to another site.

An MOC process should be developed for each transloading operation. A joint committee of the pre-airfield staff, road transport staff and the rail car owners/operators should perform the MOC. The MOC should consider HSSE, operational, quality, and engineering risks and establish site-specific procedures to address all identified risks.

Each transloading operation should meet the following minimum requirements.

- Rails cars should be constructed from stainless steel, internally epoxy lined carbon steel or carbon steel.
- The following sections of this recommended practice are applicable to transloading operations and shall be followed:
  - 1) the offloading of road or rail transport (see 7.4);
  - 2) loading of road or rail transport (see 10.3.2 and 12.5);

- 3) filtration shall be used in transloading, it shall meet the requirements in 6.9 and be maintained as described in Section 16;
- 4) when rail cars are used as temporary storage exceeding 48 hours, they shall be routinely drained of water as described in 9.1.1;
- 5) a suitable transfer unit shall be identified as part of the MOC process.

## 11 Documentation

### 11.1 Records

The results of all significant checks and testing shall be recorded on documents that are readily available and kept up-to-date. The records shall be retained for a minimum of one year. The records shall include the following.

#### 11.1.1 Records—Construction and Commissioning

Each pre-airfield storage terminal shall have readily available the following, maintained up to date.

- a) A schematic process flow diagram or piping and instrumentation diagram for fuel systems and drainage systems identifying key items of equipment, valves, etc.
- b) A general arrangement/emergency plan showing the location of all key items of equipment, safety, and environmental protection equipment and escape routes in case of emergency.
- c) Lease/ownership drawings showing plot boundaries and ownership limits and planning approvals.
- d) Reference map of the surrounding area showing water courses and access roads.
- e) Site geological and environmental data.
- f) Drawings for area classification (hazardous areas), electrical power supplies, control systems, fire prevention, ESD and alarm systems, detailed piping layouts (in particular buried pipes), tank layouts, drainage and interceptor systems, and cathodic protection. Records of any modifications, which shall also be reflected in updated “as-built” drawings.
- g) Equipment specifications for all pieces of equipment, including suppliers’ or manufacturers’ drawings, operations and maintenance instructions and other relevant literature and documentation.
- h) Design and sizing calculations, including design year and ultimate design capabilities (which shall be specified in the statement of requirements).
- i) Material and test or compliance certificates.
- j) Loss control reviews.
- k) Commissioning report.

It is recognized that an existing operation (which may have been established by others) may not have all the above information available.



### 11.1.2 Records—Quality Control

- Stock data, including daily product gauges and details of incoming quantities and delivered quantities.
- Import quality data, including full details of incoming consignments with relevant quality certificates.
- All testing results, including test certificates showing results of testing carried out on pre-airfield storage terminals stocks, and the results of control checks and conductivity tests.
- Batch records and release certificates.
- Tank settling and draining records. Draining records should record the observation of the sample from the tank sump including observation of solids (i.e. clean, slight, particulate, heavy) and water content (i.e. bright, hazy, cloudy, wet) and if microbiological growth and surfactants are present.
- Other draining records (e.g. filter sumps). Draining records should record the observation of the sample from the tank sump [i.e. observation of solids (i.e. clean, slight, particulate, heavy) and water content (i.e. bright, hazy, cloudy, wet)] and if microbiological growth and surfactants are present.
- All equipment used for fuel testing shall be inspected prior to use. All equipment needing calibration as recommend by the manufacture shall have this undertaken no less than yearly.

### 11.1.3 Records—Maintenance

- Tank inspection and cleaning records. (These shall be readily available for at least six years and ideally for the life of the tank.)
- Microfilter, clay filter, monitor and filter water separator differential pressure graphs, and element change records.
- Floating suction check records.
- Routine checks on other fixed equipment, e.g. meter calibration, level alarms, mesh strainers, hoses, bonding wire continuity, etc.
- Serviceability checks on health, safety, and environmental safety equipment.
- Checks on pumps, motors, etc.
- Annual torque wrench calibration records.

## 11.2 Signature and Retention

All records shall be signed by the person who carried out the checks/inspections. In the case of electronic data systems, it shall always be possible to identify the originator of the records.

Records of all daily, weekly and monthly checks shall be retained for at least one year for reference purposes and to allow any seasonal trends to be observed.

Records of all less frequent routine checks (tank inspections, filter records) and records of all nonroutine matters shall be retained for at least six years.

## 12 Transportation Equipment from Pre-Airfield Storage Terminals to Airfields

### 12.1 General

Wherever possible, dedicated single grade transport shall be used for the transportation of aviation fuel.

If this is not possible, grade changing of products shall be kept to a minimum and the transport must provide a record of cleaning or documentation of the previous product carried.

The use of seals on compartments on marine vessels and railcars/truck transports may provide extra assurance to maintain the integrity of the products.

### 12.2 Pipelines

Pipelines supplying airfield storage shall be dedicated to a single grade of jet fuel and segregated from other products.

Multiproduct pipelines shall only be used to transfer product to an airfield storage if that airfield is suitably equipped to prevent contamination of aviation fuels. Such facilities would typically include:

- a) facilities for segregating tankage used for pipeline receipt from tankage used to supply hydrant or fueler loading racks;
- b) facilities for handling product interfaces;
- c) facilities for readily returning off-specification product to the distribution network.

### 12.3 Coastal/Inland Waterway Vessels

Coastal and inland waterway vessels shall be designed to prevent any contamination between products. This shall include features such as fully segregated pipework or blind flanges.

The cargo tanks of new vessels intended for aviation fuel handling shall be coated internally with an approved lining. Tanks shall also be designed to permit complete draining. Vessels shall not have heating coils manufactured from copper or copper-containing alloys.

Where the last cargo was a product (or grade) different from the one to be loaded it is important to ensure that the tanks, pipelines and pumps are fully drained before loading the next cargo. Refer to the EI HM 50 for further information on vessel cleaning requirements.

All rubber seals and gaskets on lids, hatches, etc. and the glands of valves shall be maintained in good condition to prevent the entry of water into the cargo tanks.

### 12.4 Road Vehicles/Rail Tank Cars

Road and rail tank vehicles shall be designed such that tanks can be completely drained. For multicompartment vehicles, each compartment shall be capable of being drained independently.

Road and rail tank vehicles shall be constructed of aluminum or stainless steel. (If constructed of mild steel, they shall be coated internally.)

Road and rail tank vehicles shall be bottom loaded (see 6.8) and if practical, through grade selective couplings. All top manhole and gauge point covers shall seal completely against the ingress of water or dirt. Where top filling is practiced, this shall be through a drop/gauge pipe to eliminate splash filling (see 6.8).

Road vehicle tanks and trailers and rail tank cars shall be in aviation grade dedicated service. The use of grade dedicated equipment reduces the opportunity of product contamination during shipment.

Grade dedicated equipment is always preferable as described above but for emergency service or where grade dedicated road vehicle tanks/trailers and rail tank cars are not available, the grade change requirements described in 12.5 shall be followed.

## **12.5 Grade Change Procedures for Road and Rail Vehicles**

### **12.5.1 Switch Loading**

Pre-airfield storage terminals shall have agreed procedures for switch loading (see API 2003) that shall be followed in all cases where aviation fuel is involved. The most dangerous situation exists when a medium or high flash product (e.g. jet fuel) is loaded into a tank that has previously contained a low flash product (e.g. aviation gasoline) without flushing or gas freeing because the atmosphere in the tank may pass through the explosive range during filling and could be ignited by a static electrical discharge. The reverse is also true and, although in this case the vapor concentration passes through the explosive range rapidly, the same precautions are still necessary.

Switch loading precautions shall be applied where fuels having a flash point of less than 100 °F are mixed with fuels with a flash point above 100 °F either by addition of the higher flash fuel to the lower flash fuel or vice versa. Precautions shall also be applied for products with a flash point of 100 °F or above where either the fuel to be loaded or the last grade carried is at a temperature equivalent to or above its flash point.

For aviation fuels there is a particular need to ensure that contamination with other products does not occur.

### **12.5.2 Cleaning/Flushing Requirements**

Only vehicles that have carried an appropriate last load shall be used for the transportation of aviation fuels. The intent of these procedures is to allow the product quality inspector to verify that the next grade can be loaded safely and delivered in an uncontaminated condition.

When changing road and rail vehicles from one grade to another the procedures in Table 3 shall be applied to ensure that there can be no product contamination from any residues of the last grade carried. Changes of grade procedures shall be documented on the vehicle release certificate.

### **12.5.3 Reloading Procedures**

After loading the new grade, samples shall be drawn and a control check carried out.

U.S. DOT fuel ID placard and/or product grade plates/markings, color codes, and selective couplings shall be changed to suit the new grade.

## **13 General Operating, Maintenance, Inspection, and Test Requirements**

### **13.1 Bonding**

When discharging or loading road and rail vehicles, the vehicles shall always be bonded to the fixed facilities that shall be suitably grounded. Bonding connections shall be made to clean, unpainted metal surfaces.

**Table 3—Changes of Grade Procedures**

Carried	Grade to Be Loaded	
	Jet Fuels	Aviation Gasoline
1) Aviation gasoline	a or c	b
2) Motor gasoline (unleaded)	a or c	b
3) Regular/premium kerosene	b	a
4) Jet A/A1, JP-5, JP-8	b	a
5) Undyed diesel, ultra low sulfur diesel (not containing lubricity improver)	a or d	a
6) Biodiesel (FAME) Product containing up to B15 FAME Product containing greater than B15 FAME	a or d a or e	a
7) Dyed high sulfur diesel, ultra low sulfur diesel fuel (containing lubricity improver additive)	a	a
8) Black oils, chemicals, or any other products not contained in this table	Require specialist advice in cleaning to acceptable standards when vehicles have previously been in this type of service.	
a) The vehicle shall be steam cleaned (see API 2013) and dried. Detergents or cleaning chemicals shall not be used. b) The tank and pipe work shall be drained as completely as possible during the prior discharge. c) The tank and pipe work shall be completely drained and flushed with the grade of aviation fuel to be loaded to cover the internal valves of each compartment. d) One full intermediate zero FAME cargo followed by change of grade from previous cargo. e) Three full intermediate zero FAME cargos followed by change of grade from previous cargo.		

Bonding connections shall be completed before hoses are connected and prior to opening fill caps, gauge hatches, etc. and remain in position until hoses are disconnected and hatches and fill caps are closed.

Bonding wires, clips, and reels shall be checked weekly for electrical continuity. For reel-type bonding wires continuity shall be checked over at least one complete revolution of the wheel.

Buckets and metal containers used for fuel sampling and draining shall be bonded to the vehicle or tank pipework prior to and during draining operations.

The use of plastic or galvanized containers is not permitted.

### 13.2 Filling of Empty Tanks, Vehicles, and Filters

When filling an empty tank, vehicle or ship compartment, or filter vessel, the initial fill rate shall be maintained at a low value until the filling point is submerged to minimize the possibility of generating excessive static charge and product mists. This is especially important where the product contains no SDA.

Additional precautions to eliminate air in filter vessels and to provide adequate relaxation time after product without SDA flows through a filter vessel is also required (see API 2003).

### 13.3 Planned Maintenance, Inspection, and Testing

For all fixed and mobile plant and equipment, a system of planned maintenance, inspection, and testing shall be established and records kept for all activities.

## 13.4 Filtration Equipment

### 13.4.1 Strainers and Filters

All strainers, filtration and water separation equipment shall be checked and maintained regularly (Section 16).

### 13.4.2 Filter Vessels

All filter vessels shall have the dates of last inspection, and the last element change date applied on the body of the vessel or physically attached on an information plate.

All filter vessels should have filter element and vessel bolt torque data applied on the body of the vessel or physically attached on an information plate. If data is not applied to the vessel it shall be documented and kept on site.

## 13.5 Tank Level Alarms

It is recommended that the use and routine maintenance of tank level alarms be in place. **Guidance can be found in API 2610.**

## 13.6 Tank Vents

It is recommended that the routine maintenance of tank vents be in place. **Guidance can be found in API 2610.**

## 13.7 Tank Inspection and Cleaning

### 13.7.1 Inspection Frequency

All tanks that can be internally inspected from tank manways or gauge hatches should be thoroughly inspected one year after first commissioning. Thereafter, inspection for cleanliness shall be undertaken every three years, and thorough cleaning carried out if indicated by inspection results. If the inspection reveals microbial growth or buildup of sediment exceeding approximately  $\frac{1}{5}$  of the tank bottom surface, cleaning of the tank shall be undertaken. More frequent inspections shall be carried out if there are indications that fuel quality downstream of the tank is unsatisfactory; e.g. short filter lives, discolored water drainage, or slimy deposits.

For all tanks that cannot be internally inspected from tank manways or gauge hatches (i.e. internal floating roof/blanket or other obstructions that may prevent visual inspection of the tank interior from outside the tank), cleaning shall take place every three years. This three-year cleaning requirement can be extended provided the tank meets the following criteria:

- a) the tank is equipped with an internally coated bottom and coated approximately 3 ft up the side walls from the bottom (see 6.2.4);
- b) the tank is equipped with a tank sump drain system [see 6.2.5 b)];
- c) there are no indications that fuel quality downstream of the tank is unsatisfactory (e.g. short filter life, discolored water drainage, or slimy deposits) or if the condition of the tank drain samples suggest the presence of unusual signs of microbiological growth or surfactants;
- d) If satisfactory results are obtained from the six-month microbiological tank bottom samples (as described in 9.1.7).

Inspection of the external mechanical condition of the tank and fittings shall be carried out annually.

Inspection for internal mechanical condition shall be carried out in accordance with local regulatory requirements or at least every 10 years.

### 13.7.2 Inspection Procedures

#### a) Cleanliness:

Internal tank surfaces shall be thoroughly visually inspected for the presence of sediment, bacterial growth, surfactant-type contaminants, and if relevant, the condition of the lining. An assessment shall be made as to whether cleaning is necessary.

#### b) External Condition:

The tank structure and all relevant fittings shall be inspected and repairs or servicing carried out as necessary. Checklists shall be prepared to ensure a thorough inspection is conducted; the following items shall receive particular attention:

- tank base and foundation (e.g. for evidence of tank settlement or water “wash-out” damage);
- stairs and ladders (e.g. for corrosion, stair to shell welds);
- paintwork;
- roof surfaces, including any treads or nonslip areas;
- vent valves, mesh screens, gauge hatches, and gauging systems;
- tank-side valves drain lines, sampling systems;
- tank floor leak detection;
- tank grounding.

A typical Tank Inspection and Cleaning Report is shown in Annex H.

#### c) Internal Mechanical Condition:

This inspection is intended as a thorough check of the structural integrity of the tank. It shall be carried out by a suitably qualified engineer. A full report shall be prepared and be available for inspection at the site.

### 13.7.3 Tank Cleaning

Tank cleaning shall be conducted whenever an inspection reveals the need for such cleaning, i.e. by the discovery of bacterial contamination, surfactant-type contaminants, or significant quantities of sediment. Simple flushing techniques and mopping out are recommended for cleaning; no chemicals or cleaning materials shall be used as they could contaminate the aviation fuels to be stored in the tanks.

### 13.7.4 Inspection and Cleaning Records

Records shall be kept and made available for reference of the condition of the tank on inspection and cleaning. The records shall clearly indicate the type and amount of any contaminants found.

The dates of the most recent inspection and cleaning shall be stenciled on the tank shell.

## 13.8 Pipelines

Guidance can be found in API 2610.

## **14 Health, Safety, Security, Environment, and Training**

### **14.1 Health and Safety Permit to Work System**

Guidance can be found in API 2610.

### **14.2 Security**

Guidance can be found in API 2610.

### **14.3 Protecting the Environment**

Guidance can be found in API 2610.

### **14.4 Drainage**

Guidance can be found in API 2610.

### **14.5 Maintaining the Integrity of Fuel Tanks and Systems**

Guidance can be found in API 2610.

### **14.6 Training**

#### **14.6.1 General**

The nature of operations work is such that it is essential that all those involved understand the consequences of any lapses in maintaining correct procedures. It is therefore a requirement that personnel are fully trained to undertake all routine operational tasks and can respond adequately to emergency situations.

#### **14.6.2 Recruitment**

Procedures shall exist and be followed to ensure that new employees are fully capable of carrying out the required duties. Formulation and implementation of these procedures is the responsibility of local operational management, since they will clearly differ from place to place. However, certain basic factors shall be addressed, including the following:

- a) literacy,
- b) numeracy,
- c) physical condition,
- d) eyesight and hearing.

#### **14.6.3 Training**

New personnel shall be thoroughly trained in all operations and procedures that 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. Existing personnel called upon to undertake new tasks shall be similarly trained before undertaking the new task without supervision.

An employee training record shall be maintained for every employee that indicates (i) for which tasks training has been given and the date of such training, (ii) the signature of the trainer, (iii) a "yes/no" assessment of whether the trainee demonstrated satisfactory understanding of the training, and (iv) the signature of the trainee. Where necessary training records for existing personnel shall be established.

Follow-up job observation (with refresher training if it is found to be necessary) shall be undertaken by supervisory or training staff at a frequency determined by the Installation Manager based on his assessment of ongoing operator performance.

The dates and results of these follow-up observations shall be recorded on the operator's training record.

Training is to cover routine standard tasks such as sampling, tank and filter draining, etc. and tasks that are specific to a location such as pipeline fuel receipts and tank management. The latter tasks shall be the subject of specific written procedures which also form the basis of the training given. Where appropriate some of these written procedures may be displayed at the work location.

## 15 Aviation Fuel Additives

### 15.1 Introduction

This section provides guidelines on the use of aviation fuel additives. Guidance is given on the controls that shall be set up and the procedures that shall be adopted to ensure that the correct additive is added at the appropriate concentrations. Only those that may be added will be covered in this section; they are SDA, FSII, corrosion inhibitor/lubricity improver (CI/LI), sometimes referred to as lubricity improver additive (LIA), mixtures of FSII and CI/LI, and metal deactivator additive (MDA).

When additives are blended or injected into the fuel at a pre-airfield distribution terminal, then the additive amount (and conductivity when SDA is used) shall be recorded on the COA or other fuel delivery documentation, as appropriate.

An antioxidant is added at the refinery to stop or retard jet fuel oxidation. It will be on the refinery RQC when first issued. It is not injected at pre-airfield terminals but is included as an approved additive that may be seen on quality documents received by the pre-airfield distribution terminal.

### 15.2 General

Additives improve certain aspects of fuel performance, achieving the desired effect by preventing or suppressing undesirable fuel behaviors, such as corrosion, icing, oxidation, etc. Their effectiveness is due to their chemical nature and the resulting interactions with constituents in the fuel.

Only approved additives are permitted in aviation fuels, and the type and concentration are controlled by the specifications. The correct additives shall be in the fuel at the required concentrations if the fuel is to perform satisfactorily in aircraft. The additions of additives shall, therefore, be controlled and records maintained for product (and additive) verification.

### 15.3 Approved Additives

#### 15.3.1 Static Dissipater Additive (SDA)

Stadis 450 with full approval for use in US grades of aviation fuels meeting the requirements of ASTM D1655 and MIL-DTL-83133.

The permitted levels are as follows:

- first treatment, e.g. at point of manufacture or initial treatment if downstream of refinery, in concentrations up to a maximum limit of 3 mg/l;



- subsequent treatments, e.g. to restore loss of conductivity during distribution or prolonged storage, in concentrations such that the cumulative total of Stadis 450 does not exceed 5 mg/l. If, however, the amounts added previously are not known, further additions shall not exceed 2 mg/l.

### 15.3.2 Fuel System Icing Inhibitor (FSII)

FSII will only be used when it is a contractual requirement (e.g. in military fuel) or by agreement with customers for supplies to specific aircraft at specific locations. Where FSII is required and it is inadvertently omitted from the fuel, the customer shall be advised immediately.

#### 15.3.2.1 Diethylene Glycol Monomethyl Ether (DiEGME)

DiEGME is the FSII additive approved for use in all aviation turbine fuels in the United States.

DiEGME shall be purchased to meet the requirements of the two main specifications, which are:

- ASTM D4171,
- U.S. military MIL-DTL-85470 (NATO Code S-1745).

When used in Jet-A fuel, DiEGME shall be present on delivery to the purchaser in concentrations in the range 0.10 % to 0.15 % by volume.

#### 15.3.2.2 Properties

DiEGME is a colorless liquid that is completely miscible with water but has limited solubility in fuels especially at low fuel temperatures. This limited solubility means that it cannot be prediluted prior to injection with the fuel. DiEGME absorbs water from the atmosphere, and tanks in which it is stored shall be fitted with desiccant (silica gel) drier tubes or other acceptable methods to preclude atmospheric moisture from entering the storage tank. Its relatively high viscosity and density make injection and mixing difficult.

### 15.3.3 Corrosion Inhibitor/Lubricity Improver Additive

CI/LI additives for use in Jet A and military fuels, including United States, NATO, and British, are qualified to MIL-PRF-25017.

The additives are dark colored liquids and their relatively high viscosities at ambient temperature make it difficult to inject and mix low levels of the concentrated additive.

CI/LI will be used only when it is a contractual requirement, e.g. in military fuel, or by agreement in writing with customers for supplies to specific aircraft at specific locations. Where CI/LI is required and it is inadvertently omitted from the fuel, the customer shall be advised immediately.

#### 15.3.4 Metal Deactivator Additive (MDA)

Presently there is only one MDA approved for use in aviation turbine fuels. It is N,N'-disalicylidene 1,2-propanediamine, and it may only be used selectively to deal with specific thermal stability problems in some grades of turbine fuels as follows.

- a) The maximum concentration of MDA that may be added to the fuel is 5.7 mg/l. Although well below the specification maximum permitted concentration, it is sufficient to correct problems.
- b) Confirm that MDA will correct the problem by checking that a laboratory blend with no more than 5.7 mg/l MDA passes the JFTOT thermal stability test. The conductivity of the blend shall also be checked because the addition

of MDA usually depresses the fuel conductivity. If this indicates that additional SDA is required it can then be added to the batch at the same time as the MDA.

- c) After treating with MDA, test a composite of upper, middle, and lower samples to confirm that the fuel now meets JFTOT thermal stability requirements.
- d) Report on relevant test certificate the before and after thermal stability test results and the amount of MDA added.

The MDA additive under the trade name DMD in three forms: as a solid and as a liquid at two different concentrations in a solvent. The solid DMD is too difficult to dissolve in fuels to be of field use.

## 15.4 Receipt Procedures

### 15.4.1 Selection and Purchase

Only approved additives may be used. Each individual purchase order for each consignment shall clearly state the product required and the specification it shall meet. It is not sufficient merely to state that it is a repeat of a previous order. It is important to state clearly which product is being ordered as many additives are known by trade and common names that are not always unambiguous.

### 15.4.2 Supplier's Quality Documentation

Additives shall be accompanied by the supplier's quality certificate that:

- confirms that the additive complies with the relevant specification;
- contains test results verifying that the product meets the specification;
- states batch details and date of testing and is signed.

If the quality documents comply with all these requirements then no further testing is required to receive the additive into stock provided the receipt checks (see 15.6.3) have been satisfactorily completed. If the quality documents do not comply with these requirements, the product shall be quarantined until any discrepancies are resolved.

### 15.4.3 Receipt of Additives

Incoming product shall be segregated from other stocks until the following checks have been satisfactorily completed.

- a) Examine containers for damage or possible contamination during transit. Leaking or damaged containers shall be quarantined.
- b) Product in leaking or damaged containers shall be decanted into new containers and segregated from other stock. Some additives require special containers and unlined steel may not be suitable so procedures shall state the type of container to be used for the specific additive.
- c) If markings on containers are damaged and indistinct or illegible, the contents shall be regarded as suspect and unless the identity can be unambiguously established, the product shall not be used. Markings still legible but becoming faded or indistinct shall be remarked. Consult the supplier's Material Safety Data Sheet (MSDS) for advice on disposal.
- d) The markings on the containers shall correspond with the information on the supplier's quality certificate.

An appropriate MSDS will normally be supplied with every consignment of additive. Relevant precautions/information on the MSDS, such as potential hazards and personal protective equipment, shall be incorporated into written procedures and training.

## 15.5 Storage Procedures

### 15.5.1 Segregation and Grade Marking

Fuel containing FSII or CI/LILIA shall be treated as a different grade, requiring the usual grade marking, dedication, and segregation from all other fuel grades. Fuel containing SDA or MDA does not normally need to be dedicated/segregated.

There are no generally agreed-upon grade names and markings for fuels containing additives that are not mandated by the specification and are only permitted by agreement with the customer.

Grade markings shall be unambiguous and simple. Unless there is a local or national convention, the grade marking for the fuel without additive is used together with the abbreviated name of the additive, for example:

- Jet A to which DiEGME has been added would become Jet A/FSII,
- Jet A with CI/LILIA would be Jet A/LI.

### 15.5.2 Storage of Additive Containers

The use of well-ventilated buildings is recommended for storage of additive containers.

Drums may be stored upright (typically on pallets) provided that they are stored under cover, or stored with drum top covers for not more than three months (before release). Where this is not the case, drums shall be stacked on their sides with bungs below the liquid level. The bottom drums shall be held in position (e.g. by wedges) to prevent collapse of stacks.

Each additive shall be stored separately to help avoid confusion with any other materials. Product shall be used in rotation according to batch dates.

### 15.5.3 Storage/Injection Tanks

Tanks for the storage of additives shall be designed, constructed, and commissioned in accordance with local and national standards. They shall be appropriately sized and incorporate a graduated sight glass or dip stick, a low point drain sampling valve, and where required, desiccant drier tubes (see 15.3.2.2). Additives can be aggressive toward some metals, linings, and seals, so tanks and related equipment shall be constructed from materials that are compatible with and suitable for use with the additive with which they will come into contact. FSII fluids are particularly aggressive to lining materials and some metals, such as aluminum.

## 15.6 Inspection and Cleaning

### 15.6.1 Containers

Inspect containers for leakage monthly. Check markings and renew as necessary to maintain clear identity of product and batch.

### 15.6.2 Storage/Injection Tanks

At least once each month a sample shall be taken into a glass bottle from the tank low point or upstream of the injection point. If the sample is visually clear and bright, injection may begin and the sample returned to stock. If the sample is not free from contamination, the system shall be flushed until a satisfactory sample is obtained.

Storage tanks used to store/dispense additives shall be inspected internally every three years and cleaned if necessary. If internal inspection is impracticable, the tanks shall be cleaned every six years. In addition, they shall be cleaned immediately if there is evidence of accumulation of sediment as disclosed by bottom samples or by the need to clean strainers frequently. Details of inspection and cleaning will be recorded.

## 15.7 Release Procedures

### 15.7.1 Additive

Release of additives for use shall be controlled by a release certificate, which states the product name, the specification, and the supplier's batch details and is signed by an authorized signatory. This needs to be done carefully as the long chemical names of some additives are easily confused with those of some nonaviation additives.

### 15.7.2 Fuel Containing Additive(s)

Fuel containing additive(s) shall be released using an appropriate release certificate, which states the fuel grade, the additive(s), and the amount added.

When additive is injected during road loading, the additive meter readings at the start and end of the loading shall be recorded on the release certificate.

## 15.8 Quality Control and Testing

Some countries have national regulations for the quality control and testing of additives. Where such regulations are more stringent, they shall be used.

### 15.9 Shelf Life

The shelf life depends on the additive type. Generally, the supplier's recommendations shall be followed. Although some additives do not have shelf lives, the containers can deteriorate and affect the additive. Therefore, we recommend that shelf lives shall be restricted to a maximum of two years.

### 15.10 Periodic Testing

Only FSII requires periodic testing. Stadis 450, CI/LILIA and MDA are sufficiently stable not to require it. The testing requirements depend on how the FSII have been stored, as follows:

#### 15.10.1 Sealed Containers

FSII in original manufacturers' containers that are sealed does not need to undergo periodic testing.

	FSII	CI/LILIA	SDA	MDA
Periodic Test, Annually				
Containers	No <sup>a</sup>	No	No	No
Tanks	Yes	No	No	No
Static Stock, Semi-annually				
Tanks	Yes	No	No	No
<sup>a</sup> Containers/drums shall be periodic tested every 24 months while in storage.				

### 15.10.2 Storage/Injection Tanks

#### a) Static Stock

Every six months a sample shall be taken from any FSII storage tank where the stock has been held static, i.e. stock to which no replenishments have been made and irrespective of whether or not any withdrawals have been made

All storage/injection tanks containing FSII shall be sampled every 12 months and the samples subjected to periodic testing.

### 15.10.3 Periodic Tests

#### a) FSII

	Method	Limit DiEGME
Total Acidity, mg KOH/g	ASTM D1613, EI 139 (see Note)	Max 0.09
Relative density, 20 °C/20 °C or density at 15 °C, kg/l	ASTM D891 or ASTM D4052; EI 189	1.020–1.025; 1.024–1.028
Water content, mass %	ASTM D1364, EI 356	Max 0.15 (0.8 in ASTM)
NOTE Weight of sample 50g, and concentration of KOH 0.05 molar.		

### 15.10.4 Test Methods

#### a) SDA:

The concentration of Stadis 450 in fuel can be measured by standard method ASTM D7524. Conductivity, however, is simple to measure with a conductivity meter (ASTM D2624/EI 274). The lack of a suitable test method underlines the need to keep records of Stadis 450 additions from refinery to final use to ensure the specification is complied with.

#### b) FSII:

The concentration of DiEGME in aviation fuel can be determined by extracting the DiEGME with water and measuring the refractive index of the water extract (ASTM D5006). The method is suitable for use as a field test for checking that injection equipment is operating satisfactorily. Details of equipment suppliers are given in the test method.

#### c) CI/LILIA:

Standard methods are not available for measuring the concentration of these additives in fuel.

#### d) MDA:

Standard methods are not available for measuring the concentration of this additive in fuel.

## 15.11 Additive Treatment

Additive treatment is difficult because of the following.

- The additives are more dense and viscous than fuels.
- Small amounts of additive require blending homogeneously into large volumes of fuel.
- It is difficult to confirm some additive concentrations and homogeneity in treated fuel.

- Conductivity is proportionally affected by fuel temperature. Plan to compensate the SDA injection rate accordingly.
- Premixing of additives is strictly prohibited.

Hence adequate preparations shall be made to ensure appropriate equipment and site-specific written procedures are in place and training has been carried out.

### 15.11.1 Dosage Rate

Regardless of which additive or the reason for treatment, whether to achieve a certain performance or to meet a specific requirement of a customer, the amount added shall never exceed the maximum limit of the relevant specification.

Some additives are supplied diluted in a solvent so that the amount of “active ingredient” shall be determined. Others require predilution with fuel to facilitate treatment. These aspects shall be included in written procedures to prevent misunderstanding or confusion over how much is to be added.

### 15.11.2 Treatment Method

The following is the simplest and most effective method to control the amount added and to obtain a homogeneous blend in the fuel:

- injection into a flowing stream of fuel, FSII requires mixers and/or turbulent flow at the point of injection in order to assure homogeneity;
  - flow-controlled piston pump with variable stroke;
  - meter to measure the amount of additive injected.
- a) Some additives are aggressive, e.g. to lining materials, seals, and some metals, so the materials used for the injection equipment shall be compatible and suitable for use with the additive.
  - b) After initial commissioning the injection equipment shall be calibrated at regular intervals. On completion of commissioning/calibration the control for varying the stroke of the injection pump shall be sealed/locked. SDA's conductivity is sensitive to temperature variations and adjustments to the controls may be required more frequently when injecting SDAs.
  - c) Controls/procedures shall be used to ensure the additive tank always contains sufficient additive.
  - d) At the time of FSII injection the jet fuel and FSII should be as dry as possible to facilitate homogenization. The FSII shall be injected after the jet fuel has been treated through a filter-separator or water monitor filtration device.
  - e) FSII and CI/LILIA shall be added at installations and airports by this method only.
  - f) If addition of SDA is a regular requirement at an Installation, this method shall also be used.
  - g) This is the best way to add MDA but as treatment with MDA is a “one-off” infrequent occurrence, it is unlikely that the injection equipment will be in place.

NOTE Other injection methods may be acceptable.

### 15.11.3 Other Methods

If additive addition is not a regular requirement and injection is not possible, other methods are acceptable but they may only be used:

- at installations,
- for SDA and MDA additions,
- provided mixing is good enough to give homogeneous blend,
- provided satisfactory mixing is confirmed.

The following guidance shall be used for SDA and MDA additions at Installations when injection is impossible:

Predilute required amount of additive with fuel to facilitate mixing.

- a) For fuel receipts from ships and RTC, it is preferable to add directly to ship/RTC compartments before discharge so that turbulence during discharge completes the mixing.
- b) For receipts from pipeline (and ship/RTC when addition to ship/RTC is not possible) add to the reception tank before receiving fuel. Circulation may be required to obtain a homogeneous blend.
- c) If fuel in a storage tank needs to be treated and the only option is by pouring the prediluted additive through the top of the tank, extended circulation will be required to obtain a homogeneous blend.
- d) Confirm mixing is satisfactory.
- e) For SDA additions, by measuring fuel conductivity at upper/middle/lower levels in tank for MDA additions, by carrying out JFTOT on composite of upper, middle, and lower samples.

### 15.11.4 Supply and Distribution Installation

a) FSII, CI/LILIA:

- These additives shall be added by the injection method (see AD.7.2)\*.
- Addition of one of these additives to fuel creates a grade requiring dedication/segregation.
- Add as fuel is dispatched from the installation to:
  - i) minimize dedication/segregation restrictions,
  - ii) avoid problems caused by additive loss during storage at the installation.
- Loss of FSII may occur after addition at the installation and before the fuel is delivered to aircraft, so it may be necessary to add above the minimum level.

NOTE The addition of FSII may reduce the conductivity.

b) SDA:

- If treatment is regularly required the injection method (see AD.7.2) shall be used.

- If injection is not possible the methods outlined above in AD.7.3 may be used.
- The addition of SDA does not create a new grade requiring segregation/dedication.

c) MDA:

- Discuss and agree beforehand with Technical Branch the use of MDA to correct a fuel thermal stability problem.
- Injection facilities are unlikely to be set up as it will be a “one-off” requirement.

The addition of MDA does not create a new grade requiring segregation/dedication.

### 15.11.5 Calibration of Injection Pumps

Equipment used to inject additives into aviation fuels shall be calibrated every six months.

## 15.12 Records

- a) Records shall be maintained so that all aspects of additive treatment can be checked including confirmation that the correct additive was added in the required amount, traceability to a particular container of additive, and any calibration of injection pumps.
- b) When additive is injected as fuel is dispatched from an installation, the amount added shall be recorded on the release certificate.
- c) Details of all SDA additions, including upstream additions, shall be reported on the recertification test certificate.
- d) When additive is injected during fuelling, the amount added shall be determined and recorded on the delivery certificate.

## 15.13 Material Safety Data Sheets (MSDSs)

Additives are present in aviation fuels at such low concentrations that a special MSDS is not normally required. FSII is the exception because any water drained from a tank storing fuel with FSII can contain almost 50 % FSII. Users, including employees and agents as well as customers, need to be aware of this so precautions can be taken. Appropriate MSDSs shall be available at all locations where FSII additives are present in fuels. In addition, any location involved with the handling or addition of other additives to fuels shall have on site the MSDSs for those additives.

# 16 Strainer and Filtration Equipment Maintenance Checks

## 16.1 Routine Checks—Strainers

All fine mesh strainers used for product quality purposes shall be drained, opened, and inspected monthly. Strainers used for pump and valve inspection should be opened and inspected approximately yearly.

## 16.2 Routine Checks—Filters (Prefilter, Filter Water/Separator, Clay Filter)

### 16.2.1 Drain Checks

Filter vessel sumps shall be drained of any water or particulate, with the filter vessel under pressure, and the results of the visual check recorded. These checks shall be made daily (every 24 hour period) when equipment is operational; they are not required on following loadings that day unless a different issuing tank is used. Longer intervals of



drainage, to address short term unmanned operations (weekends, holidays), of no longer than three consecutive days may be undertaken if the following is met:

- 1) the storage tank(s) being used to supply the filter(s) are equipped with floating suction(s) or have the inlet suction at least 16 in. off the tank bottom and turned up from the bottom,
- 2) there is a 12-month history on negligible water or dirt observed in the filter sump,
- 3) the filter/water separators are equipped with water slug defense mechanisms that will shut down flow,
- 4) all microfilters and filter/water separators are equipped with an automatic means to shut down flow if the maximum differential pressure is exceeded.

If water or sediment is found during draining, continue draining until a clear sample is obtained. The quantities of water and sediment and any visible signs of microbiological growth in the sump draining shall be recorded. Where facilities are unused for seven days or longer, a visual check and purge, as above, shall be done at weekly intervals. For facilities used infrequently where routine purging would result in partial emptying of the filter vessel, local procedures to safeguard fuel quality and operational safety shall be established.

### **16.2.2 Differential Pressure Checks**

Differential pressure shall be observed daily during routine operations to ensure that the maximum limit is not exceeded. At weekly intervals, the observed differential pressure shall be recorded at the maximum achievable flow. A weekly graph should be prepared showing the differential pressure at, or corrected to, the maximum achievable flow.

The filter used in direct reading differential pressure gauges shall be checked and replaced as needed whenever filter vessels are inspected or filter element replaced.

### **16.2.3 Internal Inspection**

All filter vessels shall be opened at yearly intervals and inspected internally for cleanliness of vessel, element appearance, and condition of internal lining, proper fitting of elements, which shall include confirmation of torque settings, and inspection for proper operation of the vessel air eliminator and thermal relief system.

During inspection of the filter vessel, attention shall be paid to the following.

- Any gelatinous or “slimy” contaminants or sludge that could indicate the presence of surfacants.
- Any “leopard spotting,” indicating the presence of microbiological growth.
- The condition of seals, gaskets, “O” rings and the torque on element securing bolts.
- The condition of ancillary equipment such as air eliminators, pressure relief valves, etc.
- Any elements showing signs of mechanical damage. These shall be replaced.

A record shall be maintained of the results of the inspection.

### **16.2.4 Electric and Mechanical Water Defense System Check**

All electronic and mechanical water defense systems shall be checked quarterly for proper operation.

### 16.3 Clay Performance Checks (Jet Fuel Only)

When storage tank receipt recertification test results show a MSEP result of less than 85 but equal to or greater than 75, take a sample from the downstream side of the clay filter on the first shipment from the storage tank for MSEP testing. Verify the clay filter is improving the MSEP results to 85 or higher. Weekly downstream MSEP clay filter element monitoring shall continue until the next receipt takes place to verify that the clay filter effluent is not less than a MSEP rating of 85.

If SDA is injected after the clay filter vessel, then weekly MSEP samples of the clay effluent shall take place to insure that a MSEP result of greater than or equal to 85 is obtained.

Slugs of water can disable the surfactant removal capability of clay filters. Where bulk water may be present in a system the addition of a single stage coalescer (see 6.9.2) should be considered.

[paragraph deleted]

### 16.4 Element Change Criteria

#### 16.4.1 Microfilter Elements

These shall be replaced:

- if the differential pressure reaches the maximum limit set by the manufacturer;
- if element failure is indicated by a sudden drop in differential pressure;
- if samples from the downstream side of the filter contain significant quantities of particulate contaminants;
- after a maximum of three years in service.

#### 16.4.2 Filter/Water Separators: Coalescer Elements

These shall be replaced:

- a) if the differential pressure reaches 15 psi (1.05 kgf/cm<sup>2</sup>);
- b) if element failure is indicated by a sudden drop in differential pressure;
- c) for jet fuel if membrane tests downstream of the filter exceed acceptable limits of greater than 3 wet/2 dry color membrane filtration test rating on a 1 U.S. gallon (5 liter) sample (if one test exceeds the limit, a repeat shall be carried out before replacing elements);
- d) if samples from the downstream side of the filter contain significant quantities of particulate contaminants;
- e) after a maximum of three years in service.

#### 16.4.3 Filter/Water Separator Elements

Polytetrafluoroethylene (PTFE) coated or synthetic separator elements may continue in service indefinitely provided that they satisfy the manufacturers test requirements on water repellency.

#### 16.4.4 Clay Filter Elements (Jet Fuel Only)

These shall be replaced:

- a) if the differential pressure reaches 15 psi (1.0 kgf/cm<sup>2</sup>);
- b) if element failure is indicated by a sudden drop in differential pressure;
- c) if samples from the downstream side of the filter indicate a MSEP result of less than 85;
- d) after a maximum of three years in service.

#### 16.4.5 Filter Monitor Elements

These shall be replaced:

- a) if the differential pressure reaches maximum limit set by the manufacturer;
- b) if element failure is indicated by a sudden drop in differential pressure;
- c) for jet fuel if membrane tests downstream of the filter exceed acceptable limits of greater than 3 wet/2 dry color membrane filtration test rating on a 1 U.S. gallon sample (if one test exceeds the limit, a repeat shall be carried out before replacing elements);
- d) if samples from the downstream side of the filter contain significant quantities of particulate contaminants;
- e) after a maximum of one year in service.

#### 16.4.6 Monthly Colorimetric Membrane Filtration Test

At least monthly, perform a colorimetric membrane filtration test downstream of all filtration to monitor the effectiveness of the filtration equipment. A record shall be maintained of the results of the membrane test.

#### 16.5 Filter Vessel Change Out Procedure

- a) A filter element change out shall only be performed by trained staff using manufacture's recommended procedures and tools. All filtration vessel change out work shall be risk assessed, completely isolated, and a work permit issued before starting inspection or maintenance work.
- b) The lid of the vessel securing bolts shall be torqued in place to the manufacturer's recommended settings while filling takes place. To minimize the risk of fire and explosion, all filter vessels shall be filled carefully and slowly. All air shall be bled off from the unit while filling is in progress. The use of heavy greases to help with sealing shall not be used.
- c) Filling shall be supervised throughout by a trained operator. After filling, all joints and gaskets shall be carefully examined for signs of leakage.

## 17 ISO Container Handling Procedures

### 17.1 General

If aviation product contained in ISO containers is supplied from a pre-airfield storage terminal, the following procedures shall be applied.

In addition to these general requirements, locations where ISO containers are filled shall have documented procedures and systems in place to ensure health, safety, environmental, and quality considerations are adequately managed. These shall include:

- procedures for the inspection of new and used ISO containers (see 8.3.2), including rejection criteria;
- systems to ensure adequate control of any ISO container flushing, cleaning and waste disposal;
- procedures to ensure ISO container filling is carried out safely, including consideration of manual handling requirements, bonding, fire hazards, and spill hazards;
- procedures for the storage and release of ISO container product;
- recognition of any statutory requirements applicable to ISO container filling operation.

### 17.2 Materials of Construction

ISO containers used for storage of aviation fuel shall be manufactured from stainless steel, aluminum, or internally lined carbon steel. They shall be equipped with compatible filling connections to meet local or national standards and be safely filled at the pre-airfield storage terminal.

### 17.3 Filling Equipment

The supply tank and filling system for each grade of product shall be fully grade separated to provide complete protection against contamination. The product grade name and color code shall be clearly displayed on all filling equipment, tanks, pipelines, etc.

ISO container filling equipment for aviation gasoline and jet fuels shall be fitted with a filter water separator (EI 1581) or a filter monitor (EI 1583).

Filling shall be accomplished in such a way as to avoid “splash” filling; e.g. by use of a stand pipe or bottom loading coupling. The ISO container shall be bonded to the filling equipment and/or grounded. Immediately after filling, the ISO container shall be capped tightly and sealed. Each container, if permitted, is to be marked clearly with a unique number.

If permitted, the container shall be marked with:

- grade of product,
- product batch number,
- product specification number,
- date of filling.

Otherwise this information shall be provided on the release certificate clearly identifying the unique container number to the product information.

#### **17.4 Quality Control**

Provided that product is available for release, no further testing is required before filling begins.

Every ISO container shall be examined internally before filling to ensure that it is in a satisfactory condition, i.e. clean and free from rust, water, and other contaminants.

Before filling, ISO containers shall be color coded and clearly marked with the grade of fuel, batch number, filling date, and "leaded fuel" statement, if applicable, as illustrated in API 1542.

After filling, a visual check shall be carried out. ISO containers shall be sealed immediately after filling with grade marked tab seals.

All consignments of ISO containers released from pre-airfield storage terminal shall be covered by a release certificate which shall identify the product, including the container serial numbers, at any point to which the containers are transferred.

Upon arrival, the seals, product identification, batch number, and container serial number of each drum shall be checked against the release certificate and the container thoroughly examined for condition and leaks.

If the markings can be identified clearly, the seals are unbroken and the container is in good condition, no receiving tests need be preformed.

Containers shall be inspected for leaks and general condition, including markings monthly while at the terminal.

#### **17.5 Reuse of ISO Containers**

An ISO container may be reused provided the following.

- In the past the ISO container has only been used for the grade of aviation fuel with which it is to be refilled.
- The interior of the ISO container is inspected, cleaned, if necessary, if found unsatisfactory. Only the grade of fuel with which it is to be filled shall be used for cleaning the container.
- A record of inspection is maintained.
- Whenever an aviation fuel container is filled with a nonaviation product, the old grade marking and color identification shall be completely obliterated before refilling.

#### **17.6 ISO Container Handling and Storage**

All ISO containers shall be segregated by type, grade, and date of filling. Stocks shall be used in a rotation with the oldest stock being used first.

ISO containers shall be inspected for leakage after filling and at regular intervals thereafter. Markings shall be checked and renewed, as necessary, to maintain clear identity of product and batch.

Batches remaining in stock six months after the filling date shall be sampled and subjected to a periodic test.

## 17.7 Grade Segregation

ISO containers containing different grades of fuel shall be clearly separated for storage to minimize the risk of fuelling error.

There shall be a system that ensures the batches are used up in order of filling date.

## 18 Drum Handling Procedures

### 18.1 Drum Filling

If aviation product contained in drums is supplied from a pre-airfield storage terminal, the following procedures shall be applied.

In addition to these general requirements, locations where drums are filled shall have documented procedures and systems in place to ensure health, safety, environmental, and quality considerations are adequately managed. These shall include:

- procedures for the inspection of new and used drums, including rejection criteria;
- systems to ensure adequate control of any drum flushing, cleaning, and waste disposal;
- procedures to ensure drum filling is carried out safely, including consideration of manual handling requirements, bonding, fire hazards, and spill hazards;
- procedures for the storage and release of drummed product;
- recognition of any statutory requirements applicable to drum filling operations.

### 18.2 Materials of Construction

Drums used for storage of aviation fuel shall be manufactured from steel. They shall be lined with a suitable white epoxy lining (preferably with two applications of the coating) compatible with the aviation fuel.

Under no circumstances shall internally galvanized drums be used.

### 18.3 Filling Equipment

The supply tank and filling system for each grade of product shall be fully grade separated to provide complete protection against contamination. The product grade name and color code shall be clearly displayed on all filling equipment, tanks, pipelines, etc.

Drum filling equipment for aviation gasoline and jet fuels shall be fitted with a filter water separator (EI 1581) or a filter monitor (EI 1583).

Filling shall be accomplished in such a way as to avoid "splash" filling; e.g. by use of a stand pipe. The drum shall be bonded to the filling equipment and/or grounded through the rollers or through a dedicated grounding strap beneath the drum being filled.

Immediately after filling, drums shall be capped tightly and sealed.

Each drum head shall be marked clearly with:

- a unique drum number,
- the grade of product,
- the product batch number,
- the product specification number,
- date of filling.

#### **18.4 Quality Control**

Provided that product is available for release as defined in the sections on installations or depots, no further testing is required before filling begins.

Every drum shall be examined internally before filling to ensure that it is in a satisfactory condition, i.e. clean and free from rust, water, and other contaminants.

Before filling, drums shall be color coded and clearly marked with the grade of fuel, batch number, filling date, and "leaded fuel" statement, if applicable, as illustrated in API 1542.

After filling, a visual check shall be carried out on a representative number of drums; the first drum filled shall always be checked. Drums shall be sealed immediately after filling with grade marked tab seals.

All consignments of drums released from pre-airfield storage terminals shall be covered by a release certificate, which shall identify the product, including the drum serial numbers, at any point to which the drums are transferred.

Upon arrival, the seals, product identification, batch number and drum serial number of each drum shall be checked against the release certificate and the drum thoroughly examined for condition and leaks.

If the markings can be identified clearly, the seals are unbroken and the drums are in good condition, no receiving tests need be performed.

If the drums leak, the product remaining shall be transferred to another drum and downgraded. If the only replacement drum available is an empty aviation drum, this may be used but aviation markings must be obliterated.

Drums shall be inspected monthly for leaks and general condition, including markings.

#### **18.5 Reuse of Drums**

A drum may be reused provided the following.

- In the past the drum has only been used for the grade of aviation fuel with which it is to be refilled.
- The interior of the drum is inspected, cleaned and found to be satisfactory. Only the grade of fuel with which it is to be filled shall be used for cleaning the drum.
- A record of inspection is maintained.
- Whenever an aviation fuel drum is filled with a nonaviation product, the old grade marking and color identification shall be completely obliterated before refilling.

## 18.6 Drum Handling and Storage

Whenever possible, the use of well-ventilated buildings is recommended for drum storage. If drums are stored outdoors they shall be raised off the ground.

If more than five drums are stored at any location then appropriate spill containment shall be provided.

Drums shall be stacked on their sides with bungs in the horizontal position and the identification marks fully visible. The bottom drums shall be held in position (e.g. by wedges) to prevent collapse of stacks.

All drums shall be segregated by type, grade, and date of filling. Stocks shall be used in a rotation with the oldest stock being used first.

Drums shall be inspected for leakage after filling and at regular intervals thereafter. Markings shall be checked and renewed, as necessary, to maintain clear identity of product and batch.

Batches remaining in stock 12 months after the filling date and at 6-month intervals thereafter shall be sampled and subjected to a periodic test.

## 18.7 Sampling and Testing

Drummed stock requires a periodic test at yearly intervals no later than one year after the date of filling. The number of containers to be sampled and the actual number of composite samples required for laboratory testing shall be in accordance with Table 4.

**Table 4—Number of Samples to be Drawn and Analyzed**

Number of Containers of Batch	Number of Samples Taken	Number of Composite Samples Analyzed
1–3	All	1
4–64	4	2
65–125	5	3
126–216	6	3
217–343	7	3
344–512	8	3
513–729	9	3
730–1000	10	4
1001–1331	11	4

For example, if there are 1100 containers in the batch, samples will be drawn from 11 containers at random. Of these 11 samples, 3 random (but identifiable) samples (1 liter in capacity) shall be mixed to form 1 composite sample, 3 others mixed to make another sample, 3 more to make a third sample, and the remaining 2 to make a fourth sample, thus giving a total of 4 composite samples to be actually analyzed, as indicated in the table.

All drums sampled shall be resealed immediately after samples are taken. They shall be restenciled with the correct quantity and date sampled. The periodic test of the sample from each batch shall include verifying any variation from the original batch results is within the allowed tolerance.

Where the results of testing are unsatisfactory, the batch shall be quarantined pending further investigation.



## 18.8 Grade Segregation

Drums containing different grades of fuel shall be clearly separated for storage to minimize the risk of fuelling error.

There shall be a system that ensures the batches are used up in order of filling date.

## 18.9 Decanting Drummed Stock into Storage Tanks

After sampling as above, where fuel is decanted from drums into storage or into a fuelling vehicle, the following requirements apply.

The drum shall be bonded to the receiving tank or vehicle. Transfer shall be via a suitable pump and preferably through a filter water separator (EI 1581) or a monitor (EI 1583) filtration. If a power driven pump is used, it shall be of a suitable design for use in hazardous areas.

Suction stubs shall have a closed bottom with a side entry and a permanent 3 in. peg on the bottom to prevent withdrawal of product below this level. Individual drums shall not be tilted when product is being removed and the balance remaining in each drum after decanting shall be collected, permitted to settle, and the process repeated.

Before each transfer, each drum shall be thieved and the bottom sample shall be subjected to a visual check. If the sample fails this test, the product in the drum shall not be decanted.

Settling requirements are as per 5.2.

Bungs shall be replaced tightly after decanting to prevent entry of dirt and water.

Excessive numbers of drums shall not be allowed to accumulate near the transfer operation area. As drums are emptied they shall be returned to a suitable storage area.

Any variation to these arrangements shall only be allowed by specific written authority of the asset/country product quality inspector.

**Annex A**  
(normative)

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**Recertification Test Certificate**

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### JET A RECERTIFICATION TEST REPORT

For fuel supplied to ASTM D1655, Latest Issue

<b>Date:</b> <input style="width: 100%;" type="text"/>	<b>Quantity in tank before receipt</b> <input style="width: 100%;" type="text"/>	<b>BBLs</b>	<input style="width: 100%;" type="text"/>	<b>%</b>
<b>Tank No.:</b> <input style="width: 100%;" type="text"/>	<b>Quantity received</b> <input style="width: 100%;" type="text"/>	<b>BBLs</b>	<input style="width: 100%;" type="text"/>	<b>%</b>
<b>Batch No.:</b> <input style="width: 100%;" type="text"/>	<b>Total quantity in tank after receipt</b> <input style="width: 100%;" type="text"/>	<b>BBLs</b>	<input style="width: 100%;" type="text"/>	
<b>Sample No.:</b> <input style="width: 100%;" type="text"/>				

Property	Test Method <b>(Note 1)</b>	Specification Limits		A	B	C	D	E	F
				Prev Tank Recert	COA for Product Rec'd	Calc Tank Quality	Actual Recert Results	Actual Diff C-D	Acceptable Difference <b>(Note 2)</b>
Appearance	D4176 Procedure 1	<b>C&amp;B (Note 3)</b>						N/A	Spec Requirement
Saybolt Color, min	D156, D6045	+16						N/A	<b>(Note 4)</b>
Distillation	D86   D2887								
IBP, °C		Report							8
10% Recovered, °C, max		205	185						8
50% Recovered, °C		Report							8
90% Recovered, °C		Report							8
End Point, °C, max		300	340						8
Residue, Vol %, max		1.5	N/A					N/A	Spec Limit
Loss, Vol %, max		1.5	N/A					N/A	Spec Limit
Flash Point, °C, min	D56, D3828	38							3
Density @ 15°C, kg/m <sup>3</sup> <b>OR</b>	D1298, D4052	775 - 840							3
API Gravity	D1298	37 - 51							0.7
Upper									0.7
Middle									0.7
Lower									0.7
Freezing Point, °C, max	D2386, D5972, D7153, D7154	-40							3
Corrosion, Copper Strip, max	D130	No. 1						N/A	Spec Limit
Existent Gum, mg/100ml, max	D381, IP540	7							3
MSEP, min	D3948	85						N/A	Spec Limit
Particulate Matter, mg/l, max	D5452	1.0 max						N/A	Spec Limit
Thermal Stability (JFTOT) Filter Pressure Drop, mm Hg Tube Deposit Rating, visual	D3241	25.0 max <3 max						N/A	Spec Limits <b>(Note 5)</b>

**Date:** \_\_\_\_\_ **Signed:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Tank checked and released for service by:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comments:**

1. Report the actual test method used on the certificate.
2. Where minimum/maximum specification limits are given, the Acceptable Difference values do not apply to values below the minimum or above the maximum.
3. The fuel sample shall be "clear, bright and visually free from solid matter and undissolved water at ambient temperature".
4. A significant change (>5) in Saybolt color may indicate product instability and/or contamination and should be investigated.
5. JFTOT testing is optional. JFTOT shall be run if copper contamination is suspected or if the actual recertification results indicate possible contamination. Control temperature is 260°C. No Peacock or Abnormal colour deposits.

The scenarios above are merely examples for illustration purposes only (each company should develop its own approach). They are not to be considered exclusive or exhaustive in nature. API makes no warranties, express or implied for reliance on or any omissions from the information contained in this document. Users of instructions should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgement should be used in employing the information contained herein. Where applicable, authorities having jurisdiction should be consulted.

## AVGAS 100LL RECERTIFICATION TEST REPORT

For fuel supplied to ASTM D910, Latest Issue

<b>Date:</b> <input style="width: 80%;" type="text"/>	<b>Quantity in tank before receipt</b> <input style="width: 80%;" type="text"/>	<b>BBLS</b>	<input style="width: 80%;" type="text"/>	<b>%</b>
<b>Tank No.:</b> <input style="width: 80%;" type="text"/>	<b>Quantity received</b> <input style="width: 80%;" type="text"/>	<b>BBLS</b>	<input style="width: 80%;" type="text"/>	<b>%</b>
<b>Batch No.:</b> <input style="width: 80%;" type="text"/>	<b>Total quantity in tank after receipt</b> <input style="width: 80%;" type="text"/>	<b>BBLS</b>		
<b>Sample No.:</b> <input style="width: 80%;" type="text"/>				

Property	Test Method (Note 1)	Specification Limits	A	B	C	D	E	F
			Prev Tank Recert	COA for Product Rec'd	Calc Tank Quality	Actual Recert Results	Actual Diff C-D	Acceptable Difference (Note 2)
Appearance	Visual Examination	C & B (Note 3)					N/A	Spec Requirement
Color	D2392	BLUE					N/A	Pass
Knock Rating	D2700	99.5 min						3
TEL content, gPb/l	D3341 or D5059	0.56 max						0.05
Density @ 15°C, kg/m <sup>3</sup> <b>OR</b>	D1298 or D4052	Report						3
API Gravity @ 15°C	D1298	Report						0.7
Distillation	D86							
IBP, °C		Report						8
10% Evaporated at °C		75 max						4
40% Evaporated at °C		75 min						6
50% Evaporated at °C		105 max						6
90% Evaporated at °C		135 max						6
End Point, °C		170 max						10
Sum of 10% and 50%		135 min						10
Recovery, %vol		97 min					N/A	Spec Limit
Residue, % vol		1.5 max					N/A	Spec Limit
Loss, % vol		1.5 max					N/A	Spec Limit
Water Rx, vol change, mL	D1094	2 max					N/A	Spec Limit
Reid Vapor Pressure, kPa	D323, D5190 or D5191	38.0 to 49.0						4.5
Corrosion, Copper Strip	D130	No. 1 max					N/A	Spec limit
Existent Gum, mg/100ml	D381	3 max						3

**Date:** \_\_\_\_\_ **Signed:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Tank checked and released for service by:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Notes:**

1. Report the actual test method used on the certificate.
2. Where minimum/maximum specification limits are given, the Acceptable Difference values do not apply to values below the minimum or above the maximum.
3. The fuel sample shall be "clear, bright and visually free from solid matter and undissolved water at ambient temperature."

The scenarios above are merely examples for illustration purposes only (each company should develop its own approach). They are not to be considered exclusive or exhaustive in nature. API makes no warranties, express or implied for reliance on or any omissions from the information contained in this document. Users of instructions should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgement should be used in employing the information contained herein. Where applicable, authorities having jurisdiction should be consulted.

**Annex B**  
(normative)

**Release Certificate—Jet A  
(Road or Rail Car)**

**RELEASE CERTIFICATE**  
**(Road or Rail Cars)**

**1. TO BE COMPLETED BY THE SUPPLYING REFINERY OR TERMINAL**

	<b>Serial No.:</b> _____
Supplying Installation: _____	<b>JET A</b>
Dispatched to: _____	
Grade/Specification: _____	Date: _____
Transport No.: _____	Batch No.: _____
Batch API Gravity @ 60°F: _____	Quantity: _____
BOL Number: _____	Tank No.: _____

**2. TO BE COMPLETED BY THE CARRIER (TRUCK) OR LOADING TERMINAL (RAIL CAR)**

Pre-Loading Transport Checklist		Post-Loading Contents Checklist		
(1) Dedicated Jet Service? <b>YES / NO</b>	(6) Delivery hoses & couplings capped? <b>YES / NO</b>	(1) Each compartment sampled & inspected: Water free? <b>YES / NO</b> Dirt free? <b>YES / NO</b> Clear & Bright? <b>YES / NO</b> Color: _____	(2) API*: Observed	API Gravity _____ Temp °F _____
(2) If not dedicated, state previous grade: <b>YES / NO</b>	(7) Correct DOT grade plate displayed? <b>YES / NO</b>	(3) Seals Applied? <b>YES / NO</b>	API Gravity @ 60°F (1)	_____
(3) Steam Cleaned & Dried? <b>YES / NO</b>	(8) Internal valves opened & contents drained & inspected: Water free? <b>YES / NO</b> Dirt free? <b>YES / NO</b> ~ Volume drained: _____	*Up to 3 compartments from one transport may be combined for the API gravity determination.	Batch Gravity @ 60°F (2)	_____
(4) Cleaning certif. provided? <b>YES / NO</b>	I certify the product has been handled in accordance with the XXXXX Company Guidelines for loading and delivery of aviation products.	Transport Company: Driver Name (printed): Signature: _____	**Difference between (1) and (2)	± _____ ± _____
(5) Residual BOL provided? <b>YES / NO</b>			**If the difference is greater than .7 API unit, verify the correct batch gravity. Notify the terminal immediately. Do not depart until the discrepancy is resolved.	

**3. TO BE COMPLETED BY THE CARRIER (DRIVER)**

Additive	Type	Range	Observed Addition Rate	Measured
Fuel System Icing Inhibitor (FSII) (MIL-DTL-85470) ~10 gallons of FSII per 8000 gallon load	DiEGME	0.10 – 0.15 volume %	End: _____ Start: _____ Added: _____	(ASTM D5006)

**4. TO BE COMPLETED BY THE RECEIVING FUEL FARM PRIOR TO DISCHARGE**

Transport Compartment	1	2	3	4	5	6	7
1) Seals Intact							
2) Grade Identification							
3) Appearance (C & B and color)							
4) Observed API Gravity							
5) Observed Temperature (°F)							
6) API Gravity @ 60°F							
7) Batch API Gravity @ 60°F							
8) Difference between 6 & 7 (±)							

**5. TO BE COMPLETED BY THE RECEIVING FUEL FARM AFTER DISCHARGE**

Quantity Received		Customer
Tank No.		Location
Discharge Date		Customer Representative
Time		Signature

**Annex C**  
(normative)

**Release Certificate—Avgas  
(Road or Rail Car)**

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**RELEASE CERTIFICATE**  
**(Road or Rail Car)**

**1. TO BE COMPLETED BY THE SUPPLYING REFINERY OR TERMINAL**

<b>Serial No:</b> _____		<div style="background-color: black; color: white; padding: 10px; font-weight: bold; font-size: 1.2em;">AVGAS</div>
Supplying Installation: _____		
Dispatched to: _____		
Grade/Specification: _____	Date: _____	
Transport No.: _____	Batch No.: _____	
Batch API Gravity @ 60°F: _____	Quantity: _____	
BOL Number: _____	Tank No: _____	

**2. TO BE COMPLETED BY THE CARRIER (TRUCK) OR LOADING TERMINAL (RAIL CAR)**

Pre-Loading Transport Checklist		Post-Loading Contents Checklist				
(1) Dedicated AVGAS Service? <b>YES / NO</b>	(6) Delivery hoses & couplings capped? <b>YES / NO</b>	(1) Each compartment sampled & inspected: Water free? <b>YES / NO</b>	(2) API*: Observed	API Gravity		
		Dirt free? <b>YES / NO</b>		Temp °F		
(2) If not dedicated, state previous grade:	(7) Correct DOT grade plate displayed? <b>YES / NO</b>	Clear & Bright? <b>YES / NO</b>	API Gravity @ 60°F (1)			
		Color:	Batch Gravity @ 60°F (2)			
(3) Steam Cleaned & Dried? <b>YES / NO</b>	(8) Internal valves opened & contents drained & inspected:	(3) Seals Applied? <b>YES / NO</b>	**Difference between (1) and (2)		±	±
(4) Cleaning certif. provided? <b>YES / NO</b>	Water free? <b>YES / NO</b> Dirt free? <b>YES / NO</b> ~ Volume drained:	*Up to 3 compartments from one transport may be combined for the API gravity determination.	**If the difference is greater than .7 API unit, verify the correct batch gravity. Notify the terminal immediately. Do not depart until the discrepancy is resolved.			
(5) Residual BOL provided? <b>YES / NO</b>	<i>I certify that the product has been handled in accordance with the XXXX Company guidelines for loading and delivery of aviation products.</i>		Transport Company: Driver Name (printed): Signature:			

**3. TO BE COMPLETED BY THE RECEIVING FUEL FARM PRIOR TO DISCHARGE**

Transport Compartment	1	2	3	4	5	6	7
1) Seals Intact							
2) Grade Identification							
3) Appearance (C & B and color)							
4) Observed API Gravity							
5) Observed Temperature (°F)							
6) API Gravity @ 60°F							
7) Batch API Gravity @ 60°F							
8) Difference between 6 & 7 (±)							

**4. TO BE COMPLETED BY THE RECEIVING FUEL FARM AFTER DISCHARGE**

<b>Quantity Received</b>		<b>Customer</b>	
<b>Tank No.</b>		<b>Location</b>	
<b>Discharge Date</b>		<b>Customer Representative</b>	
<b>Time</b>		<b>Signature</b>	



**Annex D**  
(normative)

**Release Certificate**  
**(Pipeline, Ocean Tanker, Coastal/Inland Waterway**  
**Vessel, Storage Tanks)** |

**RELEASE CERTIFICATE**

*(Pipeline, Ocean Tanker, Coastal/Inland Waterway Vessel, Storage Tanks)*

**1. TO BE COMPLETED BY THE SUPPLYING REFINERY, TERMINAL OR INSPECTOR**

<b>Serial No:</b>		
Supplying Installation:	Date:	
Dispatched to:	Vessel:	
Grade/Specification:	Pipeline:	
Order No:	Tank:	

**Shipping Record:**

Tank No.	Batch No.	Sample No.	Quantity (Units)	Density/Gravity @ 15°C/60°F			
				U	M	L	C
				U	M	L	C
				U	M	L	C
				U	M	L	C
				U	M	L	C
				U	M	L	C

U = Upper sample  
M = Middle sample  
L = Lower sample  
C = Composite sample (equal portions of U, M, L or a running sample)

**Tanks settled for the required time (jet fuel) - 1 hour per foot depth of fuel or 24 hours, whichever is less:**  **YES**  **NO** (15 minutes per foot depth for Aviation Gasoline)

**Tanks drained of any accumulated water & sediment and sumps confirmed clear & bright before release:**  **YES**  **NO**

**COMMENTS:**

Certified that the products detailed herein conform to the relevant specifications and have been handled in accordance with the local quality control procedures.

**Date:** \_\_\_\_\_ **Name:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

One (1) copy to be kept on file at the supplying installation.  
One (1) copy to be provided to the receiving installation.

**Annex E**  
(normative)

**Filter Inspection and Element Change Report**

**Example - FILTER INSPECTION AND ELEMENT CHANGE REPORT**

Make ..... Model ..... Serial No. ....  
Element Type (1<sup>st</sup> stage) ..... (2<sup>nd</sup> stage) .....  
Number of Elements (1<sup>st</sup> stage) ..... (2<sup>nd</sup> stage) .....  
Operating Flowrate ..... Operating Pressure .....

**1. PERFORMANCE DATA (EXISTING ELEMENTS BEFORE CHANGE)**

Date elements placed in service ..... Date elements changed .....  
Throughput since last change ..... Meter totaliser reading .....  
Differential pressure at time of change .....  
Reason for change .....

**2. EXAMINATION OF DISMANTLED UNIT                      DATE .....**

(Include a sketch on reverse side to show location of damaged elements or lining)

- a) Conditions of elements ..... b) Conditions of element web, seals, rod etc. ....
- c) Is there any evidence of bypassing? ..... d) Are any elements ruptured? .....
- e) Condition of vessel interior ..... f) Condition of air eliminator .....
- g) Condition of vessel cover "o" ring .....

**3. DETAILS OF PARTS INSTALLED**

- a) First stage element part number ..... No. installed ..... Date of manufacture .....
- b) Separator element part number ..... No. installed ..... Date of manufacture .....
- c) Vessel cover "o" ring .....

**4. DETAILS OF ANY REPAIRS MADE**

.....  
.....  
.....

**5. INSTALLATION CHECKS**

- a) Are elements correctly tightened (record torque)? .....
- b) Are elements correctly seated after tightening? .....
- c) Check for leakage during flow test.....
- d) Check differential pressure gauge for correct zero and full deflection.....
- e) Differential pressure reading .....

Date Installation Completed: ..... Installed By: .....Supervised By: .....

.....

**Annex F**  
(normative)

**Filter Differential Pressure Report**

|



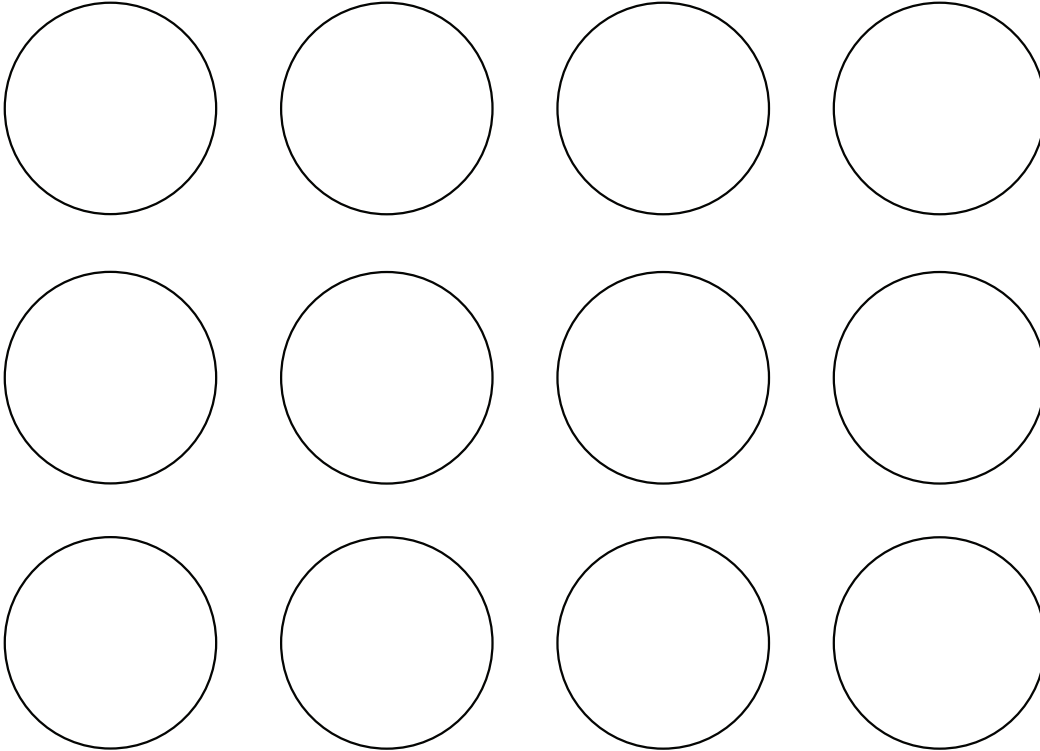
**Annex G**  
(normative)

**Membrane Color Filtration Report**

|

### MILLIPORE MEMBRANE COLOUR RATING RECORD (ASTM COLOUR STANDARDS)

Terminal: ..... Year .....  
.....



SAMPLING DATE	WET RATING	DRY RATING	FLOWRATE	Batch Number	SIGNATURE

- Notes:
1. Sample volumes to be 5 litres
  2. Pressure not to be less than 2.4 bar (35psi) during sampling to obtain a reasonable sampling rate.



**Annex H**  
(normative)

**Tank Inspection and Cleaning Report**

**Example - TANK INSPECTION & CLEANING REPORT**

<b>Terminal/Airport :</b>	<b>Report Reference :</b>
---------------------------	---------------------------

<b>1. Tank Data</b>			
Tank Number :		Tank Capacity :	
Vertical <input type="checkbox"/>	Horizontal <input type="checkbox"/>	Other <input type="checkbox"/>	
Above Ground <input type="checkbox"/>	Semi-Buried <input type="checkbox"/>	Buried <input type="checkbox"/>	
Date Constructed :		Leaded <input type="checkbox"/>	Unleaded <input type="checkbox"/>
Extent of Lining :		Date of Lining :	
Grade Before Cleaning :		Grade After Cleaning :	
Date of Last Repair :		Type of Repair :	
Date of Last Inspection :		Date of This Inspection :	

<b>2. Type of Inspection:</b>	<b>By Entry <input type="checkbox"/></b>	<b>Without Entry <input type="checkbox"/></b>
Entry Permit Number :	Date :	

<b>3. Cleaning Method :</b>

<b>4. Inspection of Fittings</b>	
<i>Item</i>	<i>Condition</i>
Contents Gauge	
Temperature Gauge	
Level Alarms	
Floating Suction/Swing Arm/Cables/Bonding	
Water Drain Facilities	
Valves: Inlet	
Outlet	
P & V	
Leak Detection Systems/"Tell-Tale" Pipes	
Under-Floor Valves	
Internal Deck (if fitted)	
Earthing	
Other Fittings (Specify)	

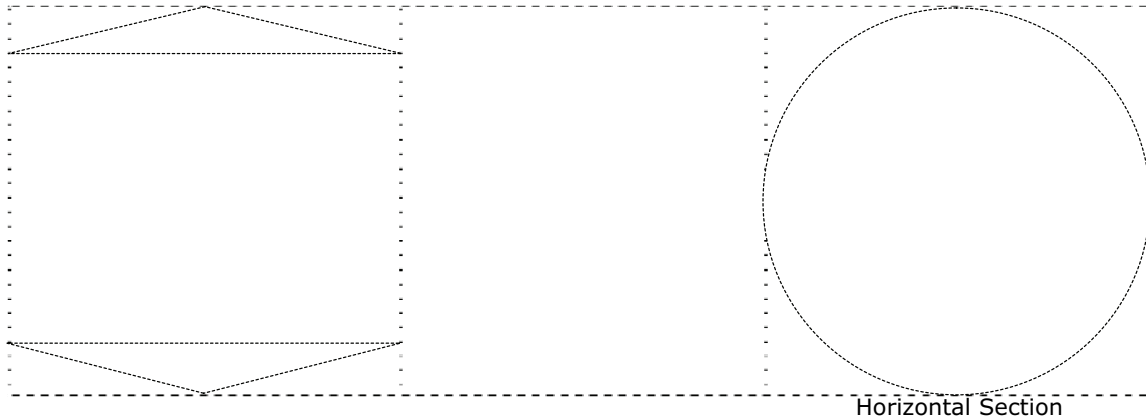
<b>5. Details of Contamination Removed</b>	
Quantity of Sludge:	Quantity of Water :
Comments:	

<b>6. Details of External Examination :</b>

**Example - TANK INSPECTION REPORT (continued)**

<b>6. Details of Internal Examination :</b>
<b>(a) Floor</b>
<b>(b) Walls</b>
<b>(c) Columns and Beams</b>
<b>(d) Roof</b>

**8. Diagram**



<b>9. Remarks</b> (reason for inspection. Quality control test results etc.)

<b>10. Recommendations</b> (*) <i>Delete as appropriate</i>
(*) The tank is considered to be clean and satisfactory for the storage of aviation product.
(*) The following actions are recommended before the tank can be considered suitable for the storage of aviation product

<b>11. Inspected by :</b>	<b>Signed :</b>
<b>Date :</b>	

**Annex I**  
(normative)

**Visual Water Drains Report**

|

**STORAGE TANK, FILTER AND LOW POINT DEWATERING VISUAL CHECK RESULTS RECORD**

Terminal: .....

Date: .....

**KEY FOR RESULTS:**

C & B = Clear and Bright      SW = Suspended Water  
FW = Free Water                T = Trace

Origin of Sample	Time	Result Initial Sample	Quantity Flushed	Result Final Sample	Authorised Signature

*Note:*  
*Details of any unusual results or reasons for rejection etc. should be recorded on the back of this form.*

**I certify that I have today flushed the above equipment and carried out visual checks with the results shown**

\_\_\_\_\_ **Authorized Signature**

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