Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport

API RECOMMENDED PRACTICE 1543
FIRST EDITION, JULY 2009

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Downstream Segment

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Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

Introduction

Aviation fuels pass through a variety of storage and handling facilities from refinery to airport. As aviation fuels are stored and transported in storage and transportation systems where contact with non-aviation products may occur (e.g. multiproduct pipelines, nondedicated ship or barge) a fuel quality monitoring program is required in addition to equipment, operating, inspection and maintenance standards. This program should consist of documentation from the refinery source showing the quality of fuel being released which can be compared to ongoing monitoring of the fuel at downstream sites, typically by laboratory means as it is transported towards the aircraft. The purpose of this practice is to ensure the fuel remains on specification.

If this original documentation is not available then full certificate of analysis (COA) laboratory testing is required to verify the fuel is still within the limits of the fuel specification. Although in this case the amount, type, and usage of approved additives in the fuel is unknown.

The consequences of a failure to supply the correct, on specification product to aircraft is potentially so serious that it is essential for each organization in the supply chain have a fuel quality monitoring program in place with documents demonstrating that the fuel continues to meet the original fuel specification.

This RP provides guidance for documenting, ongoing monitoring and laboratory testing (fuel quality monitoring program) of aviation fuel quality throughout the supply chain. This document is not intended to offer guidance on all aspects of fuel handling.

An effective fuel quality monitoring program will facilitate the delivery of on specification fuel which is fit for use. Fit for use means that the fuel not only meets the relevant specification, but also is essentially free of non-aviation products, unapproved additives and other contaminants.

Design, construction, operations, maintenance and additional inspection requirements for pre-airfield storage terminals can be found in API 1595.

Design, construction, operations, maintenance and additional inspection requirements for airport facilities can be found in the airport site operations standard/manual (i.e. ATA 103 or other applicable industry standards). Additional information may be found in API/EI 1540.

Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport

1 Scope and Purpose

This recommended practice (RP) was developed to provide guidance on the development of an aviation fuel monitoring and testing program (fuel quality monitoring program) for aviation fuel from point of manufacture to delivery to the airport. “Proper handling” entails documenting and testing aviation fuel quality as product is transported throughout the supply chain to maintain the original product specification.

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 RPs that need to be referred. The distinction between mandatory, recommended and optional provisions in the referenced documents are not changed by nature of their reference in this standard.

The values stated for this standard are in U.S. (USC) customary units.

2 References

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

API *Manual of Petroleum Measurement Standards* (*MPMS*) Chapter 8, *Sampling*

API Recommended Practice 1540, *Design, Construction, Operation and Maintenance of Aviation Fueling Facilities, IP Model Code of Safe Practice Part 7*

API Recommended Practice 1595, *Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-airfield Storage Terminals*

ASTM D156 [1], *Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)*

ASTM D910, *Standard Specification for Aviation Gasolines*

ASTM D1655, *Standard Specification for Aviation Turbine Fuels*

ASTM D3420, *Standard Test Method for Pendulum Impact Resistance of Plastic Film*

ASTM D4057, *Standard Practice for Manual Sampling of Petroleum and Petroleum Products*

ASTM D4306, *Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination*

ASTM E1, *Standard Specification for ASTM Liquid-in-Glass Thermometers*

ASTM E100, *Standard Specification for ASTM Hydrometers*

ATA 103 [2], *Standard for Jet Fuel Quality Control at Airports*

EI HM50 [3], *Guidelines for the Cleaning of Tanks and Lines for Marine Tank Vessels Carrying Petroleum and Refined Products*

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1 ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.
2 Air Transport Association, 1301 Pennsylvania Ave, NW, Suite 1100, Washington, DC 20004, www.airlines.org.
3 Energy Institute, 61 New Cavendish Street, London, UK W1G 7AR, www.energyinst.org.

EI 64 C, *Standard Thermometers*

ISO 649-1 [4], *Laboratory glassware—Density hydrometers for general purposes*—Part 1: *Specification*

3 Definitions

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

3.1
batch
A distinct quantity of fuel that can be characterized by one set of test results including the type and amount of additives present.

3.2
batch makeup and clearance record
A document used to establish new batches and record the individual batch information that defines a newly formed batch. This document provides the history on how incoming receipts were managed to assure product quality and traceability (see Annex F).

3.3
batch number
A unique traceable batch reference number.

3.4
control check
This is a visual check (for color, clear and bright, solid material, and undissolved water) plus fuel API Gravity (or density) determination. This check is frequently made to confirm the correct grade and unchanged quality of fuel stocks by comparison of the API Gravity result (or density) with the relevant batch API Gravity (or density). Should the (temperature corrected) gravities (densities) differ by more than 0.7 API [3 kg/m^3 (±0.003 kg/l)] 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.

3.5
dedicated
Tankage, piping, valves, filters, etc. that are used to handle one grade of aviation product and no other products.

3.6
grade dedicated road transports
Road transports that are used to handle one grade of aviation product and no other products. Before becoming grade dedicated, road transports are required to go through a grade change process before being used in aviation fuels (see API 1595).

3.7
line sample
A sample obtained from a line sampling point, drawn while the product is flowing.

3.8
lower sample
A sample obtained from the middle depth of the lower third of the tank contents.

3.9
middle sample
A sample obtained from the middle depth of the tank contents.

3.10
multiple-tank composite sample (ships, barges, etc.)

[4] International Organization for Standardization, 1 ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, www.iso.org.

This is a mixture of individual composite samples (see 3.14 below) from multiple compartments containing the same grade of product. The mixture is blended in proportion to the volume of product in each compartment.

3.11
quality certification statement
A certification statement shall appear on all quality certificates confirming that the product meets the requirements of the relevant specification. An example of a suitable statement is as follows:

"Certified that this sample meets the relevant specification with respect to the above tests and complies with ASTM DXXXX, Latest Revision."

3.12
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.

3.13
segregated (isolated tanks and pipelines)
To achieve positive segregation for product quality control, the inlet and outlet pipelines on each tank, as well as any piping connections to other grades of products shall be fitted with either:

a) 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);

b) a removable distance piece; or

c) a spectacle blind.

3.14
single-tank composite sample
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.

3.15
test certificates
The purposes of a properly documented series of test certificates outlining the properties of the aviation fuel is listed below.

a) Provide assurance that the product has been tested and meets the relevant specification.

b) All records shall be dated and signed by the person responsible. For computer-generated records, a password-protected access system, traceable to the individual person, is acceptable as an alternative to a signature.

c) Support the release of products for delivery to customers. Facility management is responsible for ensuring that the appropriate certificates cover aviation products in their care. The key documents include the RQC, COA, RTC, RC, and DD.

The key documents are listed below.

3.15.1
certificate of analysis
COA
This certificate is issued by a laboratory other than that of the originating refinery, often at some point downstream of the point of manufacture. It contains determinations of all the properties required in the relevant specification, but will not necessarily provide information regarding the type and amount of any additives in the fuel. COAs shall be dated and signed by an authorized representative of the laboratory concerned and identify the fuel specification.

It shall include details relating to the identity of the originating RQC and/or COAs to allow the traceability of the product described. If the originating RQCs are not available, then a COA shall be completed with a note stating:

“Certified that this sample meets the relevant specification with respect to the above tests and complies with ASTM DXXXX Latest Revision. No certification is given regarding the types and amounts of any additives that may be present other than those reported above.”

3.15.2
delivery document
DD
This document supports any delivery of product. It is used to document the volume of product moved, pricing and other information required such as product hazard classification and other regulatory requirements. The most common DD is the bill of lading (BOL) document used in road or rail transport deliveries.

3.15.3
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, for example, after transportation in ocean tankers or multiproduct pipelines, etc. The RTC (see Annex A and Annex B for minimum requirements) 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.

3.15.4
refinery certificate of quality
RQC
This certificate is the definitive original document describing the quality of an aviation fuel. As well as containing determinations of all the properties required in the relevant specification(s), it provides information regarding the type and amount of any additives in the fuel. It therefore represents a complete certification of a product's conformance with the relevant specification. RQCs shall always be dated and signed by an authorized representative of the refinery's quality organization and document the fuel specification manufactured against it (i.e. ASTM D1655 latest revision for Jet A or Jet A1, ASTM D910 latest revision for aviation gasoline).

3.15.5
release certificate
RC
This document supports any transfer of product, confirming compliance with the relevant specification(s), and contains at least the following information (see Annex C and Annex D for use by road or rail transport, and Annex E for pipeline or marine vessel) below.

a) Date and time of transfer.

b) Grade of fuel.

c) 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 for conversion to standard temperature conditions, but some areas are required to use 20 °C (68 °F).

d) Confirmation that the storage tanks and filtration (where applicable) have been sumped and are free of visible water.

e) Signature of person authorized to release the product.

3.16
upper sample
A sample obtained from the middle depth of the upper third of the tank contents.

4 Contamination of Aviation Fuels

Aviation fuel can become contaminated during transport resulting in product that is unsuitable for use. Contamination can arise from other products and from additives [e.g. static dissipater, corrosion inhibitor, drag reducing additives (DRAs)] used in other products, which can affect fuel properties even in extremely small concentrations. Wherever contamination of this nature can occur (nondedicated transport or nonsegregated storage), recertification testing shall be performed to confirm that the fuel was delivered on specification with no significant changes to any of the properties. It is important that the results of the quality checks (see Annex A and Annex B for minimum requirements) are compared with the results from the refinery certificate of quality (RQC) or most recent certificate of analysis (COA) to determine if contamination has occurred. **It is not sufficient to compare results against the specification limits alone**.

Water is an ever-present contaminant in aviation fuel. Water will be present in solution (dissolved) and as “free” (undissolved) water. The higher the temperature of the fuel the more dissolved water the fuel can hold [at 60 °F (15 °C)] jet fuel can contain up to 80 parts per million (ppm) water. As the fuel temperature drops dissolved water may drop out of solution and can cause the fuel to appear cloudy. Water in solution cannot be detected by eye or chemical reaction (e.g. syringe and capsule detector or Agua-Glo® [5]), and cannot be removed by settling or filtration. Jet fuel containing dissolved water will appear “clear and bright.”

Free water will appear as drops or as a layer on the bottom of the tank or sample container (bulk water) or as very fine droplets distributed throughout the fuel (suspended water). Bulk water and suspended water can be detected by visual examination of a sample; suspended water generally giving the fuel a hazy or milky appearance. Low concentrations of suspended water may not be detected visually [a number of methods exist for the detection of suspended water at low concentrations in Jet Fuel (e.g. the Velcon Hydrokit® [5], Shell Water Detector® [5] and the Gammon Aqua-Glo® [5]) (ASTM D3420)].

[5] This term is used as an example only, and does not constitute an endorsement of this product by API.

"Solid matter" or "particulate" is another common contaminant in fuel. Particulates usually enter the fuel as airborne dust or rust and scale from pipelines and tanks. Other possible sources of particulates include clay from ruptured filters at refineries, terminals or airports and refinery chemicals such as catalyst fines or salt from dehydrators. Particulates can normally be detected in a sample by eye, especially if the sample is swirled to create a vortex, concentrating any contaminant in the center. Membrane filtration (millipore) is often used to detect particulates and obtain a quantitative measure of the contamination in jet fuel.

5 Field Sampling and Equipment

5.1 Sampling

Personnel shall undertake sampling 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. The failure to carry out sampling correctly could lead to off specification product being cleared for aviation use, or result in delay and additional costs due to repeat sampling and testing. Sampling shall be in accordance with the latest requirements of API *MPMS* Ch. 8, ASTM D4057, and ASTM D4306.

5.2 Equipment—Hydrometers and Thermometers

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

— *Hydrometers*. ASTM E100 or ISO 649-1.

— *Thermometers*. ASTM E1 or EI Appendix A.

— *Thermo-hydrometers for Jet A/A-1*. ASTM 255HL and ASTM 55HL.

— *Thermo-hydrometers for Aviation Gasoline*. ASTM 258HL and ASTM 58HL.

— *Anton Paar DMA 35N Handheld Densitometer (Intrinsically Safe Model)*. They shall be operated in accordance with ASTM/EI 559/08 which includes cleaning and calibration instructions.

— *Alternate and Field Use Thermometers and Hydrometers*. Alternative type thermometers (e.g. containing non-mercury type fluids for environmental/health reasons or local regulations) which do not meet the requirements above may be used for product quality checks. The thermometers used in this case shall have scale increments of no greater than 0.5 °C (1 °F) or less. In the case of dispute with field type instruments, the instruments discussed above shall be used as the referee method.

— *Thermo-hydrometers*. Some hydrometers are supplied with thermometers installed internally in the hydrometer bulb. These thermo-hydrometers are commonly used as field instruments, and to provide sufficient accuracy during field checks, their scale graduations should be in 0.5 °C (1 °F) increments, or less.

6 Fuel Quality Monitoring Program

6.1 General

The batch system has been designed to allow the traceability of product to the point of manufacture and is the basis for any fuel quality monitoring program. Each tested batch, once approved for use as aviation fuel, is given a unique and traceable batch reference number. Whenever new product is added to an existing batch, a new batch is established, since the integrity of the old batch has been lost.

Where product can be positively identified by documentary evidence as belonging to a particular batch covered by a related RQC or COA, then it is only necessary to conduct such additional recertification tests as are required to prove that product quality has not changed.

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 batch quality certificates 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.

When a quality certificate does not accompany the product received into pre-airfield or airfield storage or one is not available, a full COA test, to the relevant fuel specification, shall be carried out before release.

6.2 Refinery

6.2.1 General

After the storage tank in the refinery has received aviation fuel to the capacity as determined by the refinery it shall be segregated from the production unit(s) and all other transfer lines, tested for compliance with the applicable fuel specification and a RQC issued by the refinery.

If product is moved within the refinery between storage tanks, prior to shipment out of the refinery, it shall be batched after each movement. If the movement within the refinery is through a grade dedicated and segregated piping system, then no laboratory testing is required but a control check shall be performed on an upper, middle and lower sample of each tank to check for layering. An additional storage tank composite sample shall be prepared and a control test performed to determine the new batch API Gravity for that tank.

If it is not transferred through a grade dedicated and segregated piping system than a recertification test on a composite sample from each storage tank shall be performed. A new batch number shall be assigned following transfers within the refinery and a batch makeup record shall be established. This batch makeup record shall accompany the release document as evidence of the establishing of the new batch API Gravity and identifying which RQC(s) and, where applicable, recertification test report(s) makes up this new batch.

6.2.2 Shipment from Refinery into a Pipeline

Care shall be exercised to ensure product integrity after the refinery shipping tank or tanks have been certified (see 6.1).

If the line from the shipping tank(s) to the pipeline injection point is grade dedicated and positively segregated, the opportunity for contamination is extremely small and only a control check shall be performed on the head of each shipment during the transfer to the pipeline. Additional testing can be performed based on local practices or experience by the refinery or pipeline operators.

However, if the line from the shipping tank or tanks to the pipeline injection point is not dedicated or the appropriate safeguards for segregation are not installed, product quality shall be monitored during the transfer. Line samples shall be taken for a control test and flash point test for jet fuel (using an approved flash point test method from the fuel specification) from the head, middle and tail of each tank shipment to ensure contamination has not occurred. Pumping into the pipeline shall be stopped if the measured gravity is ±0.7 °API from the batch value, if the flash point for jet fuel is outside reproducibility limits of the test methods used and/or if dirt and water or an unusual color is observed. Additional testing can be performed based on local practices or experience by the refinery or pipeline operators.

A one-gallon (1-gal) single tank composite sample shall be obtained from the issuing tank and a 1-gal line composite from as near the pipeline injection point as possible for retention. If multiple tanks are used to complete the pipeline

shipment, a 1-gal single tank composite sample from each tank and composite line samples for each issuing tank taken as near to the pipeline injection point as possible shall be obtained and kept for 30 days.

Design, construction, operations, maintenance and inspection requirements for refinery operated storage tanks, filtration systems if used, can be found in API 1595.

The introduction of ground fuels containing or made exclusively of bio-components (e.g. FAME) is a concern in a refinery where these fuels are transferred through common piping or ancillary equipment (e.g. pumps, meters, valves) also handling aviation grade fuels.

When a refinery uses common piping or ancillary equipment to co-transport aviation fuels and ground fuels (containing FAME) the refinery shall complete a management of change (MOC) process to determine additional safeguards required to preserve the integrity of the aviation fuel. Issues which shall be considered but not limited to are listed below.

1) Examine their facilities to identify any potential sources of low level cross contamination. Areas to inspect should include but not be limited to ingress and egress manifolds, pump stations, valve integrity, dead legs, meter bays.

2) Review operating procedures associated with these facilities to ensure they are effective at preventing low level contamination.

NOTE 1 m^3 B5 in 10,000 m^3 jet fuels is equivalent to 5 ppm FAME in jet fuel.

6.3 Pipeline

6.3.1 General

Well-defined procedures shall be developed and implemented to eliminate the opportunities for contamination in any pipeline network that handles aviation products.

The pipeline owner/operator shall develop a comprehensive aviation fuel quality assurance and monitoring program based on industry, local practices and previous experience that shall be designed to maintain the quality of fuel while in transit. This should take the form of in-transit testing of certain fuel properties and testing for fuel contaminants such as particulate, water and surfactant levels. In addition, random full specification testing should also be considered.

In non-fungible product systems, where the original batch identity of the fuel is not lost, the pipeline owner/operators shall maintain a system to forward RQCs, COAs and recertification test certificates as applicable to receiving terminals or airports in advance of the product being received at these points.

The introduction of ground fuels containing or made exclusively of bio-components (e.g. FAME) is a growing concern on pipelines handling aviation fuels. When a pipeline co-transports aviation fuel and ground fuels (containing FAME) the operator shall complete an MOC process to determine additional safeguards required to preserve the integrity of the aviation fuel. Issues which shall be considered but not limited to are listed below.

1) Examine their facilities to identify any potential sources of low level cross contamination. Areas to inspect should include but not be limited to ingress and egress manifolds, pump stations, valve integrity, dead legs, meter bays.

2) Review operating procedures associated with these facilities to ensure they are effective at preventing low level contamination.

NOTE 1 m^3 B5 in 10,000 m^3 jet fuels is equivalent to 5 ppm FAME in jet fuel.

The contamination by additives in non-aviation products that precede aviation fuel shipment can have a profound effect on the properties of aviation fuel resulting in product that is off specification and unsuitable for use. Where additives are used in non-aviation product shipments leading aviation products, a risk based review of controls in place shall be carefully considered to prevent inadvertent mixing with aviation fuels. When new additives are to be used in non-aviation 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 non-aviation product contains 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.

The time product is allowed to remain “static” in the pipeline should be minimized to avoid the increased propensity for mixing at interface boundaries under no-flow conditions (see API 1595 for additional guidance on pipeline operations).

For all pipeline shipments, the batch number assigned by the pipeline shall be cross-referenced on the delivery document (DD) to the batch number from the original quality documentation and/or release certificate. The quality documentation from the injection point (see 6.1 and corresponding pipeline DD) should be forwarded directly to the receiving installation by the pipeline operator.

Moving product in and out of intermediate tankage in a pipeline delivery system before arriving at the designated receiving installation can mix multiple batches. Where possible, this should be avoided so as to prevent commingling and loss of batch identity.

6.3.2 Fungible Pipeline Systems

A “fungible batch” is defined as a batch of product meeting the pipeline operators established specifications, which is commingled with other quantities of product meeting the same specification. In this case, tracing batches back to original injection point RQCs, COAs or recertification certificates is not possible.

Multiproduct fungible pipeline systems are operated in a manner that prevents traceability of individual shipments. However, the principles regarding product movements still apply and should be used whether the pipeline is operated as a fungible or segregated system.

For all pipeline shipments, the batch number assigned by the pipeline shall be cross-referenced on the DD to the batch number from the original quality documentation and/or release certificate.

The quality documentation from the injection point (see 6.1 and corresponding pipeline DD) shall be kept on file by the pipeline operator but there is no need to forward on to the receiving terminals or airports.

6.3.3 Notification of Quality Assurance and Aviation Fuel Monitoring Program Results

The data obtained by the pipeline quality assurance program on product being shipped is an important tool that shall be used to advise receiving sites of potential issues that could affect the quality of the fuel being received. When test results of aviation fuel in transit show the fuel to have changing fuel properties or properties outside fuel specification limits, the receiving site shall be notified promptly before receipt takes place. This is to allow the receiving site adequate time to develop a corrective action plan.

Data obtained on free water content, particulate or surfactant levels on each batch should be regularly communicated to the receiving site before receipt. This is to allow the receiving site adequate time to develop a corrective action plan for receiving contaminated product.

6.4 Shipment by Tanker or Inland/Coastal Waterway Vessel

6.4.1 Independent Inspector

An independent third-party inspector should be appointed to oversee the loading of marine vessels and barges. The inspector is responsible to ensure that the loading procedures agreed to by the supplier and receiver, if a different legal entity, are followed and that appropriate inventory and fuel laboratory testing records are kept.

6.4.2 Vessel Acceptance

Wherever possible, ships tanks should be dedicated to a single grade of aviation fuel. If the tanks are not dedicated, the previous three cargoes shall be advised and the cleaning certificates available for review to determine if the tanks have been properly prepared to carry aviation fuel. If multiple products are carried, there shall be positive segregation between the compartments. Shippers of record shall have a documented process in place to manage compartment grade changes.

All metal parts in contact with aviation fuel should be free of zinc, cadmium, copper and their alloys. Any vessel chartered for the purpose of transporting aviation fuel in which the cargo will be exposed to these metals or alloys shall be approved in advance.

The introduction of ground transport fuels containing or made exclusively of bio-components (e.g. FAME) is a growing concern for tankers and inland/coastal waterway vessels transporting aviation fuels. A previous cargo containing ≥ 15 % FAME **shall not** be considered an acceptable previous cargo for aviation fuel. Expert advice should be sought on the proper cleaning procedures when using vessels that carried a product containing FAME as one of the last three cargoes.

Experience has shown that switching from a cargo that contained FAME (e.g. B5) to jet fuel requires a hot water tank wash and a fresh water rinse (but preferably also an intermediate FAME-free cargo) to remove FAME residue. Switching from neat FAME (B100) to jet fuel requires particular care and some advocate at least three intermediate (zero-FAME) cargoes plus the hot water wash/cold water rinse before loading jet fuel. Industry best practice for cleaning ships tanks can be found in EI HM50, *Guidelines for the Cleaning of Tanks and Lines for Marine Tank Vessels Carrying Petroleum and Refined Products.*

6.5 Refinery or Intermediate Storage into Marine Vessels or Barges

Before loading commences, it shall be confirmed that the vessel has been properly prepared to transport aviation fuel. The compartments to be loaded shall be visually examined and gauged. If visual inspection is not possible due to an inert gas system, a letter from the ship's master shall be obtained stating that the vessel is fit to accept an aviation fuel cargo.

The RQC, COA and, when applicable, recertification certificates for each shore tank contributing to the cargo shall be available before loading commences. A release certificate (RC) shall accompany any transfer of product. Copies of all quality documentation shall be placed on the vessel and communicated to the receiving installation (disport) electronically or by facsimile. Assigning new batch numbers to shipments by marine vessel or barge is not required.

If the line from the storage facility to the loading port is grade dedicated and positively segregated, the opportunity for contamination is extremely small and only a control check needs to be performed during the transfer. When the shipment is from a single tank, a 1-gal single tank composite sample shall be obtained from the shore shipping tank and retained for a minimum of 30 days. If multiple tanks are used to complete the shipment, 1-gal single tank composite samples from each shore tank shall be obtained and kept for 30 days.

However, if the line from the shipping tank or tanks to the load port is not dedicated or the appropriate safeguards for segregation are not installed, product quality shall be monitored during loading. Line samples shall be taken for gravity (density) and visual examination from the head, middle and tail of each tank shipment to ensure contamination

has not occurred. Pumping into the vessel shall be stopped if the measured gravity differs from the batch density by more than ≥ 0.7 °API (density ±3 kg/m^3) or if dirt, water or an unusual color is observed. One-gallon single tank composite samples shall be obtained from the issuing shore tank and line samples (head, middle and tail) taken from the dock line as near as possible to the vessel and retained for 30 days. If multiple tanks are used to complete the pipeline shipment, 1-gal single tank composite samples from each shore tank and line samples from as near the transfer point as possible shall be obtained and kept for 30 days.

The inspector shall take first-foot middle or running samples from each compartment during loading to check product quality. The following properties shall be measured as listed below.

— *Appearance*. Clear and bright—visually free from solid matter and undissolved water at normal ambient temperature.

— *API Gravity*. Within ±0.7 °API of batch gravity.

— *Flash Point*. Within ±5 °F of batch flash point—jet fuel only.

The following property should also be measured as significant changes in Saybolt color from the RQC/COA as compared to the first-foot level batch would usually be cause for investigation as follows:

— *Saybolt Color*. ASTM D156 (jet fuel only) as follows in the table below.

RQC/COA Saybolt Color	Significant Change
> 25	> 8
$\leq$ 25, but $\geq$ 15	> 5
< 15	> 3

The results of the first-foot sample will be used to confirm that contamination has not taken place. The API Gravity and flash point results shall be compared with the shore tank quality certificate. If the comparisons of the results exceed the specified values or if dirt, water or an unusual color is observed, vessel loading shall be stopped and the responsible party contacted immediately.

Supply arrangements should 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 aviation fuels.

Special precautions shall be exercised to assure product quality if a vessel fitted with heating coils made of copper or its alloys is chartered to carry jet fuel. Prior to loading, product shall be tested by the supplying installation for thermal stability according to test method ASTM D3241, JFTOT Procedure, at a heater tube control temperature of 275 °C. Fuels that do not pass a 275 °C JFTOT should not be loaded on a ship fitted with copper heating coils.

Once loading is complete, the inspector should obtain three 1-gallon (5-gal for aviation gasoline) multi-tank composite vessel samples, consisting of a middle or running sample from each compartment, which shall then be sealed and labelled in the presence of the ship's responsible officer. The samples may be required for the following:

— immediate testing by the supplying refinery, terminal or contract laboratory;

— retention at load port; and

— onboard transportation to the receiving installation (disport)—upon arrival at disport, the inspector shall retain this sample for 30 days.

The following properties should be measured, as a minimum, on one multi-tank vessel composite sample.

— *Appearance*. Clear and bright—visually free from solid matter and undissolved water at normal ambient temperature.

— *Saybolt Color*. Significant changes in Saybolt color from the RQC/COA as compared to the first-foot level batch would usually be cause for investigation as follows in the table below (jet fuel only).

RQC/COA Saybolt Color	Significant Change
> 25	> 8
≤ 25, but ≥ 15	> 5
< 15	> 3

— *API Gravity*. Within ±0.7 °API of batch gravity.

— *Flash Point*. Within ±5 °F of batch flash point (jet fuel only).

— *MSEP*. ≥ 85 (jet fuel only).

— *Millipore Color*. Report only jet fuel.

— *Thermal Stability*. At 260 °C on barges/ships with copper or copper bearing coils, use jet fuel only.

If the cargo consists of more than one batch, the comparison shall be based on calculated values weighted for the amount of each batch contributing to the cargo. If the comparisons of the results exceed the specified values or if dirt, water or an unusual color is observed, the responsible party shall be contacted immediately. The cargo shall not be released until an adequate explanation is found or until it is confirmed that the cargo meets the remaining unchecked specification properties.

6.6 Shipment by Road or Rail Tank Car

Shipments of aviation fuel to road or rail tank car shall take place via dedicated and segregated loading lines from the shipping tank. If these are not available then special procedures and quality monitoring standards shall be developed.

Truck trailers and railcars should meet the requirements described in API 1595.

Assigning new batch numbers to shipments by road or rail tank car is not required. An RC shall be issued showing the pre-loading and post-loading inspection results on a representative sample drawn from the compartment low point. For multiple compartment tanks, all compartments shall be tested, however composite samples may be taken from groups of three compartments to reduce the total number of tests. The date, batch number, API Gravity (density) shall be supplied with each road or rail car.

7 Product Receipt, Sampling, Testing and Release at Pre-airfield Storage Terminals Upstream of an Airport

7.1 Documentation

Each consignment of product received shall have documentation confirming that it meets the relevant specification. This documentation shall consist of a refinery quality certificate or COA. If applicable a copy of the latest recertification test certificate (RTC) shall be provided. For pipeline receipts, batch number, API Gravity (density) and other relevant information may be communicated pending arrival of the RQC or COA, the RC and DD. Records shall be maintained

of the consignments received together with all results of analyses. These records and supporting documents shall be retained for a minimum of one year.

7.2 Receipt—General

For additional detailed requirements on receiving aviation fuels into a pre-airfield storage terminals please refer to API 1595.

After delivery is complete, the receipt tank or tanks shall be positively segregated to ensure that the product cannot be contaminated by subsequent incoming product or contaminate product in other tanks that have already been tested and approved for release. The stock shall be quarantined and a new batch number assigned to the tank contents and logged in a batch makeup and clearance record.

After settling (a minimum of 30 minutes), samples from upper, middle and lower samples shall be drawn for a control check. When upper, middle and lower samples are free of sediment and suspended water but the API Gravities indicate layering (i.e. API Gravity differences between samples exceed ±0.7 °API), then the following tests should be carried out on each sample:

— Jet fuel: density, flash point, initial boiling point, end point.

For laboratory testing, a set of upper, middle and lower samples shall be combined into a single-tank composite sample. Samples used for control check determinations shall not be included in the composite sample. Samples taken for inclusion into the composite sample may be taken at the same time as the control check samples are drawn.

If, after settling, the product is not free of suspended water and particulate matter then further settling time shall be allowed before a fresh set of samples is taken for testing. Settling shall continue until product is free of suspended water and sediment.

After completion of settling draining of any accumulated water and receipt of satisfactory test results, the product can be formally released to airport storage or loading rack. Where fast turnaround of product is essential, and the tanks are provided with inlet/outlet filtration and floating suctions, reduced times may be allowed (see API 1595).

7.3 Receipts 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. Where 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) then 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 on jet fuel receipts should be performed on the commencement sample of each pipeline receipt. This color membrane filtration test should provide information to the pre-airfield distribution terminal about the particulate level of fuel being received and of potential filtration issues and allow trending of receipt quality 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 not take place until clearance has been given by the product quality manager of the pre-airfield storage terminal.

If receipt is from fully segregated storage via a dedicated single-grade pipeline and into a fully segregated tankage system, only control check testing is required at the receiving installation. A new batch reference number shall be assigned and recorded along with the new batch gravity (density).

If any of the samples fail the control check then the receipt shall be quarantined. Delivery to the aviation storage shall only be resumed after the manager of the installation has given clearance.

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

If the RQC or COA for the product received is not available (i.e. aviation fuel delivered from a fungible system or a pipeline system with multiple break out tanks which mixes three or more different batches) or if three or more new batches are delivered, 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.

Tanks may be released on receipt of a satisfactory RTC or COA and after being sumped of any free water.

7.4 Receipts by Ocean Tanker and Coastal/Inland Waterway Vessel

7.4.1 Vessel Discharge

The inspector shall obtain two 1-gal multi-tank composite samples made up of a middle sample from each compartment for pre-discharge testing and retention. The samples shall be sealed and labelled in the presence of the ship's responsible officer. The following properties below shall be measured on one multi-tank vessel composite sample.

— *Appearance*. Clear and bright—visually free from solid matter and undissolved water at normal ambient temperature.

— *API Gravity*. Within ±0.7 °API of batch gravity.

— *Flash Point*. Within ±5 °F of batch flash point (jet fuel only).

— *MSEP*. $\geq$ 85 (jet fuel only)

— *Millipore Color*. Report only (jet fuel only).

— *Thermal Stability*. At 260 °C (on barges/ships with copper or copper bearing coils—use jet fuel only).

The following property should also be measured as significant changes in Saybolt color from the RQC/COA as compared to the multi-tank composite sample would usually be cause for investigation as stated below.

— *Saybolt Color*. ASTM D156 (jet fuel only):

RQC/COA Saybolt Color	Significant Change
> 25	> 8
$\leq$ 25, but $\geq$ 15	> 5
< 15	> 3

Discharge may commence provided the results of the tests are within the limits of acceptability. If the results do not meet the criteria above, discharge shall not commence and the responsible party shall be contacted immediately.

7.4.2 Receipts by Vessel

After receipt, each tank shall be positively isolated to ensure that the product cannot be contaminated by subsequent incoming product or contaminate product in other tanks that has already been tested and approved for release. Product shall be allowed to settle for a specified period, the tank checked for layering, accumulated water and sediment drained and a single-tank composite sample drawn for recertification testing. The appropriate recertification testing can only be accomplished if the RQC or most recent COA is available for the new receipt and the previous quality information is on hand for any product remaining in the receipt tank. If this quality documentation is not

available or if more than three new batches are received into the tank, full COA testing shall be performed. After completion of settling, draining of any accumulated water and sediment and receipt of satisfactory test results, the product can be formally released. A 1-gal single-tank composite sample (5 gallons for aviation gasoline) from each receipt tank shall be drawn and retained.

The composite sample shall be taken in an approved sample container, labelled and sealed in the presence of the ship's responsible officer. The sample shall be retained at the installation for 30 days.

7.4.3 Special Instructions

Additives shall not be added to the cargo during loading or in transit. Any additive treatment shall be approved by the responsible party and shall be carried out at the discharge terminal only.

Cargoes should not be purchased “on the water” without the proper quality documentation being available. The documentation shall include the RCQ or the most recent COA representing the cargo carried and a cleaning certificate indicating the pre-loading cleaning process and three previous cargoes. The documentation shall contain a quality certification statement confirming the cargo meets the requirements of the relevant specification. The quality certificate shall contain information on the type and concentration of all additives present. Copies of the latest shore tanks and ships loading quality certificate shall be available in case of dispute. The marine vessel acceptance requirements shall apply.

For cargoes purchased on the water without complete documentation, the following additional pre-discharge instructions apply:

— a middle sample from each compartment shall be obtained and tested for appearance, and gravity, and additionally for jet fuel flash point and MSEP;

— a vessel composite sample shall be prepared from a middle sample drawn from each compartment and a complete COA laboratory test performed to verify that the fuel is still within the limits of the specification.

7.5 Receipts by Road or Rail Tank Car

7.5.1 Pre-discharge

For additional detailed requirements on receiving aviation fuels into a pre-airfield storage terminal, refer to API 1595.

7.5.2 Receipts from Road/Rail Transport

Wherever possible, bulk transport should be dedicated to the transportation of one grade of aviation fuel, and appropriate engineering and procedures carried out to maintain grade selectivity. Only one grade of fuel shall be carried at one time.

Product receipt shall be through grade dedicated and segregated lines into tankage. After receipt, each tank shall be positively isolated to ensure that the product cannot be contaminated by subsequent incoming product or contaminate product in other tanks that has already been tested and approved for release.

Product shall be allowed to settle for a specified period, the tank checked for layering, accumulated water and sediment drained and a single-tank composite sample drawn for a control check. Settling shall continue until product is free of suspended water and sediment. A new batch reference number shall be assigned and the new batch gravity (density) recorded on a batch makeup and clearance form. The single-tank composite sample shall be retained for 30 days.

7.6 Transfers of Fuel within an Intermediate Facility

If product is moved within the terminal storage tanks, prior to shipment out of the terminal, it shall be batched after each movement. If the movement within the terminal is through a grade dedicated and segregated piping system, then no laboratory testing is required but a control test shall be performed on an upper, middle and lower sample of each tank to check for layering. An additional storage tank composite sample shall be prepared for control check to determine the new batch API Gravity for that tank. If it is not transferred through a grade dedicated and segregated piping system than a recertification test on a composite sample from each storage tank shall be performed.

A new batch number shall be assigned and a batch makeup record shall be established. This batch makeup record shall accompany the release document as evidence of the establishing of the new batch API Gravity and identifying which RQC(s) and, where applicable, recertification test report(s) makes up this new batch.

7.7 Release and Shipment from Intermediate Storage

Aviation fuel shall only be released for delivery to airport depots or loading racks if the following procedures have been satisfactorily completed:

— settling period,

— draining of any significant volumes of water,

— laboratory testing, and

— RC (see examples in Annex C and Annex D for road transports and Annex E for pipeline and marine ships and barges).

For any shipment from the site, a copy of the RC and the RQC (if available) and the recertification testing performed on the tank fuel that is being shipped from should accompany each shipment of product.

8 Receipts at Airport Depot

8.1 Documentation

All transfer of product to airport depots shall be supported by a release document containing the delivery batch number and gravity. Each consignment of product received shall have documentation confirming that the batch meets the relevant specification. It shall be possible to trace batches back to the originating RQC or most recent COA or RTC.

It is the responsibility of the airport depot manager to ensure that the documentation supplied with the incoming consignment of product is appropriate and clearly marked or stamped with a release statement and that it is properly signed by a representative of the supplying installation.

Records shall be maintained of the consignments received together with results of all analyses. These records shall be retained for a minimum of one year.

8.2 Receipt—General

Each grade should be received into delivery storage via a segregated line from segregated intermediate storage.

After initial settling, if the product is not free of suspended water and particulate matter, then further settling time shall be allowed before a fresh set of samples is taken for a repeat control check. If, after further settling, the product is not

free of suspended water and particulate matter then further settling time shall be allowed before a fresh set of samples is taken for testing. Settling shall continue until product is free of suspended water and sediment.

For laboratory testing a set of upper, middle and lower samples shall be combined into a single-tank composite sample. Samples used for control check determinations shall not be included in the composite sample. Samples taken for inclusion into the composite sample may be taken at the same time as the control check samples are drawn.

After completion of settling draining of any accumulated water and receipt of satisfactory test results (see 4.3), the product can be formally released to airport storage or loading rack. Where fast turnaround of product is essential, and the tanks are provided with separate inlet and outlet filtration and floating suctions, reduced times may be allowed.

8.3 Receipts by Pipeline

8.3.1 Receipt by Grade-segregated and Dedicated Pre-airfield Terminal Tankage and Delivery Pipeline to the Airport Tankage

If receipt is from segregated storage via a dedicated and segregated single-grade pipeline and into a segregated airport tankage system, a control check is required at the receiving installation. Additional testing may be required and can be found in the airport site operations standard/manual (i.e. ATA 103).

The stock shall be quarantined and a new batch number assigned to the tank contents along with the new batch gravity (density) and logged in a batch makeup and clearance record.

If any of the samples fail the control check then the receipt shall be quarantined. Delivery to the aviation storage shall only be resumed after the manager of the installation has given clearance the fuel is acceptable.

8.3.2 Receipt by Grade Nonsegregated and/or Dedicated Pre-airfield Terminal Tankage and Delivery Pipeline to the Airport Tankage

If receipt is from nonsegregated storage and/or via a nondedicated and segregated single-grade pipeline, recertification testing shall be carried out after receipt of product into airport tankage.

After delivery is complete, the receipt tank or tanks shall be positively isolated to ensure that the product cannot be contaminated by subsequent incoming product or contaminate product in other tanks that have already been tested and approved for release. The stock shall be quarantined and a new batch number assigned to the tank contents and logged in a batch makeup and clearance record.

If the RQC, COA or recertification tests for the product received by pipeline from non-grade segregated and/or dedicated pre-airfield terminal tankage is not available (i.e. aviation fuel delivered from a fungible pipeline system or a pipeline system or one with multiple break out tanks which mixes three or more different batches, or a nondedicated pre-airfield terminal where the requirements in Section 7 are not met) then full specification testing (COA) shall be carried out.

A new batch reference number shall be assigned and recorded along with the new batch gravity (density).

If any of the samples fail the control check or the recertification or COA testing if applicable, then the receipt shall be quarantined. Delivery to the aviation storage shall only be resumed after the manager of the installation has given clearance the fuel is acceptable.

8.4 Receipt by Marine Vessel

See 7.4 for additional information.

A new batch reference number shall be assigned and the new batch gravity (density) recorded on a batch makeup and clearance form.

8.5 Receipt by Road/Rail Transport

After control check testing confirms the product quality is acceptable, discharge may commence. Additional pre-discharge testing may be required and can be found in the airport site operations standard/manual (i.e. ATA 103).

Product receipt shall be through grade dedicated and segregated lines into tankage. After receipt, each tank shall be positively isolated to ensure that the product cannot be contaminated by subsequent incoming product or contaminate product in other tanks that has already been tested and approved for release. Product shall be allowed to settle for a specified period, the tank checked for layering, accumulated water and sediment drained and a single-tank composite sample drawn for a control check.

A new batch reference number shall be assigned and the new batch gravity (density) recorded on a batch makeup and clearance form. The single-tank composite sample shall be retained for 30 days.

8.6 Transfers of Fuel within an Airport Facility

If product is moved within the airport storage tanks, prior to shipment out to the hydrant or load rack, it shall be batched after each movement. If the movement within the airport is through a grade dedicated and segregated piping system, then no laboratory testing is required but a control test shall be performed on an upper, middle and lower sample of each tank to check for layering. An additional storage tank composite sample shall be performed to determine the new batch API Gravity for that tank.

A new batch number shall be assigned and a batch makeup record shall be established. This batch makeup record shall accompany the release document as evidence of the establishing of the new batch API Gravity.

Annex A
(informative)

AVGAS 100LL Recertification Test Report
(For Fuel Supplied to ASTM D910, Latest Edition)

Date:		Quantity in tank before receipt		BBLs	%
Tank No.:					
Batch No.:		Quantity received		BBLs	%
Sample No.:		Total quantity in tank after receipt		BBLs	

Date: _____ **Signed:** _____ **Title:** _____

Property	Test Method (**Note 1**)	Specification Limits	A Prev Tank Recert	B COA for Product Rec'd	C Calc Tank Quality	D Actual Recert Results	E Actual Diff C–D	F 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^3 **OR**	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/100 ml	D381	3 max						3

Tank checked and released for service by: _____ **Date:** _____

Comments:

NOTE 1 Report the actual test method used on the certificate.
NOTE 2 Where minimum/maximum specification limitsare given, the acceptable difference values do not apply to values below the minimum or above the maximum.
NOTE 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
(informative)

Jet A Recertification Test Report

Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipments from Refinery to Airport

Date:		Quantity in tank before receipt		BBLs	%
Tank No.:		Quantity received		BBLs	%
Batch: No.:		Total quantity in tank after receipt		BBLs	
Sample No.:					

Property	Test Method **(Note 1)**	Specification Limits	A Prev Tank Recert	B COA for Product Rec'd	C Calc Tank Quality	D Actual Recert Results	E Actual Diff C–D	F Acceptable Difference **(Note 2)**
Appearance	D4176 Procedure 1	C&B **(Note 3)**					N/A	Spec Requirement
Saybolt color, min	D156, D6045	+16					N/A	**(Note 4)**
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 at 15 °C, kg/m^3 **OR**	D1298, D4052	775 – 840						3
API Gravity	D1298	37 – 51						0.7
Density/API Gravity Tank Composite Sample								3, kg/m^3 or 0.7 API
Density/API Gravity Tank Upper Sample								3, kg/m^3 or 0.7 API
Density/API Gravity Tank Middle Sample								3, kg/m^3 or 0.7 API
Density/API Gravity Tank Lower Sample								3, kg/m^3 or 0.7 API
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 **(Note 5)**

Date: _____ **Signed:** _____ **Title:** _____

NOTE 1 Report the actual test method used on the certificate.
NOTE 2 Where minimum/maximum specification limits are given, the acceptable difference values do not apply to values below the minimum or above the maximum.
NOTE 3 The fuel sample shall be "clear, bright and visually free from solid matter and undissolved water at ambient temperature".
NOTE 4 A significant change (> 5) in Saybolt color may indicate product instability and/or contamination and should be investigated.
NOTE 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 ºC. No Peacock or abnormal color deposits.

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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 C
(informative)

Release Certificate (Road or Rail Cars)

1. TO BE COMPLETED BY THE SUPPLYING REFINERY OR TERMINAL

		Serial No:	
Supplying Installation:		**JET A**	
Dispatched to:			
Grade/Specification:		Date:	
Transport No.:		Batch No.:	
Batch API Gravity at 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? ***YES / NO***	(**6**) Delivery hoses & couplings capped? ***YES / NO***	(**1**) Each compartment sampled & inspected: Water free? ***YES / NO***	(**2**) API*: Observed	API Gravity		
				Temp °F		
(**2**) If not dedicated, state previous grade:	(**7**) Correct DOT grade plate displayed? ***YES / NO***	Dirt free? ***YES / NO*** Clear & Bright? ***YES / NO*** Color:	API Gravity at 60°F (1)			
			Batch Gravity at 60°F (2)			
(**3**) Steam Cleaned & Dried? ***YES / NO***	(**8**) Internal valves opened & contents drained & inspected:	(**3**) Seals Applied? ***YES / NO***	**Difference between (1) and (2)		±	±
(**4**) Cleaning certif. provided? ***YES / NO***	Water free? ***YES / NO*** Dirt free? ***YES / NO*** ~ Volume drained:	*Up to 3 compartments from one transport may be combined for the API gravity determination.	**If the difference is greater than 0.7 API units, verify the correct batch gravity. Notify the terminal immediately. Do not depart until the discrepancy is resolved.			
(**5**) Residual BOL provided? ***YES / NO***	*I certify the product has been handled in accordance with the XXXX company guidelines for loading and delivery of aviation products.*	Transport Company: Driver Name (printed): Signature: Certification Date:				

3. TO BE COMPLETED BY THE CARRIER (DRIVER) OR TERMINAL STAFF

Additives	**Type**	**Range**	**Observed Addition Rate (Meter)**	**Measured Value**	**Test Method**
Conductivity Improver	Stadis® 450	50 – 600 pS/m			ASTM D2624
Fuel System Icing Inhibitor	DiEGME	0.10 – 0.15 vol %			ASTM D5006

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

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

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

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

DISTRIBUTION:
Original – Return to XXXX Company with invoice
Pink – Give to **loading terminal** after loading
Yellow – Give to **customer** after unloading
Green – Carrier

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Where applicable, authorities having jurisdiction should be consulted.

Annex D
(informative)

Release Certificate (Road or Rail Car)

1. TO BE COMPLETED BY THE SUPPLYING REFINERY OR TERMINAL

		Serial No:	
Supplying Installation:		**AVGAS**	
Dispatched to:			
Grade/Specification:		Date:	
Transport No.:		Batch No.:	
Batch API Gravity at 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? ***YES / NO***	(**6**) Delivery hoses & couplings capped? ***YES / NO***	(**1**) Each compartment sampled & inspected: Water free? ***YES / NO***	(**2**) API*: Observed	API Gravity		
(**2**) If not dedicated, state previous grade:	(**7**) Correct DOT grade plate displayed? ***YES / NO***	Dirt free? ***YES / NO*** Clear & Bright? ***YES / NO*** Color:		Temp °F		
(**3**) Steam Cleaned & Dried? ***YES / NO***	(**8**) Internal valves opened & contents drained & inspected:	(**3**) Seals Applied? ***YES / NO***	API Gravity at 60 °F (1)			
(**4**) Cleaning certif. provided? ***YES / NO***	Water free? ***YES / NO*** Dirt free? ***YES / NO*** ~ Volume drained:	*Up to 3 compartments from one transport may be combined for the API gravity determination.	Batch Gravity at 60 °F (2)			
			**Difference between (1) and (2)		±	±
			**If the difference is greater than 0.7 API units, verify the correct batch gravity. Notify the terminal immediately. Do not depart until the discrepancy is resolved.			
(**5**) Residual BOL provided? ***YES / NO***	*I certify that the product has been handled in accordance with the XXXX Company guidelines for loading and delivery of aviation products.*	Transport Company: Driver Name (printed): Signature: Certification Date:				

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

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

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

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

DISTRIBUTION:
Original – Return to XXXX Company with invoice
Pink – Give to **loading terminal** after loading
Yellow – Give to **customer** after unloading
Green – Carrier

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Annex E
(informative)

Release Certificate (Pipeline, Ocean Tanker, Coastal/Inland Waterway Vessel)

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

Serial No:	

Supplying Installation: Date:

Dispatched to: Vessel:

Grade/Specification: Pipeline:

Order No:

Shipping Record:

Tank No.	Batch No.	Sample No.	Quantity (bbls)	Density/Gravity At 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 = upper sample
M = middle sample
L = lower sample
C = composite sample (equal portions of U.M, L or a running sample)

COMMENTS:

Certified that the products detailed herein conform to the relevant specifications and have been handled in accordance with the quality control procedures in API RP 1595.

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.

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Annex F
(informative)

Batch Makeup and Clearance Record

Installation: **Product:** **Tank No:**

Date Tank Replenished	Supply Source	Batch Number	Batch Gravity	Batch Volume (bbls)	Tank Qty Before Receipt	Date Tank Sampled	New Batch Number	Lab Sample Number	Tank Layered (*Yes/No*)	New Batch Gravity	Comments

NOTE Use one sheet for each storage tank.

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