PREAMBLE

a. This Aerospace Standard (AS 6401) publication has been developed jointly by:

1) the Society of Automotive Engineers (SAE) “Aviation Fuel Operations Committee (G-16)” hereinafter known as “the G-16”, an international group of subject matter experts in the fuel field that includes oil companies, standards groups, fuel quality audit pools, into-plane providers, airlines; and

2) other aviation fuel industry stakeholders who also provided their technical expertise & feedback.

b. The AS 6401 is published via a joint-copyright between the Joint Inspection Group (JIG) and the Society of Automotive Engineers (SAE).

c. Suggested revisions are invited, & should be submitted to the Aerospace Stds Specialist: SAE International, 400 Commonwealth Dr, Warrendale, PA 15096 USA Attn: Ms. M. Lemankiewicz (lemankm@sae.org) Tel: 724-772-7147, Fax: 724-776-0243

DISCLAIMER

a. The information contained in this Standard is subject to constant review due to changing regulatory requirements and technological advancements

b. This standard is intended to refer to fuels of a Jet A/A-1 nature. In the case where other fuels are used of a “wide-cut” nature (e.g. Jet B), then local procedures shall be followed.

c. No subscriber or reader should act on the basis of any such information without referring to applicable laws and regulations and/or without taking appropriate professional advice.

d. Although every effort has been made to ensure accuracy, the G-16 shall not be held responsible for the loss or damage caused by errors, omissions, misprints, or misinterpretation of the contents contained within this AS 6401 standard.

e. Furthermore, the G-16 expressly disclaims any and all liability to any person (or equipment), in respect of anything done or omitted, or the consequences of anything done or omitted, by any such person in reliance on the contents of this publication.

NOTE: The current members of the G-16 Committee are available from the SAE website at: www.sae.org
INTRODUCTION

a. This publication has been compiled from accepted industry practices per the following standards:

1) Air Transport Association (ATA) 103;
2) Canadian Standards Association (CSA) B836;
3) Coordinated Agency for Supplier Evaluation Inc (CASE) 2A;
4) IATA Fuel Quality Pool (IFQP) Standards; and
5) Joint Inspection Group (JIG) Guidelines.

b. Various related Standards documents (e.g. National Fire Protection Association (NFPA), American Petroleum Institute (API), applicable civil aviation regulations (e.g. Federal Aviation Administration [FARs] & AC 150/5230-4A; Transport Canada [CARs]; and European Aviation Safety Agency [EASA/JARs], etc), were reviewed and provided the framework for this document and are, where necessary, incorporated by reference within the Standard. A listing of those documents is provided in Section 2.

c. The Standards contained in this publication are primarily intended to:

1) ensure that the safe practices contained herein can be applicable in all areas of the world (also see d. below). Whenever possible, the best practices of the documents referred to in Introduction b. above were migrated into this new global standard;
2) include suitable reference to environmental protection controls and facilities that are receiving increased emphasis and regulation in most regions;
3) apply to jet fuel commercial aviation operations, however, many of the practices and procedures are suitable for military operations, except where they conflict with specific regulations and codes that are designed to fulfill military requirements; and
4) ensure that the harmonized & standardized content reflect current levels of technical knowledge and industry experience.

d. In those cases where there may be a deviation between this standard and any pre-existing standards in North America, the G-16 will convene the necessary taskforce to undertake the required research to ensure technical justifications allow for their resolution as soon as practical.

e. The features relating to design of equipment are primarily intended for new facilities or equipment, and for existing facilities or equipment which are significantly upgraded. It is not therefore intended that the guidance be applied retroactively where it is not practical to do so.

f. In the case of conflict between this standard and any local regulations, local regulatory requirements prevail.
g. Users of this publication should be aware that proper consideration 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.

h. Every effort has been made by the G-16 to assure the accuracy and reliability of the data contained in this publication; however the G-16 makes no representation, warranty, or guarantee in connection with this publication, and hereby expressly disclaim any liability or responsibility for loss or damage resulting from its use, or for the violation of any local or regional laws or regulations with which this publication may conflict.

i. The G-16 is a committee sanctioned by SAE within their Aerospace General Projects Division, and differs from the AE-5C “Aviation Ground Fuelling Systems Committee”, in that the G-16 is more concerned with the operation of facilities and equipment by an end user, as opposed to the detailed design by an equipment manufacturer.

j. SAE is a non-profit educational and scientific organization dedicated to advancing mobility and developing technical information on aerospace, aircraft, and all other types of self-propelled vehicles including: automobiles; buses; off-highway equipment; marine; rail; transit systems; and trucks.

k. This publication has used the Oxford English Dictionary as its foundation for spelling consistency (e.g. colour, fuelling).

l. The use of the word “shall” implies that the requirement is mandatory, whereas the use of the word “should” implies that the requirement is “recommended.”
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GLOSSARY OF TERMS
SECTION 1

1 SCOPE:

1.1 Purpose:
To provide one consolidated operational standard that is accepted and applicable globally for the safe receipt, storage and distribution of quality aviation jet fuel for the aviation industry.

1.2 Benefits:
Benefits are having:
   a. common fuel related procurement standards;
   b. standardized supplier quality practices;
   c. consistent application of standards leading to the potential for audit pooling activities; and
   d. a reduction in the number of audits.

1.3 Field of Application:

1.3.1 Applies to a broad spectrum of aviation industry that handles, transports, or uses aviation fuel such as:
   a. purchasers / users (i.e. airlines);
   b. suppliers (i.e. oil companies); and
   c. into-plane service providers.

1.3.2 This Standard is specifically concerned with the operation and testing of facilities and equipment by an end user, as opposed to the detailed design of systems or equipment.

1.3.3 This Standard is intended to be applicable to larger, international airports with significant commercial traffic.

NOTE: Standards for smaller airports outside North America, can be found in the the Joint Inspection Group (JIG) 4 document.
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SECTION 2

2 REFERRED PUBLICATIONS

2.1 American Petroleum Institute (API)
   a. API 2013 “Cleaning Mobile Tanks in Flammable or Combustible Service”
   b. API 650 “Welded Steel Tanks for Oil Storage”
   c. API RP 652 “Lining of Above Ground Petroleum Storage Tank Bottoms”

2.2 American Petroleum Institute (API) / Energy Institute (EI)
   a. API/EI 1529 “Aviation fuelling hose and hose assemblies”
   b. API/EI 1540 “Recommended Practice, Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities”
   c. API/EI 1542 “Identification markings for dedicated aviation fuel manufacturing and distribution facilities, airport storage and mobile fuelling equipments”
   d. API/EI 1550 “Filtration Handbook”
   e. API/EI 1581 “Specification and Qualification Procedures for Aviation Jet Fuel Filter Separators”
   f. API/EI 1582 “Specification for Similarity for API/EI 1581 Aviation Jet Fuel Filters/Separators”
   g. API/EI 1584 “Four-inch Hydrant System Components and Arrangements”
   h. API/EI 1590 “Specification and qualification procedures for aviation fuel microfilters”
   i. API/EI 1597 “Procedures for overwing fuelling to ensure delivery of the correct fuel grade to an aircraft”

2.3 American Society for Testing and Materials (ASTM)
   a. ASTM D2624 or IP274 procedures for “Conductivity Meter calibration”
   b. ASTM D2276 or IP216 “Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling”
   c. ASTM D6469 “Standard Guide for Microbial Contaminantion in Fuels and Fuel Systems”
   d. ASTM D6986 “Standard Test Method for Free Water, Particulate, and Other Contamination in Aviation Fuels (Visual Inspection Procedures)”
2.4 Energy Institute / Institute of Petroleum (EI / IP)
   a. EI 1583 “Specification and Qualification Procedures for Aviation Fuel Filter Monitors with
      Absorbent Type Elements”
   b. “Guidelines for the investigation of the microbial content of petroleum fuels and for the
      implementation of avoidance and remedial strategies”
   c. IP 160 “Density and API Gravity of Crude Oil and Petroleum Products-Hydrometer Method”
   d. IP 274 “Determination of electrical conductivity of aviation and distillate fuels”
   e. IP 365 “Density and Relative Density of Liquids by Digital Density Meter”
   f. IP 599 “Digital Thermometer operation”

2.5 Comitee Europeen des Normalisation (CEN)
   a. EN 12312-5 “Aircraft Ground Support Equipment-Specific Requirements - Part 5 Aircraft
      Fuelling Equipment”
   b. BS EN 14015:2004 “Specification for the design and manufacture of site built, vertical,
      cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at
      ambient temperature and above”

2.6 International Air Transport Association (IATA)
   a. “Guidance Material on Microbiological Activity in Aircraft Fuel Tanks”
   b. “Guidance Material on Turbine Jet Fuels Specifications”
   c. “Guidance Material on Standard Into-Plane Fuelling Procedures”
   d. “Dangerous Goods Regulations”

2.7 International Civil Aviation Organization (ICAO)

2.8 International Organization for Standardization (ISO)
      Part 1: Development and operation of proficiency testing schemes”, and
      Part 2: Selection and use of proficiency testing schemes by laboratory accreditation bodies”
2.9 National Fire Protection Association (NFPA)
   a. NFPA 407 - "Standard for Aircraft Fuel Servicing"

2.10 Society of Automotive Engineers (SAE)
   a. AS 1852 "Nozzles and Ports – Gravity Fuelling Interface Standard for Civil Aircraft"
   b. ARP 5789 “Aviation Fuel Facilities”
   c. ARP 5818 “Design & Operation of Aircraft Refuelling Tanker Vehicles”
   d. AS 5877 "Detailed Specification for Aircraft Pressure Refueling Nozzle"

2.11 International Safety Guidelines for Oil Tankers and Terminals (ISGOTT)

2.12 Joint Inspection Group (JIG)
   a. JIG 4 - "Smaller Airport Guidance Material"

2.13 Underwriter’s Laboratory (UL)
   a. UL 58 - “Standards for Safety for Steel Underground Tanks for Flammable and Combustible Fluids”
   b. UL 142 - “Steel Aboveground Tanks for Flammable and Combustible Liquids”
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SECTION 3

3 OPERATIONS AND QUALITY ASSURANCE

3.1 Quality & Safety Management

3.1.1 This Section, in conjunction with applicable specifications, describes the minimum requirements for a fuel vendor's quality program.

3.1.2 Vendors should be prepared, with reasonable notice and taking into account operational requirements, to accept external technical and quality management audits from their customers or regulatory agencies.

3.1.3 It is recommended that vendors have a pre-employment and post accident drug/alcohol program for all personnel dealing with the receipt, handling, storage and dispensing of fuel.

3.1.4 All programs that identify an individual (per their Policies and Procedures Manual), by title, who are responsible for the effectiveness of a program, shall have a process to ensure the continuity of the program during the primary individual’s absence.

3.2 Quality Program

3.2.1 The vendor shall have an established quality program to assure safe receipt, storage and distribution of fuel in accordance with this Standard.

3.2.2 The vendor shall have an internal audit and surveillance function that:
   a. periodically reviews its programs to assure there are procedures in place that assure compliance with this Standard, regulatory requirements, and good industry practice; and
   b. verifies that operations are being conducted in accordance with these programs (e.g. for a small operation it may be as simple as a one page checklist).

NOTE: This review period is typically done on an annual basis, but shall not exceed two years.

3.2.3 The vendor’s internal audit and surveillance function shall contain provisions assuring that appropriate corrective action is promptly taken to:
   a. correct any reported discrepancies;
   b. locate and correct similar discrepancies, if they exist, in areas not audited; and
   c. correct the root cause of any problems.
3.2.4 The quality program shall be detailed in a policies and procedures manual. The purpose of the manual is to provide operational guidance to management and staff.

3.2.5 It is recommended that this manual is reviewed and revised as necessary every two (2) years, with a full revision at least every five (5) years. It shall be made readily available on-site to employees and to the customer’s auditor or designee.

3.2.6 The document shall include, but not necessarily be limited to, a detailed description of:

a. Responsibility - There is a clearly identifiable, qualified and knowledgeable person who is accountable for the quality of a process.

b. Authority - There is a clearly identifiable, qualified and knowledgeable person with the authority to establish and modify a process.

c. Procedures - There are documented methods for accomplishing a process

d. Document Control – there is a page in front of the manual, indicating “Manual Reviewed By and Date Reviewed” (including updates and what was updated) for review/audit purposes.

e. Controls - There are checks and restraints designed into a process to ensure a desired result.

f. Process Management - The vendor measures and assesses its processes to identify problems or potential problems.

g. Interfaces - The vendor identifies and manages the interactions between processes.

h. Operations - There are documented methods for:

1) receipts;
2) transfers;
3) storage;
4) dispensing; and
5) handling contaminated fuel and customer notification;
6) notifying customers of inoperative systems that impact operations;

**NOTE:** If an airline requires notification of any new, additional, replacement, or modified equipment that is placed into operation, that requirement should be inserted as part of the airline’s fuel contract / fuel manual.

7) defuelling procedures;
8) reporting of observed deficiencies or safety hazards;
9) product inspection & routine check program;
10) quality control and maintenance record keeping requirements and record retention time (refer to Section 11 Records);
11) fuel meter and equipment calibration program;
12) training program;
13) document & data control system; and

3.3 Technical Data Program

3.3.1 All actions shall be accomplished in accordance with this standard.

3.3.2 The vendor shall have a documented system to ensure that:
   a. all technical data & documentation is kept current and there is a record of revisions received and filed.
   b. only the latest technical data is available to persons performing assigned tasks; and
   c. the technical data used by persons performing these actions is appropriate for the work being done, readily available, in good condition, and in adequate quantity.

NOTE: It is not intended that every document be located at each site. However, any documentation related to employees correctly performing their jobs shall be available on-site.

3.3.3 The vendor shall name specific individual(s), by title, as responsible for maintaining the technical data:
   a. up to date and properly distributed; and
   b. in an environment that will protect it from loss or damage.

3.4 Tool/Test Equipment Calibration Program

3.4.1 The Vendor shall undertake a risk review of all critical monitoring and measurement devices and establish a list of such equipment. As a minimum, these shall include the master pressure gauge, fueling nozzle/venturi pressure gauge, torque wrenches and fuel delivery meters.

3.4.2 Vendors shall document and implement a detailed calibration program that ensures that monitoring and measuring devices, including personally owned and customer supplied equipment used to provide evidence of product conformity, are calibrated periodically to ensure their accuracy & precision, and are traceable to national or international measurement standards.

3.4.3 The calibration program shall:
   a. identify the individual(s) responsible, by title, for the operation of the calibration program;
   b. identify the gauges and meters in the program, the frequency of calibration, and the applicable tolerance or specification.

NOTE: Detailed gauge & meter calibration requirements are described in Section 8.6.
   c. provide a system for identifying the calibration status of each piece of equipment in the calibration program, and their calibration due dates (e.g. decals or tags).
3.4.4 Any tools and test equipment that are out of calibration or are past due calibration check, shall be clearly identified and/or removed from service.

3.4.5 Calibration records shall:
   a. show the date the item was calibrated or checked;
   b. show the date the next calibration is due;
   c. identify the individual or, where applicable, the outsource vendor that accomplished the calibration or check;
   d. in the case where the item was calibrated by an outside agency, contain a certificate of calibration; and
   e. record the details of any adjustment or repair required, and identify the standard, including the part number and serial number, used to calibrate the tool or equipment.

3.5 Training

3.5.1 For information regarding personnel training, refer to Section 12.

3.6 Alternate Means Of Compliance (AMOC)/Variance

3.6.1 Where compliance to this standard cannot be achieved, an AMOC/Variance process is required and approval is dependent upon the national regulations, and contractual agreements between the vendor and air operator, for the respective location.

3.6.2 The AMOC process shall include the following:
   a. the requirement which the alternative means is replacing;
   b. detailed explanation as to why compliance with requirements is not possible or practical;
   c. detailed explanation of how the AMOC does not impact the end result of the requirement it replaced; and
   d. the period of time the alternative method is to be reviewed and/or effective.
SECTION 4

4  FUEL QUALITY & TESTING

4.1 General

4.1.1 At appropriate stages during the handling and storage of aviation fuels, samples will be required for laboratory or visual examination in order to establish that fuels meet the requirements of the relevant specifications, or to detect contamination or deterioration.

4.1.2 IATA Guidance Material for Aviation Turbine Fuels & Specifications lists further information regarding jet fuel specifications such as: Jet A, Jet A-1, and TS-1.

4.2 Fuel Testing - Refinery Certificate of Quality (RCQ)

4.2.1 The RCQ is the definitive original document describing the quality of an aviation fuel. It contains the results of measurements, made by the fuel originator’s laboratory, of all the properties listed in the latest issue of the approved specification.

4.2.2 It also provides information regarding the addition of additives, including both type and amount of any such additives. In addition, it includes details relating to the identity of the originating refinery and traceability of the fuel described.

4.2.3 RCQs shall always be dated and signed by an authorised signatory.

4.3 Fuel Testing - Certificate of Analysis (CofA)

4.3.1 A CofA is issued by a laboratory and contains the results of measurements made of all the properties included in the latest issue of the approved specification, excluding particulate content test. It does not however include details of the additives added previously. Where possible, it shall include details relating to the identity of the originating refinery and to the traceability of the fuel described.

4.3.2 The CofA shall be dated and signed by an authorised signatory, and shall not be treated as a Refinery Certificate of Quality.

4.3.3 Sample quantity required is 2 litres (0.5 US gallons) minimum. An approved sample container as specified in section 4.13 shall be used.
4.4 Fuel Testing - Recertification Test Certificate (RTC)

4.4.1 The RTC document contains the results of the recertification test (see 4.4.8 below) and confirms that the fuel is satisfactory. It shall be dated and signed by an authorised signatory.

4.4.2 This test 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 multi-fuel pipelines, etc. The results of all recertification tests shall be checked to confirm that:
   a. the specification limits are met; and
   b. no significant changes have occurred in any of the properties.

4.4.3 This check should be made by comparing the recertification results with the corresponding values shown on the most recent analysis made on the fuel (e.g. with a Refinery Certificate of Quality, or previous Certificate of Analysis, or previous Recertification Test Certificate). Only by checking that the determined properties have not changed can it be safely assumed that the remaining unchecked specification properties have also not changed significantly and remain satisfactory.

4.4.4 The check shall be carried out by recording all relevant details on forms of the type shown in Appendix E. Acceptable differences are given for guidance on the forms. If one or more of the results exceeds these values then the fuel shall not be released until an adequate explanation from a fuel specialist is provided, or until a full specification test has been conducted to confirm its acceptability.

4.4.5 In circumstances where more than one new batch is received into a tank:
   a. where sampling identifies layered fuel, and facilities and circumstances permit, the tank contents should be circulated and resampled. Where circulation is not possible, samples shall be taken in accordance with section 6.3.3.
   b. separate column should be used for each batch, and for any stock which was in the tank (refer to sample “Recertification” form in Appendix E).
   c. the comparison shall be based on calculated (weighted average) values taking into account the amount of each batch in the tank.

4.4.6 If more than three new batches are received into a tank from non-dedicated systems, the comparison becomes difficult and possibly meaningless, and therefore the contents of the tank shall be tested against all the requirements of the specification.
4.4.7 Where fuel can be positively identified by documentary evidence as belonging to a particular batch covered by a related Refinery Certificate of Quality, then it is only necessary to conduct such additional tests as are required to prove that fuel quality has not changed. The results of such tests shall be compared with the results of the last tests, as well as reviewed for compliance with the specification. These recertification tests are:

a. appearance/colour;

b. distillation;

c. flashpoint;

d. density/API gravity;

e. freezing point;

f. corrosion (copper);

g. existent gum;

h. conductivity (to be carried out on bulk stock in storage, or immediately after taking a sample from storage tanks on fuels containing static dissipater additive);

i. MSEP;

j. Thermal Stability (JFTOT), when fuel:
   1) is received from a source (e.g. a marine vessel equipped with copper pipework in their cargo tanks) contrary to recommended practice; or
   2) has been static in storage for six (6) months.

k. Sample quantity of 2 litres (0.5 US gallons) minimum shall be taken, in an approved container as detailed in section 4.13.

4.4.8 If any test results indicate that the sample does not comply with the applicable specification, or that contamination has occurred, the fuel shall be immediately quarantined and remain under quarantine until further testing has established that the quality is accepted for aviation use. If testing shows that the fuel is not acceptable for aviation use it shall be removed.

NOTE: refer to Appendix E for an example of a suitable form for jet fuel recertification.

4.5 Fuel Testing - Periodic Test Certificate

4.5.1 This document contains the results of the Periodic Test and confirms that the fuel meets the specification and quality requirements. It shall be dated and signed by an authorised signatory.

4.5.2 A Periodic Test is carried out to certify that jet fuel which has been static in storage, or in the case where less than half of the fuel has been replaced in a six (6) month period, conforms to the
relevant specifications and that the quality of the fuel has not changed since the last tests were carried out.

4.5.3 Samples for periodic tests should be taken from each tank which has contained fuel and which has had no fuel receipts for the specified period.

4.5.4 The results of all periodic tests should be checked carefully against previous analysis reports to confirm that no significant changes have occurred. Where significant changes have occurred, the recertification tests process in 4.4.4 applies.

4.5.5 The test requirements are the same as the recertification test plus the thermal stability (JFTOT) test.

4.6 Fuel Testing - Release Certificate

4.6.1 This document supports any transfer of fuel, confirming compliance with approved specifications and contains at least the following information:

a. date and time of loading or transfer;

b. grade of fuel;

c. batch number and batch density/API gravity, corrected to standard temperature (e.g. 15°C, 60°F), of the fuel in the tank from which it originated;

d. a statement indicating that on the date of release, the tank low point was drained of any visible sediment and undissolved water, and that the fuel fully meets the appearance requirements of the applicable specification.

4.6.2 The Release Certificate shall be dated and signed by an authorised signatory.

4.7 Appearance Testing - Visual

NOTE: refer to ASTM D6986 for further details.

4.7.1 In all phases of fuel handling, appearance of jet fuel should always be clear and bright (visually free of undissolved water, sediment and suspended matter).

4.7.2 Visual Appearance Tests provide a quick method for detecting free water, solids, and other traces of possible contamination. Samples should be taken under full flow conditions to ensure that any contamination is dislodged. The two most common methods used for evaluating the visual appearance of aviation fuel samples are:

a. the Clear and Bright Test; and

b. the White Bucket Test.
4.7.3 Colour of jet fuel generally ranges from water white to straw. Other colours (i.e. green or red) may be an indication the fuel has been contaminated by other fuels or unauthorized additives.

4.7.4 If colour contamination is suspected, a clean white porcelain bucket is best suited for the detection of unusual colour (e.g. low concentrations of dyed fuel, crude oil characteristics, refinery processing).

4.8 Appearance Testing - “Clear & Bright”

a. Ensure the fuel sampling tap is free of loose contaminants.

b. Displace sample line content.

c. Fill a suitable clean container (preferably a glass jar) with approximately 1 litre (1 quart) of fuel, with enough room to create a vortex.

d. The jar is then closed, swirled and examined for traces of solids and/or water at the vortex bottom.

e. Inspect the container for water droplets, solid contaminants, hazy/cloudy condition or dark slime, and observe the colour of the fuel. There should be no suspended or visible free water, and sample should be clear and bright (slight sparkle). There should be no visible suspended, or free, water.

f. Air bubbles may cause hazy appearance immediately after the sample is drawn, but haze clears from the bottom up. Therefore, while small water droplets and air bubbles may appear similar, air bubbles will rise while water droplets will settle upon standing.

4.9 Appearance Testing - “White Bucket”

a. Ensure the fuel sampling tap is free of loose contaminants.

b. Displace sample line content.

c. Partially fill a suitable clean white porcelain bucket with approximately 4 litres (1 gallon) of fuel, to a depth of at least 15 cm (6 inches).

d. Let the sample settle for 1 minute to remove air bubbles.

e. Place the bucket on a level surface and inspect the bottom for water droplets, solid contaminants, hazy/cloudy condition, dark slime, and observe the colour of the fuel. It may be necessary to perform a water detection test (refer to Appendix D) to determine the difference between a haze caused by entrained water or air bubbles.

NOTE: Regarding the observation of pink or reddish discolouration in fuel, in North America a white bucket test can be performed with a “referee” certified white bucket.
4.10 Appearance Testing - Action Required if Red Dye is Detected (Referee White Bucket Test)

a. The white bucket test shall be used to inspect for red dye contamination. The referee white bucket shall be the white porcelain bucket obtained from Gammon Technical Products, GTP-1746B or GTP-1746C.

b. This test requires collecting approximately an eight litre (two US gallon) sample with a fuel depth of 15 centimeters ± 2.5 cms (6 inches, ±1.0 in). The inspector (with normal vision or wearing corrective non-tinted lenses) performs a visual examination of the fuel for colour under normal daylight conditions, or in any well-lighted room such as an office with fluorescent lighting.

c. If the inspector is not sure of the fuel colour, a consensus of the colour should be obtained from several individuals.

d. Jet fuel with no visible red tint should be judged acceptable for use in aircraft.

e. A red tint resulting from refinery processing will usually disappear when exposed to Ultra-violet rays (i.e. sunlight, or artificial light). Jet fuel is acceptable for use if the red tint disappears in less than 30 minutes after being exposed to Ultra-violet rays (i.e. sunlight, or artificial light).

f. Jet fuel produced by blending a red dyed fuel with a non-dyed fuel may be acceptable, providing the resulting fuel has no visible red tint, and fuel satisfies (ASTM D1655) specifications. Blending is not to be performed at an airport fuel storage facility without prior authorization by affected airline(s).

4.11 Table - Rating of White Bucket Sample

a. Rating Definitions

<table>
<thead>
<tr>
<th>Solids Contaminant Indicators</th>
<th>Moisture Content Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clean</td>
<td>A. Bright</td>
</tr>
<tr>
<td>2. Slight Particulate Matter</td>
<td>B. Hazy</td>
</tr>
<tr>
<td>3. Particulate Matter</td>
<td>C. Cloudy</td>
</tr>
<tr>
<td>4. Dirty</td>
<td>D. Wet (Free Water)</td>
</tr>
<tr>
<td></td>
<td>E. Surfactants or Microbial</td>
</tr>
</tbody>
</table>

b. Solids Contaminant Indicators

1) Clean  - Refers to lack of particles, silt or sediment, flakes, dye, rust or solids.
2) Slight Particulate Matter - Contains several fine to moderate sized particles.
3) Particulate Matter  - A sample in which many small particles may be seen floating or settled on the bottom.
4) Dirty  - Discolouration or many particles dispersed in the fuel or settled on the bottom.
c. Moisture Content Indicators

A - Bright - Brightness is a quality independent of the colour of the sample and refers to the lack of suspended or free water in the sample. Bright fuel tends to sparkle.

B - Hazy - A condition resulting from fine droplets of moisture dispersed throughout the sample producing a dull hazy appearance. This can be a temporary condition brought about by a drop in temperature. During the first minute, the fuel can appear hazy due to air bubbles.

C - Cloudy - The result of extremely fine droplets of water dispersed throughout the sample giving it a milky appearance.

D - Wet - Any form of free water appearing as droplets or bulk water on the bottom of the bucket or clinging to the sides.

E - Surfactants or Microbial - Slime in the bottom of the bucket or at the fuel/water interface appearing as a dark brown/black layer, scum or lacy material floating in or on the sample. Further testing to determine whether this is microbial growth would be required.

4.12 Sampling & Testing

4.12.1 Sampling shall be undertaken by competent, trained personnel using correct procedures and apparatus. This is to ensure that the sample obtained is truly representative of the fuel from which it has been drawn.

a. Samples shall be drawn from a gauge hatch or other suitable opening giving direct and unrestricted access to the bulk of the liquid.

b. Containers shall be as specified in Section 4.13, "Sample Containers".

c. Prior to sampling, the apparatus and the container shall be flushed and rinsed thoroughly at least three times with the fuel to be sampled and allowed to drain before use.

d. No sample container shall be completely filled with liquid. Approximately 5% vapour space should always be left to allow for expansion.

4.12.2 Containers shall be sealed and labelled immediately after filling. The label attached to the sealed container should bear the following relevant information where applicable:

a. Sample number;

b. Date and Time;

c. Taken by;

d. Place;

e. Type of Sample;

f. Tank number / Vehicle Compartment number / or location;
g. Batch number;
h. Grade or Specification;
i. Test Required / Performed;
j. Airline;
k. Aircraft Registration; and
l. Inspector / Sampler Mark.

4.12.3 Records shall be maintained of all samples taken.

4.12.4 If samples are required by a customer or other authorised party, a duplicate shall be taken and retained until a clearance for disposal is obtained.

4.12.5 Laboratory Testing shall be accomplished in accordance with the latest edition of the referenced testing standards (e.g. IP "Standard Methods for Analysis and Testing of Petroleum and Related Products", or ASTM Standards).

4.12.6 Laboratories used in the analysis of aviation fuel should, wherever practicable, participate in a recognised aviation jet fuel interlaboratory cross-check program to assure the quality of their testing work.

NOTE: For additional guidelines, refer to:

a) ISO/IEC Guide 43-1:1997 "Proficiency testing by interlaboratory comparisons - Part 1: Development and operation of proficiency testing schemes", and


4.13 Sample Containers

4.13.1 Laboratory Sample Containers

a. Glass or metal, or specially approved plastic containers for laboratory testing or for retention samples shall be new or provided by the laboratory in a clean condition.

NOTE: Samples stored in clear glass jars shall not be exposed to sunlight for extended periods, as this may affect the fuel quality and cause the sample to fail laboratory testing.

b. Metal containers shall be steel with suitable internal epoxy lining, or seamless aluminum alloy. Plastic containers may be used only after examples of the constructional material have been checked for compatibility with the fuel(s) to be stored.

c. Containers, even when new, shall be carefully rinsed at least three times with the fuel to be sampled; this is critical, particularly in the case of MSEP testing.
4.13.2 Field Sampling Containers

a. Clear, clean glass jars of 2 litres (approx. 0.5 US gallons) minimum capacity with wide necks and screw caps should be used for fuel examination in connection with the Visual Check procedure.

b. Where, in addition, buckets are used, these should be manufactured from good quality stainless steel, or coated with either white enamel, porcelain, or epoxy. The use of plastic (without adequate electro-static discharge capability), or any galvanised containers is not permitted. Buckets and metal containers shall have a capacity of at least four (4) litres (approx. 1 US gallon), and be equipped with an effective bonding cable and clip. Buckets and metal containers used for fuel draining shall be bonded to the vehicle or tank pipework prior to, and during, the draining operation and to the receiving vessel/tank when decanting.

c. Closed Circuit Samplers or VisiJars can also be used.

4.14 Packaging Containers for Air Transport

4.14.1 Containers for the transportation of samples by air shall be of an International Civil Aviation Organisation (ICAO) approved design, and shall be transported in accordance with the latest edition of the "ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air", "IATA Dangerous Goods Regulations" and / or local governing regulation.

4.15 Fuel Quality Field Test Equipment

4.15.1 Hydrometers

a. When using a hydrometer, the test for density / API gravity shall be carried out in accordance with either the ASTM D1298/IP 160 or IP 365 test method standard (see 4.15.2 for Digital Density Analyzers).

b. The scale reading at the intersection of the fuel surface on a freely floating hydrometer, in addition to the temperature of the fuel at the time of the test, are observed and recorded. The observed readings are then used to correct the density/API gravity to standard temperature for the test. The use of clear glass or clear plastic hydrometer observation cylinders is preferred since accurate hydrometer readings can only be obtained with an opaque plastic or metal cylinder when the sample’s level is at the top of the cylinder. This could result in fuel spillage, unless special plastic hydrometer observation cylinders (as described in ASTM D1298) are used which address the spillage and correct observation of the meniscus.

c. The accuracy of the thermometer (to within 0.5°C [1ºF]) and hydrometer (to within 0.001 kg/m³ [0.125º API gravity]) shall be checked every six months, or when readings are suspect. These checks may be carried out by means of one of the following options:

1) send to a laboratory;

2) check against a reference thermometer/hydrometer on site;
3) check against a reference fluid provided by a laboratory; or
4) check by comparison with other thermometers/hydrometers.

d. Hydrometers shall be to BS 718 (types M50SP or L50SP) or ASTM E-100. Units can be in either SI volumetric (kg/m³) or API gravity degrees.

e. BS 718 defines L50SP, with subdivisions at intervals of 0.0005 kg/m³ and M50SP with subdivisions at intervals of 0.0010 kg/m³. For ease of reading the L50SP is recommended. For jet fuel, hydrometers in the ranges 0.7500 kg/m³ to 0.8000 kg/m³ and 0.8000 kg/m³ to 0.8500 kg/m³ will normally be required. Note that some manufacturers supply units in the range 0.7750 kg/m³ to 0.8250 kg/m³ thus halving the number of hydrometers needed in most climate zones. ASTM E-100 lists hydrometers in graduations of API gravity degrees. ASTM hydrometers 4H62 and 5H62 cover the range required for jet fuel.

f. Before each period of use, hydrometers should be carefully examined to ensure that:
   1) the etched line on the hydrometer stem corresponds to the arrow (or line) at the first major sub division of the paper scale, and its position can be detected by a fingernail. Other instruments have a vertical red (or other colour) line such that the lower end shall exactly be aligned with the first major graduation at the top of the scale.
   2) the bitumen weighting material has not flowed, (causing the hydrometer to float in a non-vertical plane). Hydrometers shall not be left in direct sunlight or near heating appliances and should be stored vertically; and
   3) the glass is intact.

4.15.2 Digital Density Analyzers
   a. Digital density devices provide a more accurate and faster determination of liquid density in most situations. They shall be operated in accordance with IP 599, which includes cleaning and calibration instructions.

4.15.3 Thermometers
   a. Thermometers shall meet requirements of ASTM E-1 (No. 12F for Fahrenheit, or 12C for Celsius), or IP 64, or equivalent technical specification.
   b. Before each period of use, thermometers should undergo a careful visual examination to ensure that there are no gas bubbles trapped in the fluid column or bulb, and that there is no separation of the fluid column.
   c. Thermometers shall not be left in direct sunlight or near heating appliances.
   d. Digital thermometer devices provide a more accurate and faster determination of liquid temperature in most situations. They shall be operated in accordance with ASTM/IP 599/08 which includes cleaning and calibration instructions.
4.15.4 Digital Thermometers
   a. Digital thermometer devices provide a more accurate and faster determination of liquid temperature in most situations.
   b. They shall be calibrated in accordance with Chapter 7.3 of the API Petroleum Measurement Standards.
   c. These are precision instruments which should be handled with care. They should not be jolted or set down roughly, and the cable should be checked regularly for cuts, breaks or abrasion.

4.15.5 Field use Thermometers and Hydrometers
   a. Alternative type thermometers (e.g. containing non-mercury type fluids for environmental/health reasons or local regulations) which do not meet the requirements of para. 4.15.4 may be used for fuel quality checks. The thermometers used in this case shall have scale increments of no greater than 0.5°C (1ºF).
   b. In the case of dispute with field type instruments, the instruments referred to in 4.15.1 and 4.15.3 shall be used for the referee method.

4.15.6 Thermohydrometers
   a. Some hydrometers are supplied with thermometers installed internally in the hydrometer bulb.
   b. Thermohydrometers are commonly used as field instruments, and to provide sufficient accuracy during field checks, their scale graduations should be in 0.5ºC (1ºF) increments, or less.

   NOTE: For inventory checks, thermohydrometers should have scale graduations of 0.25ºC (0.5ºF) increments.

4.15.7 Conductivity Meters
   The conductivity test shall be carried out in accordance with ASTM D2624 or IP 274 procedures.
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SECTION 5

5 AIRPORT FACILITY RECEIPT PROCEDURES

5.1 Receipt - Documentation

5.1.1 Any transfer of jet fuel to an airport fuel storage facility shall be supported by a Release Certificate, prior to receiving the incoming fuel from intermediate or pre-airport storage tanks.

5.1.2 At the airport, a record shall be maintained of the Release Certificate and batch number, quantity and receiving tank(s), together with the results of all tests carried out. The Release document shall contain the date and time of transfer (or road tanker/railcar loading), grade of fuel, batch number and density at 15°C (or corrected to applicable national standard temperature) or API gravity at 60°F (or corrected to applicable national standard temperature) of the fuel in the tank(s) from which the fuel originated and confirmation that the tanks were drained of observed water from each tank low point (“water free” certification).

5.1.3 Where applicable each batch shall be accompanied by a Refinery Certificate of Quality (RCQ), or a Certificate of Analysis (CofA). These documents shall show fuel grade and confirm that the batch conforms to the relevant specification. Where applicable, a Recertification Test Certificate (RTC) shall also accompany each delivery showing that the fuel properties have not changed while in transit. All of these documents shall be readily available at the airport fuel storage facility.

5.1.4 When fuel is received into intermediate, or pre-airport, storage from a multi-product pipeline where batch identity to specific RCQ’s or CofA’s is lost (i.e. fungible product pipelines where multiple batches are mixed together or where fuel enters various intermediate storage tanks in transit and is commingled with more than three separate batches), comparison of test results of receipt tank(s) is not possible, nor will fuel additive dosage levels be available. For this type of intermediate storage, a CofA test certificate shall be obtained with notation that fuel additive concentrations used in manufacture are not available.

5.1.5 Batch number, Density/API gravity and other relevant information may be communicated by fax, E Mail or other devices pending mailing of the RCQ above.

5.1.6 The following deviation from the above would be acceptable, subject to agreement by the airport fuel storage facility operator and/or owner:

   a. A RCQ/CofA is not required to be available at the airport fuel storage facility, but shall be available at the supplying location. It is the airport fuel storage facility Manager's responsibility to ensure that these Certificates are available.

   b. Where a large number of different batches is involved, a RCQ may not be appropriate, in which case, a CofA is required. However, the RCQ shall be available at the supplying location, except in the case described in 5.1.4 above.
5.1.7 At locations where either 5.1.6a or 5.1.6b above are applicable, an example of a recent RCQ from each supplying refinery should be available at the airport fuel storage facility, except in the case described in 5.1.3.

5.1.8 In the case where fuel has been received into airport fuel storage facility through a non-dedicated (i.e. multi-product) system from intermediate or pre-airport storage, a Recertification Test shall be performed on a single-tank composite sample from each storage tank receiving fuel.

5.1.9 When fuel is received into an airport fuel storage facility from a multi-product pipeline, where batch identity to a specific RCQ or CofA is lost (i.e. fungible product pipelines where multiple batches are mixed together or where fuel enters various intermediate storage tanks in transit and is commingled with more than three separate batches), a comparison of test results of receipt tank(s) is not possible, nor will fuel additive dosage levels be available. For this type of airport fuel storage facility receipt, a CofA test certificate shall be performed on a single-tank composite sample from each storage tank receiving fuel, with notation that fuel additive concentrations used in manufacture are not available.

5.1.10 For fungible pipeline systems (i.e. pipeline systems with multiple input and delivery points where fuel to the same specification is interchangeable) it may not be possible, for each batch delivered from the pipeline, to provide a Certificate of Analysis which identifies the originating refinery. However, even in this situation, the pipeline operator shall have original Refinery Certificates of Quality and volume data for all batches entering the system so that the authenticity of all fuel can be assured.

5.1.11 Records and documents shall be retained for a minimum of 1 year.

5.2 Receipt - General

5.2.1 A clear, documented communication procedure shall be in place with third parties to address routine receipt procedures, emergency response and quality issues.

5.2.2 Airport fuel storage facility staff shall prepare receiving tank(s) and associated equipment prior to transfer of fuel (i.e. gauging/dipping, sumping of tank(s) and inlet filtration, correct inlet and outlet valve positioning) to ensure that the available capacity of the receiving tank(s) is greater than the volume of fuel to be transferred to the tanks. Where more than one tank is required to receive the fuel a pre-planned sequence should be established prior to receipt in order to anticipate at what time the tank changeover will be required, and to identify specific actions required including sequence of valve opening and closure.

5.2.3 The control check should be used to confirm the correct grade and unchanged quality of the fuel stocks by comparison of the result with the value shown on the documentation. Should these figures (corrected to local standard temperature) differ by more than 3 kg/m³ (1º API gravity) or are outside the relevant fuel specification density/API gravity range, contamination should be suspected and the matter investigated before fuel is accepted for use.

NOTE: The relaxed limit of 1º API gravity in the USA is due to the prevalence of thermometers not meeting ASTM E100. At the next revision to this Standard, this parameter will be reviewed again.
5.2.4 The flash point test should be used to confirm the correct grade and unchanged quality of the fuel stocks received from non-dedicated pipeline or ships by comparison of the result with the value shown on the documentation. In the case where a middle distillate (i.e. diesel, gasoil) was used in the previous batch, then a flash point test is not required. Should these figures differ by more than 3°C (5°F), or are outside the relevant fuel specification range, contamination should be suspected and the matter investigated before fuel is accepted for use.

5.2.5 If, during fuel receipt, the fuel storage facility receipt filter differential pressure rises at a much faster rate than is typical for the location, or if excessive water or solids are suspected or observed in routine samples, a Colorimetric Filter Membrane Test may be conducted upstream of the receipt filtration as a check on the quality of the incoming fuel. The result, if greater than either 6 (wet) or 5 (dry) may be used to initiate further investigations but should not normally be used as the basis for halting the (pipeline/vessel) transfer or rejecting fuel. The investigation process should include some or all of the following steps:

a. perform a double membrane Colorimetric test upstream of the receipt filtration to check for colour bodies. If the difference between the colour ratings of the two membranes is 3 (wet) or less, no further investigation is necessary;

b. if the difference exceeds 3 (wet), perform a gravimetric filter membrane test upstream of the receipt filtration to quantify the problem (refer to Appendix A7.3);

c. gravimetric test results in excess of 1.0 mg/l obtained upstream of the receipt filtration are considered excessive and merit discussions with the supplier.

5.2.6 Where the receiving facility does not retain control of fuel receipt filtration, Membrane Filtration and Chemical Water Detection tests shall be carried out at the beginning, middle, and end of the receipt.

5.2.7 It is not acceptable to simultaneously receive and dispense fuel from the same tank.

5.2.8 Airport Fuel storage facility staff should periodically monitor inlet filtration differential pressure (dp), tank levels, and check systems for leaks. Record the dp at the end of each receipt.

NOTE: In North America, in addition to the Control Check, the following tests shall be performed at the beginning, middle, and end of the receipt:

1) Colorometric Membrane (with particulate assessment);
2) Visual Appearance in a White Bucket;
3) Chemical Water Detection;
4) Flashpoint, if received from a non-dedicated source; and
5) Thermal stability (JFTOT), if received from a source with copper or copper-alloy.
5.3 Receipt - Single Grade Pipeline

5.3.1 During receipt of jet fuel, samples shall be drawn from the pipeline at the start, middle, and end of the transfer, and a Control Check carried out on each sample.

5.3.2 If a transfer consists of more than one batch and/or tank, then an additional Control Check should be carried out at the time of arrival of each batch.

5.3.3 Airport fuel storage facility staff should:
   a. be aware that pipeline volumes between shipping tanks and sampling points may contain fuel from a previous batch. Fuel tests should be timed to coincide with actual arrival of jet fuel from shipping tank. The samples should be taken as close as practicable to the receiving tank; and
   b. use extreme care and vigilance when performing the visual appearance test. Any unusual result (i.e. water, solids, or colour) shall be investigated, and the appropriate action taken by the facility operator.

5.4 Receipt - Multi-Product Pipeline

5.4.1 Subject to approval by the airport fuel storage facility participants (e.g. owner, lessee, airline or operator) in special circumstances, the final airport storage may receive fuel from a multi-product pipeline. Approval will only be given if the final pipeline connection to the airport fuel storage facility is dedicated to jet fuel and is designed and operated to minimize the chance of contamination from the multi-product pipeline.

5.4.2 Where an existing airport fuel storage facility is fed by a multi-product pipeline, aviation jet fuels shall only be received via lines reserved for middle distillates (e.g. kerosene, gas oil, undyed diesel/heating fuel).

5.4.3 The same procedures as sub-section 5.3 above shall be followed, but with the sampling performed every two hours.

5.4.4 The most important quality protection measure in multi-product pipeline movements is the method of handling interface cuts. Care should be taken to ensure that the leading and trailing interface between grades is directed into non-aviation storage.

5.4.5 To limit the degradation of jet fuel due to interface commingling or pipeline pick up, leading and trailing consignments should be one of the following methods, listed in order of preference:
   a. middle distillate;
   b. light distillate; or
   c. motor gasoline.
NOTES:
1) Motor gasolines should be free of detergent type additives in pipelines handling jet fuel.

2) Fuel shall not be received that has had flow improvers (e.g. drag reducing agents) used immediately before jet fuel transfers. Where DRA or FAME (fatty acid methyl esters) are used, stringent precautions to avoid jet fuel contamination should apply.

5.4.6 Certain additives, because of their surface active properties, are known to be harmful to aviation fuels. When fuels containing these additives precede jet fuel pipeline consignments, there is a danger that the resultant pickup can lead to quality problems. When harmful additives are known to be included in fuels intended for transportation within multi-product pipelines carrying jet fuel, the pipeline carrier company shall be requested to exclude the additives from the fuel entering the pipeline and injection should take place after the break out points.

5.5 Receipt - Ocean Tanker, Coastal / Inland Waterway Vessel

5.5.1 General

a. Wherever possible, vessels should be dedicated to one grade of aviation fuel. Discharge should be through segregated systems into jet fuel tankage. A dedicated vessel is one which transports exclusively one grade of fuel in all cargo compartments and which has transported the same grade of fuel during the previous journey. A vessel which utilizes cargo tanks for ballast on return journey, irrespective of the previous cargo carried, shall be treated as a non-dedicated vessel.

b. Where an existing airport fuel storage facility is fed by vessel, aviation fuels shall be received via dedicated jet fuel lines

c. One or more tanks shall be segregated for receipt, checked for water, and any water removed before receipt begins.

d. Mixed cargo vessels are not permitted to discharge jet fuel directly to final airport storage unless special receipt storage is provided where the fuel is recertified, then transferred through segregated lines to service tanks.

e. 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 jet fuels. The captain of all ships or coastal vessels shall be requested to verify, before discharge, the absence of such heating coils. If any are found in compartments used for the transport of jet fuels (or if there is any doubt), a thermal stability test shall be performed.

f. Wherever possible, fuel to fuel pumping should be adopted, without the introduction of water to separate fuels or to clear lines handling aviation fuels. If lines handling aviation fuels have been left full of water, it should not be sea water but should be fresh or suitably buffered water.

g. When receiving multi-product cargoes, the discharge sequence should be arranged to minimize the effects of interface contamination or aviation grades. Leading and trailing grade interfaces shall be diverted into non-aviation storage or slop tanks.
5.5.2 Procedures Before Discharge

a. If the vessel contains only one grade of fuel and had transported the same grade on the last voyage, the requirements of this section apply.

b. The following documents shall be checked before commencing discharge:
   1) Release Certificate and Refinery Certificate of Quality (RCQ); or
   2) Release Certificate and Certificate of Analysis (CofA), if the cargo has been shipped from another terminal;
   3) Bill of lading;
   4) Ullage report;
   5) Inspector’s (surveyor’s) report from load port;
   6) Inventory of samples from loading; and
   7) Recertification Test results on ship loaded samples, if applicable, which may be transmitted to receipt location by e-mail or fax.

c. The cargo hatches shall be checked to ensure they are closed and the security seals are in place. If a hatch is found unsecured, or security seals are broken or missing, an investigation shall follow to ensure the fuel shipment has not been compromised.

d. The ullage of each vessel compartment shall be checked. If the ullage in any compartment differs greatly (e.g. by 0.2%) from the loading figures shown on the ullage report, the captain of the vessel should be consulted; if no satisfactory explanation is obtained, the suspect compartment should not be discharged and the supplying company advised. Fuel in the suspect compartment may be unloaded only if the results of a recertification test carried out on a composite sample from the compartment are satisfactory.

e. Each vessel compartment shall be checked for free water using water detection paste and the results recorded. If a substantial amount of water is found in any compartment, the captain of the vessel shall be promptly informed. “Substantial amounts of water” is to be determined locally depending upon facility configuration & design. Contingency plans, as agreed with the supplying company, should be available to deal with this situation.

f. A one litre Middle Sample shall be drawn from each compartment and a Control Check carried out before accepting the fuel for discharge. If satisfactory results are obtained and the density/API gravity is within 3 kg/m³ (1º API gravity) of the results reported on the release certificate, the fuel can be accepted.

g. For fuels containing static dissipater additive (SDA), the conductivity of these samples should also be checked. If necessary, SDA can be added during discharge in a manner that ensures adequate mixing with the fuel (see section 5.7).

h. If the control check result is not satisfactory, the supplying company concerned shall be advised, a letter of protest should be served on the captain of the vessel, and the cargo shall
not be discharged unless agreed by airport fuel storage facility participants (Owner, lessee, or operator). Site specific procedures shall be available to determine the next actions.

i. Where static dissipater additive is used, the conductivity of the samples shall be measured to determine whether additional additive is required. The conductivity results, and any additive addition, shall be recorded.

j. A 5 litre (or 1 US gallon) Multiple-Tank Composite Retention Sample shall be drawn, made up from a Middle Sample from each compartment. This composite sample shall be taken in an approved Retention Sample Container (refer to sub-section 4.13), labelled and sealed in the presence of the ship's responsible officer. The sample shall be retained at the fuel storage facility until the relevant batch.

5.5.3 Procedures During Discharge

a. During fuel receipt, samples shall be drawn from the receipt pipeline at a point as close to the ship as possible for a Control Check.

NOTE: In North America, in addition to the Control Check, the following tests shall be performed:

1) Colorometric Membrane (with particulate assessment);
2) Visual Appearance in a White Bucket;
3) Chemical Water Detection;
4) Flashpoint, if received from a non-dedicated source (e.g. ship or dock line); and
5) Thermal stability (JFTOT), if received from a source with copper or copper-alloy.

b. For dedicated vessels, line samples shall be drawn approximately five minutes after commencement, and immediately before the end of discharge. For receipt from non-dedicated vessels, samples should also be taken at least every two hours during discharge. Any observed contamination should be reported to the Captain of the vessel, or his representative. If substantial amounts of water or particulate are observed, the discharge should be stopped and the situation investigated.

c. The simultaneous discharge of two grades of fuel is only permitted if the ships’ cargo tank and lines, discharge manifold, and shore lines are fully segregated.

d. Airport Fuel storage facility staff should periodically monitor inlet filtration differential pressure (dp), tank levels, and check systems for leaks. Record the dp at the end of each receipt.

NOTE: Follow ISGOTT safety requirements for discharge of vessels.

5.5.4 Procedures After Discharge

a. After discharge, the vessel compartments should be checked to ensure that they are empty; and the shore receiving tank(s) inlet and outlet valves shall be closed and secured.

b. The storage tank contents should be sampled and subjected to a Control Check, and for fuels containing SDA, a Conductivity Test.
c. A Composite Sample taken from each receiving tank shall be given a Recertification Test if a non-dedicated ship and/or receiving pipeline is used.

d. Fuel shall only be released for use if the results are satisfactory and confirm that no contamination has occurred.

5.6 Receipt - Road Transport or Rail Tank Car

5.6.1 Road bridging vehicles (i.e. tanker trucks) and rail tank cars supplying airport fuel storage facilities should be dedicated to one grade of aviation fuel and be provided with couplings chosen to give maximum practical degree of grade security. Where equipment is fitted with more than one size/design of discharge coupling, the unused one should be sealed or preferably removed. Adapters that change the size or design of the outlet coupling can only be used if selectivity is not compromised.

5.6.2 Where the vehicle or rail car is not dedicated to one grade of aviation fuel, it is the responsibility of the supplying location and transport company to ensure that effective cleaning and change of grade procedures (draining, flushing and testing) are followed, recorded, and that equipment outlet couplings and grade markings are changed.

5.6.3 On arrival at the fuel storage facility, the vehicle or rail car should be inspected to ensure that:

a. any required seals on outlet and filling points (and on manways if tank-top can be accessed safely) are intact;

b. unloading hoses are clean and in good condition; and

c. the grade markings on the sides and outlet are correct.

5.6.4 The documents shall correctly identify the equipment and quantity and grade of fuel. A copy of the release certificate and, where equipment is not grade dedicated, details of the previous load carried and the most recent change of grade procedure shall be available and checked before receipt of the fuel.

5.6.5 Road bridging vehicles shall be bonded before off-loading of the fuel.

a. Following a minimum "settling time" of 10 minutes, drain samples shall be drawn from each compartment, and a control check carried out. Up to three compartments from one vehicle may be combined for the density/API gravity determination. This determination shall be compared with the density/API gravity of the originating batch as shown on the release certificate.

NOTE: Where the receiving location can show a history of receiving clean dry fuel, the "settling time" can be relaxed.

b. If a difference of more than 3kg/m³ (1º API gravity) is found, a possibility of contamination exists and the matter should be investigated further before the fuel is accepted for aviation use.
5.6.6 If water (more than 2 litres / 0.5 US gallons) and/or sediment are present, the fuel shall be allowed to settle for another 10 minutes, then a fresh sample shall be taken. This process shall be repeated (up to a maximum of three attempts) until clean, water-free samples are obtained before commencing receipt.

5.6.7 After three attempts, failure to achieve such clear samples from any one compartment shall be reported promptly to the supply source and the vehicle quarantined awaiting the results of investigation.

5.6.8 Vehicle discharge operations shall, at all times, be supervised by fuel storage facility staff. They should monitor filtration differential pressure, tank fill levels, and for any leaks. If this is not practical, clear procedures shall be agreed upon.

NOTE: The following section 5.6.9 is not applicable in North America.

5.6.9 Where driver-controlled receipts have been agreed in writing by all parties (fuel owner, facility operator, and the transport company), driver training & procedures that meet, or exceed, normal facility receipt procedures shall be clearly documented and audited.

a. The participants shall also introduce additional procedures and equipment to avoid the possibility of a spillage or of receiving contaminated fuel.

b. Driver Controlled Deliveries shall only be made where the vehicles are dedicated, bottom loaded, fitted with grade selective systems.

c. The following controls are required:
   1) delivery vehicles should be equipped an interlock system.
   2) to ensure that the driver is in constant attendance, the normal journey time from the supplying location and the airport shall be less than 4 hours, and the vehicle shall not be parked overnight;
   3) for each new fuel batch a 2.5 litre retention sample shall be taken from the tank truck by the driver and retained at the receiving location until tank release;
   4) offloading facility shall be equipped with a deadman of a type that requires periodic action by the operator to maintain the flow; and
   5) receiving tanks shall be fitted with a high level alarm system that shuts down the fuel flow.

d. Electronic densitometers meeting IP 599 which convert density readings to density at standard temperature are recommended because of their ease of use and accuracy.

e. Where the driver controls the truck loading operation at the supplying location, 2.5 litre tank retention samples should be taken at least daily from each supplying tank. These samples shall be retained at the supplying location for at least a week or until the supplying tank is refilled.
f. The scope of the additional tasks to be performed by the drivers at the receiving location should be clearly identified and specific written procedures prepared.

g. All drivers authorised to perform Driver Controlled Deliveries shall receive training in the additional tasks to be performed and the training shall be recorded. The receiving location shall maintain records of the training provided and shall only allow access to those drivers who have been trained.

h. It is recommended that random checks by a responsible person at the receiving location should be performed at least quarterly to ensure that agreed procedures are followed.

5.6.10 After discharge, the compartments should be checked to ensure that they are empty and the receipt filter sump drained of any water. Multiple deliveries into a fuel receiving tank during a single day may be considered a single receipt, provided the tank does not change from receipt to delivery status during that period.

5.7 Static Dissipater Additive (for fuel specified to contain SDA)

5.7.1 To ensure that acceptable levels of conductivity are achieved into-aircraft, a minimum conductivity target for fuel receipts should be established (typically 100 pS/m), to ensure that the fuel is always above the minimum specification of 50 pS/m at the point of delivery to the aircraft, taking into account the typical reduction in conductivity experienced at the airport. Adding SDA to jet fuel at the airport should be avoided. Alternative solutions such as blending low conductivity fuel into higher conductivity fuel are preferred.

5.7.2 In exceptional circumstances where it is necessary to add SDA at the airport, the following procedures shall apply:

a. Validate the requirement to add static dissipater additive. If the documentation for a receipt indicates that the conductivity may be low, confirm the conductivity on a sample drawn at the commencement of the receipt.

b. When an additive is to be blended into jet fuel, written procedures for quality control, documentation, and safe handling procedures shall be prepared and applied. Items normally covered would be:

1) additive received is to be clearly identified as approved in the controlling fuel specification. Each receipt shall be accompanied by documentation verifying identity;

2) the additive batch documentation is to be checked for validity before release for blending;

3) released additive is to be held in a clearly designated storage area, and the storage and handling procedures are to be in accordance with manufacturer’s recommendations;

4) only trained operators are to handle additive;
5) the addition rate is to be monitored at regular intervals, taking into account any pre-dilution of the additive;

6) the effectiveness of blending in storage tanks is to be verified after at least 30 minutes settling by taking Upper, Middle, and Lower Samples, and checking each sample for conductivity.

c. The amount of static dissipater additive required should be determined carefully, taking into account the maximum cumulative concentration permitted by the latest issue of the applicable fuel specification.

5.7.3 Low Conductivity Fuelling Protocol

NOTE: the following content is not applicable for Jet A used in North America.

a. Experience has shown that low conductivity jet fuel is, very occasionally, unresponsive to additional doping with static dissipator additive. Where the conductivity of jet fuel in airport storage, or hydrant systems, falls below the specification minimum and the response to redoping with static dissipator additive is poor, the following "Low Conductivity Fuelling Protocol", intended as a temporary measure, may be adopted.

b. Participants in a jointly operated location can continue to deliver fuel to aircraft with conductivity in the range 25-50 ps/m provided:

1) that the fuel fully meets all other aspects of the specification; and

2) after reviewing the fuel receipt and storage records, there is no evidence that the loss of conductivity is linked to a fuel quality issue that affects the fuel’s suitability for use.

c. This protocol shall always be seen as a temporary measure to allow airports to continue to operate where the conductivity of fuel in storage tanks or the hydrant cannot be recovered.
SECTION 6

6 AIRPORT FUEL FACILITIES

6.1 Design Features & Equipment

6.1.1 General

a. Observance of certain fundamental practices in the design of these facilities is considered essential to ensure that fuel quality is maintained.

b. Any new installation, or alteration, or extension of the existing facilities shall be designed and commissioned in accordance with recognised industry standards (e.g. SAE AS 5789 Aviation Fuel Facilities, API/EI 1540, and others as outlined in this Section).

c. A current schematic diagram identifying valves, etc. (i.e. piping diagram, computer display, etc), shall be available locally for reference by the persons operating the equipment.

d. All facilities utilised for handling aviation fuels shall be fully grade-segregated. There shall be no interconnecting lines between pipelines that handle different fuels.

e. No copper or cadmium alloys, cadmium or zinc plated (i.e. galvanised) steel shall be permitted for piping, nor shall zinc-rich internal coatings be used for piping or tankage.

f. All pump start/stop switches at fuel receipt and refueller loading areas should be safely accessible and clearly identified in accordance with local regulatory requirements.

h. Fuel Identification signs (per API/EI 1542 Table below) and other applicable signs (e.g. “No Smoking”, “Flammable”, etc.) shall be prominently displayed.

i. An adequate number of suitable fire extinguishers shall be readily available, in accordance with local requirements.

j. Fuelling vehicle parking, road/rail discharge and fueller loading areas shall be constructed of a low-permeability material. The surface areas shall have a positive slope and drainage to an oil/water interceptor.
6.2 Fuel equipment markings - API/EI 1542 Table

Fuel identification recommendations for airport fuel storage, installations, and terminals with dedicated fuel storage handling facilities.

<table>
<thead>
<tr>
<th>Product</th>
<th>Colour Code</th>
<th>Piping &amp; Misc. Equip</th>
<th>Banding</th>
<th>Labelling</th>
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<tbody>
<tr>
<td><strong>Aviation Gasoline Grades</strong></td>
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<tr>
<td>Avgas 80</td>
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<td>AVGAS 80</td>
</tr>
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</tr>
<tr>
<td><strong>Aviation Turbine Fuels</strong></td>
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</tr>
<tr>
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<tr>
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<td># 3 JET Fuel</td>
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<tr>
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<td>Black</td>
<td></td>
<td>TC-1 / TS-1</td>
</tr>
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</table>
6.3 Storage Tanks

6.3.1 The number and size of tanks should be sufficient to provide adequate working capacity, taking into account peak period airport requirements, supply replenishment arrangements, and strategic stock coverage. Allowance should also be made for settling, testing and tank cleaning requirements.

6.3.2 Aviation fuels should be stored in horizontal or fixed roof vertical tanks (or fixed roof vertical tanks with an internal floating roof/cover if required by local legislation) designed in accordance with the following standards:

a. vertical tanks - API 650, EN 14015 or equivalent;
b. horizontal tanks - UL 142, EN 12285/2 or equivalent;
c. buried tanks – UL 58 or equivalent.

6.3.3 Above-ground tanks shall be contained within bunds/dikes constructed to meet local legislation. Tank top walkways should have non-slip surfaces, handrails and kick plates.

6.3.4 Tanks shall be:

a. constructed and installed to avoid ingress of water and dirt, and to provide a positive low point to collect water and sediment for ease of removal. To achieve this, horizontal tanks should be installed with a minimum continuous slope of 1:50, and vertical tanks should have a cone-down bottom with a minimum continuous slope of 1:30 to a centre sump;

b. prominently numbered and marked with grade stored, (API designation) and, as a minimum, show the date of the most recent internal inspection and cleaning;

c. completely coated internally, including the underside of the roof, with a light coloured epoxy material, approved as being compatible with aviation fuels (see API/EI 1541).

NOTE: In North America, existing tanks shall, as a minimum, be coated internally on the bottom and on the sides to a height of two metres (six feet). All new tanks, and tanks where major repair work is undertaken, shall be fully coated internally.

<table>
<thead>
<tr>
<th>Product</th>
<th>Colour Code</th>
<th>Piping &amp; Misc. Equip</th>
<th>Banding</th>
<th>Labelling</th>
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<td>PT / RT</td>
<td>Yellow</td>
<td>Black</td>
<td></td>
<td>PT / RT</td>
</tr>
</tbody>
</table>

* Unpainted aluminium alloy or stainless steel piping is acceptable.
6.3.5 Tanks shall be fitted with:
   a. free vent devices with coarse mesh screens (typically with 5mm or ¼ inch diameter holes) to
      prevent the ingress of foreign bodies;
   b. a low point sump with a drain line and suitable valve for the draining of water and sediment. The
      volume of the drain line shall be clearly marked.
   c. separate product inlet and outlet connections. Inlet pipes should discharge near the bottom of
      the tank and be designed to minimise turbulence (in horizontal tanks the inlet pipe should be
      at the high end, directing flow towards the low end sump);
   d. manholes (at least two) to facilitate entry for gas freeing and cleaning;
   e. gauge hatches to provide means of sampling and tank dipping;
   f. floating suction arms, bonded to the tank shell, with position indicators and/or check cables
      bonded to the tank shell (For effective bonding of check cables they shall be installed with
      permanent metal to metal contact with the tank shell. Position indicators are recommended for
      large above-ground vertical tanks);

**NOTE:** Where legislation requires the installation of internal floating roofs/covers it is critical to ensure that
the floating suction will not interfere with the operation of the floating cover.
   g. automatic high-level alarm devices to prevent tank overflow. Low level alarm systems are also
      recommended.

6.3.6 At locations supplied by vessel or pipeline or by multiple simultaneous discharge of road tankers or
rail tank cars, storage tanks shall be fitted with a high level audible alarm and a separate “high-
high” level system that shuts down the fuel flow when a pre-determined level of fuel in the tank is
reached.

6.3.7 For locations supplied by single discharge of road tanker or rail tank car an audible high level alarm
or a single shut down device is the minimum requirement.
6.4 Tank Sampling & Product Recovery Systems

6.4.1 All storage tanks shall incorporate a facility for the removal of water and sediment from the low point/sump. For small horizontal tanks, draining into a suitable bucket (see 4.13.2) via a tank-side valve or, for buried tanks, a thief pump with suction to the low point is acceptable. In the case of large underground tanks, an electric or air driven diaphragm drain pump is desirable to enable water or sediment to be removed by rapid withdrawal of a large sump sample.

6.4.2 For all above-ground vertical tanks and large above-ground horizontal tanks a product sampling and recovery system as outlined below is required.

6.4.3 The drain line from the tank low point/sump (see 6.3.5 b) should be:
   a. of non-rusting material, to avoid galvanic action created by dissimilar metals (for example between stainless steel and mild steel);
   b. of approximately 50mm diameter; and
   c. fitted with a self-closing/spring-loaded in-line sampling valve.

6.4.4 The drain line should lead to a large capacity stainless steel or internally lined sample receiving vessel, provided with:
   a. self-closing/spring-loaded quick-acting valve at entry;
   b. cone-down bottom with drain valve;
   c. means of easy access for visual inspection and cleaning; and
   d. suitable product return system.

6.4.5 The sample receiving vessel should be of at least 200 litre (50 USG) capacity or larger, depending on, for example, the storage tank size or mode of delivery of product to the storage tank.

6.4.6 Provision shall be made for taking a running sample from the tank drain line from a location between the tank and the sample-receiving vessel. The running sample may be taken into an open container (eg, a glass jar or white porcelain or stainless steel bucket) or a suitable glass closed system.

6.4.7 Product from a tank sample receiving vessel may be returned to the storage tank via a pump and segregated pipeline or drained or pumped to a Jet Fuel Recovery/Reclamation Tank.

6.4.8 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).
6.5 Jet Fuel Recovery Tanks

6.5.1 Jet Fuel Recovery tanks, where installed, should be identified as “Jet Fuel Recovery Tank Intended for Aviation Use” and shall:
   a. have a sloped bottom (minimum 1:30) to a positive sump with drain or pump. Sump shall be located in the lowest point of the tank with the drain or pump pick-up at the lowest point of the sump;
   b. be of stainless steel or carbon steel, internally lined with a light coloured epoxy coating;
   c. be designed to avoid the ingress of water and contaminants with all tank openings and vents being located above-ground;
   d. have overfill protection;
   e. have a means of access for visual inspection and cleaning;
   f. have suitable secondary spill containment as applicable; and
   g. have a placard/decal close to the tank sump drain indicating the volume of tank drain piping.

6.5.2 Pipework
   a. Airport fuel storage systems that receive aviation fuels from non-dedicated or non-segregated receipt pipelines located prior to the airport fuelling system (i.e. from off airport supply terminals) or directly from non-dedicated and non-segregated marine vessels shall have receipt storage tanks equipped with tank inlet and outlet valves which shall be physically and positively segregated using one of the following methods:
      1) a double block and bleed (DBB) valve arrangement. This can be either a single DBB valve with two independent seals and a cavity between them or two valves with a drain arrangement in a pipe spool between them. When the valves are in a closed position the cavity or drain spool shall be checked to confirm no fuel is passing; or
      2) a removable distance (spool) piece; or
      3) a spectacle blind, pancake/skillet flange or equivalent.

   NOTE: This is to ensure that aviation fuels requiring a recertification test (see 4.4) are isolated from certified fuel in the airport fuel storage system until the fuel has been tested.

   b. Wherever possible, all newly installed pipelines shall be routed above ground. Where buried pipelines are unavoidable they should be located in sleeves, trenches or sand-filled culverts
   c. Buried pipework should be cathodically protected as per section 7.1.12. Prior to installation, an external coating should be applied to provide additional protection from corrosion.
d. Single valve separation is acceptable as tank isolation for dedicated and segregated systems as the aviation fuel has already been certified and no additional certification testing is required after transfer into airport storage tanks.

e. All hydrant lines, and any other lines where water can accumulate, shall incorporate low points to facilitate the removal of water and sediment.

f. All piping shall be clearly marked in accordance with API/EI 1542 fuel name and colour coding, and with flow direction arrows.

g. Road bridger/transport (i.e. tank truck) and railcar receipt connections shall be fitted with selective couplings of a size and type chosen to give maximum practical degree of grade security.

h. Where more than one grade of aviation fuel is available at the airport, grade selective couplings or devices shall be fitted to truck bottom loading connections and hydrant pit valves.

i. Jet fuel without static dissipater additive, shall require:
   1) relaxation time (30 seconds minimum) between the filter and the receiving vessel (i.e. airport tank or mobile refueller); and
   2) a reduced initial loading/filling rate of a maximum of 1 meter (3 feet) per sec, until the inlet pipe-work is submerged (determined through measurement), at which point the maximum flow rate can begin.

6.5.3 Filtration - General

a. For filter selection guidance refer to API/EI 1550.

b. All new vessels and element combinations shall meet (API/EI 1581) latest edition. Existing vessels and element conversions shall meet, by test or similarity, the latest edition of API/EI 1581 / API/EI 1582. For existing vessels, conversion to the latest edition shall occur within 12 months of qualified elements becoming available for a specific vessel. If qualified by similarity, a similarity data sheet shall be maintained locally and a data plate reflecting such qualification shall be attached to the filter vessel.

c. All monitors shall meet EI 1583. Monitors shall not be used where there is a possibility that jet fuel contains FSII additive.

**NOTE:** In the USA, monitors shall not be used for filtration at the storage facility.

d. Additional filtration details can be found in Appendix A of this standard.

e. Automatic water drain valves on filter sumps are not permitted.
6.5.4 Filtration - into Storage
   a. Filter/water separators meeting the performance requirements of API/EI 1581 shall be provided at inlet to storage
   b. It is acceptable for existing installations to be equipped with filter monitors meeting the requirement of EI 1583, provided they are used only where it can be confirmed no FSII was injected in the inbound fuel.
   c. A pre-(micro) filter meeting the requirements of API/EI 1590 may be installed upstream to remove solids and extend the service life of coalescer elements installed in filter/water separators.
   d. Depending on the quality of fuel received into storage, hay packs and clay treaters for the removal of water and surfactants respectively, may be required upstream of the filter/water separator.

6.5.5 Fuel Delivery from Storage
   a. Filter/water separators meeting the performance requirements of API/EI 1581 shall be provided prior to loading racks and into-hydrant delivery lines.
   b. It is acceptable for existing installations to be equipped with filter monitors meeting the requirement of EI 1583, provided they are used only where it can be confirmed no FSII was injected in the fuel.

NOTE: In the USA, filter/water separator vessels dispensing fuel directly into hydrant systems or loading racks shall be fitted with a slug valve to stop the flow of fuel when bulk water in the filter sump reaches a predetermined level.

6.5.6 Receipt and Delivery by one Filter Vessel
   a. Although not recommended, at locations where a single filter vessel is used for both receipt and delivery, a filter separator meeting API/EI 1581 shall be used. This is acceptable, provided that the facility piping is designed to ensure that all fuel received shall pass through the filter (i.e. separate pipelines shall be used for fuel receipt and delivery to fuelling equipment).

6.5.7 Test Stand for Fuelling Vehicles
   a. A test stand for new and upgraded facilities, capable of simulating both gradual and rapid termination of fuel flow into aircraft, shall be available.
   b. The stand should be capable of accepting simultaneous full flow deliveries from all combinations of deck and/or reel hoses likely to be used.
c. An example of a suitable test stand is shown in Appendix B3. A master meter may be installed as part of the test stand design.

d. All pipework, fittings, and filter membrane test points should be stainless steel or epoxy lined carbon steel.

e. Test stand pressure gauges should have a range of 0 - 10.5 bar (0 - 150 psi) and be clearly visible from the stand valves. For ease of reading, analog gauge faces of 100-127mm (4-5 inch) diameter are recommended.

f. Gauges filled with glycerine/silicone fluid shall not be used for surge pressure testing because movement of the pointer is dampened, making them unsuitable for recording peak surge pressures.

g. At locations without a hydrant system, fuel circulation into a vehicle tank is an acceptable alternative to using a test stand for pressure control system checks.

6.5.8 Hoses

a. All refueller loading, and hydrant low point flushing, hoses shall meet the latest edition of API/EI 1529, EN 1361, or equivalent. Refueller loading hoses meeting the latest issue of BS 3492, or equivalent, rated for the maximum pressure of the loading system, are also acceptable.

b. Railcar and road bridger/tank truck discharge (suction) hoses may be of any suitable type (including reinforced industrial types).

c. All receipt and delivery hoses shall be carefully checked for condition before introduction into use, and thoroughly flushed with the fuel to be used in accordance with API/EI 1540.

d. Fuel loading hoses, and other hoses (e.g. hydrant low point flushing hoses) which may be subjected to pressure, shall be pressure tested in accordance with Appendix C of this Standard.

NOTE: In the USA, when using hoses with:

a) factory fitted couplings, in-service pressure testing is not currently a requirement;
b) re-attachable couplings, in-service pressure testing of hoses is required.

e. The condition of hoses used for receipt from road or rail tank car should be checked visually during use.

f. All hoses shall be given a permanent identification (e.g. the hose serial #), and a record maintained of the date of manufacture, the date put into service and details of all testing.

g. All fuelling hoses shall be installed within 2 years of the date of manufacture, and have a maximum service life of 10 years from the date of manufacture.

NOTE: Hose operability range is normally -30°C (-22°F) to +55°C (131°F). Cold temperature hoses are normally rated to -40°C (-40°F).
6.6 Operations & Maintenance

6.6.1 Housekeeping and General Maintenance

a. Airport Fuel Facilities and fuel handling equipment shall be clean, tidy, free of leaks, and well maintained, with any deficiencies repaired in a timely manner. Ladders, walkways and handrails are to be kept free of rust. Tank bunds (dikes) should be kept free of vegetation, and bund drain valves kept closed and secured when not in use.

6.6.2 Fire Extinguishers

a. Fire extinguishers should be marked with identity numbers. A record showing location and all inspections and maintenance for each extinguisher should be kept up to date.

b. All extinguishers shall be serviced by the manufacturer or by an approved contractor at least once per year. The maintenance dates should be recorded on a label or tag attached to each extinguisher.

c. Inspections of the condition of all extinguishers shall be carried out on a regular basis, at least every month. These inspections are to ensure that:

   1) extinguishers are in their specified places and are readily accessible;
   2) the condition of the hose and nozzle are physically undamaged and visually free of blockages;
   3) the pressure gauge on permanently pressurized extinguishers is within the safety zone and functioning by tapping gently to check that the pointer is not stuck;
   4) the powder contained in dry powder extinguishers is not compacted. Check at least every 6 months by inverting hand held extinguishers and shaking.

6.6.3 Fuel Settling and Testing

a. After fuel has been received into storage tanks via a fully segregated system, inlet and outlet valves shall be closed. A system to indicate the status of the fuel in the tank shall be used. This can be achieved by positioning a “settling” sign at the tank outlet valve or by the use of a control system to ensure that the valves remain closed until fuel release has been approved.

b. After fuel has been received into storage tanks via a non-segregated system, tank isolation shall be achieved by means of block and bleed valves or other means of positive segregation. A system to indicate the status of the fuel in the tank shall be used. This can be achieved by positioning a “settling” sign at the tank outlet valve or by the use of a control system to ensure that the valves remain closed and secured until fuel release has been approved.
c. Where free water and sediment levels into storage can be consistently maintained at low levels through the use of approved filters, and the tanks meet the design requirements of section 6.2, the minimum settling times before release are:

1) horizontal tanks (with floating suction): 1 hour;
2) vertical tanks (with floating suction): 2 hours.
3) In any other case, 3 hours per metre (1 hour per foot) depth of fuel, or 24 hours, whichever is less.

d. After settling, drain off any water which has collected at the bottom of the tank.

6.6.4 For tanks supplied by a Dedicated and Segregated System, take a Bottom Sample, and provided it is free of suspended water and sediment, perform a Control Check.

6.6.5 Tanks Supplied by a Non-Dedicated and/or Non-Segregated System.

a. After the fuel has been received into receipt tankage, sampling and recertification testing are required.

b. Individual Upper, Middle and Lower Samples shall be taken for appearance and density. Density differences in excess of ±3 kg/m³ (±1° API) will indicate layering, and will require Flash Point, Initial Boiling Point, End Point testing, on each individual sample, before proceeding with Recertification Testing.

c. Test results outside the variability limits for Flash Point, Initial Boiling Point, or End Point may indicate contamination.

d. If samples taken are within the above variability limits then a composite sample shall be prepared for recertification testing.

e. After satisfactory recertification test results have been obtained, the fuel may be released. If the results are not satisfactory the fuel shall remain quarantined until further testing has established that it is acceptable.

f. Where layering has occurred and the Recertification Test is satisfactory, local written instructions to cover the problem of releasing fuel which has significant density differences between layers will be required.
6.6.6 Draining and Sampling

To ensure fuel quality is satisfactorily maintained in storage, the following procedures shall be applied:

a. Storage tank sumps/low points shall be checked daily for the presence of water and sediment. Additional checks should be made when frequent or heavy rainfall occurs.

b. Flush at full flow a quantity in excess of the line content from the storage tank sump/low point to the sample receiving vessel, and then take a running sample from the line for a visual check. If this check indicates unsatisfactory fuel, flush a further quantity into the sample receiving vessel and take another running sample from the line for a visual check. Repeat until a satisfactory sample is obtained.

c. If a satisfactory sample cannot be obtained after flushing several times or if large quantities of water are found, the tank shall be quarantined and the sample retained until measures, decided by the Manager, have been taken.

d. After tank flushing and sampling, the fuel in the sample receiving vessel shall be settled and any free water removed before being returned to storage. Where there is a possibility of jet fuel, flushed from a storage tank containing tested fuel, being contaminated with untested fuel (e.g. where a fast flush sample receiving tank is connected to more than one storage tank), the flushed fuel shall be returned to untested fuel tankage.

e. Static stock (i.e. stock to which no fuel has been added) shall be sampled (Composite Sample) for Periodic Test (refer to Section 4.5) after six months. Samples should also be taken from each tank in which less than half the fuel has been replaced during the six month period. If the results are unsatisfactory, the tanks shall be quarantined and a Composite Sample taken from each tank for Certificate of Analysis testing, which shall prove satisfactory before the fuel can be released.

f. Where storage tanks are fitted with double block and bleed valves and positive segregation is required, the block valves shall be drained after receipt of fuel, and checked prior to release, and at least weekly by opening the bleed valves and draining any fuel into a suitable container. If the checks release a significant quantity of fuel or if there is a continuous flow of fuel indicating a leaking block valve, then appropriate measures including additional fuel sampling and testing shall be taken to ensure that the quality of the fuel is satisfactory before the tank is released.

g. Daily, typically in the early morning hours before the start of operations, filter vessels shall be drained of any free water while under pressure. Details of any free water or sediment found shall be recorded. A sample shall then be taken for a Visual Check. Additional requirements for filter inspection and maintenance are shown in Appendix A.
6.6.7 Tank Routine Checks

a. Floating suction arms shall all be checked monthly to ensure proper operation and floatation.

b. Free vents and mesh screens should all be checked monthly, or more frequently as dictated by local conditions, for condition and any obstructions (e.g. nests, leaves) or damage.

c. Pressure/vacuum relief valves, where fitted, should be checked and serviced in accordance with manufacturers’ recommendations.

d. High level alarm systems shall all be checked for correct operation at least annually in accordance with written procedures, and more frequently if required by local regulations or recommended by manufacturers. A monthly functional check of high (but not “high-high”) level alarms should also be performed where possible. Tanks should not be filled to the level at which the high level alarm is activated, except during this check.

6.6.8 Tank Internal Inspection and Cleaning

a. All tanks shall be thoroughly inspected and cleaned one year after first commissioning. Thereafter, inspection for cleanliness shall be undertaken annually, and thorough cleaning carried out if indicated by inspection results.

b. If the inspection reveals microbial growth, or build up of sediment exceeding approximately 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, discoloured water drainage, or slimy deposits).

c. All tanks shall be cleaned every three years as necessary, or more frequently if indicated by inspection results as being necessary.

d. The three-year cleaning requirement can be extended to seven (7) years, provided the tank meets the following criteria:

1) the tank is fully internally coated;
2) the tank is equipped with a tank sump drain system;
3) 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 microbial growth or surfactants;
4) if satisfactory results are obtained from the 6 monthly microbial tank bottom samples per the monitoring sampling programme.

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

a. Inspection for internal mechanical condition shall be carried out in accordance with local regulatory requirements or at least every seven (7) years.
b. No chemicals, or cleaning materials which could contaminate the aviation fuel to be stored in the tanks, shall be used. Also refer to section 8.6.14.

c. Detailed records of the types and quantity of sediment found, and of the condition of the tank interior fittings and coatings, shall be maintained. A sample form is shown in Appendix E. The dates of the most recent tank inspections and cleaning should be marked on the tank shell.

NOTE: Refer to Section 11 for record retention details.

6.6.9 Meter Calibration (Custody Transfer Only)
Meters used for custody transfers shall be calibrated in accordance with Section 8.6.10.

6.7 Jet Fuel Recovery Tanks – Internal Inspection
Tanks shall be inspected quarterly for cleanliness and condition. Cleaning and repairs to internal lining shall be carried out as necessary. An industry approved microbial growth test may be carried out as an alternative to quarterly inspections. In this case the inspection interval may be extended to one year.

6.8 Reclaimed Fuel - Intended for Aviation use

6.8.1 Reclaimed fuel shall not be handled any differently than aircraft quality fuel, and any containers or equipment used shall be clean and dedicated to that purpose. Equipment used for cleaning hydrant pits shall not be used for handling reclaimed fuel.

6.8.2 Every effort should be made to remove visible solids and water prior to moving fuel into a reclaim tank, or returning to storage from a reclaim tank preferably via a filter/water separator or monitor.

6.8.3 Fuel eligible for reclaim shall be limited to:

d. fuel from the following sources:
   1) tank sumps;
   2) filter sumps;
   3) low point drains;
   4) high point vents/relief valves; OR

e. fuel samples from:
   1) fuel receipts from dedicated sources;
   2) membrane filtration tests;
   3) gravity/density checks;
   4) into-plane samples; OR

f. fuel from equipment maintenance:
   1) during filter internal inspection/changeout;
   2) during tank & pipework drainage for inspection/cleaning/repair.

CAUTION: Fuel from any source, other than those listed above, shall not be reclaimed.
SECTION 7

7 HYDRANT SYSTEMS

NOTE: Additional guidance on hydrant systems can be found in API/EI 1540 chapter 5, or SAE 5789 section 5.

7.1 Design

7.1.1 After completion of a new or extended hydrant system installation, before the system is placed into service the structural integrity of the system shall be tested in accordance with API/EI 1540.

7.1.2 Each grade of aviation fuel shall be handled in a completely segregated system. There shall be no inter-connecting lines between pipelines which handle different fuels.

7.1.3 Where more than one grade of fuel is available, hydrant pits & couplers shall be clearly identified, selective, and grade marked in accordance with API 1542 (refer to table in Section 6.2).

7.1.4 High-Point and Low-Point Connections

a. High-point and low-point connections for underground pipelines shall be installed in pits that permit access to the connection.

b. Low points of hydrant systems shall be, in the case of new systems, fitted with a minimum 35 mm (1.5 in) manually valved connection suitable for the attachment of a flushing hose rated for the full pressure of the hydrant system.

c. Low points of hydrant systems shall be fitted with a valved connection, suitably sized for effective flushing. Single valve isolation with dry break coupling is sufficient for most arrangements. The flushing hose shall be rated for the full pressure of the hydrant system.

d. All hydrant low point drains shall be clearly identified.

e. High points of hydrant systems shall be fitted with a valve connection.

7.1.5 Surge Suppressors, where required, shall be:

a. installed as close as possible to fuel dispensing points or other possible sources of pressure surges; and

b. constructed of steel with a pressure rating at least equal to the system design pressure, and designed to absorb anticipated pressure surges.
7.1.6 All new hydrant lines shall be lined internally with an epoxy material approved as being compatible with aviation fuels.

7.2 Hydrant Integrity and Pressure Testing

7.2.1 All new hydrant systems shall have tightness control capabilities incorporated into the design to prove their integrity. Where significant modifications to an existing hydrant system are planned, consideration should be given to incorporating a tightness control system (leak detection).

7.2.2 Tightness control systems should be checked on a regular basis in accordance with written procedures based on the system manufacturer’s recommendations. All tightness control checks shall be recorded.

7.2.3 Where no automated tightness control system exists, as a minimum, a risk assessment should be performed and a system established to regularly monitor the hydrant system for any leakage.

7.2.4 Hydrant systems which are fitted with a method to confirm the integrity of the system should be checked on a regular basis (at least monthly) in accordance with written procedures based on the manufacturer’s recommendations and taking into account national and local regulations.

7.2.5 For existing hydrants without leak detection systems it is strongly recommended that the system is checked for leakage at least every 6 months by means of one of the available tightness control systems.

7.2.6 As a minimum, where no leak detection system exists, the system shall be checked at least monthly at normal operating pressure when no fuellings are in progress and the pressure decay over time (minimum 2 hours) recorded. The pressure decay (typically less than 10 psi) should be compared to previous results. Any increase in pressure drop that cannot be attributed to changes in test pressure or fuel temperature is an indication of a possible hydrant leak or isolation valve failure.

7.2.7 All checks shall be recorded.

7.2.8 Further information about the checking of hydrant system integrity is contained in the API/EI 1540 Recommended Practice, Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities (sections 5.3.4, 5.3.5 & Annex E).

7.2.9 All buried fuel pipes and hydrant systems without an operational leak detection system shall be pressure tested annually to Maximum Operating Pressure (MOP) to confirm their leak tightness. MOP is defined as maximum pump output pressure at maximum tank head. Where possible the pressure test should be of 8 hours’ duration (see API 570), but if test results confirming the absence of leaks can be established positively this may be reduced to a minimum of 1 hour. If test results suggest the possibility of a leak, a pressure test at 110% of Maximum Allowable Operating Pressure (MAOP) should be performed. Where the MAOP is not known, the test should be performed at 125% of the maximum working pressure of the system. Testing shall be in accordance with written procedures which highlight the fact that this normally requires the isolation of pressure relief valves.
7.2.10 All pressure test records shall identify both the fuel temperature and pressure against time for the duration of the test.

7.2.11 The condition of the pipe at the soil/air interface at the into-ground point shall be inspected and recorded at the same frequency as the pressure test.

NOTE: Further information concerning tightness control is contained in the API/EI 1540 (chapter 5 and Annex E). SAE 5789 refers to leak detection in section 5.

7.2.12 On all new hydrant systems, or when performing significant modification on the hydrant system, pit valve equipment shall be:
   a. 100mm (4 inch) API/EI 1584, and be compatible with hydrant vehicle intake couplings; and
   b. equipped with fuel or air-operated dual pilot valves, and may also incorporate a lanyard quick closure.

7.2.13 Existing hydrant systems fitted with 63mm (2.5 inch) pit valves are acceptable, but consideration should be given to incorporating a lanyard-operated slow-close isolating valve as an interim measure, until an upgrade to the API standard occurs during the next major hydrant modification.

7.2.14 Cathodic Protection
   a. Unless corrosion studies indicate otherwise, hydrant systems and underground piping should be cathodically protected, and appropriate signs for impressed current systems shall warn against separation of system components without prior de-energization.
   b. To ensure the system is operating correctly, the cathodic protection shall be tested at least annually in accordance with manufacturer’s recommendations by a suitably qualified person.
   c. An agreed maintenance programme shall be in place to ensure remedial action takes place when deficiencies are discovered.

7.2.15 Emergency Stop Button (ESB) / Emergency Fuel Shut off (EFS)
   a. All hydrant systems shall be provided with emergency fuel shut off devices that, when activated, will stop fuel flow to all hydrant pit valves in a selected area. These shall be installed outside probable spill areas, clearly marked so that they are visible, readily accessible from all fuelling positions, and with operating instructions clearly indicated.
   b. A monthly functional check of the hydrant emergency fuel shut down system shall be performed in accordance with a detailed written test method. The results of each monthly check, including details of the location of the emergency fuel shut down devices checked, shall be recorded.
   c. The function of each emergency fuel shut down device shall be checked every six months.
NOTES:
i) If for any reason the emergency shut off system cannot be repaired immediately, the hydrant operator shall have an alternate plan (approved by the jurisdictional authority) in effect for the temporary continued use of the system.

ii) At some airports the hydrant emergency stop system is controlled by stop buttons located on the fuelling vehicle or carried by the fuelling operator. These systems shall be clearly identified and tested.

7.2.16 Hydrant Pit Design
   a. The hydrant valve shall be installed in a hydrant pit, and the hydrant pit shall be fitted with a load-bearing cover capable of withstanding the greatest live load expected from aircraft and other equipment.
   b. Hydrant pits & covers shall be designed for easy & safe access for fuel & maintenance personnel. Whenever practicable, the hydrant pit area shall remain clear of obstructions.
   c. All hydrant pit covers shall be securely tethered by chain, cable, or permanently attached to pit.
   d. The apron surface shall be graded to form a gradual slope away from the hydrant pit to minimize water entering the hydrant pit.

7.2.17 Flushing Equipment
   a. The equipment used for flushing low points and unused hydrant pits should have a tank constructed of mild steel internally coated with a light coloured epoxy material, approved as being compatible with aviation fuels, or of aluminium alloy or stainless steel.
   b. Equipment should have a low point with drain valve, a sampling point in the inlet pipework for taking a running sample and be equipped with API 1529, or EN 1361 type C (semiconductive) hose with a pressure coupling.
   c. To ensure effective bonding via the semi-conductive hose, there should be no isolating flanges fitted between the connection to the hydrant and the flushing equipment chassis.

CAUTION: Due to the possible presence of vapour in the low point, and to guard the cathodic protection from damage, bonding cables should not be used.
   a. Flushing equipment should be checked for the presence of water and sediment before use.
   b. Flushing equipment should be fitted with at least one 9kg / 20lb (minimum) dry powder fire extinguishers.
   c. Refer to Section 7.3.3 for operational flushing requirements.
7.3 Engineering Work and Re-commissioning

7.3.1 Hydrant Operators shall notify into-plane fuelling organizations of any major modifications, changes, or construction work to the hydrant system, which may impact the into-plane operation. The into-plane fuelling organization shall then notify the aircraft operator of any service disruption.

7.3.2 Similarly, prior to any engineering work the into-plane fuelling organisations should be advised of the location of such work (i.e. by the hydrant operating company, hydrant users, or other responsible parties).

7.3.3 After re-commissioning of the hydrant system, the Aircraft Operators shall be notified, and to minimize the potential for contamination additional flushing of the hydrant low points, and visual checks of the fuel, will be required.

NOTE: Pipework modifications, or uprating of hydrant pumps can alter the flow conditions in the hydrant and cause dormant contaminant to be re-entrained in the fuel. For additional details refer to API/EI 1540.

7.4 Operations

7.4.1 A system of determining hydrant pit usage shall be maintained to ensure that unused laterals are noted, and flushed after 3 months without use.

7.4.2 All routine checks (as applicable) shall be performed on unused segments of hydrant systems before return to service.

7.4.3 Flushing Low Points

a. All designed low points of the hydrant shall be flushed thoroughly on a weekly basis, with the flushing equipment valve fully open, to ensure removal of any water or sediment.

NOTE: In North America, flushing is performed monthly.

b. There shall be an effective means of shutting down the flow quickly in the event of disconnection or hose burst during flushing.

c. The quantity flushed from the low point shall be approximately 50 to 200 litres (10 to 50 gallons) in excess of the capacity of the flushing pipework. The actual quantity flushed will depend upon the design of the system and the amount of contamination usually observed.

d. After the initial flush, a running sample shall be drawn for Visual Check. A second flushing of the low point may be required to obtain a satisfactory sample.

e. If excessive water or sediment is found, or if it is not possible to obtain a clear & bright sample, action shall be taken to notify the into-plane fuelling organisations, and to identify the source of the contamination.

f. After use, the flushed fuel shall be allowed to settle, and any water or sediment removed from the low point of the equipment before the fuel is returned to storage.
NOTE: If it is intended to return the fuel to storage, the equipment used for low point flushing shall be dedicated for that purpose.

g. If unusual amounts of water or sediment are found in the equipment after the flushing operation, flushing shall be repeated.

7.5 Maintenance

7.5.1 Pit Entry - Safety Precautions

a. Entry into pits, tanks, and other hazardous confined spaces should be avoided unless necessary for maintenance purposes, and shall be controlled by a confined entry permit system.

NOTE: for more Safety-related information, refer to Section 10.

7.5.2 Pit Cleaning, Maintenance and Routine Checks

b. The hydrant pit shall be checked weekly, or more frequently, dependant upon local weather conditions and water table. Check for general condition (i.e. seals, cover, etc), and clean any debris (e.g. fuel, water, sand, etc) as necessary. Records shall be kept of inspections and any maintenance work performed.

c. It remains the Into-plane operator's responsibility to report any deficiencies found during normal fuelling operation.

d. Regular functional checks, and hydrant pit valve testing (in Appendix H), shall be made on the correct operation of the lanyard-controlled quick release valve (valve closing time shall be between 2 and 5 seconds). The performance checks of the valve shall be made under pressure at the highest flow rate practicable and may be carried out during a fuelling operation. Records shall be kept of all results.

e. With some existing (non API/EI type) hydrant pit valves, the valve closing time may exceed 5 seconds. In this situation, it is necessary to observe the overshoot which should not exceed 5% of maximum flow of the equipment.

f. Hydrant pit valve adapter tolerances shall be checked by using a wear gauge, where available from the manufacturer.

g. On a monthly basis, check that hydrant valve vaults are clear for emergency access, and that there are no fuel leaks, standing liquid, or debris, and general condition of all components.

h. Verify proper operation of pit valves, in accordance with Appendix H, and correct any deficiencies found.
SECTION 8

8 AIRCRAFT FUELLING EQUIPMENT & OPERATIONS

8.1 Design Features

NOTE: The material contained in this section shall be used in conjunction with local regulations. Overall design and construction should meet all applicable local standards. This section does not detail all of the requirements necessary.

8.1.1 Fuelling equipment, including Tank Trucks and Hydrant Servicers, shall be designed for use with aviation fuel, and constructed to acceptable and recognized safety standards.

8.1.2 The equipment shall incorporate satisfactory tank venting arrangements, appropriate pressure relief valves, hydrostatically tested pumping circuits, electrical components appropriate for the area classification of the location in question, braking system safeguards, externally mounted emergency stop buttons.

8.1.3 Fuelling equipment having air tanks shall have automatic, or manual, valves for removal of accumulated water, and the manual valves shall be identified and readily accessible.

8.1.4 All smoking related equipment (e.g. cigarette lighters, ashtrays) shall be removed from the vehicle cab.

8.1.5 Engine exhaust systems shall be designed, located and installed such that they minimize the risk of fire in the event of a fuel spill.

8.1.6 Lift platforms installed on fuelling equipment shall have:
   a. fall protection (e.g. handrails and toe boards);
   b. access ladders/stairway and/or emergency platform release;
   c. emergency fuel shut off;
   d. non-skid platform; and
   e. at least two proximity sensors (on new vehicles).

NOTE: Consideration should be given to installing proximity sensor(s), to prevent inadvertent contact with aircraft, on platforms not already so equipped.
8.2 Product & Equipment Identification

8.2.1 All fuelling vehicles shall carry only one grade of fuel. Grade identification, in accordance with API/EI 1542, shall be displayed prominently on each side of the unit, and shall be visible from the control panel and the fill point (refer to table in Section 6.2).

8.2.2 Signage/Placards
All placards shall comply with regulatory requirements, but as a minimum, fuelling equipment shall be identified as follows:

a. NO SMOKING posted prominently in the vehicle cab and on both sides of the equipment;

b. a vehicle fleet number and company name.

8.3 Equipment Requirements

8.3.1 Pipework

a. All pipework and accessories shall be made of mild steel, stainless steel, or aluminum. Mild steel pipework shall be protected internally with an epoxy lining material compatible with aviation fuels.

CAUTION: Copper alloys, galvanised steel, or plastic materials are not permitted.

b. The use of copper-containing materials for other components in contact with the fuel shall be minimized, and no zinc or alloy materials containing more than 5% zinc shall be used.

8.3.2 Filtration

a. All jet fuel fuelling vehicles shall be fitted with at least the following filtration equipment:

1) filter monitors meeting performance requirements of the latest edition of EI 1583; or
2) filter/water separators meeting the performance requirements of API/EI 1581, or
3) a 3-Stage filter vessel meeting the latest edition of API/EI 1581 & EI 1583 may be used.

b. All new filter/water separator vessel and element combinations shall meet the latest edition of API/EI Specification 1581.

c. To replace the elements in a vessel with those of another model/type, it is required that a similarity sheet be provided by the new supplier that documents that the filter/water separator remains qualified to API/EI 1581. Similarity shall be in accordance with API/EI 1582.

d. Similarity documentation should be requested by the user and retained on file for the service life of the vessel. The similarity sheet should indicate that all of the operational parameters meet or exceed the requirements stated for the original elements installed in the vessel. A similarity sheet and corresponding data plate, should also be issued with each new vessel, to document the qualification to API/EI 1581.
e. Where fuelling equipment is equipped with filter/water separators, consideration shall be given to fitting a system to detect free water in the sump.

**NOTE:** In the USA, filter/water separator vessels dispensing fuel directly into hydrant systems or loading racks shall be fitted with a slug valve to stop the flow of fuel when bulk water in the filter sump reaches a predetermined level.

f. All filtration vessels on mobile equipment shall include:

1) air elimination, preferably with a flow indicating sightglass;
2) a means of monitoring differential pressures (refer to Appendix A 2.1.3);
3) manual, preferably spring-loaded, sump/low-point drain valves;
4) upstream and downstream membrane sampling connections, including probes and dust covers;
5) pressure relief valves, or other devices that will prevent over pressurization due to thermal expansion of fuel, including a means for accommodating relieved fuel;
6) identification of filter drain valves; and
7) as a minimum, a placard indicating month and year of last filter inspection & change-out.

### 8.3.3 Electronic Programmable Logic Control (PLC) units

g. Some fuelling vehicles are fitted with PLCs that are designed to control pressure and flow to pre-set conditions. Where such equipment is installed it is a requirement that certain critical pressure and flow rate information is clearly displayed on the outside of the vehicle. The continuous display of all information is preferred but, for electronic readouts, a single selective display is acceptable.

h. Any alterations to PLC software shall be controlled by a change management process.

i. All vehicles, whether fitted with conventional pneumatic or electrical pressure control equipment or PLC controlled, shall display as a minimum:

1) filter differential pressure;
2) flow rate; and
3) nozzle fuelling pressure, or venturi simulated nozzle pressure.

### 8.3.4 Hoses and Hose Couplings

a. All fuelling and inlet hoses shall be of one continuous length, smooth bore synthetic rubber construction complying with the requirements of the latest editions of API 1529 or EN 1361 type C (semi-conductive).

b. Inlet hose couplings should preferably be factory fitted. However these, and discharge/delivery hose couplings, may be an approved re-attachable type.
8.3.5 Hose-End Strainer
A suitable type of hose-end strainer of not coarser than 60 mesh shall be fitted to pressure fuelling couplings and overwing fuelling nozzles.

8.3.6 Interlock System
a. All fuelling vehicles shall be fitted with an interlock system to prevent drive away, roll away and jet blast blow away during fuelling of aircraft. This system shall be activated whenever fuelling nozzles/couplers, hydrant inlet couplers, bottom-loading connections, lift platforms, folding tanker top handrails, and fuelling cabinet covers (if equipped) are removed from their normally stowed positions. Power take-off (PTO) as part of the interlock system is also recommended.

b. The system shall be designed so that no operator action (such as engaging the handbrake) is required to arm and/or activate the interlock mechanism. Emergency interlock overrides shall be sealed in the interlock operating position. The seal shall be easy to break in an emergency. The reason for breaking interlock override seals shall always be recorded. Written procedures shall be used to control the use of the override.

NOTE: For details and related documents for Interlock system, refer to API 1540 Design, Construction Operation and Maintenance of Aviation Fuelling Systems”.

c. On all vehicles, highly visible warning lights shall be installed in the vehicle cab as follows:
   1) interlock status - amber in colour - which lights whenever an interlock protected component is removed from its stowed position;
   2) an emergency override status - red in colour - which lights whenever the override mechanism is activated.

d. When a vehicle is in emergency override, an external lighting or audible warning system (e.g. 4-way flashers) shall also be activated to alert the operator.

8.3.7 Pressure Fuelling Nozzles
Pressure fuelling nozzles shall be qualified to SAE AS 5877.
8.3.8 Overwing Nozzles
   a. Overwing (trigger) fuelling nozzles shall:
      1) not have hold-open ratchets; and
      2) be grade marked and colour coded (e.g. black tape band for Jet A and Jet A-1).

   b. Nozzle spouts shall not be painted or coated.

   c. Jet A or Jet A-1 overwing nozzles shall have a spout in accordance with section 8.14.

   d. Not all jet aircraft have fuelling orifices large enough for the jet fuel spout. Where smaller
diameter spouts have to be used to deliver jet fuel, the larger jet fuel spout should be replaced
immediately after use.

   e. As an additional precaution, at some locations it may be appropriate to modify nozzle stowage
arrangements such that the brake interlock system prevents the vehicle from driving away
unless both spouts are stowed, the larger spout being attached to the fuelling hose and the
smaller diameter spout being stowed elsewhere on the vehicle.

   **NOTE:** Nozzle spout designs shall meet the requirements of SAE AS1852.

8.3.9 Dust Covers
   All hydrant couplers and aircraft fuelling nozzles shall have dust covers,
or other protective devices, to prevent debris from accumulating on their mating surfaces.

8.3.10 Pressure Control Systems
   a. All jet fuel delivery equipment (refuellers and hydrant servicers) shall be fitted with pressure
control systems to protect aircraft from excessive flow and shock pressures (surge) which can
damage aircraft fuel systems. The pressure control equipment shall be of a type and design
which has undergone a formal approval test procedure.

   b. The minimum requirements for pressure control equipment are as follows:
      1) for maximum achievable pump/hydrant pressure below 3.5 bar (50 lbf/in²)
         not required.
      2) for maximum achievable pump/hydrant pressure 3.5 to 5.5 bar (50 to 80 lbf/in²),
a HEPCV is required (per Note above). An ILPCV is also required for vehicles with
maximum flow rates of 1000 litres/min or more per delivery hose
      3) for a maximum achievable pump/hydrant pressure above 5.5 bar (80 lbf/in²),
a HEPCV and an ILPCV is required.

   c. Hose End (Primary) Pressure Control Valves (HEPCVs) are situated at the nozzle, at the end
of the delivery hose.
d. In-line (Secondary) Pressure Control Valves (ILPCVs) are situated on the vehicle, in the inlet coupler (hydrant servicer), or in the hydrant pit valve

e. A second HEPCV is acceptable in place of an ILPCV, provided that the maximum inlet pressure does not exceed 6 bar (90 lbf/in²).

f. Appendix B includes an explanation of the function and testing of pressure control valves.

NOTE: In the USA, all aircraft fueling equipment shall meet these additional specific pressure control requirements:

a) separate and independent primary and secondary pressure control devices shall be fitted on all jet fuel delivery equipment (refuellers and hydrant servicers);

b) primary pressure control is intended to protect the aircraft under conditions of constant flow and also from pressure surge caused during aircraft valve closure. Primary pressure control devices must limit fueling pressure, at the fuel nozzle, to 40 psi or less under conditions of constant flow;

c) secondary pressure control is intended to protect the aircraft in the event of primary pressure control failure. Secondary pressure control devices must limit fueling pressure, at the fuel nozzle, to 50 psi or less under conditions of constant flow;

d) a pressure gauge is required for monitoring aircraft fueling pressures. Gauges should be located where they will be visible to the equipment operator during aircraft fueling operations. Gauges shall have a minimum face diameter of 4 inches and must have an accuracy of +/-2% of full scale. Digital pressure displays shall have a minimum character height of 3/4 inch;

e) instead of the HEPCV as the Primary Pressure control valve as described below and in Appendix B an inline pressure control valve [ILPCV] with pressure loss compensation may be substituted. This ILPCV shall meet the requirements of [b] and control maximum peak (transient) shock or surge pressure at the aircraft manifold to 8.3 bar (120 lbf/in²).

f) an ILPCV valve without compensation as described in Appendix B shall not be used.

8.3.11 Fire Extinguishers

a. All refuelling tanker trucks and hydrant servicers shall carry at least two 9kg (20 lbs), type BC chemical fire extinguishers, unless a different size or type is specified by local regulation. The extinguishers, one on each side of the vehicle, shall be readily accessible in a quick release housing.

NOTE: In North America, in accordance with NFPA requirements, only one fire extinguisher is required on a hydrant servicer.

b. All extinguishers shall be equipped with a tag or label, showing servicing dates.

CAUTION: Unless otherwise specified by local regulation, A-B-C rated multipurpose dry powder fire extinguishers shall not be used in the vicinity of aircraft, or on any type of refuelling vehicle, due to their corrosive properties.

NOTE: Additional information concerning fire extinguishing media is included in API/EI 1540 “Recommended Practice, Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities”, or NFPA 407. Local airport authorities are responsible for the provision and maintenance of ramp-based fire fighting equipment.
8.3.12 Bonding Cable
   a. A bonding cable, electrically bonded to the vehicle chassis, shall be provided with a suitable clamp. The resistance between the clamp and the vehicle chassis should not exceed 25 ohms.
   
   b. If a reel assembly is used, then the cables and clamps should have a resistance not to exceed 25 ohms between the clamp and the vehicle chassis.
   
   c. To ensure continuity, clamps shall be made of a suitable conductive material (e.g. copper alloy or brass), and not anodized or painted to ensure proper contact is made with the bonding point. Where US Government aircraft are to be refueled, use the clamp per Mil-C-83413-7.
   
   d. Cables shall be galvanized, stainless steel, or braided copper, and covered with a durable, brightly coloured plastic insulation (e.g. green, yellow) to ensure high visibility. The insulation colour shall be different from that of the lanyard cable, where used.

   NOTE: *The plastic cover on bonding cables is not for electrical reasons, rather it is a Health & Safety issue to protect the hand of the operator from being cut when handling the cable, and is colour coated to help prevent a trip hazard.*

8.3.13 Emergency Fuel Shut off
   a. All aircraft fuelling equipment shall be fitted with clearly identified emergency shut down systems. The requirements for refuellers and hydrant servicers are described in sections 8.4.7 and 8.5.3

8.3.14 Deadman Control System
   a. All aircraft pressure fuelling equipment shall have a deadman control system that will completely stop fuel flow.
   
   b. On all new vehicles, the deadman control system should be designed to require periodic action (i.e. reactivation) by the operator within a pre-determined time interval to prevent automatic closedown. All deadman control systems shall meet the performance requirements of Appendix B4. In hydrant systems the deadman control shall, where possible, activate valve closure upstream of the hydrant servicer inlet hose.
   
   c. Intrinsically safe radio-controlled (i.e. wireless) deadman controls are also permitted, provided the device is set-up to ensure the operator remains within 10 metres (30 feet) to the fuelling operation.

   NOTE: *Deadman systems sometimes include an override switch. This is for operation only in emergencies. If not of the spring-loaded (auto-return) push button type, it shall be safety wired and sealed in the non by-passed position. Written procedures shall be used to control the use of the override.*
8.3.15 Fuel Delivery Meter
   a. All fuelling equipment shall be fitted with a fuel meter capable of measuring to the required
      accuracy and preferably incorporating a rate of flow indicator (refer to Section 8.6.9).
   b. The fuelling system shall be arranged so that all fuel which passes through the meter is
      delivered to the aircraft.

8.4 Refuellers

8.4.1 General Requirements
   Each refueller shall be equipped with:
   a. a top vent that operates automatically during filling and discharging;
   b. fall protection (e.g. handrails);
   c. access ladders and non-skid walkways; and
   d. rollover protection (to safeguard dome covers, pressure and vacuum vents, and vapour vents),
      with adequate drainage to disperse any water accumulation.

8.4.2 Tanks
   Tanks shall be constructed of mild steel protected internally with a
   light-coloured epoxy lining compatible with aviation fuels, or aluminum alloy, or stainless steel.

8.4.3 Tank Drains
   a. The tank shall drain to a low point sump which incorporates a self closing internal valve. The
      drain outlet/sample point should incorporate a spring-loaded (self closing) type valve.
   b. Single compartment tanks are preferred, but if multi-compartment tanks are used, then each
      compartment shall have separate drain lines, not manifolded together. All drain lines shall
      have a constant downward slope.
   c. All tank drain valves shall be clearly identified.

8.4.4 Tank Vents and Dome Covers
   a. Tanks shall be vented by a suitable system.

   NOTE: Additional details may be found in SAE ARP 5818 “Design and Operation of Aircraft Refueling Tanker
   Vehicles, and EN 12312 – 5 “Aircraft Ground Support Equipment-Specific Requirements - Part 5 Aircraft Fuelling
   Equipment”.
   b. Dome covers shall incorporate a mounted hinge with latches that will automatically cause the
      cover to close with forward motion of the vehicle. The cover shall also be equipped with
      watertight, fuel resistant seals and gaskets.
NOTE: Dome covers that are incorporated into an interlock system are acceptable.

8.4.5 Bottom Loading

a. All mobile refuellers shall:

1) be bottom loaded through an approved self-sealing dry-disconnect;

CAUTION: Top-loading is not recommended due to its impact on fuel quality, static charge generation, and safety implications. Any existing top-loaded vehicles shall be modified for bottom-loading within 5 years of the initial publication date of this Standard.

2) have an automatic high level shut off that incorporates a manual pre-check device;

3) incorporate a brake interlock system that will prevent the vehicle from being moved until the bottom loading coupler has been disconnected from the vehicle.

b. High-level shut offs shall be set at, or below, the compartment safe fill levels, taking account of the maximum flow rate that may be achieved during refueller loading and the time taken to stop the flow.

c. Two independent high-level shut off devices shall be installed on:

1) refuellers filled from a hydrant system; and

2) new refuellers.

NOTE: for sensor details, refer to Appendix F.

8.4.6 Piping Drains

All main fuel piping should be equipped with low point drains located to permit complete draining.

8.4.7 Emergency Fuel Shut off

a. The tank outlet shall be fitted with internal valves capable of being shut quickly in an emergency.

b. Refueller tank trucks shall have an emergency shut off device that will stop fuel flow. This can either be an engine stop button (that will also shut down the Power Take Off, if used), or an emergency fuel shut off device. In either case on new vehicles:

1) there shall be two (2) activation devices, located one on each side of the vehicle; and

2) where the refueller is fitted with a lifting platform an additional shut off device shall be located on the platform.
8.5 Hydrant Servicers

8.5.1 Selective Couplings
a. Where more than one fuel grade is delivered by hydrant systems, selective couplings shall be used.

8.5.2 Lanyards
a. Lanyards for hydrant pit valve operation shall be of adequate strength (e.g. cord with steel heart strands), and it is recommended that they are of a highly visible colour (e.g. red). The selected colour should be in line with any local regulations concerning the recommended colours for emergency systems, and shall be different to that of the fuelling vehicle bonding cable.

b. There should be no electrical connection between the fuelling vehicle and the hydrant system. If lanyards are attached to vehicle-mounted reels, the reels should be electrically isolated from the vehicle.

8.5.3 Emergency Shut off
a. In the case where pit valve lanyards are not utilised, an emergency fuel shut off system is required. There shall be a minimum of two (2) shut off controls, one on each side of the vehicle, capable of immediately shutting down the fuel flow.

b. In addition to a deadman control, a hydrant servicer shall have an emergency fuel shut off device that will stop fuel flow. This can either be a:
   1) hydrant pit valve lanyard; or
   2) vehicle mounted emergency shut off device. In the case of new vehicles there shall be a minimum of two activation devices, one on each side of the vehicle.

c. Where the hydrant servicer is fitted with a lifting platform, a means of activating an emergency shut down system shall be provided from the platform.

8.6 Maintenance, Inspection and Testing Of Fuelling Equipment

8.6.1 General
a. Fuelling equipment shall be maintained in safe operating condition at all times. Maintenance work shall be scheduled so that all units receive thorough attention, in accordance with the equipment manufacturer’s instructions.

b. All relevant checks (e.g. routine inspections, maintenance, modifications, etc) shall be recorded in detail. Defects shall be rectified as soon as practical.
c. Defects that have safety critical implications, may affect fuel quality, or may affect delivery pressure control shall be rectified immediately, or removed from service.

**NOTE:** *For examples of safety critical items refer to Appendix I.*

d. If fuelling equipment is out of service for a period in excess of one month, it shall be thoroughly checked, operationally tested (including fuel flushing and testing), in order to ensure that the equipment is in proper operating condition before being used. All records related to the equipment (e.g. inspection, maintenance, etc) shall be up to date prior to return to service.

e. Equipment new to the site, or following major repair or overhaul, shall be thoroughly checked, flushed and tested in order to ensure that it is in proper operating condition before being brought into service. All relevant routine equipment checks, including a colorimetric filter membrane test, shall be performed and the results recorded.

8.6.2 Records

A record shall be kept for each piece of equipment detailing all work carried out (e.g. servicing, inspections, repairs and replacements).

**NOTE:** *for additional details refer to Section 11 Records.*

8.6.3 Vehicle - Serviceability

In order to ensure that fuelling vehicles operate satisfactorily, routine chassis and engine serviceability checks, as recommended by the vehicle manufacturer, shall be carried out and recorded.

8.6.4 Interlocks – Functional Testing

a. The operation of at least one interlock, and the override seal integrity, shall be checked as part of the daily vehicle inspection.

b. Weekly functional tests of the complete interlock system shall be carried out and recorded, including a driveaway test, and a functional test of the interlock override switch and associated warning light.

**CAUTION:** *Attempting to drive a heavy fueller from standstill while performing the weekly check can damage vehicle components. This check should be performed carefully to avoid transmission damage.*

c. Any defects found, at any time, shall be recorded and immediately rectified, or the equipment removed from service.

8.6.5 Bonding Wire – Condition & Continuity

a. All electrical bonding wires, including clips and reels, shall be visually checked for general condition and for firm attachment of the bonding clip, and have a resistance check for electrical continuity (not to exceed 25 ohms resistance) at the following frequencies:

1) cable and reel - weekly;

2) fixed cable - monthly (steel), weekly (copper);
3) Scully or equivalent bonding systems – annually, or following any maintenance on the system.
   
b. Where a reel is fitted, electrical continuity should be checked over several revolutions of the reel while slowly unreeling the bonding wire. Record the results of the check.

8.6.6 Filtration Equipment
Requirements for testing, inspection and maintenance of these units are given in Appendix A1.

8.6.7 Pressure Control and Deadman System
   
a. Daily, perform a functional check of the deadman control system, and remove vehicle from service if the deadman control does not operate correctly.

b. Monthly, check the correct operation and performance of deadman control systems (may be during aircraft fuelling), in accordance with the requirements detailed in Appendix B4.

c. Quarterly, check the correct operation of pressure/surge control equipment under dynamic (flowing) conditions in accordance with procedures detailed in Appendix B, as appropriate for the equipment at the location concerned.

8.6.8 Aviation Hoses - Commissioning, Testing and Repair
   
a. Each hose shall be given a permanent identification when first received, either on a new fuelling vehicle or into stock, and a "Hose Inspection Test Record" started. Date of manufacture, date when put into service, and details of all testing shall be recorded.

b. The maximum shelf storage life for all fuelling hoses is two (2) years, and the maximum overall service life is limited to ten (10) years, both periods from the date of manufacture.

c. Hose Commissioning

   1) New aviation hoses shall be filled with fuel, and should be left to soak for a minimum of eight (8) hours, at an ambient temperature between 15°C (60°F) and the flashpoint of the jet fuel specification.

   NOTE: In North America, hose soaking is currently not a requirement.

   2) They shall also be tested in accordance with the six-monthly pressure test procedure as described in Appendix C, and a colorimetric filter membrane test performed.

   3) All hoses shall be flushed with at least 2,000 litres (500 gallons) of fuel. Flushed fuel and the hose end strainer shall be visually inspected until no evidence of hose manufacturing residue is detected.

   NOTE: Additional details on hose pressure testing can be found in Appendix C2.
d. Hoses in Service
   1) All vehicle hoses under pressure shall be inspected and tested routinely in accordance with Appendix C.
   2) Hoses shall be kept under observation during each fuelling operation and, if a defect is observed, delivery shall be stopped and the hose replaced.
   3) Where reattachable couplings are used, damaged hoses may be shortened by removal of the damaged end section, provided that the remainder of the hose is satisfactory. After shortening the hose and refitting the couplings, before being returned to service, the hose shall be subjected to the six monthly test procedure, but at 20 bar (300 psi).

e. Grooved Pipe / Flexible Joints
   1) Where Grooved Pipe joints (e.g. Victaulic type grooved joints) or flexible pipe joints are installed in fuelling vehicle piping under pressure (greater than 5 psi) the joint shall be subjected to a visual check under maximum operating pressure. This pressure test should take place concurrently with the monthly fuelling hose pressure test.
   2) The visual check shall consist of an inspection for leaks, housing cracks or other damage, loose bolts and other abnormal condition. Loose bolts may be detected by marking a line across the bolt and assembly and observing any misalignment.
   3) Where grooved joints and/or flexible pipe joints are fitted in suction positions, they shall be subjected to visual inspection every six months. No pressure test is required.
   4) When grooved type joints are disassembled (e.g. to repair leaks or remove adjacent valves) care should be taken when inspecting the gasket to ensure it is free of cuts, wear, cracking, swelling and other damage.
   5) For either type of joint, if any doubt exists on their condition, they shall be removed and a manufacturer’s recommended replacement installed.
   6) Where a flexible joint uses a hose-type material, then they shall:
      1) be installed within 2 years of the date of manufacture;
      2) not be painted; and
      3) have a maximum service life of 10 years from the date of manufacture.

8.6.9 Bulk Meters
Meters shall be calibrated to operate with the minimum accuracy and repeatability requirements shown below.
   a. The meter shall be calibrated to 75% of rated flow, or max achievable flow if less. If error is equal to or greater than 0.1%, adjust as close to “zero” as possible.
b. In order to check meter accuracy at low flow rates a further run should be performed at 20% of rated flow of the meter under test. The error at this flow rate shall not exceed ±0.20%

c. The meter shall also have a repeatability of ±0.05% when operating throughout the flow range from 20% to 100% of rated flow.

NOTE: Further guidance can be found in petroleum industry standards such as ISO 3170 (IP 475) “Petroleum Liquids-Manual Sampling”; and the API “Manual of Petroleum Measurement Standards”.

Where government or local regulations are more stringent they should be followed, and where they may require different calibration criteria, alternative procedures may be considered, provided the performance standard achieved is not reduced.

8.6.10 Meter Calibration Criteria (Custody Transfer Only)

a. New meters and meters that have been repaired or overhauled shall be calibrated at the location before being brought into service. Meters in service shall be proved at least once per year, unless government or local regulations require different calibration frequencies. Calibration history should be used to determine if more frequent calibration is required. To prevent unauthorised adjustment, meters shall be adequately sealed after calibration, and before being returned to service.

b. Meter proving may be performed by means of a calibrated master meter or calibrated prover tank. Master meters should be of approximately similar rated flow to the meter being tested. Prover tanks should have a capacity exceeding the equivalent of one minute of fuel flow at maximum flow rate.

c. Master meters should be recalibrated at least every three (3) years, or less frequently at locations where volume throughput is low. Prover tanks should be recalibrated by an approved authority on a five (5) year cycle, and after internal painting, when damaged or moved (unless designed to be moveable), or following any structural change.

d. Meters with erratic performance, or those not capable of being adjusted to meet calibration criteria shall be removed from service for repair, overhaul and recalibration, or disposal.

e. Meters with pulse transmission from the meter drive to an electronic display generally match or exceed the accuracy of mechanical bulk meters. Calibration procedures should be based on the manufacturer’s recommendations.

8.6.11 Meter Records and Documentation

a. Meter testing procedures meeting the requirements of 8.6.9 shall be written. Where meter proving is performed by a third party contractor, a copy of their procedures meeting those same requirements shall be made available.

b. A valid certificate of calibration should be available for each meter. Meter proving test records shall be completed for each meter proved. Details of the meter under test including rated flow,
start and finish meter totalizer readings and the results of each calibration run shall be recorded.

c. Meter history shall be retained for at least three (3) years, detailing any adjustments and accuracy obtained.

8.6.12 Pressure Gauge Testing

a. All gauges shall be regularly checked for accuracy and free movement and adjusted, repaired or replaced as necessary.

b. Venturi gauges and nozzle pressure gauges, where fitted, shall be checked quarterly against the calibrated pressure control gauge, and that pressure control gauge shall be calibrated every six (6) months.

c. All other vehicle pressure gauges (e.g. indicating pump delivery pressures etc.) shall be calibrated at least every twelve (12) months.

d. Testing shall be done against a master gauge or dead-weight tester, and shall be accurate to within ±2% of full scale.

e. Master gauges shall be recalibrated at a frequency specified by the manufacturer, or where no frequency is given, at a minimum of every three years either by a certified test facility (preferred) or by a certified dead weight tester.

f. Where a dead weight tester is used, personnel shall be trained & qualified.

g. Records of current calibration / calibration certificates for master gauges shall be available.

h. New master gauges should be a minimum of 15cm diameter (6 inches), existing gauges should be at least 10cm (4 inches). Master gauges should have scale divisions of 1 psi maximum and a typical range of 0 to 13 bar (0 to 200 psi), minimum range 0 to bar 10 (0 to 150 psi).

i. Certificates/Documents prepared at time of calibration should include calibration values at steps of 10% over the range of the master gauge. In order to demonstrate linearity across the range of the gauge the required accuracy at each calibration step shall be within +/-0.5% of the full scale deflection.

j. Piston type differential pressure gauges (e.g. Haar or Gammon type) shall be checked every six months for free movement throughout the full piston travel, and visually for correct zeroing.

k. The date and results of all pressure gauge checks shall be recorded.
8.6.13 Leaking Nozzles and Couplers

Any leaking nozzles and hydrant couplers shall be removed from service, checked for wear using the appropriate wear gauge, and repaired in accordance with the manufacturer’s recommendations. Records of repairs and adjustments shall be maintained as per Section 11.

8.6.14 Refueller Tank Inspection and Cleaning

a. Refueller tank interiors shall be visually inspected when sufficiently empty of fuel to permit unobstructed viewing of the tank bottom. This shall be accomplished from the top through existing manways, at least on a quarterly basis. Where records confirm a history of good internal cleanliness (e.g. no visible accumulation of sediment or evidence of microbial growth) and condition (e.g. no cracks or broken welds), the inspection interval may be extended up to a maximum of one year.

b. Where refueller tanks require cleaning, only lint-free mops or cloths shall be used. Under no circumstances shall solvents, chemicals, or detergents be used. If it was necessary to use water for interior cleaning, any water shall be removed and the tank ventilated until all interior surfaces are dry. All cleaning material and waste shall be disposed of in accordance with environmental regulations and standards.

c. Top loaded fuelling equipment shall be cleaned internally every twelve months

d. If there are visible signs of contamination or damage, then the tank shall be drained and tank entry will be necessary, at a maximum interval of two (2) years.

NOTE: If torches or flashlights are used when inspecting tank interior from the tank-top, they shall be rated as intrinsically safe.

e. For bottom loaded fuelling equipment, the maximum interval between tank entry and cleaning is two (2) years but this may be extended to a maximum of seven (7) years, and ten (10) years in the USA. Extended intervals beyond two years are subject to a history of clean fuel as evidenced by records of clean tank drain samples and continuous records of filter membrane colorimetric results of 3 (dry) or less.

NOTE: If evidence indicates the deterioration of internal tank conditions, the operator should increase the cleaning frequency back to the two (2) year entry and cleaning cycle.

f. Independant of tank cleanliness, an inspection shall be performed of the tank structural integrity (e.g. for weld integrity) at a maximum interval of ten (10) years, unless otherwise required by local regulations.

g. Visual inspections of refueller tanks shall include a check on the condition of tank vents and top hatch gaskets. Roof area water drains shall also be checked monthly to ensure that drain lines are not blocked.

h. Where refueller tank integrity or condition is suspect, tank entry may be required, in accordance with national confined space entry safety standards.
8.6.15 Hose-End Strainers

a. Wire mesh strainers fitted to under-wing, and over-wing nozzles, shall be visually inspected monthly.

b. Equipment, as illustrated below, should be used when carrying out this procedure on under-wing pressure couplings to ensure that any contaminant that may be present is not dislodged from the strainer prior to examination.

c. If it is necessary to disassemble the hose-end coupler to remove the strainer for inspection, its integrity shall be checked by pressurising the hose to working pressure after reassembly, prior to return to service.
8.6.16 Fire Extinguishers
   a. Inspection and servicing of vehicle fire extinguishers shall be performed as per 6.3.2.

8.7 Into-Plane Sampling Procedures

NOTE: This sub-section 8.7 does not apply to North America, unless specifically required by the airline operators (e.g. outlined within their contract and/or fuel procedures manual).

As a minimum, the following checks shall be performed. To satisfy customer and participant requirements additional sampling may be required.

8.7.1 Refuellers
   a. After the fuel contained in the vehicle delivery pipework and filter vessel has been displaced, a one-litre (one quart) sample shall be taken downstream (outlet side) of the filter for a Visual Check, including chemical water detector.

   b. If water, or particulate matter, is found in the initial sample (e.g. a distinctive colour change is obtained with the chemical water detector), a second sample shall be drawn immediately.

   c. If the presence of water, or particulate matter, is confirmed, the fuelling shall be stopped and the airline representative informed immediately. No further delivery shall be made until the reasons, for the presence of water or particulate matter, have been determined and remedial action taken.

   d. The sampling procedure frequency shall apply as follows:
      1) the first fuelling of the day;
      2) the first fuelling after loading or topping-up the refuellers; and
      3) the first fuelling following exposure to heavy rain or snowfall.

8.7.2 Hydrant Vehicles
   a. Samples shall be taken at every fuelling operation for Visual Check, and at least one (jet fuel) sample from each fuelling shall be checked with a chemical water detector.

   b. After the fuel contained in the vehicle delivery pipework and filter vessel (typically 1000 Litres (265 US gallons)) has been displaced, a one litre (1 quart) sample shall be taken downstream (outlet side) of the filter for visual contamination. If water is found in the sample (e.g. a distinctive colour change is obtained with the chemical water detector), a second sample shall be drawn immediately.

   c. If the presence of water is confirmed with the second sample, then the fuelling shall be stopped immediately, and the hydrant operator/supervisor and airline representative informed.
d. A one litre (1 quart) sample shall be drawn from the filter separator sump or inlet (upstream) side of the monitor vessel under pressure immediately after each fuelling for visual examination. If water is found in the sample, or a distinctive colour change is obtained with the chemical water detector, a second sample shall be drawn immediately. If the presence of water is confirmed with the second sample, then the hydrant operator/supervisor and airline representative shall be informed immediately.

e. No further delivery shall be made until the reasons for the presence of water have been determined and remedial action taken.

f. If a hydrant vehicle is withdrawn from service, or is reassigned to another aircraft before the fuelling operation is completed, sampling as per item d. above shall be performed before leaving the aircraft.

8.7.3 Sample Disposal and Retention

a. Fuel samples shall be disposed of into a suitable container on the vehicle or returned to the fuel storage facility in securely closed sampling containers and recovered as described in Section 6.8.

b. Procedures shall ensure that fuel samples which have failed a Visual Check are not delivered to aircraft but are retained, for investigation if necessary.

8.8 Driving and Positioning of Fuelling Vehicles

8.8.1 Daily Fuelling Vehicle Check

a. Prior to the first fuelling operation of the day, a fuelling vehicle check shall be performed, and the vehicle inspection form completed.

NOTE: Refer to Appendix E Records for a sample checklist of various other vehicle items to be checked.

b. In the case where fuelling personnel switch to a different vehicle, they shall ensure that:
   1) the daily check was performed on that vehicle and recorded; and
   2) a complete walkaround (360°) is performed to check for general condition & operation of the vehicle (e.g. tires, stowage of equipment, lights, etc).

8.8.2 Driving

a. Vehicles shall not exceed the speed limits imposed by the Airport Authorities. Where no regulations exist, a limit of 25 km/h (15 mph) shall be enforced on the apron. As soon as practicable after leaving its parking place, brakes shall be tested to ensure satisfactory operation.

NOTE: Drive within designated areas; comply with road markings and advisory signs; do not tailgate and always yield right-of-way to taxiing aircraft.
CAUTION: Never cross an active taxiway or runway without permission of air traffic control or the airport ground controller.

b. Vehicles shall not approach an aircraft until the aircraft anti-collision lights have been switched off.

c. Vehicles shall be brought to a complete stop 15m (50 ft.) from the aircraft to assess the best approach route and check that brakes are functioning properly. Low or first gear shall be engaged, and the aircraft shall be approached at a walking pace (e.g. no more than 5 km/h (3 mph)).

CAUTION: To minimize the risk of collision with an aircraft, never approach the aircraft fuselage perpendicularly (i.e. a right angle) with any vehicle (nose-in).

8.8.3 Fuelling Vehicle Approach & Positioning – Underwing

a. Refuellers and hydrant fuelling vehicles should, if possible, always move forward into the fuelling position.

NOTE: If the above is not possible due to airport gate design, or aircraft configuration, it is recommended that individual gate or approach plans are developed, and visual reference aids used as necessary to assist with aligning the vehicle.

b. The preferred fuelling position is with the hydrant servicer or refueller engine forward of the aircraft wing leading edge. However, fuelling vehicles may approach from either the front or rear of the aircraft and may park with the engine underneath the aircraft wing.
c. If reversing is unavoidable, a competent guide man shall assist unless an alternative system (e.g. reversing cameras and proximity sensors) has been approved (refer to section 3.6).

d. Truck and trailer combinations shall not be reversed into position.

e. Extreme care should be taken to avoid the possibility of collision with any part of the aircraft or ground servicing equipment while manoeuvring into (and away from) the fuelling position.

f. For refuellers a clear exit path shall be maintained throughout the fuelling operation to allow the fuelling vehicle to be driven away quickly in the forward direction in the event of an emergency. If the exit path becomes obstructed by vehicles or equipment, the fuelling operation shall be stopped until the vehicle/equipment is moved clear of the refueller exit path.

**NOTE:** Some US airport design limitations may require the fuelling vehicle to reverse in, or out, of position as there is no safe way to drive forward.

g. For hydrant servicers, a clear exit path in the forward direction should also be maintained but, given the lower inherent risk in a servicer (with no large quantity of aviation fuel on board) and that a servicer shall not be driven away in the event of an emergency during fuelling, this is not considered mandatory.

h. At locations where the obstruction of the exit path is a continuing problem this should be brought to the attention of the airport authority.

i. No vehicle is permitted within the fuelling safety zone.

j. No fuelling vehicle shall be parked in a position where all or part of the vehicle is directly under the aircraft’s engines, Auxiliary Power Unit (APU) exhaust system, air conditioning unit, or fuel tank vents.

**CAUTION:** The fuelling operator should be aware of the possible hazard of aircraft leading or trailing edge flaps being lowered without warning and striking the fuelling vehicle.

k. Aircraft servicing vehicles conducting non-fuel-dispensing activities on behalf of the aircraft operator shall not be positioned within the fuelling safety zone during fuelling operations.

l. Fuel dispensing hoses and hydrant vehicle inlet hoses should be positioned to minimize the risk of baggage handling and other aircraft servicing vehicles driving over them and causing damage.
m. If underwing deck hoses are to be used, it must be possible to connect hoses to the aircraft fuelling point without exerting any sideways pressure which could damage the aircraft adapters. Once connected, hoses should hang freely and vertically from the fuelling point.

n. In the case of underwing fuelling of low-wing aircraft, special precautions shall be taken to ensure that vehicles used have a sufficiently low profile and care should be taken to ensure proper clearance.

o. When positioning vehicles underwing, full account shall be taken of the potential for aircraft to settle, so as to avoid the possibility of the aircraft wing, fuel panel door, or other surfaces bearing down on the vehicle as the aircraft settles under increased fuel, baggage, cargo and passenger loads.

p. When in position, the driver shall not leave the cab until the parking brakes have been applied.

q. It is the responsibility of the Location Manager/Fuelling Supervisor to ensure that the access/egress plans allow fuelling vehicles to be positioned safely relative to the aircraft as described above. If it is not possible to meet all of the requirements, the supervisor shall take action with the Airport Authority or Airport Safety Committee in writing.

r. If the Location Manager/Fuelling Supervisor is not satisfied that fuelling vehicles can be positioned safely, he may decide not to allow fuelling operations to proceed.

8.8.4 Stand-Off Position - Refuellers and Hydrant Vehicles
8.9 Hydrant Pit/Inlet Hose Identification and Protection

NOTE: Hydrant vehicle inlet hoses, inlet couplers, and hydrant pit valves are vulnerable to damage caused by other aircraft servicing vehicles. This has been demonstrated by a number of major incidents in recent years, each of which could have had catastrophic effects including fire and loss of life. Incidents have occurred in both good and poor weather conditions, in daylight and at night.

In order to improve the visibility of the hydrant pit valve at all times:

a. a high visibility hazard marker, providing 360° visibility, shall be displayed above the pit opening (e.g. a four-winged flag constructed from high visibility material, or alternative designs/equipment that provide a similar all around visibility may be used); and

b. during the hours of darkness, the hydrant pit valve and inlet hose shall be illuminated. Where insufficient terminal illumination is present, red or orange safety lamps or vehicle-mounted searchlights may be used for this purpose.

8.10 Bonding - Aircraft and Fuelling Equipment

8.10.1 The aircraft, fuelling vehicles, and overwing nozzles shall be electrically bonded together using designated bonding points throughout the fuelling operation to ensure that no difference in electrical potential exists between aircraft and fuelling units.

8.10.2 Bonding between fuelling vehicles and aircraft shall be completed before any aircraft delivery hoses are connected or tank filler caps opened. Bonding shall be maintained until all hoses have been finally disconnected or tank filler caps replaced.

8.10.3 Grounding of the fuelling equipment is not permitted, unless specified by the Aircraft Maintenance Manual (AMM).

8.10.4 To avoid accidents with personnel working around the aircraft, bonding cables should always be of a visible colour, and placed on the ground.

CAUTION: In the event a bonding cable becomes disconnected during a fuelling operation, the fuel flow shall be stopped before reconnecting the bonding cable.

8.10.5 When overwing fuelling, care should be taken to follow the correct procedure for bonding and inserting the nozzle into the tank fill point. If the filler caps have been removed prior to the fuelling operation, they should be replaced and vapour in the vicinity allowed to disperse before commencing the fuelling operation.

8.10.6 The procedure may vary with aircraft type, but the following is recommended to equalize electrical potential:

a. where a bonding point is available, attach nozzle bonding jack or clip to the bonding point, or fill point cover flap with the fill point cover flap still closed;
b. where there is no bonding point, touch the nozzle to the filler cap with the fill point cap still closed;

c. open fill point cover, and remove cap;

d. make contact between the nozzle and fill point prior to inserting nozzle; and

e. insert fuelling nozzle and ensure that contact is maintained.

8.11 Fuelling Procedures

8.11.1 General

a. Fuelling is not permitted during severe local electrical storms that are in close proximity to the airport.

**NOTE:** In the absence of local regulations defining "close proximity", as guidance information, fuelling is not permitted when electrical storms are located within 8 km (5 miles) of the airport.

b. The stability of fuelling platforms when fully extended may be affected by high winds and it is recommended that fuelling at height should not be permitted in wind speeds in excess of (e.g. 40 knots, 75 km/h, 45 mph), unless a different wind speed limit is specified by the manufacturer.

c. Ascertain fuelling requirements. In the case of overwing (trigger nozzle) fuelling, the grade of fuel required shall be confirmed.

d. Fire extinguishers shall be readily available. They may remain on the fuelling vehicle provided they are carried in open housings or in racks with quick release fastenings.

e. Immediately prior to connection of the fuelling vehicle coupling, the aircraft fuel adaptor shall be checked to ensure that it appears to be in good condition with no missing or damaged lugs and no signs of contamination. No connection shall be made to an adaptor with a missing lug.

f. Adaptors with cracks or showing signs of significant wear should be brought to the attention of the airline representative and fuelling should not proceed until the representative has confirmed that the adaptor condition is acceptable.

g. Hoses shall be run out on routes which will prevent them from being run over by aircraft-servicing vehicles. Kinking and twisting of hoses shall be avoided. Pressure fuelling couplings and overwing nozzles shall not be dragged over the ground. Dust caps shall be fitted at all times while couplings are not in use.
8.11.2 During Fuelling

a. During fuel delivery, the operator shall position himself at a point where he has a clear view of the vehicle control panels and aircraft fuelling points.

b. Deadman control shall always be held in-hand, and never be wedged or blocked open.

c. Where access to the aircraft fuelling points is from a vehicle platform, it shall not be raised or lowered while fuel is flowing, unless the fuelling hoses and piping do not travel down with the platform. Whenever possible the operator should control the fuelling from ground level.

d. Connected fuel hose shall be kept clear of the elevating platform while the platform is in motion. The design of the elevating platform (photo shows pantograph system) shall ensure that the fuel hoses do not become pinched or bound when the platform is in motion.

e. During fuelling operations, no aircraft maintenance shall be conducted which could provide a source of ignition for fuel vapours, or that may result in a fuel spill (i.e. overflow valve testing).

f. During fuelling operations, the operator:

1) shall be alert and monitor the work area at all times, including:
   1) checking for any leaks and spills;
   2) ensuring the integrity of fuel hose and bonding connections;
   3) observing that the filter differential pressure is normal;
   4) monitoring pressure control equipment by observing vehicle pressure gauges. If pressures exceed acceptable limits the fuelling shall be stopped;
   5) observing aircraft fuel panel controls and warning lights where additional services have been agreed (refer to section 8.16).

2) shall not sit in the cab;

3) shall not fuel an aircraft when the aircraft fuel tank high-level shut off switch is overridden or inoperable, unless the airline provides additional instruction, guidance, or training (e.g. by referring to airline maintenance personnel, operations, etc), and it is agreed to in writing.
g. Fuel spills are a fire hazard and cause environmental damage. Aircraft engines when hot can be a fire ignition source and extra care shall be taken to prevent spillage of fuel during hot engine operations, particularly when fuelling equipment is in close proximity to the aircraft. Should a spillage occur, fuelling operations shall cease immediately, the affected airline shall be notified immediately, and action be taken in accordance with local airport regulations. For more details refer to Section 10.

h. Operational problems can be caused by unsuitable location of the aircraft, caused by misalignment of the aircraft in the parking spot, or by inappropriately located hydrant pits. In these cases, the operator should initiate steps with the airline to arrange for the aircraft to be moved.

i. Fuelling personnel should not operate aircraft fuel systems controls, except as provided in Section 8.16.

j. It is the responsibility of the airline to:
   1) determine the volume of fuel to be loaded and to instruct fuelling personnel accordingly;
   2) obtain periodically, from the fuelling company, the density (specific gravity) of the fuel being delivered, and to make any associated calculations;
   3) manipulate aircraft tank valves and switches, and to check the security of tank fill caps, covers and components; and
   4) to operate drip and dip sticks where it is required.

NOTE: Some airlines have special arrangements where the fuelling operator has airline trained personnel who perform this function.

k. Fuelling personnel shall only service the aircraft types for which they have been trained. See section 8.16 below.

l. After the aircraft has been fuelled in accordance with the airline requirements and delivery documents completed and signed, the fuelling operator should disconnect the fuel delivery hose, and ensure that the fuel adaptor caps and fuel panel doors are secured.

m. As a final check prior to drive away, the operator should walk completely around the vehicle to ensure all equipment is disconnected and stowed, look up to check that the aircraft flaps are not lowered and there is sufficient vertical clearance to drive away, and the vehicle is clear to leave the area. Fuelling vehicles shall be driven away from the aircraft slowly in a forward direction, whenever possible.

n. Activation of the emergency interlock system override is prohibited, except in emergency situations to remove the vehicle from the vicinity of the aircraft. The vehicle is to then be removed from service until repaired.
8.12 Underwing - Hydrant System

8.12.1 In addition to the procedures given above, the following should be applied:

a. The fuel grade shall be checked before the connection is made to the hydrant.

b. Hydrant pit identification shall comply with section 8.9.

c. The connection sequence for hydrant fuelling shall follow local or national standards (e.g. NFPA-407 requires hydrant coupler connected prior to bonding).

d. Where local or national standards do not exist, the recommended practice outlined below shall be followed:

1) position hydrant vehicle at aircraft and engage parking/emergency brake;
2) secure wheel chocks where local regulations or airline policy require;
3) remove/open hydrant pit cover and insert a high visibility hazard marker in pit;
4) bond hydrant servicer to aircraft;
5) In locations where hydrant pit valve pilot device is lanyard operated, attach lanyard to pit valve and extend lanyard on the apron such that it is free of obstructions and readily accessible to fuelling operator and other apron personnel for use in an emergency, pull lanyard to check that pit valve is closed;
6) remove any dirt and/or moisture on the pit valve adapter and hydrant coupler;
7) attach hydrant coupler to hydrant pit valve, and where:
   1) air or fuel sense line(s) are independent, they should be attached to the appropriate control point; or
   2) hydrant pit valve pilot device is either air (or fuel) sense or air (or fuel) sense and lanyard operated, attach air (or fuel) sense line to hydrant pit valve pilot device.

CAUTION: Couplers shall never be connected if the liquid level present in the pit is covering the pit valve. The liquid shall be removed to a level that permits safe access to the pit valve.

1) open any panels and remove fuel caps as required;
2) perform visual check of aircraft fuel adaptor condition for damage;
3) attach nozzles to fuel manifold adapters on aircraft;
4) manually activate pit valve, however, if the start of fuelling is delayed or if the vehicle is left unattended, the hydrant pit valve shall be closed;
5) activate deadman control to start delivery, in some cases this may be at the direction of the airline (e.g. via dispatch load slip).

e. at conclusion of fuelling, reverse the above sequence.

CAUTION: It is not recommended that fuelling be performed when an aircraft engine’s “hot section” is located directly above the hydrant pit, or directly in front of and within ~ 1 metre (40 inches) forward or above the pit.
8.12.2 Whenever the vehicle is left unattended (e.g. for airline signature of delivery receipt) the hydrant pit valve shall be closed.

8.12.3 Dust caps shall be fitted to pit valve adapter and vehicle couplings at all times when not in use.

8.12.4 Draw samples and carry out checks as described.

8.12.5 When disconnecting never drag the fuelling nozzle or hydrant coupler. They should be carried back to the vehicle. The bonding cable should also be walked back.

CAUTION: To avoid hose damage (see photo) hydrant servicers shall not remain coupled to the hydrant pit valve after completion of fuelling.

8.13 Underwing – Refuellers

8.13.1 In addition to the procedures in 8.11, the following shall be applied:

8.13.2 Ensure that the following sequence is observe:
   a. Bond fueller to aircraft;
   b. Check condition of aircraft fuel adaptor(s);
   c. Connect all delivery hoses to aircraft;
   d. Activate deadman control to start fuel flow.

8.13.3 At conclusion of fuelling, the reverse sequence is to be followed.

CAUTION: The transfer of fuel between refuellers during fuelling operations (where a refueller is filled from another vehicle during aircraft fuelling) is not allowed. This practice may result in vapour release from the tank vents, adds to the congestion around the aircraft, and reduces the possibility of moving the fuelling equipment away from the aircraft in the event of an emergency.

8.14 Overwing Fuelling

8.14.1 In addition to the procedures for underwing fuelling by fuelers, further measures are required to ensure that the correct grade of fuel is delivered when using an overwing (trigger) nozzle. Also refer to API/EI 1597:
   a. Fuelling personnel should never make an assumption about the grade of fuel required. Grade confirmation between the customer and fuelling personnel shall take place. Whenever possible, written confirmation of the grade of fuel required shall be provided by the customer.
b. Before fuelling commences, the operator shall check that the grade requested is the same as the grade marked on the aircraft, adjacent to the tank filler cap, and the same as the grade marked on the overwing fuelling nozzle.

c. If there is no grade marking on the aircraft, fuelling shall not commence until a Fuel Grade Verification Form reconfirming the grade of fuel required has been completed by the pilot or responsible ground servicing personnel. This form should be in English and local language. A sample form is shown in Appendix E 2.1.

d. If the grade marking on the aircraft is different to that of the fuelling equipment, fuelling shall not commence until the discrepancy has been fully investigated and resolved.

e. For Avgas overwing fuelling, a nozzle with a maximum external diameter of 49mm (2 in.) should be used (photo below left).

f. For jet fuel overwing fuelling, a nozzle with a spout with a major axis of at least 67mm (2.7 in. Duckbill) should be used (photo above right).

g. Certain jet fuel aircraft types have filling orifices which are too small to accept the jet fuel spout, necessitating the use of a smaller diameter spout.

h. Written procedures shall be prepared to ensure that after fuelling such aircraft the smaller spout is removed from service and replaced by the larger jet fuel spout.

8.14.2 The following additional precautions are applicable for overwing fuellings:

a. Loose articles shall not be carried in caps, jackets or shirt pockets as these might fall into aircraft tanks;

b. Hoses shall be routed over the leading edge of the wing (and not the trailing edge) in such a manner that avoids the possibility of damage to the aircraft;

c. Ladders and wing mats should be used as appropriate to avoid damage to the aircraft. Care should be taken in positioning ladders to avoid damage to the aircraft caused by settling while fuel, baggage, cargo and passengers are being loaded;

   CAUTION: Where overwing fuelling is required, and the height exceeds two metres (six feet), fuelling shall only occur with the proper work platform in place, or when personal protective equipment (i.e. fall protection) is worn.

d. Overwing nozzles shall be held open manually, and shall never be wedged open (i.e. via notches, latches, or any type of hold-open devices);
e. Prior to fuelling smaller aircraft, and where a nozzle extension or funnel is required to avoid splash fuelling, ensure that the grade of fuel is verified with airline representative completing the Fuel Grade Verification Form, as per item c. above;

f. Overwing fuelling should be performed at low pressure to reduce potential for “hose whipping”.

8.15 Diesel Aircraft Engines

8.15.1 Several companies are now producing aircraft engines that are powered by jet fuel or diesel. These engines are being installed on aircraft that typically had previously been fitted with engines that used Aviation Gasoline (Avgas).

8.15.2 These aircraft represent a serious risk of misfuelling by the delivery of Avgas to an engine designed for diesel fuel. Also, because these aircraft were originally designed for use with Avgas, most will have filling orifices that are too small for the normal 67mm jet fuel nozzle.

8.15.3 Only aviation fuel grades (jet fuel and aviation gasoline) may be delivered to aircraft fuel systems.

   a. Although some engines fitted to certain aircraft types may be certified for use with jet fuel and diesel, DIESEL FUEL SHALL NOT be supplied to those aircraft.

   b. The use of a Fuel Grade Verification Form (see sample in Appendix E.2.1) is required for all refuelling of these aircraft types.

8.16 Additional Services

8.16.1 When an airline requests additional services, the fuelling company shall obtain from the airline:

   a. a written request detailing the extent of the work required, which may include extracts from the appropriate IATA Guidance Material on Standard Into-Plane Fuelling Procedures; and

   b. written details of any appropriate training that will be provided by the airline.
8.16.2 Training, written procedures and certification shall be provided by the airline to personnel nominated by the Manager. This will include retraining on an annual or other agreed frequency. All training given shall be recorded.

8.16.3 An agreement detailing the additional services shall be signed by the airline providing indemnification to the fuelling company.

8.17 Fuelling & Aircraft Passengers

8.17.1 Fuelling operations where passengers are Boarding, on Board, or Disembarking may be carried out provided it is permitted by, and procedures are in accordance with, national and local airport regulations, and is requested by the airline.

8.17.2 Fuelling operations shall be stopped should a hazardous situation such as spillage arise, or there is any infringement of airport regulations which could lead to a dangerous incident.

8.17.3 Passengers shall not be allowed to remain on-board helicopters during routine fuelling operations.

NOTE: In the exceptional case of a medical/ambulance flight, the invalid on a stretcher may remain on board. In this case the engines may run with the rotors stopped.

8.18 Fuelling with Auxiliary Power Units (APU) in operation

8.18.1 In the case of tail/rear-mounted APUs, fuelling/defuelling operations may continue when APUs are started or stopped.

8.18.2 Body-mounted APUs shall not be started, or stopped, during fuelling/defuelling operations. In the case where the APU shuts down, hoses shall be disconnected prior to an attempted restart.

8.18.3 If the APU exhaust discharges:
   a. across the upper surface of an aircraft wing, overwing fuelling shall not be carried out while the APU is running;
   b. to the side or rear of the aircraft, fuelling vehicles shall be positioned to avoid any risk of coming in the path of the exhaust stream.

NOTE: In the event of a fuel spill, fuelling shall be stopped immediately, and the airline representative or aircraft crew informed.
8.19 Fuelling with Ground Power Units (GPU) in Operation

8.19.1 Ground Power Units shall be positioned at least 6 meters (20 feet) away from fuelling vehicles and wing tank vents.

8.19.2 The engine of the GPU shall be started and electrical connections made before fuelling begins. The unit shall not be disconnected or switches operated during fuelling.

8.19.3 In the event of a fuel spill, the engines on the GPU shall be stopped until the spillage is removed, and there is no danger from flammable vapours.

8.20 Fuelling with Air Conditioning Units in Operation

Fuelling operations may be carried out subject to the same conditions as outlined above except that, in the event of fuel spillage, the ACU shall be stopped. This is to prevent the possibility of flammable vapours being ingested into the aircraft cabin.

8.21 Load Adjustment and Maintenance Defuel Procedures

NOTE: It may be necessary either to off-load fuel from an aircraft after the completion of the fuelling operation, for aircraft fuel load adjustment purposes, or to off-load (normally) large quantities, usually at the airline maintenance base, to permit aircraft maintenance work to be carried out.

Although both operations are designated “Defuelling” each is treated differently and the procedures for each have been separated in order to clearly identify the differences.

8.21.1 Defuelling shall normally take place into a refueller or static tank. Defuelling directly into a joint-use hydrant system is not permitted.

8.21.2 Before defuelling commences, the fuelling equipment hose-end regulator (where fitted) shall be locked in the fully open position.

NOTE: In order to protect delicate parts, such as ball valves and meter gears, it is recommended that the nozzle strainer be either reversed (where equipped), or removed and cleaned before and after defuelling.

8.22 Load Adjustment

8.22.1 This procedure is only applicable following a fuel uplift where the aircraft has been over fuelled. Load adjustments are normally performed following fuelling, and any fuel returned should be defuelled by the organisation that performed the fuelling.

8.22.2 Changes of the intended operation can be caused by changes in forecasted en-route weather conditions, or aircraft changes for operational reasons, where the aircraft is planned to operate a different sector, or one with a significantly different cargo or passenger load.

8.22.3 Load Adjustments are only acceptable where there is certainty that all the fuel on board the aircraft is to the same grade and visually free of any contamination. Locally agreed procedures shall specify appropriate checks on the aircraft fuel quality that shall include, as a minimum, a satisfactory Visual Check on sump samples drawn from all aircraft tanks before any fuel is offloaded.
NOTE: If water is found in the fuel tank drains with an appearance other than clear, a check shall be performed to determine the microbial activity. (Refer to Appendix G).

8.22.4 The amount of fuel taken off the aircraft, in the event of a Load Adjustment, shall be no more than 10% of the fuel that has just been uplifted onto the aircraft and no more than 10% of the capacity of the fuelling equipment or tank used. This defuelled fuel may be delivered to any customer, after re-filling the fuelling vehicle/tank and performing circulation and sampling for Visual Check, including a water check with chemical detector for fuel, all of which shall be satisfactory.

NOTE: In North America, prior to delivering defuelled fuel from another airline, the recipient airline shall provide written permission to allow uplift of that defuelled fuel.

8.22.5 Load Adjustments in excess of 10% of fuel uplift, or 10% of defuel capacity of the available defuel equipment tank, shall be treated as a Maintenance Defuel.

NOTE: The limitation of 10% is to ensure that the fuel freeze point is not significantly affected.

8.23 Maintenance Defuel

8.23.1 The IATA Guidance Material on “Microbiological Contamination in Aircraft Fuel Tanks” should be used as a guide and a Request for Defuel form, example in Appendix E, used for the acceptance of defuelled fuel.

8.23.2 To protect the quality of the fuel in the fuelling equipment from being contaminated by the fuel off-loaded from the aircraft, the following procedures shall be adopted before defuelling begins.

8.23.3 The quality and grade of fuel contained in the aircraft tank shall be established by:
   a. taking sump samples for a Visual Check and a water check by chemical detector; and
   b. the airline representative verifying the grade of fuel uplifted on the two previous refuellings. Normally this information is available in the Aircraft Technical Log.

NOTE: If water is found in the fuel tank drains with an appearance other than clear, a check shall be performed to determine the microbial activity. (Refer to section Appendix G).

8.23.4 Where the aircraft is found to contain a mixture of Jet A-1 or Jet A with:
   a. military jet fuel with FSII (e.g. AVTUR, AVCAT, JP-8 or JP-5);
   b. Russian TS-1 or RT fuel; or
   c. if there is any reason to suspect the quality of the fuel, then the off-loaded fuel shall be segregated and a Certificate of Analysis test, and a test for microbial activity shall be performed (both of which must be successful if the fuel is to be re-delivered to aircraft).
8.23.5 If the quality of the fuel is not suspect, or if it passed the applicable tests above, it may be delivered to an aircraft of the same Airline, or to an aircraft of another Airline with their written permission.

8.23.6 If the aircraft is found to contain a mixture of Jet A-1 or Jet A with:
   a. wide-cut fuel (Jet B, AVTAG or JP-4); or
   b. a military jet fuel, then the fuel shall be disposed of, unless the Airline from whose aircraft the fuel has been defuelled, provides written permission that it can be returned to an aircraft from the same Airline.

8.23.7 Defuelled fuel may be received into segregated storage until re-delivery to the aircraft concerned, or to an aircraft of the same Airline.

8.23.8 When a refueller has contained fuel of suspect quality, it shall be drained and inspected internally for cleanliness and the absence of any remaining fuel. All drain points should be purged to clear pipework and components (filters, pumps etc.) of fuel. The filter elements shall be replaced and the refueller should then be filled to capacity and 1,000 litres (250 gallons) should be delivered at maximum flow rate through each hose back into a storage tank containing at least 20,000 litres (5,000 gallons) of the fuel grade.

**NOTE:** Fuel containing FSII additive shall not be redelivered via filter monitor elements. Refer to API EI 1550 Filtration Handbook.

8.24 Segregated Defuel Facilities

As an alternative to Load Adjustments or Maintenance Defuel procedures, fuel removed from an aircraft can be accepted into a dedicated defuel vehicle or segregated storage facility. In this case, a full CofA and microbial testing shall be required before returning this fuel for use.

8.25 Fuelling With One Aircraft Engine Running

**CAUTION:** Overwing fuelling with any engine running is not permitted under any circumstances.

8.25.1 Fuelling of an aircraft that has any propulsion engine running is a non-routine emergency operation and requires very strict safety precautions.

8.25.2 The procedure outlined below applies specifically to underwing fuelling, and should be used only when an aircraft engine must be left running because it cannot be restarted due to inoperative aircraft APU and no ground start equipment available (e.g. air start unit, GPU, battery pack, etc).

8.25.3 The fuelling supervisor shall ensure that the fuelling operation with one engine running, as requested by the customer, is within the scope of the current airport regulations.

8.25.4 The procedure for fuelling with one engine running is as follows:
   a. fuelling with one engine running shall not be performed unless airline’s authorised representative requesting this kind of operation accepts responsibility;
b. the fuelling operation shall be supervised by a qualified airline representative;

c. because of its non-routine nature, the operation shall be reviewed beforehand by the airline and fuelling company representatives;

d. the aircraft shall be positioned at a distance of at least 50 metres (160 feet) away from the passenger loading area of the terminal, and any other building or other aircraft;

e. the aircraft should be parked into the wind;

f. where one-man fuelling would normally be carried out, an additional supervisor or senior operator should also be present;

g. Fuelling is not to be started until all passengers have vacated the aircraft and are kept at a distance of at least 50 metres (160 feet);

h. all personnel involved in the fuelling operation shall be clear of the running engine, and all other personnel not directly needed for the fuelling operation shall maintain a safe distance of at least 50 metres (160 feet) from the aircraft;

i. mobile fire-fighting equipment with engine running and properly manned, shall stand by the aircraft;

j. fuel shall be loaded on the side opposite to that of the running engine.

k. Under no circumstances may fuelling take place on the same side of the aircraft as that where an engine is running;

l. when additional fuel is required on the other side of the aircraft, and cross-feeding is not possible, the operation should be carried out in the following order:

1) remove fuelling equipment from the side where the fuelling has just been completed;

2) airline personnel start engine on the side which has just been fuelled;

3) airline personnel shut down the engine of the side to be fuelled;

4) position fuelling equipment adjacent to the wing to be fuelled as far from the running engine as possible;

5) load fuel.

8.26 Fuelling Operations in Hangars

8.26.1 Fuelling/defuelling is not permitted in hangars, or similar enclosed buildings, except by special agreement with the airlines and the authorities having jurisdiction (e.g. Fire Marshall, Airport Authority).

NOTE: Defuelling or refuelling of any fuel mixture containing wide-cut fuel is not permitted under any circumstances.
8.26.2 Satisfactory liability/indemnification protection shall be obtained from the airlines.

8.26.3 In the case where fuelling/defuelling in a hangar environment does occur, the following applies:

a. Guidelines:
   1) overspill/dump valve testing is not permitted as part of this fuelling/defuelling operation;
   2) technical supervision of the operation should be maintained by a nominated airline supervisor in charge of the aircraft;
   3) Fire Officer should be nominated, and always present, to be in charge of the safety aspects of the operation, being responsible for co-ordination of the pumping operation;
   4) adequate fire fighting equipment, containment equipment and absorbent material for accidental spillage shall be immediately available. Protection by an automatic water or foam deluge system is desirable.

b. Precautions:
   1) only one aircraft per hangar may be fuelled/defuelled at any one time;
   2) hangar doors shall always be open sufficiently wide to provide ventilation, and workstands positioned to allow clear and immediate passage of personnel and fire fighting equipment if needed;
   3) fuelling vehicles should remain outside hangars whenever possible;
   4) within the fuelling zone:
      1) no hot work (e.g. welding, brazing) or similar activity be permitted in the hangar;
      2) no maintenance work involving connection/disconnection, breaking, making, or switching of avionics circuits. Only essential electrical services required may be "on";
      3) only staff essential to the fuelling/defuelling should be permitted in the hangar;
      4) adjacent floor pits shall be closed;
      5) no pedestrian or vehicular traffic should be permitted;
      6) area shall be placarded "flammable vapours present";
      7) staff within the area may not carry matches or other means of ignition, and footwear shall be free of exposed metal studs, nails, tips, etc;
      8) no electronic equipment shall be used unless intrinsically safe.
5) the hose inside the hangar used to connect from the aircraft adapter to the fuelling vehicle hose at the hangar door shall:
   1) be one continuous length, or a dry-break joint;
   2) belong to, and be inspected by, the Customer for serviceability before use;

6) local airport regulations should be thoroughly reviewed, and authorities consulted as appropriate.

c. Procedures: (also refer to Sections 8.22 & 8.23 Defuelling)
   1) position fuelling vehicle outside hangar door, being sure that doors are sufficiently open and access to the hangar door is not blocked;
   2) establish bonding between aircraft and fuelling vehicle;
   3) connect in-hangars fuelling hose to aircraft and position mating coupling for fuelling vehicle hose outside hangar door;
   4) connect fuelling vehicle hose to in-hangar hose coupling;
   5) check that established safety precautions have been taken. A fuelling/defuelling check list to be filled out and countersigned by the airline supervisor and/or fire officer prior to commencement of fuelling is desirable;
   6) fuelling/defuelling may then commence at the direction of the airline nominated fire officer;
   7) deadman control shall always be used;
   8) check for any leakages;
   9) at conclusion of operation, disconnect in reverse sequence.
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SECTION 9

9 REFUELLER LOADING

9.1 Refueller Loading - General

9.1.1 Procedures and equipment used for loading refuellers should ensure that there is no possibility of a fuel spillage.

9.1.2 Refueller High Level Shut off Systems (see also 8.4.5)
   a. All bottom-loaded refuellers shall be equipped with at least one high-level shut off device that incorporates a “pre-check” system to simulate a high level condition in the fueller tank.
   b. New refuellers and refuellers that are filled from a hydrant system shall be equipped with two independent high-level shut off devices.

9.1.3 All high level shut off devices shall be functionally tested at least quarterly.

9.1.4 A "pre-check" is not required for refuellers equipped with an electronic PLC-controlled fail safe system. PLC-controlled high level alarm systems shall be tested annually.

9.1.5 Single sensor PLC-controlled alarm systems shall be functionally tested, at least quarterly, to verify sensor operation.

9.1.6 Two independent sensor PLC-controlled alarm systems installed on vehicles shall require annual testing for the high-high alarm.

9.2 Refueller loading facilities

9.2.1 Pipework shall be grade marked and colour coded to API 1542 with flow direction arrows.

9.2.2 If more than one grade of fuel is available, couplings that are physically incompatible shall be used to ensure only the correct hoses appropriate to the fuel grade can be connected. Adaptors which change the size or design of the outlet shall not be used.

9.2.3 Refueller loading hoses shall meet API/IP 1529 or EN 1361 type C standards. Additionally, hoses meeting the latest issue of BS 3492, or equivalent, rated for the maximum pressure of the loading system are also acceptable.

9.2.4 Dust caps shall be clean, in good condition, and fitted whenever hoses are not in use.
9.2.5 Fire extinguishers shall be easily accessible.

9.2.6 Pump shut down buttons shall be easily accessible and clearly identified. Their function shall be checked every month and the check recorded.

9.2.7 Some loading racks are equipped with Electronic Level Control (eg. Scully or equivalent) systems. Further information on these systems is contained in Appendix F.

9.2.8 Bonding cables shall be provided at the loading rack and their continuity shall be checked as per 8.6.5. Where loading is controlled by an Electronic Level Control system where bonding to the refueller is required to activate the loading pump, a separate bonding cable is not required if the system ensures electrical continuity between the vehicle and loading pipework.

9.3 Refueller loading procedures

9.3.1 A bonding connection between the loading pipework and the vehicle shall be made before the hose is connected and shall not be removed until the hose is disconnected at completion of loading.

9.3.2 During loading the pre-check device for the high-level shut off device shall be tested.

9.3.3 Unless equipped with two independant high-level shut off devices:
   a. refuellers should not be filled to the level at which a high-level shut off is activated;
   b. additional precautions are required to ensure that equipment is not over-filled. These include the use of a meter to limit the loaded quantity to a pre-calculated amount and/or the observation of refueller contents gauges during loading.

9.3.4 The use of a deadman to control the loading operation is strongly recommended. The type that requires periodic action by the operator within a pre-determined time interval to maintain fuel flow is preferred. Refer to section 8.3.14 for deadman details.

NOTE: A deadman system alone is not a preventative measure. It is a reactive, damage limitation, device unless activated before an incident occurs.

9.3.5 The operator controlling the loading operation shall remain in attendance throughout and shall have immediate access to a means of stopping the fuel flow quickly.

9.3.6 On completion of loading, the fuel shall be allowed to settle for at least 10 minutes. The refueller tank sump shall then be drained of any water and sediment and a sample taken for Visual Check.

NOTE: In North America, where water slug valves are installed in loading line filters, this check is not required.
9.4 Installations - Existing

9.4.1 In older installations that do not have loading meters, loading is often done against a high level sensor in the refueler tank that operates a foot (internal) valve, with no other safeguard against tank over fill. Some designs do not fail-safe, and spills have been experienced with this method of operation. Appropriate modifications to loading facilities and refuellers to meet the requirements of 9.1, 9.2 and 9.3 shall be made within 5 years of publication of this standard.
SECTION 10

10 HEALTH, SAFETY, ENVIRONMENT, AND EMERGENCY PROCEDURES

10.1 Management of Health, Safety and the Environment

10.1.1 Fuel storage, handling and into-plane fuelling operations should have a Health, Safety and Environment (HSE) Policy. It is the responsibility of the management of the facility to ensure that a suitable policy, conforming to local and national Health, Safety and Environment regulations, is available and enforced.

10.1.2 Oversight of the HSE management system is the responsibility of the facility management to adjust for changing circumstances, and to achieve continuous improvement in performance. As a minimum, the HSE system or programme for the facility should consist of the following;

a. a system for managing HSE in fuel handling operations;

b. a written policy for managing environment, health and safety controls should be developed and made available upon request (incl. an alcohol & drug policy, and personal protective equipment);

c. individuals at the facility will be given clear accountability for HSE activities in their job descriptions;

d. training will be provided to enable nominated staff to systematically review HSE factors and to self assess the performance of the operation;

e. the risks inherent in the operation should be reappraised and prioritized periodically;

f. HSE performance factors should be monitored;

g. HSE policies applicable to third parties should be communicated to those interfacing with the fuelling facility (e.g. contractors, ground personnel, airport authority, local & airport authorities and neighbours); and

h. changes in HSE regulations that could affect the operation should be monitored.

10.2 Safety and Training

10.2.1 General

This section deals with those aspects of safety, which are the direct concern of operating personnel. It is the responsibility of the Manager of the fuelling operation to ensure that the personnel under his control are adequately trained. For more details refer to Section 12.
10.2.2 Mobile Cellular Telephones
   a. Only communication equipment (e.g. cell phones, PDAs with phone capability) marked as intrinsically safe shall be used outside of the vehicle cab, or during aircraft fuel servicing operations within the fuelling zone.
   b. Mobile cellular telephones may be used by the fuelling operator inside the cab of the fuelling vehicle when the vehicle is parked, with the cab doors closed.
   c. While a fuelling vehicle is in motion, only hands-free communication devices may be used.

10.2.3 Electrical Storms and Lightning Precautions
   a. Fuel handling operations shall be suspended where lightning flashes are in the immediate vicinity of the airport.
   b. A written procedure shall be established with the airport authority to set the suspension criteria at each airport as approved by the fuelling agent, and the airport authority.

10.2.4 Prevention of Ignition of Flammable Vapours
   a. Natural fibre, natural/synthetic blend or non-electrostatic generating clothing should be worn by fuelling operators.
   b. Plastic containers without adequate electro-static discharge capability shall not be used.
   c. Precautions shall be taken to prevent the ignition of flammable vapours from all sources of ignition including (but not limited to):
      1) open flames;
      2) smoking;
      3) metal cutting and welding;
      4) hot surfaces;
      5) frictional heat;
      6) static electricity;
      7) lightning;
      8) electrical and mechanical sparks;
      9) spontaneous ignition (including heat producing chemical reactions);
      10) radar emissions;
      11) auxiliary power unit start-ups; and
      12) radiant heat.
10.3 Static Electricity

10.3.1 Introduction

In the aviation fuel industry, it is vital to understand how static electricity may be generated, the associated risks, and how to manage them. For example, static electricity can be created by:

a. pumping aviation fuel through pipes or filters;

b. flowing water through oil or fuel as in an oil interceptor (oil/water separator);

c. dropping a solid object into a liquid;

d. splash loading or filling;

e. passing synthetic rope through a gloved hand; or

f. the removal of clothing.

**CAUTION:** Strict adherence to aviation fuel handling procedures and practice is required to manage the risk of ignition.

10.3.2 Prevention of Electrostatic Ignition

a. Ignition hazards from electrostatic sparks can be eliminated by controlling:
   1) electrostatic charge generation;
   2) accumulation or discharge of electrostatic charges; and
   3) vapour-air mixtures in areas where electrostatic spark discharges may occur.

b. Floating roof tanks, or cone roof tanks equipped with internal floating pans/COVERS offer reduced vapour emissions compared to cone roof tanks without. However, this additional protection should be examined relative to the following recommendations for minimising electrostatic charge generation and spark discharges:

   1) floating roof tanks are not recommended for airport facilities because they provide less protection from water and solids contamination than cone roof tanks.

   2) if, due to consistently high fuel temperatures approaching or exceeding the flash point of the fuel, a floating roof is required and the use of a cone roof tank with the internal floating pan shall be considered;

   3) drawing fuel level in a floating roof tank down to the point where the roof legs rest on the tank bottom shall be avoided as a routine operation. When the roof is in a landed position, the presence of a vapour space requires that the tank be treated as a cone roof tank.
10.3.3 Precautions and Procedures

a. Antistatic Clothing

1) natural fibre, natural/synthetic blend, or non-electrostatic generating, fire retardant synthetic, (e.g. Nomex, textile clothing) should be worn. Wearing of nylon or similar synthetic clothing next to the skin is not recommended;

2) additionally, shirts shall not have open type breast pockets containing unclipped pencils, pens or other loose articles, which could fall out and into fuel tanks or samples; and

3) where possible, footwear should be antistatic. Safety shoes with exposed steel caps shall be replaced.

4) repeated entry and exit into refuelling cab may also increase static electricity generation.

b. Bonding and Grounding

1) Jet fuel without static dissipater additive has a conductivity of less than 50 picosiemens/meter. It is therefore a low conductivity liquid and hence a static accumulator. Even with the addition of a static dissipater additive it is only considered as medium conductivity and any electrical potential differences shall be equalized. Dependent upon geographic location the jet fuel may or may not contain static dissipater additive.

2) There are 3 ways for a static charge to escape or dissipate:
   1) discharge directly to earth;
   2) by coming into contact with something oppositely charged, or charged at a lower level which could result in an incendive spark creating, in the presence of fuel and air, a high risk of ignition; or
   3) over time through slow leakage of the charge.

3) Aviation fuel has a low conductivity, and therefore a static charge will dissipate slowly over time. Time is important in managing the risk posed by static build up, even when all equipment and containers are properly bonded to earth. This is called the relaxation time. No gauging, sampling, or dipping operations shall be carried out until that time has elapsed. Relaxation time can last from a few seconds up to 30 minutes dependent on the situation.
4) Some basic, but vital, rules to minimize the risk of static electrical build-up and discharge are:

1) always apply the relevant relaxation period according to the fuelling procedures;

2) personnel should remain off tank roofs during receipts, and for 30 minutes after filling;

3) wait 30 minutes before lowering any sampling or measurement equipment into a tank after any movement;

4) wait at least 5 minutes before sampling from trucks, rail cars and refuellers;

5) when sampling from tanks, never use plastic buckets or synthetic rope. Only metal or rope constructed of natural fibres may be used;

6) always ensure that all loose objects are secured such, as pens, before sampling. Dropping an object into a tank of fuel with a different electrical charge can cause a static spark;

7) extend fill pipes to the bottom of containers to avoid static caused by turbulence and splashing;

8) always bond equipment, vehicles and aircraft in accordance with procedures;

9) observe correct bonding procedures when sampling from tanks or vehicles and even when filling small containers;

10) whenever possible, use copper bonding spots on fixed installations.

c. Paint is a good insulator, and should never be applied to any bonding equipment.

d. Electrical Storms – In the case of road & rail tank movements, stop all activity during electrical storms that are within close proximity. Where practical, stop other tank movements (both filling and emptying).

NOTE: In the absence of local regulations defining "close proximity", as guidance information, movement is not permitted when electrical storms are located within 8 kilometres (5 miles) of the facility.

10.4 Use of Static Dissipater Additive

One way to reduce the potential electrostatic hazard during jet fuel handling is by the use of a static dissipater additive such as Stadis 450. However, periodic monitoring shall be performed to ensure that static dissipater additive treated fuel delivered into aircraft has the required conductivity.
10.5 Environmental, Security and Emergency Procedures

10.5.1 Personnel should be able to analyse a variety of situations, act in a disciplined manner and apply the correct procedures with confidence. This can only be achieved if procedures have been prepared to cover all possible emergencies, and training carried out to ensure that all personnel are familiar with the procedures and proficient in their assigned duties. Refer to Appendix K for examples of procedures that should be considered.
SECTION 11

11 RECORDS

11.1 General

11.1.1 All records should be signed by the person who carried out the checks. The vendor shall maintain a current roster identifying those individuals who sign off required checks, by their employee number and sample initials. The roster shall be available for review upon request.

11.1.2 For computer generated records, a password-protected access system, traceable to the individual person, is acceptable as an alternative to a signature.

11.1.3 For all electronic record keeping databases, a back-up system (at least weekly) is also required.

11.1.4 Vendors shall have a detailed internal records retention policy that is in accordance with local regulatory requirements.

11.1.5 The person responsible for a task is required to sign, or initial, all records. Forms of any type, or design, may be used as long as they provide a clear and concise record of events.
11.2 Minimum retention period - Table

11.2.1 All key records and documents, including electronic back-up records, shall be retained on-site for a minimum of one year before disposal, unless otherwise specified in this Table.

<table>
<thead>
<tr>
<th>RECORD TYPE</th>
<th>RETENTION PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Checks:</strong></td>
<td>- daily, weekly, and monthly</td>
</tr>
<tr>
<td></td>
<td>- per local regulations, or as a minimum for at least one (1) year.</td>
</tr>
<tr>
<td><strong>Fuel Quality Related Documents:</strong></td>
<td></td>
</tr>
<tr>
<td>Release and Test Certificates</td>
<td>3 years</td>
</tr>
<tr>
<td>Delivery notes and Release documents</td>
<td>3 years</td>
</tr>
<tr>
<td>Fuel quality records</td>
<td>3 years</td>
</tr>
<tr>
<td><strong>Maintenance Related documents:</strong></td>
<td></td>
</tr>
<tr>
<td>General housekeeping &amp; maintenance records</td>
<td>3 years</td>
</tr>
<tr>
<td>Critical Systems &amp; hydrant/equipment testing</td>
<td>3 years</td>
</tr>
<tr>
<td>Calibration Certificates</td>
<td>3 years</td>
</tr>
<tr>
<td>Filter records</td>
<td>6 years</td>
</tr>
<tr>
<td>Tank &amp; vessel inspections</td>
<td>for the life of the facility</td>
</tr>
<tr>
<td>Hose record</td>
<td>for the life of the hose</td>
</tr>
<tr>
<td>Waste Disposal records</td>
<td>forever</td>
</tr>
<tr>
<td><strong>Other documents:</strong></td>
<td></td>
</tr>
<tr>
<td>Incident Investigation reports</td>
<td>life of the facility</td>
</tr>
<tr>
<td>Training and Personnel records</td>
<td>while the employee is working within the department (may also be archived by Human Resources)</td>
</tr>
<tr>
<td>Technical audit records (internal &amp; external)</td>
<td>two audit cycles</td>
</tr>
</tbody>
</table>

11.2.2 Some samples of various records and forms can be found in Appendix E *(under development).*
SECTION 12

12 PERSONNEL AND TRAINING

12.1 General

12.1.1 It is the responsibility of the fuelling facility Manager to ensure that the personnel under his control are trained to perform their required job function per company manuals.

12.1.2 The majority of accidents can be attributed to lack of attention to, failure to carry out, or deviations from, prescribed procedures. Training of all personnel in every aspect of their normal operational and emergency procedures is important in order to strive for “accident-free” operations.

12.1.3 No employee shall be engaged in aviation fuel handling, or fuel quality control, duties that have a degree of colour blindness, which may preclude correct identification of aviation fuel colour, and its related identification colour code.

12.1.4 Personnel should be tested for colour blindness at the time of initial employment, and periodically as required by local regulations.

12.2 Training Program

12.2.1 The vendor shall have a documented training program for all personnel that handle fuel, which includes:

a. Fuel Quality;
b. Safe operation of equipment; and
c. Emergency procedures.

12.2.2 The documented training program should also include content related to Health & Safety, and IATA’s Guidance Material on Standardized Into Plane Fuelling Procedures, where relevant.

12.2.3 The vendor shall assure that each employee is properly trained for the work the individual is to perform. Although the contents of each of the components may vary to reflect individual company requirements, each employee’s training shall include the training subjects relevant to the tasks that they perform. Documentation of the training for each employee shall be maintained.

12.2.4 The vendor shall document both formal (classroom) and on-the-job training. It will be the responsibility of the site management/supervisor to ensure that only qualified employees (including contract personnel) refuel aircraft without supervision. Documentation of all training records and certifications shall be filed on site, and made available for review on request.
12.2.5 Training records (basic & recurrent) shall include:
   a. a description of the training;
   b. date of instruction and duration;
   c. name of instructor and student and signature of both;
   d. name of organization conducting the training if performed by an outside agency; and
   e. documented results (written or practical), as applicable, to establish employee competency.

12.2.6 New personnel shall be thoroughly trained in all operations and procedures that they will be
required to perform in the course of their duties, and in all actions to be taken in the event of an
emergency. Personnel required to undertake new tasks shall be fully trained before undertaking the
new task without supervision.

12.2.7 Step-by-step procedures for all critical tasks (e.g. aircraft fuelling; hot refuelling of helicopters;
refuelling in a hangar environment; defuelling; fuel quality control) shall be clearly documented (i.e.
hardcopy or electronic) in order to facilitate the initial and recurrent training of employees.

12.2.8 Follow-up job observation should be established, and the dates and results of these observations
shall be recorded in the operator’s training record. As a minimum, an annual review of employee
training requirements shall be performed, and any refresher training provided as deemed
necessary.

12.2.9 A three-year refresher training program for critical tasks should also be established.

12.3 Fire Training

12.3.1 Drills should be attended by all personnel on a regular basis, as per local regulatory requirements.
All personnel shall be familiar with the location of fire extinguishers, fire alarm systems and the
procedure for calling the fire service and other emergency services.

12.3.2 Training of fuelling personnel, taking into account equipment of the type located at the fuel storage
facility and on fuelling vehicles, should include various fire emergency procedures (e.g. evacuation
procedures, practical (i.e. “hands-on”) fire-fighting training, etc) per local regulations. Where
possible, this training should be carried out in co-operation with the local airport authority and/or fire
service.

12.3.3 Periodically, operations personnel shall be given the opportunity of discharging fire extinguishers in
accordance with local regulatory requirements. Their participation shall be recorded in their training
record.

12.3.4 Emergency situations which could occur during fuel handling (e.g. fuel spillage, fire, injuries to
personnel) should be simulated to provide practice in the most effective measures necessary to
deal with them and to ensure that all personnel clearly know their duties.
12.3.5 Fuelling personnel shall be familiar with the location and operation of emergency stop switches and controls on fuelling vehicles, on the apron and at the installation. A drawing/plan of the installation identifying the location of fire fighting equipment, emergency shut down devices and exits and assembly points should be prominently displayed.

12.4 Fuel Spill Avoidance & Response

12.4.1 Training of fuelling personnel, taking into account equipment of the type located at the fuel storage facility and on fuelling vehicles, should include various emergency fuel spill situations.

12.4.2 This training should be carried out as per national/local regulatory requirements, and where possible, in co-operation with the local airport authorities, fire services, and other affected groups.

12.5 Hijack Scenario Training

12.5.1 In the unlikely event of a hijacking where fuelling may be required, training of fuelling personnel should be carried out as per national/local regulatory requirements, and in co-operation with the local airport authorities, fire services, and other emergency response personnel or affected groups, as necessary.
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NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX A

FILTRATION EQUIPMENT

A.1 General Types

NOTE: Filter selection process and detailed filter information is available in API/EI 1550.

A.1.1 Filter/water separators
Filter/water separators are designed to separate and remove from the fuel:

a. all solid contamination in excess of 0.26 mg/L. (1 mg per USG);

b. free water in excess of 15 ppm.

This is accomplished in a two-stage operation by two separate filtering media elements installed within the filter vessel:

First Stage – The coalescing, or first stage, consists of a number of individual filter/coalescer elements, grouped in a symmetrical arrangement on the inlet side of the filter. The unfiltered fuel entering the vessel passes through these elements from the inside to the outside before entering the water fallout area of the vessel.

As the fuel passes through these elements, the coalescers perform a dual function:

a. removing solid contaminants from the fuel; and

b. coalescing water (bringing together small droplets of water in the fuel to form large droplets).

Second Stage – The separator, or second stage, consists of a number of individual separator elements grouped in a symmetrical arrangement on the outlet side of the filter vessel. Flow is from outside to inside. Each element shall be of synthetic or teflon-coated construction (not paper). Instead of using a number of individual elements, a basket type Teflon coated separator is sometimes used. As the fuel passes through, the separator's main function is to repel the final traces of coalesced water that did not fall out of the fuel stream by gravity. In some cases, a multi-stage (i.e. “third” stage) may be installed. Typically this is a filter monitor element housed within a 2nd stage separator element, providing an extra level of protection. For details refer to API/EI 1550.

A.1.2 Filter Monitor
The main type of water absorbing filter used for final filtration of jet fuel prior to entering the aircraft. Filter monitors are not fail safe, the water removal performance can degrade in service such that there may not be any signs of this condition for the operator. They do not provide 'continuous monitoring of fuel', nor do they provide a positive shut off of fuel flow.
A.1.3 Clay Treaters

A Clay Treater is designed to use attapulgus clay either in replaceable bags or cartridges. Clay Treaters are usually placed upstream of a Filter/water separator system. This special clay absorbs surface active agents (surfactants) and colour bodies in the fuel which are not otherwise removable. The removal by adsorption of surface active agents and colour bodies depends upon the:

a. intimate contact of fuel and clay;
b. residence time of the fuel in the clay bed;
c. condition of the fuel and clay.

Water will form channels in the clay bed and prevent the uniform passage of fuel through the clay bed. Excessive amounts of free water in the fuel will deactivate the clay bed; rust or other particulate matter can prematurely increase the pressure drop through the bed. With use, and especially in the presence of water, the clay will become overloaded and deactivated. If these conditions exist, the installation of a hay pack and/or micronic filter upstream of the clay unit should be considered.

Clay will remove some types of additives, such as static dissipaters and corrosion inhibitors, which may be required in the fuel specification. Therefore, installation of clay treaters should provide for downstream injection of additives at locations where additives are required in the fuel.

Two types of replaceable cartridges are available:

a. Bag Type – The bag type is constructed of cloth with cloth lifting "ears" located 180 degrees apart. A felt centre tube liner is provided to reduce migration of the clay particles.
b. Cartridge Type – The cartridge type is constructed with a perforated centre tube covered by felt. The end caps are rigid and have gaskets for more positive sealing. The cartridge type is provided with a wire lifting handle for ease of installation and removal from the vessel.

A Clay Treater used for Airport depot inlet filtration may not be used in continuous service, but only when low MSEP or other problems may warrant its use. It is not advisable to let a Clay Treater vessel remain unused for an extended period (e.g. more than one month) as microbial growth may develop in the vessel while it is out of service.

Clay treaters not in regular service, which contain fuel, shall be have their vessel mounting plate low point drained of water/sediment at the same frequency as if they were in service. There shall also be a regular frequency, of not less than monthly, in which the vessel is flushed with fuel during a regular Airport depot receipt. During periods when the Clay treater is not in service, the routine MSEP/Swift Kit testing is not required.

A.1.4 Single stage Filter/coalescer Vessel (Hay pack)

Single stage water filter/coalescer s, commonly referred to as Hay Pack filters, are horizontal, cylindrical shaped housings to protect downstream filtration (Clay Treaters and/or Filter/water separators) from gross amounts of water and heavy solids. The coalescing first starts as fuel enters the vessel. Due to reduced velocity, free water will fall out by gravity. As the fuel passes through the media further coalescing occurs. At the same time, solids tend to drop out due to the reduced velocity and are removed by filtration.
A.1.5 Micro (Pre) Filter
A Micro (Pre) Filter vessel containing cartridges is used in removing solid contaminants such as rust, dirt, scale, granular and other types of solids from aviation fuels. Micro (Pre) Filters are usually installed upstream of Filter/water separators and Clay Treater (where installed). Filter elements are typically constructed of pleated paper and are available in various micron ratings dependent on the size of the contaminant being encountered in the fuel.

Synthetic pleated micro (pre) filters elements should be used when water is present in the fuel. For details refer to API/IP 1590.

A.2 Requirements – Filtration
A.2.1 All Filter Vessels shall be equipped with:

A.2.1.1 Air Eliminator Valve
There is a risk of internal fire or explosion if fuel is pumped into a vessel which contains air. Therefore, with the exception of small single-element vessels, automatic air eliminators shall be installed on all filter 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 discharge system shall be wire sealed in the open position during normal operations. The discharge pipe work from the air eliminator should be arranged such that any fuel that escapes is returned to a recovery system. Where appropriate, soft seat non-return valves, with an opening pressure of 7 KPa (1 psi) shall be installed into the pipe work to prevent fuel from draining out of the filtration vessel under gravity and the ingress of air.

A.2.1.2 Pressure Relief Valve
With the exception of small single-element vessel, each filter shall be fitted with a pressure relief valve to ensure that the design working pressure of the vessel is never exceeded. The operation of relief valves requires the discharge piping to be open at all times when the vessel is in service. Any isolation valves in the discharge system shall be wire sealed in the open position during normal operations. The discharge pipe work from the relief should be arranged such that any fuel that escapes is returned to a recovery system.

A.2.1.3 Pressure Differential Gauge
All filters shall be equipped with direct reading differential pressure gauges to indicate pressure loss across the unit except for small single-element vessels. Each gauge shall have a suitable valve on its downstream/low pressure line, so the line can be vented to allow a full deflection check of the gauge periodically. Where a filter/water separator vessel is equipped with a third stage (monitors), then the differential pressure gauges shall be installed to measure the total differential pressure across the vessel.

A.2.1.4 Vessel Low Point Drain and Sample Connections
All filter vessels shall have a drain connection at the lowest point of each chamber. The main sump drain line should be fitted with a spring-loaded closed valve permitting regular check samples to be conveniently taken. The outlet of the drain line shall be equipped with a dust cap to prevent entry of extraneous material. Automatic water drain valves shall not be installed on any filters.

Upstream and downstream sampling point connections (either permanently installed, or allowing the quick installation by hand) consisting of probes, dry break connection and dust caps or plugs shall be installed on all filter vessels to assist in measuring the performance of the filter vessel.
A.2.1.5 Fixed Platforms
Working platforms with handrails shall be installed around all filter vessels where the vessel can not be opened
and elements changed by the operator at ground level. Portable ladders do not meet this requirement.

A.2.1.6 Internal Lining
Unless constructed from stainless steel or aluminum, the interior of each vessel shall be completely lined with a
light coloured epoxy meeting API/EI 1541.

A.2.1.7 Placard/Signage
The dates of the last internal inspection and element change shall be indicated on the vessel, and the volumetric
capacity of the drain line shall be marked as close to the drain point as practicable. Manufacturers recommended
torque settings applied to all elements, as well as vessel cover lid, shall be readily available at each site.

A.2.1.8 Nameplates
A permanent metal nameplate shall be securely attached to the vessel and include the manufacturer’s name and
address, vessel serial number and model number, date of manufacture, design code of the vessel, design
pressure and maximum flow rate of the vessel.

Where the filter information has changed from the original dataplate, a removable nameplate describing the
vessel flow rate; vessel model number; and model and number of elements shall be securely attached to the
vessel. New Filter/water separators, Monitor and Micro (Pre) Filter vessels shall meet the name plate (data plate)
requirement of their respective industry standard (e.g. API/EI 1581, EI 1583 and API/EI 1590) respectively.

A.2.2 Filter/water separators
Filter separators shall meet the performance requirements of API/EI 1581.
All new vessel and element combinations shall meet the latest edition of API/EI 1581.

For existing vessels, element conversions should meet, by test or similarity, the latest edition of API/EI 1582
requirements as soon as practicable, and in any case within five years of the publication becoming effective. New
edition elements should be purchased as soon as practicable.

All Filter/water separators shall be equipped with the additional equipment described below:

A.2.2.1 Water Defence System
Each Filter/water separator delivering fuel directly into aircraft shall be equipped with a water slug shut off device
as described in API/EI 1581. This device shall be equipped with an external mechanism for testing.

The implementation of monitoring procedures to assess the contents of the filter sump after aircraft fuelling is an
alternative to installing the water slug shut off device.

To ensure water does not get delivered to the refueller or hydrant, installation of a water defence system may be
an option for certain fuel storage facility/tank farms. For example, in the US and certain other countries Filter/water
separators located in the fuel storage facility/tank farm shall be equipped with a water slug shut off device or sump
water level alarm as described in API/EI 1581. This device shall be equipped with an external mechanism for
testing.

NOTE: The water slug shut off device option does not apply to pipeline receipt filtration (but the sump alarm
applies).
A.2.3 Monitors

Filter monitor vessel and element combinations shall meet the performance requirements of EI 1583.

Monitors shall be equipped with a pressure limiting device that will prevent excessive differential pressure from damaging the elements in the event of a complete blockage. This device shall be equipped with an external mechanism for testing. Sampling to assess the contents of the filter sump after aircraft fuelling is an alternative to installing a pressure limiting device.

A.2.4 Clay Treaters

A.2.4.1 Clay treater vessels shall have:

a. welded steel construction meeting ASME Code, section VIII construction, stamped and certified;

b. working pressure to a minimum of 1034 KPa (150 psi) or greater dependent on local requirements;

c. interior of each vessel shall be completely lined with a light-coloured epoxy meeting API/EI 1541;

d. removable cartridge mounting posts;

e. swing bolt closures;

f. hydraulic head lifts.

A.2.4.2 Clay Elements

Elements should be canister or bag type. Internal mounting equipment shall not contain cadmium, copper or zinc containing material. Flow rate per canister should not exceed 26 litres/min (7 US gallons/min).

A.2.5 Hay Packs (also known as Single stage Filter/coalescer Vessels)

A.2.5.1 Hay Packs shall have:

a. welded steel construction meeting ASME Code, section VIII construction, stamped and certified;

b. design working pressure to a minimum of 1034 KPa (150 psi) or greater dependent on local requirements;

c. have interior of each vessel shall be completely lined with a light-coloured epoxy meeting API/EI 1541;

d. swing bolt closures.
A.2.5.2 Water Defence System
All hay packs located in the fuel storage facility/tank farm should be equipped with a water slug shut off device, or sump water level alarm (for pipeline delivery), as described in API/EI 1581 for filter /separators. This device shall be equipped with an external mechanism for testing.

A.2.5.3 Coalescing Elements
The hay pack element may consist of packed fibreglass or “Excelsior” (fibrous compressed hay-like) material. Internal mounting equipment shall not contain cadmium, copper or zinc containing material.

A.2.6 Micro (Pre) Filters
Micro (pre) filters shall meet the performance requirements of API/EI 1590.

A3 Routine Checks

A.3.1 All Filters

A.3.1.1 Daily Free Water Check
Preferably at the start of the morning shift or prior to, or at the beginning of, the first fuelling of the day, filter vessels shall be drained of free water, preferably under pressure. Details of any free water or sediment found shall be recorded. A sample shall then be taken for a Visual Check. Additional filter sump sampling for Mobile Refuellers is described in Section 8.9.

A.3.1.2 Differential Pressure (dp)

A.3.1.2.1 General
Whenever fuel passes through a filter, a drop in pressure should occur. The difference in pressure between the inlet and outlet of the filter vessel is known as differential pressure (dp), and is one indicator of filter element condition. The purpose of observing dp across a filter vessel is to monitor the changing condition of the elements. Dp will fluctuate proportionately to flow rate. Fuel shall be flowing through a filter vessel in order to have a dp.

During all pumping/fuelling operations, the dp should be regularly observed to ensure that the maximum limit is not exceeded.

It is recommended that the flow rate and dp shall be recorded in the vehicle log on a daily basis. For accuracy, these checks should be undertaken when the flow rate is steady and as close as possible to maximum achievable flow rate. Unexpected variations should be reported and investigated.

Once a week, at the highest flow rate normally achieved, the dp and flow rate shall be recorded. A weekly graph shall be prepared showing the dp at, or corrected to, maximum flow rate.

NOTE: Alternatively a flow rate can be predetermined, the dp observed, and corrected to the maximum flow rate.

Verify the proper operation of filter differential gauge(s) every 6 months in accordance with gauge manufacturers’ procedures. Accuracy shall be within ±2 psi.

Some direct reading gauges have small filters in their inlets. Where such gauges are fitted, the filters shall be replaced annually to assure proper operation.
A.3.1.2.2 Filter/water separators, Micro (Pre) Filters and Filter Monitors
Filter monitors or separator elements shall be:
   a. investigated if a sudden drop (i.e. >3 psi) in dp occurs under similar flow conditions, corrected to maximum achievable flow rate, or
   b. replaced when a sudden drop (i.e. >5 psi) in dp occurs under similar flow conditions.

A.3.1.2.3 Clay Treaters
Sudden increase in differential pressures for a given flow rate, could mean the clay has been:
   a. fractured by contact with water, or
   b. contaminated with rust, or other particulate matter.

Any sudden changes in dp shall be investigated immediately.

A3.2 Membrane Filtration Tests

A.3.2.1 General
All filter membrane tests (colorimetric and gravimetric) shall be carried out at a flow of at least 50% of the rated flow of the filter and according to ASTM D2276/IP216. All results shall be recorded and the colorimetric membranes retained for 3 years.

A Colorimetric Filter Membrane Test shall be carried out downstream of the filter:
   a. monthly for receiving filtration at fixed facilities;
   b. quarterly on into-hydrant and refueller loading filters (tests shall be performed on at least one filter each month in rotation such that every filter is checked quarterly);
   c. monthly on each vehicle;
   d. after new hose installation; and
   e. after filter replacement.

Where fuel quality or filtration problems are suspected upstream (e.g. receipt filter differential pressure rises at a much faster rate than is typical for the location, or if excessive water or solids are suspected or observed in routine samples), a Colorimetric Filter Membrane Test may be conducted upstream of receipt filtration as a check on the quality of the incoming fuel. Refer to Section 5.2.5 & A7 for details.

A.3.2.2 Colorimetric Filter Membrane Test
This test may be carried out using a sample point at:
   a. the hose end; or
   b. on the test rig; or
   c. the vehicle pipe work downstream of the filter.

Alternatively, the tests may also be carried out during aircraft fuelling using a closed sample point in the vehicle pipe work, or nozzle, downstream of the filter.
A.3.2.3 Double Membrane Colorimetric / Gravimetric Testing

Either a double membrane colorimetric test, or a gravimetric test, shall also be carried out on each vehicle at least every six months.

**NOTE:** it is recommended that the tests are performed on a schedule that is staggered over the year.

Double membrane colorimetric testing may be carried out as an alternative to gravimetrics, provided that fuelling equipment meets the filtration requirements of section 8.2, that the airport fuel storage facility receipt and delivery filtration meets API 1581 requirements, and that airport fuel storage facility tankage meets the design requirements of Section 6.

If the test results are unsatisfactory (see A7), additional tests should be carried out. If the results are confirmed, then the vehicle should be withdrawn from service and the filter vessel opened for inspection.

All filter membrane tests (colorimetric and gravimetric) shall be carried out at a flow of at least 50% of the rated flow of the filter and according to ASTM D2276/IP216. All results shall be recorded and membranes retained for 3 years.

A3.3 All Filter Vessel Internal Inspections

Open up (per manufacturer’s instructions) the filter housing at least annually and inspect its internal cleanliness & condition, noting the following items:

a. Check all elements for appearance, and:
   1) replace any found damaged; and
   2) investigate any signs of microbial growth (e.g. leopard spotting), and replace elements if confirmed.

b. Check all elements for secure mounting. The tightness of element attachment nuts shall be checked with a torque wrench, adjusted in accordance with the element manufacturer’s recommendations. Take care not to damage the elements.

c. A representative sample (i.e. 20%) of Teflon-coated and Synthetic separator elements from Filter/water separators shall be inspected and tested in accordance with the manufacturer’s recommendations. The test results shall be recorded, and if one or more are found to have failed the water repellency test, then all elements are required to be tested.

d. Any separator elements that:
   1) are damaged shall be replaced; or
   2) fail the water repellency test can be reused if successfully restored in accordance with manufacturer’s recommendations.

e. Inspect the vessel interior surface to ensure that no flaking or pitting is taking place;

f. Inspect condition of the cover seal, and replace if necessary;
g. With the exception of separator elements which routinely need to be removed for testing, elements should only be removed if necessary to repair damage to the vessel coating. Where it is found necessary to remove elements, replace them with a completely new set.

**NOTE:** Elements should be handled carefully while wearing clean gloves to avoid skin contact.

h. Look for corrosion, charring, or any evidence of internal ignition around the inside of the housing which would indicate improper functioning of the air eliminator. Make any necessary repairs.

After opening for inspection or filter element changeout, procedures should ensure that the vessel is refilled very slowly to allow any entrapped air to vent, and to ensure that no damage is caused to the installed elements.

A.3.4 Monitoring of Clay Treater effluent

Check Microseparometer (MSEP) levels upstream and downstream of Clay Treater on a monthly basis, when the clay treater are in continuous use, or more frequently if low MSEP (less than 85) fuels are being received or suspected. Detailed instructions for performing the test are contained in (ASTM D3948).

MSEP provides a field method for determining water separation characteristics of jet fuel. Fuel containing little or no surfactant has excellent water separation characteristics. Fuel containing significant amounts of surfactant has very poor water separation characteristics. The better the water separation rating, the more effective system filtration equipment will be in removing free water. The operator should be cognizant of the fact that this is a very sensitive test. Erroneous results can be obtained if improper sample containers are used. This is especially true with new unlined metal containers.

The test is particularly useful in monitoring clay treatment vessel performance. Tests are normally performed on samples from the upstream and downstream sides of the vessel and the results compared. Assuming a relatively low rating upstream (e.g. 70), the downstream result should be higher if the clay is active. No improvement or a worsening of the rating on the downstream side of the vessel are indications of spent clay. When upstream and down, and stream MSEP results are between 90-100, then comparison is not possible between upstream and downstream samples and the clay activity should be considered acceptable.

In a well maintained fuel handling system equipped with a clay treatment vessel, an improvement of water separation ratings of up to 15 numbers should be achieved. Any MSEP result below 85, on the clay treater outlet, would be grounds for investigation.

For example: if upstream results are:
- above a 70 MSEP then a possible change out of clay elements is warranted; or
- below a 70 MSEP then an investigation in the quality of the fuel being received is warranted as the Clay treater is performing satisfactorily.

The Velcon SWIFT kit may be an acceptable alternative to MSEP for determining clay activity on a regular basis, although MSEP results should still be the criteria for change out of spent clay.

This test kit measures the interfacial tension (IFT) of the fuel which varies with surfactant levels in the fuel. Active clay should typically show an improvement between samples taken from the downstream and the upstream of the clay treater.

a. If the Downstream Swift Kit results are higher than the upstream, but obtaining downstream results of greater than 37 dynes/cm, the clay elements are considered active.
b. If the Downstream Swift Kit results are same as upstream, but obtaining results of greater than 37 dynes/cm, no determination of the clay can be determined as the fuel has little in the way of surfactants.

c. If the Downstream Swift Kit results are the same as upstream, but obtaining results of 32-37 dynes/cm, the clay is likely exhausted and confirmation of on repeat samples for MSEP results shall be performed, as described above, to verify condition of clay elements. If upstream results are between 32-37 dynes/cm, then an investigation in the quality of the fuel being received is warranted dependent on fuel receipt criteria (such as a check of upstream fuel quality for MSEP).

d. If the Downstream Swift Kit results are the same as upstream, but obtaining results of <32 dynes/cm, clay is exhausted. The Clay elements should be replaced, or confirmation of repeat samples for MSEP results shall be performed to verify condition of clay elements. If upstream results are between 32-37 dynes/cm, then an investigation in the quality of the fuel being received is warranted dependent on fuel receipt criteria (such as a check of upstream fuel quality for MSEP).

Check Swift Kit IFT results levels upstream and downstream of clay treater on a monthly basis, or more frequently if low MSEP (less than 85) fuels are being received or suspected. Detailed instructions for performing the test are contained in the Swift Kit manufacturer’s instructions. The Swift Kit has a one year shelf life and should not be used if it has expired.

A4 Filter Vessel Element Change Criteria

A 4.1 Micro (Pre) Filters
Micro (Pre) filter elements shall be replaced

a. if the filter element has reached its maximum manufacturers recommended service life

b. if the differential pressure reaches the manufacturer’s recommended maximum at (or corrected to) the maximum operating flow rate through the filter vessel as currently installed. The maximum operating flow rate will usually be less than the design or rated flow of the vessel.

c. if flow rate falls to unacceptably low levels

d. if abnormal filter membranes are obtained

e. if unusual sediment is found downstream of the filter; or

f. In the case where there is a sudden drop in, or no, differential pressure without any obvious cause being found, then inspect elements for rupture and replace as necessary.

After each vessel inspection or element change, mark the date of the inspection or change on the vessel and update the filter records showing the reason and results of the inspection and details of new elements installed.

A 4.2 Clay Treaters
Where it has been established following testing, that Clay Treater element performance has degraded, as described below, they shall be replaced:

a. if the differential pressure reaches 1.0 bar (15 psi), or manufacturers recommended dp change out requirements, or reaches a level that reduces flow rate excessively;

b. if the MSEP downstream results are less than 10-15 numbers higher than the upstream results, then the Swift kit results may be used as a change-out criteria; or

c. if unusual sediment (i.e. excessive clay granules indicating an element rupture or microbial growth) is found downstream of the filter, or in the treater sump drain.

After each vessel inspection or element change, mark the date of the inspection or change on the vessel and update the filter records showing the reason and results of the inspection and details of new elements installed.

A 4.3 Filter/water separator

A.4.3.1 Filter/coalescer Elements
Filter/coalescer Elements shall be replaced every three years. Station, fuelling agents, FBOs, etc., will submit proposed time extension program in writing. If accepted, airlines will provide written approval, which shall be available for review.

NOTE: In North America, they shall be replaced every 12 months, or their life may be extended beyond 12 months, provided all affected airlines approve the filter/coalescer element life extension program.

Filter/coalescer Elements shall also be replaced:

a. if the differential pressure reaches 1.0 bar (15 psi) at, or corrected to, the maximum operating flow rate through the filter vessel as currently installed;

b. the maximum operating flow rate will usually be less than the design or rated flow of the vessel;

c. if filter membrane tests indicate elements are not performing (see A.1.7);

d. if there is a sudden drop in differential pressure without any obvious cause being found (see A 3.1.2.2)

e. if unusual sediment or traces of free water are found downstream of filter;

f. if a problem is observed during annual inspection (e.g. damage or microbial growth/contamination (i.e. leopard spotting)).

It is not mandatory to perform routine single element tests. If, however, a test is carried out and the element fails, all the filter/coalescer elements in the vessel shall be replaced.

A 4.3.2 Filter/water Separator: Separator Elements
Teflon-coated and synthetic elements shall be:

a. inspected and tested annually in accordance with the manufacturer’s recommendations and/or when filter/coalescer elements are inspected or changed;
b. changed if washing, in accordance with the manufacturer’s instructions, fails to restore them.

A 4.4 Monitor Type Elements
Monitor type elements shall be replaced every 12 months per manufacturers recommendations, or:

a. if the differential pressure reaches the manufacturers recommended dp change out requirements;

b. if flow rate falls to an unacceptably low level;

c. if abnormal filter membrane results are obtained;

d. if unusual sediment or more than a trace of free water is found downstream of the vessel;

e. if there is a sudden drop in differential pressure without any obvious cause being found (see A 3.1.2.2).

A.4.5 Hay Packs (Single stage Filter/coalescer Elements)
Each hay pack element shall be replaced every three years, or:

a. if the differential pressure reaches the manufacturers recommended dp change out requirements;

NOTE: changing individual elements to recover dp is permitted, provided their 3 year life is respected.

b. if flow rate falls to an unacceptably low level;

c. if unusual sediment or more than a trace of free water is found downstream of the vessel;

d. if there is a sudden drop in differential pressure without any obvious cause being found (see A 3.1.2.2).

A 5 Records
Also refer to Section 11 and Appendix E.

A 5.1 A record shall be kept of all filter maintenance showing at least the following;

a. number and type of new elements installed;

b. differential pressure before and after change;

c. throughput since previous change; and

d. reason for change with any relevant details.

A 6 Differential Pressure Gauges
All differential pressure gauges shall be tested are per requirements of A 3.1.2.
A.7 Filter Membrane Monitoring

A record shall be maintained, showing clearly the test results for each filter. Refer to Section 11 for retention time.

A 7.1 Colorimetric Filter Membrane Test
Test monitors containing one un-weighed membrane are required. After test, the wet exposed membranes should be colour rated against the ASTM Colour Standards in the recommended manner. They should then be air/oven dried, and again rated against the colour standard. Colour rating in the wet condition after sampling provides an immediate indication of fuel cleanliness. The wet and dry ratings should be recorded for future reference/comparison.

A colour rating of 3-DRY or greater downstream may indicate a particulate contaminant problem. If a colour rating of 3-DRY or greater is observed, proceed as follows:

a. Perform a double membrane particulate test as per A7.2 below. If top and bottom membranes (when both are wet or dry) have a colour rating difference of 2 or less, fuel is to be considered clean and acceptable.

b. If difference is 3 or greater, conduct a gravimetric (weight) analysis per the text below. Fuel is unacceptable if gravimetric test (as per ASTM D2276) results exceed 0.2 mg/L (0.8 mg/G) based on test sample size taken.

A 7.2 Double Membrane Colorimetric Test
Test monitors containing two un-weighed membranes are required. The reason for using two membranes is to distinguish between particulate contamination and harmless colour bodies.

If the fuel is dirty the upper (upstream) membrane may have a significantly darker colour after testing than the lower membrane. If the fuel contains soluble colour bodies then both membranes will be stained by the test. After test, the exposed membranes should be allowed to dry and then rated against the ASTM Colour Standards in the recommended manner.

A 7.3 Gravimetric Test
This testing is not normally done on a routine basis. It is mostly used for investigating the performance of a filter vessel, or where there is a dispute regarding the cleanliness of fuel being received. Test monitors containing two pre-weighed membranes (or a matched weight pair) shall be used for this test.

Tests shall be carried out in the recommended IP/ASTM manner with the unit on test delivering at a steady flow rate via suitable test facilities (refer to Appendix B3.4) back into storage tanks, or alternatively into a separate receiving container (refuellers should not be recirculated). Line pressure at the sampling point should be approximately 2.5 bar (35 psi) and total flow rate should be at least 50 % of the rated flow of the equipment.

After test, the used monitor shall be returned, without opening, to the laboratory, and the gravimetric result determined in accordance with the IP/ASTM procedure. Any results outside the normal range for the location shall be investigated. Any result of 0.20 mg/litre or more shall be reported immediately and a repeat gravimetric membrane test carried out.

To determine whether there is a continuing problem an immediate investigation shall be carried out, including a double membrane colorimetric test and filter vessel inspection, until the cause of the problem has been identified or until the repeat gravimetric test result is reported as satisfactory.

A 8 Filter and Treater Change-out Procedure
For cartridge units, the manufacturer's operating manual gives specific instructions regarding the cautions and procedures for the removal of spent cartridges, and for the installation of new cartridges. The appropriate operating manual should be referred to prior to the change-out.

When new elements have been installed in refuellers and hydrant vehicles, circulate fuel through the unit, preferably back to storage, at maximum flow for a minimum of 5 minutes to remove small fibres and manufacturing residue before returning the unit to service.

The following table lists the various filter types and their maximum service life.

<table>
<thead>
<tr>
<th>Filter Type</th>
<th>Service life</th>
<th>Maximum Pressure Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>bars (kg/cm²)</td>
</tr>
<tr>
<td>Micro (pre)filter</td>
<td>3 years</td>
<td>Manufacturer recommended Max.</td>
</tr>
<tr>
<td>Clay Treater</td>
<td>3 years</td>
<td>1.0</td>
</tr>
<tr>
<td>Filter/coalescer *</td>
<td>3 years</td>
<td>1.0</td>
</tr>
<tr>
<td>Monitor</td>
<td>1 year</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* NOTE: In North America, filter/coalescer s shall be replaced every 12 months, or their life may be extended beyond 12 months, provided all affected airlines approve the filter/coalescer element life extension program.

The maximum pressure differential listed in the table above is the actual value, and not the value in addition to the installation pressure.
NOTES: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX B

OPERATION OF PRESSURE CONTROL SYSTEMS AND DEADMAN CONTROL VALVES

B 1 General

Aircraft systems are generally designed to accept a fuelling flow rate commensurate with the following design parameters:

• a maximum fuelling pressure of 3.8 bar (50 psi) [see Note] in the vehicle delivery nozzle, under flow conditions; and
• to withstand a maximum surge pressure of 8.3 bar (120 psi), due to a second valve closure.

To ensure that these limits are not exceeded, fuelling vehicles are equipped with pressure control valves in accordance with Section 8.3.10.

NOTE 1: In the USA there are additional specific requirements that require fuelling pressure control systems to never allow the actual fuel pressure measured at the fuel nozzle outlet to exceed the following limitations:

• 40 psi under conditions of constant flow by the primary pressure control devices; and
• 50 psi under conditions of constant flow by secondary pressure control devices.

B 2 Types of Valves, Their Purpose and Control Limits

B 2.1 Hose End Pressure Control Valve (HEPCV)

This unit, which is installed on the delivery nozzle, includes a spring which is rated at a specified pressure (the “spring datum setting”). The spring datum setting is normally 45 psi.

NOTE 2: In the USA, the spring datum setting is normally 35 psi.

The HEPCV has two functions:

1) Pressure Surge Control - the pressure in the aircraft manifold shall not exceed a maximum peak (transient) shock or surge pressure of 8.3 bar (120 psi). Surge can be induced by automatic closure of the aircraft tank valves when the tanks are full, by manual switching, or by an on board electrical failure. A rapid increase in downstream pressure causes the HEPCV immediately to limit system pressure and reduce flow rate. It closes more quickly than the aircraft tank valves, allowing excessive pressure to be dissipated into the vented aircraft tanks.

2) Primary Pressure Control – if an aircraft tank high level automatic shut off valve fails to close, fuel passing into the vent/overspill system would cause a restriction and the tank could be damaged by over-pressurisation. By limiting fuel delivery pressure, the HEPCV also limits the flow rate which could pass into the vent system. Normally this pressure must not exceed 3.5 bar (50 psi) [see Note 1 above].
B 2.2 In-line Pressure Control Valve (ILPCV)

The ILPCV limits the delivery pressure, even if the HEPCV does not function correctly. On refuellers and fixed (cabinet type) dispensers, it may act as a pump by-pass (or control the output of a pump), or be installed in-line in the main delivery pipe work. On hydrant servicers it is usually installed in the inlet coupler or hydrant pit valve. The ILPCV may be installed to act in one of two ways:

1) Without Pressure Loss Compensation (Direct Sensed)
   Pressure on entry to the delivery hoses is limited to a maximum of 3.8 bar (55 psi). If the HEPCV seals leak at shut off, the static pressure will be restricted to this value. The system is simple to test and adjust but is not flow rate sensitive. Maximum flow performance may be limited due to pressure losses downstream of the control point. On many applications, the control point is remote from the valve, connection being made via a fuel sense line.

2) With Pressure Loss Compensation (Venturi Sensed)
   The ILPCV is used to control pressure under flow conditions to a maximum 3.8 bar (55 psi) [see Note 1 above] at the hose end. Generally, downstream pressure losses are compensated for by connecting the fuel sense line to the throat of one or more venturis, where the flow area is much smaller than in the adjacent pipe work. This creates a lower pressure, similar to that further downstream at the hose end, at all flow rates. The main advantage of this system is improved high flow performance.

B 3 Testing

B 3.1 Test Objectives
   Fuelling vehicle pressure control systems and deadman control valves are flow tested quarterly to check on their performance against control limits over a range of flow rates up to the maximum attainable. Similar testing shall be carried out after:

   a. any repair, alteration, or adjustment to the pressure control equipment; or

   b. any other changes such as the replacement of a vehicle hose (e.g. change in diameter or length) that could affect the performance of the control systems.

Testing shall be carried out by competent personnel who fully understand the operation of the valves, the purpose of the tests, and the failure conditions that can occur. A record of the test results shall be maintained showing the valves tested and the flow rates and pressures obtained.

B 3.2 Test Procedures
   At each location there shall be detailed written test procedures specific to the vehicle pressure control systems and test facilities at that location. These procedures should be based on the requirements of this appendix and with reference to equipment manufacturer’s documentation. Alternatively, appropriate existing written procedures extracted from the operating manual of one of the participant companies may be adopted.
B 3.3  Test Facilities
A test facility capable of simulating both gradual and rapid termination of fuel flow into aircraft shall be available. The facility should be capable of accepting simultaneous full flow deliveries from all combinations of deck and/or reel hoses likely to be used.

An example of a suitable test stand is shown in B 3.4.1 below.

All pipe work, fittings and filter membrane test points should be stainless steel, aluminium or epoxy lined carbon steel.

Test stand pressure gauges should have a range of 0 – 10.5 bar (0 – 150 psi) and be clearly visible from the stand valves. 8-11 cm (4-5 inch) diameter faces are recommended for ease of reading. Gauges filled with glycerine/silicone fluid should not be used because movement of the pointer is dampened, making them unsuitable for recording peak surge pressures. Gauges should be checked for accuracy (+/- 0.14 bar (2 psi)) every six months using a suitable master gauge accurate to at least +/-0.5 % full scale when checked against a deadweight tester.

B 3.4  Test Procedures
When testing vehicles equipped with dual pressure control systems, each system shall be tested individually and without interference from the other pressure control valve system. When testing HEPCVs, the ILPCV system should be adjusted to provide an outlet pressure substantially in excess of the HEPCV test limits (at least 0.7 bar (10 psi) in excess of the HEPCV test limits. For pressure loss compensated systems (venturis) this is achieved by adjusting the air reference pressure to 6.9 bar (100 psi). When testing the ILPCV system the HEPCVs should be deactivated by means of a by-pass or block-out device. The pressure observed on the test stand gauge should be recorded.
B 3.4.1 HEPCV Testing

Having adjusted the ILPCV system (if fitted) as described in 8.3.10, each individual valve in the HEPCV system is tested for the control of surge pressures induced by rapid closure of aircraft tank valves. With valves A and B (see figure below) fully open, each hose should be connected in turn and tested from maximum flow.

Valve A should be adjusted to the point at which the flow rate starts to reduce. Valve A should then be closed with a closure time of 2 seconds. The peak pressure (surge) indicated briefly on the test stand gauge should not exceed 8.3 bar (120 psi). Having recorded the pressure surge, valve A should be opened fully to release the locked in pressure.

Each HEPCV should also be tested individually for control of pressure over a range of flow rates. With each hose connected in turn, and starting from maximum flow, valve B (ball valve) should be closed slowly and evenly in approximately 30 seconds. The pressure indicated on the test stand gauge should not exceed 3.8 bar (55 psi) above the spring datum rating (see Note 1) during closure except at very low flow rates (just before shut down). At shut down when valve B is fully closed, the pressure should not exceed 0.7 bar (10 psi) above the spring datum setting.

The pressure at closure should be recorded. Valves A and B should remain closed for 30 seconds and the pressure recorded again. An increase in pressure at no flow conditions is known as pressure creep and is an indication that the HEPCV seals may be faulty. The maximum allowable pressure creep is 0.35 bar (5 psi).

After completion of the HEPCV testing, the ILPCV air reference pressure shall be adjusted to the correct setting and sealed or locked in this position.
B 3.4.2 ILPCV Testing
Having deactivated the HEPCVs by means of by-pass or block-out devices, or deactivated one of the dual ILPCVs as described in 8.3.10, the ILPCV system to be tested, is tested for the control of pressure over a range of flow rates. Hoses should be connected for maximum flow conditions (e.g. two deck hoses or two reel hoses).

For ILPCV compensated systems using more than one venturi or other device (e.g. electronically compensated) to act on the ILPCV (for example one for the reel hose(s) and a second one for the deck hoses), the test shall be carried out separately on each venturi.

It is important that the hose arrangement used during the test is that for which the venturi is designed (for example, if the venturi is designed for two deck hoses then both deck hoses shall be connected and HEPCV’s deactivated). With valves A and B fully open, valve B should be adjusted to the point at which the flow rate starts to reduce. The flow rate should be reduced gradually, using valve B, and the pressures indicated on the test stand gauge be recorded at a range of flow rates from maximum flow to zero flow.

For ILPCV compensated systems the recorded pressures on the test stand gauge should not exceed 3.8 bar (55 psi) [see Note 1] over the full flow range and 0.7 bar (10 psi) above this control pressure setting at shut down. If the recorded pressures exceed these limits the system should be adjusted by a competent person and the test repeated.
For venturi compensated systems the pressures indicated on the venturi gauge should be within 0.3 bar (5 psi) of the recorded pressures on the test stand gauge in the range of 2.4 to 3.8 bar (35 to 55 psi) and at shut down.

For non-compensated ILPCV systems the recorded pressures on the test stand gauge and the fuel sense gauge should not exceed 3.8 bar (55 psi) [see Note 1] at maximum flow and 5.5 bar (80 psi) at shut down.

Having released the locked in pressure by fully opening valve B, valve A should be closed with a closure time of 2 seconds from full flow, and the peak pressure (surge) indicated briefly on the test stand gauge should be recorded.

After completion of the ILPCV testing, the HEPCV by-pass or block-out devices shall be removed or the deactivated ILPCV reactivated.

Some vehicles are equipped with dual HEPCVs. The second HEPCV is fitted as an alternative to an ILPCV. Each HEPCV should be tested separately in accordance with B 3.4.1 with the other unit being removed or blocked open.

Sample forms for the above tests can be found in Appendix E (Records).
B 4  Deadman Control Valve

The purpose of the deadman system is for the operator to stop the fuel flow quickly and easily in an emergency, and to stop the flow automatically if the operator is incapacitated. All pressure fuelling vehicles are equipped with a deadman control system in accordance with section 8.3.14.

The deadman valve is also normally used for starting or stopping fuel flow. To ensure that high pressure is not suddenly imposed on the aircraft, the effective opening time (from commencement of flow to full flow) of the valve shall be at least 5 seconds. Conversely, the closure time shall not be so fast that it results in excessive upstream shock pressures, which could damage other equipment on the vehicle or, in the case of a hydrant system, dispensers on adjacent stands. The limit on valve closure time is minimum 2 seconds, maximum 5 seconds.

The deadman performance may be tested on the test stand, during fuelling operations, or while circulating fuel into a refueller or trailer. With hoses connected for maximum flow conditions the deadman should be tested to ensure that it is functioning correctly.

The following should be checked and recorded:

a. the valve opening time (from start of flow to full flow) should be at least 5 seconds;

b. from maximum flow conditions, valve closure should be progressive and close between 2 and 5 seconds, measured from the moment that the deadman is released;

c. from maximum flow conditions, the fuel delivered during the valve closure test, as indicated on the vehicle meter, should not exceed the greater of 200 litres or 5% of the flow rate per minute, measured from the moment that the deadman is released (for example, from a flow rate of 4,200 litres/min the volume overrun should not exceed 210 litres).
APPENDIX C

HOSE INSPECTION AND TEST PROCEDURES

C 1 Monthly Inspection

Fully extend the hose and apply full pump or maximum operating pressure with the delivery nozzle or coupling closed.

C.1.1 While under pressure inspect for external damage, leakage and other signs of weakness. It is recommended that the inspection (under maximum operating pressure) of long hose is performed by forming a vertical loop and rolling this slowly along the length of the extended hose. Inspect for coupling slippage indicated by misalignment of the hose coupling and exposed areas where slippage had occurred.

C.1.2 With the hose fully extended release the pressure completely and inspect for soft areas.

Particular attention should be paid to sections of the hose within about 45cm (18in) of couplings, since these sections are particularly prone to deterioration. These sections shall be examined for weakness by pressing the circumference to feel for soft spots, blisters etc.

C.2 Pressure Testing

C.2.1 A pressure test, using a hydrostatic test pump, shall be carried out:
- when commissioning new vehicles;
- whenever couplings are attached or re-attached to hoses;
- when accidental damage to a hose is suspected; and
- routinely every 6 months.

NOTE: Excluding re-coupled hoses, at the time of publication of this Standard, pressure test requirements do not apply in the US unless specifically required by the customer (e.g. outlined within their contract and/or fuel procedures manual). This is currently under further data review & evaluation, and may ultimately become compulsory within the US.

Recommended test pressures are:
- 20 bar (300 psi) for commissioning and after attachment of couplings;
- 15 bar (225 psi) for routine testing of fuel delivery hoses of 50mm (2 inch) or greater diameter, hydrant servicer hoses, and other hoses that may be subjected to hydrant pressure; or
- 10 bar (150 psi) for hoses of less than 50mm (2 inch) diameter. Routine hydrostatic pressure testing of hoses is not required where the fuelling equipment pump pressure is less than 5.5 bar (80psi).
C 2.2 Hose Test Procedure

It is recommended that hose testing does not take place when the fuel temperature exceeds its flashpoint.

Fully extend and connect hose to suitable hydrostatic test pump and fill with the appropriate grade of fuel. It is not necessary to remove the hose from the fuelling equipment if suitable isolating valves are provided to protect lower pressure-rated components that may not be stressed to accept the testing pressure.

NOTE: If delivery hose is tested with the hose end coupling attached, procedure and equipment used should ensure that the full pressure is applied to the hose without damaging the internal components of the nozzle. Appropriate PPE including eye protection shall be worn.

Gradually apply test pressure and bleed any entrapped air from the hose and test equipment.

CAUTION: Because of the possibility of a hose burst, do not closely inspect the hose during pressurisation and wait for 1 minute after reaching maximum test pressure before inspecting. Maintain pressure for at least 3 minutes and only as long as is necessary to inspect for external damage and coupling slippage.

Release pressure completely, re-pressurise to 3.5 bar (50 psi) and examine as described in C 1.1. Finally, release pressure and drain test pump to prevent possible contamination of fuel during future use. If unfiltered fuel has been used during the test procedure, the hose should be flushed before the vehicle is returned to service.
NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX D

WATER DETECTION KITS

NOTES:
At the time of writing this document, a number of in-line testing device technologies are being developed, which may replace some of the following.

For all of the following water detection methods, follow the detailed manufacturer’s instructions for the proper performance of the test.

D.1 Shell Water Detector (Int’l)

This widely used method consists of a small piece of sensitised filter paper mounted in a detector head, which fits the standard taper on hypodermic syringes. A 5 ml sample is sucked through the detector head into the syringe. The outer edges of the filter paper are sealed off from the passage of fuel so that when a ‘wet’ fuel is drawn through it, any resultant colour change is sharply contrasted. Any colour change indicates the presence of suspended water. An initial indication occurs at about 5/10 ppm when the capsule turns a pale yellow/green. The colour deepens to a distinct green, indicating a limiting water content of 30 ppm. At higher levels of contamination, the colour further deepens to a blue/green and finally a blue/black. It has a relatively short shelf life with the expiry date stamped on the bottom of each container and box.

D.2 Velcon Hydrokit (Int’l)

Designed as a "go-no-go" test which consists of adding fuel to a vial containing a pre-measured amount of water-sensitive powder. If water is present, in excess of 15 or 30 ppm (depending on the kit used), the powder turns pink within two minutes of the fuel contacting it. Compare any powder colour change against the colour card. If there is no colour change within two minutes, the fuel is considered acceptable. Any colour change occurring after two minutes should be ignored. It is packaged under vacuum in test tubes and has a shelf life of 2 years.

D.3 Metrocator (Int’l)

The test, which may be used in detecting free water in concentrations from 5 ppm to greater than 60 ppm, consists of adding a pre-measured amount of water-sensitive powder to a sample of fuel in a special bottle. A disc of filter paper is placed in the screw cap of the bottle. After shaking the contents, blue spots appear on the test wafer (disc), and when compared to a standard, indicate the amount of free water that is present in the fuel. Compare the disc with the reference photographs to determine the water content.
D.4  POZ-T Device (only used in Russia and C.I.S.)

The device consists of a 50ml stainless steel syringe incorporating a plastic clamp, which clamps the Indicator of Fuel Quality (IKT) used to determine the contamination level of mechanical impurities (solid matter) and emulsified (free) water in aviation kerosene and Avgas.

The IKT consists of two layers of a chemically treated pad which change colour when contamination is detected. The mechanical impurities are filtered on a white indicator layer first and develops dark grey brown spots.

The impurities are determined by the colour intensity of these spots. Any emulsified water passing through the indicator develops blue spots on the yellow layer. The number of spots determines the water content in the fuel.

D.5  Aqua Indica (Indian subcontinent)

The contents of a gelatin capsule are shaken with 100 ml of the fuel, contained in the glass bottle or graduated glass cylinder for 30 seconds as per given instructions. The powder particles react with the water droplets uniformly dispersed in the fuel and indicate colour change as they precipitate at the bottom of the bottle/cylinder. The intensity of the colour changes with the quantity of aqueous dispersion in the fuel.

Indications:
At 0 & 5 ppm: Greyish powder/grains
At 10 ppm: Appearance of a few pink particles
At 15 ppm: Distinct pink colour indication
At 20 & 25 ppm: Pink colour further increases
At 30 ppm: Distinct pink colour further intensified.

D.6  Aquadis (Indian subcontinent)

100 ml of sample is poured into a dry and clean tube. Ensure no discolouration of Aquadis capsule. Empty contents of one capsule in sample, close tube with stopper and shake for 5/10 seconds. Stand sample for 2 minutes and assess sample as follows:
- White, light grey or dusty grey: No water present
- Faint pink precipitate: Moisture 10-15 ppm or more.
D.7 YPF Water Detection Capsule (South America)

The principle is similar to the Shell Water Detection kit.

With the stainless steel syringe, 20 ml of fuel is extracted through the capsule.

Any colour change from orange/yellow to green-blue, means that free water is present. Since this test is very sensitive for moisture, weather conditions will affect the detection capsule.

D.8 Aqua Glo (USA)

The test is capable of detecting free water concentrations as low as 1 ppm. The test consists of passing a measured amount of fuel through a chemically coated paper disc. The disc is then compared to a known colour card. The chemical will glow in ultraviolet light proportional to the amount of water in the fuel.

D.9 Pasta Wladikina (only used in C.I.S.)

This paste detects free water in fuel. The colour of the paste is originally light brown to yellow. If the fuel contains free water, the paste colour changes to pink. Only used for water tests of rail cars and/or storage tanks.
NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX E

RECORD AND FORM SAMPLES

THIS APPENDIX IS UNDER DEVELOPMENT

E.1 The following samples are for example purposes only, and may be used as the basis for further development to meet the specific operation.

Records shall be kept of:
- All daily drainings;
- Daily differential pressure readings;
- All dp graphs.

Records shall be kept of all filter maintenance showing at least the following:
- Number and type of new elements installed;
- Differential pressure before and after change;
- Throughput since previous change; or
- Reason for change and any relevant details.
E.2 SAMPLE FORMS

E.2.1 FUEL GRADE VERIFICATION FORM - SAMPLE

This form shall be used where aircraft grade markings not clearly displayed or are missing. It shall also be used for all fuellings of diesel engined aircraft.

TO BE COMPLETED BY AIRLINE OR AIRCRAFT AUTHORISED REPRESENTATIVE

To: ............................................................................................. (Into-plane Service)
At: ................................................................................................. (Airport)

Aircraft Registration Number: .......................................................

☐ Tick if the aircraft is diesel engined.

The Aviation Fuel requirements for this aircraft are as follows:

<table>
<thead>
<tr>
<th>FUEL GRADE (*)</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>JET A-1</td>
<td></td>
</tr>
<tr>
<td>(Aviation Turbine Kerosine)</td>
<td></td>
</tr>
<tr>
<td>AVGAS 100 LL</td>
<td></td>
</tr>
<tr>
<td>(Aviation Gasoline)</td>
<td></td>
</tr>
</tbody>
</table>

(*) Write either JET A-1 or AVGAS 100LL in appropriate box.

I confirm that the above fuel grade is suitable for use in the aircraft referred to above.

Name .................................................................

Position ................................................. Date .............................................

Signature ...................................................... Time ...........................................
### E.2.2 FILTRATION FORM - SAMPLE

#### FILTRATION DETAILS

The following details should be recorded and kept up to date.

<table>
<thead>
<tr>
<th>Type (MF / FWS / Monitor / Clay / Hay Pack)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Filter No.</td>
</tr>
<tr>
<td>Vessel</td>
</tr>
<tr>
<td>- make</td>
</tr>
<tr>
<td>- model</td>
</tr>
<tr>
<td>- rated flow</td>
</tr>
<tr>
<td>Coalescer/Monitor elements</td>
</tr>
<tr>
<td>- make</td>
</tr>
<tr>
<td>- model</td>
</tr>
<tr>
<td>- quantity</td>
</tr>
<tr>
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<td>- make</td>
</tr>
<tr>
<td>- model</td>
</tr>
<tr>
<td>- quantity</td>
</tr>
<tr>
<td>Last change of elements</td>
</tr>
<tr>
<td>- date</td>
</tr>
<tr>
<td>- throughput</td>
</tr>
<tr>
<td>- differential pressure</td>
</tr>
<tr>
<td>Previous change of elements</td>
</tr>
<tr>
<td>- date</td>
</tr>
<tr>
<td>The following details were updated</td>
</tr>
<tr>
<td>On ..................................(date)</td>
</tr>
<tr>
<td>Current throughput (since last change)</td>
</tr>
<tr>
<td>Current differential pressure</td>
</tr>
<tr>
<td>Latest filter membrane tests</td>
</tr>
<tr>
<td>- Colorimetric (wet and dry)</td>
</tr>
<tr>
<td>- Gravimetric (mg/litre, into-plane)</td>
</tr>
<tr>
<td>Other data/comments</td>
</tr>
</tbody>
</table>
**E.2.3 MAINTENANCE DEFUEL CHECKLIST - SAMPLE**

**Maintenance Defuel Checklist**

Completion instructions:
Section 1 of this form is to be completed by the Customer (e.g. the applicable airline or maintenance representative).
Section 2 of this form is to be completed by the Fuel Handling Company representative.
For additional details of this form, refer to the AS 6401 Defuel Procedure.

### Section 1

<table>
<thead>
<tr>
<th>Date (yyyy-mm-dd)</th>
<th>Time (local)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer rep (Name)</td>
<td></td>
</tr>
<tr>
<td>Department (if applicable)</td>
<td>Phone</td>
</tr>
<tr>
<td>A/C Type</td>
<td>A/C Toll #</td>
</tr>
</tbody>
</table>

All questions must be answered:

1. The sample of fuel to be defueled is in accordance with the microbiological contamination limits, as indicated by the certified test kit results, and outlined in IATA's "Substance Material on Microbiological Contamination in Aircraft Fuel Tanks".
   - [ ] Yes
   - [ ] No
   - [ ] Not Applicable

2. The Aircraft Logbook indicates that the fuel onboard has not been treated with biocide within the previous three (3) refuellings.
   - [ ] Yes
   - [ ] No

3. The defueled fuel can be refueled, without any additional quality test, to aircraft of this airline.
   - [ ] Yes
   - [ ] No

4. The fuel uploaded at the previous two (2) locations was (specify both locations & fuel grade):
   - Location 1: [ ] Grade:
   - Location 2: [ ] Grade:
   - FSII:

5. Is a CoA Test required?
   - [ ] Yes
   - [ ] No

   Attach fuel analysis report

6. [ ] Fuel to be downgraded
   - [ ] Fuel returned to system.
   - [ ] Fuel to be stored and refueled into the same aircraft, or other aircraft of this airline (in the case where the defueled fuel specification is unknown, or a biocide treatment occurred within the previous three (3) refuellings). If YES, specify required storage dates, or disposition action.

   Storage [ ] to
   - [ ] other aircraft
   - [ ] same aircraft

7. Prior to defueling, a quality check of the fuel from the drain points of all tanks has been performed by the Airline representative.
   - [ ] Yes
   - [ ] No

### Section 2

<table>
<thead>
<tr>
<th>Date (yyyy-mm-dd)</th>
<th>Time (UTC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel delivered to Airline / Customer Name:</td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td>Fuel Receipt #:</td>
</tr>
<tr>
<td>Fueling Vehicle ID:</td>
<td>Fuel Receipt #:</td>
</tr>
</tbody>
</table>

*G19401 (2000-11-26)*
E.2.4 TBA – SAMPLE

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E.2.5 TBA - SAMPLE

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NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX F

VEHICLE OVERFILL SENSOR MECHANISMS

NOTE: The following are typical examples of vehicle overfill sensor mechanisms, it is not intended to be an all-inclusive list.

F 1  Float operated valve

A float operated valve is installed in the sense line at the high-level in the refueler tank. A manually operated ball valve, to enable simulated closure of the float valve, should be fitted in the sense line at a position to enable the operator to check (i.e. a pre-check) the functionality of the foot valve at the start of each loading.

Where this type of high-level system is installed, it continues to be important to ensure that provisions are available to check the operation of the system.

F 2  Jet level sensor

It is fitted in a small chamber at the high-level in the refueler tank. In the chamber, the high pressure sense line feeds a small orifice nozzle that projects a jet of fuel to the open end of the downstream section of the sense line that maintains pressure to hold open the foot valve.

As the chamber fills with fuel, the jet stream flow is interrupted, causing loss of pressure in the downstream section of sense line, thus causing the foot (internal) valve to close under spring pressure.

The design of the jet level sensing arrangement is fail safe. However, as with the float operated design, a manually operated valve to check the system shall be fitted in the sense line for a functionality check of the foot (internal) valve at the start of loading. This design is completely self-contained, requiring no external power source, either electrical or pneumatic.

F 3  Electronic Level Control (e.g. Scully or equivalent):

utilizes an optical (recommended) sensor to maintain a signal to a solenoid-controlled valve to hold it in the open position. Interruption of the signal transmission through the sensor causes the valve to close. The signal through the sensor is continually monitored (dynamic self-checking), and any faults in the electronic circuit will also result in shut down, thus providing fail safe protection.

The controlled valve(s) may be on the refueler and/or on the loading rack. If on the refueler, this is in addition to the foot (internal) valve that shall be internally mounted for safety reasons.
For loading rack application, a connecting lead is used that also provides ground verification for permissive loading control. The system design can also include an audible alarm and/or an operator-controlled “deadman” control switch.

**NOTE:** Any fittings mounted inside the tank that will come in proximity with or become immersed in the fuel as the level rises, shall be electrically bonded to the bottom of the tank to prevent risk of ignition by static discharge.

F4 Secondary Protection:

F 4.1 When considering secondary protection, regard shall be paid to the different types of operation that may be used in filling the refueler tank in addition to conventional re-loading (e.g. defuelling of aircraft, transfer of fuel from another refueler, and reloading from a hydrant system).

F 4.2 These alternatives make it necessary to have high level sensor control on a foot valve at the refueler tank inlet. Additionally, the high level sensor (or second sensor, dependent on design configuration) in the refueler tank can be connected to the loading rack to close a valve in the loading line and/or shut down the pump(s).

F 4.3 The foot (internal) valve that has traditionally been used is a balanced, spring operated, piston valve that is held open whenever inlet line pressure on the piston is higher than the back pressure from the tank contents head. The inlet line pressure is fed through a sense line to the valve via a high level sense mechanism that will interrupt flow through the sense line and cause valve closure if the pre-set high level is reached.

F5 Minimum Acceptable Configuration Options for New Installations

F 5.1 Pre-set loading meter (primary) with a high level sensor (also known as “jet-able” or “jet level sensor”) shut down of refueler foot valve (secondary). With this arrangement, consideration might also be given to the additional installation of electronic level control of the loading line valve. This would be set to activate at a lower level than the high level sensor and would become the secondary protection during loading at the rack. The prime purpose of the high level sensor system would be to provide high level cut off protection during other filling operations (e.g. defuelling or loading ex hydrant). It would also provide third stage protection at the loading rack.

F 5.2 Pre-set loading meter (primary) with electronic dynamic self-checking high level shut down of refueler control valve (secondary). With this arrangement, consideration might also be given to extend the electronic level control to the loading line valve.
F 5.3 Electronic dynamic self-checking high level shut down of valve in loading line (primary) with high level sensor shut down of refueler foot valve (secondary).

NOTE: *primary and secondary protection systems shall be independent of each other therefore with electronic control of both refueler foot valve and loading line valve by a common system, there shall be an alternative back up.*

F 5.4 The purpose of supplementing with electronic control of a loading line valve would be to minimize exposure of loading hoses/arms to loading system line pressures and to give the added benefit of a permissive grounding system. The electronic level control system could also initiate pump(s) shut down, but in the case of multiple loading positions, this would be undesirable because of interference with other loading operations. Emergency stop buttons, strategically located on loading stands, would be used to stop pumps if necessary.
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NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX G

MICROBIAL GROWTH

G 1 Preamble - How Microbes Cause Problems in Fuels

Although there are hundreds of thousands of types of micro-organisms, one of particular interest in aviation is the fungus, Hormoconis resiniae (formerly known as Cladosporium resiniae). Since its spores are airborne, they can easily enter fuel storage tanks and vehicles but are too small to be removed by filtration.

The interface between fuel and free water affords an ideal site for their growth, hence the need to limit the accumulation of bulk free water. This is particularly so in warm climates as the growth rate of the spores increases rapidly.

If the conditions are suitable, the fungus can multiply rapidly to block filters screens or pipes. It is difficult to dislodge and can form barriers, which prevent water draining to the sump of tanks. Within these areas, corrosion can take place.

Visual indications of microbial growth are discoloured or murky water and sometimes, murky fuel. Scum will float at the fuel/water interface and with heavy contamination a fungal mat is formed, generally brown/black in colour but in some cases red, grey or white.

The phenomenon of fuel spoilage has been recorded since the 1930’s when investigators reported the presence of sulphate reducing bacteria and other microbes in gasoline and kerosene. When aviation fuel use changed from gasoline to kerosene, the associated organisms, and the nature and the frequency of the problems, also changed. In the 1960’s, numerous fouling and corrosion problems occurred in aircraft wing tanks.

Within the fuel storage space in the aircraft wings, a water bottom is formed, water dissolves in fuel uplifted at ambient temperatures, but is deposited from solution when the fuel cools in flight. Water also condenses from humid air within the cold wing structure. Fuel is replaced after every flight, but the water may be frozen and/or drained infrequently. Growth, fouling and spoilage occur when the wing warms up.

Growth does not occur to any significant extent when the fuel is cold and most microbial growth can be anticipated in warm inboard tanks, short haul aircraft and under-utilised aircraft and helicopters.

The incidence of contamination problems in aircraft is very much influenced by the climate in which the aircraft is operating and the efficiency of water draining procedures. Luxuriant growth can occur in warm water bottoms in ground storage installations.

The consequences of microbial spoilage can be exceedingly severe; the aviation industry significantly improved the design of both ground and aircraft fuel installations to maximise water removal and minimize water accumulation (cone down bottoms, fixed roofs, fast flush systems, lined tanks etc).

As a result of these changes, the incidence of microbial problems significantly reduced in the 1980’s and early 1990’s. However, the trend towards the installation of hydrant systems for fuel loading at airports, as opposed to batch delivery by vehicles, has hindered the control of microbial growth in some Airport aviation fuel systems.
Hydrant systems utilise underground pipelines, which may accumulate water, microbes and sludge at low points and release them into the fuel when flow velocity increases at a critical stage in the fuel distribution - just prior to loading onto the aircraft. It is thus critical that hydrants are properly designed for the flow requirements and routine maintenance of the hydrant low points is performed.

How Microbes Cause Problems in Fuels

G 2 Fuel in Distribution and Use

The fuel and its additives are the main nutrient source and thus sustain microbial growth in the water phase close to the interface. In many fuel contamination problems the contaminated interface/water bottom is in contact with the fuel phase for a relatively short time. Because fuel is used or moved on and then replaced, a fresh nutrient supply of additives and fuel is presented to the micro-organisms in the residual water bottom on a regular basis. One cannot expect much chemical change to occur in fuel if the contact time with contaminated water is short. In this case the microbial problem is primarily one of fuel fouling and corrosion of tanks and pipes. Typically one or all of the following problems may be experienced.

G 3 Fuel and system fouling

If micro-organisms and the fouling materials they produce are disturbed from the bottom of a tank or the interface into the fuel, they can cause engine fuel filter blockage.

G 4 Fouling of aircraft fuel gauge probes

This can cause volume reading errors; these have resulted in pollution incidents when tanks have been over-filled and aircraft fuel shortages due to over-estimates of fuel available.

G 5 Microbes, typically moulds

can proliferate on the 'socks' of coalescer filters and prevent effective water separation. The microbes colonising the socks contaminate the fuel passing through the filter/coalescer. (photo shows heavily contaminated filter/water separator).

Although some fouling and spoilage problems are entirely attributable to micro-organisms, in many cases they are only an aggravating factor, for example by producing slimes which trap and entrain other particulates.
G 6  Corrosion:

In storage tanks severe pitting corrosion of the internal steel surface of the tank floor (photo at right) can occur as a result of the activity of the anaerobic Sulphate Reducing Bacteria. In aircraft fuel tanks, aerobic microbes can cause corrosion of aluminum wing planks by creating local oxygen gradients and by producing aggressive organic acids.

*Photo shows Storage tank wall pitting corrosion*

G 7   Free Water

The microbes colonise a free water phase, particularly near the fuel/water interface. Without water, significant proliferation is impossible. This is a primary reason for the extensive (daily) sump draining requirements for aviation facilities.

*Photo shows Microbes in free water*

G 8  Dispersion

Any agitation readily disperses the microbes and their associated polymeric slime from the water phase and interface into the fuel phase.

G 9  Distribution

Microbes are rarely distributed evenly within fuel systems. Microbes and microbial material will slowly settle downwards. Hence upper tank fuel will normally be less contaminated than lower fuel. The settling rate is dependent on the size and mass of microbial aggregates.

*Photo shows Microbes settling in free water*

G 10  Biofilm

Microbes will attach to surfaces in exceedingly high numbers as biofilms, where they probably play an important role in continually replenishing the populations of freely suspended microbes. Biofilms pose particular problems, as they can be exceedingly hard to kill.
G 11  Anti-Microbial Strategies For Fuel

Anti-microbial strategies are preferably avoidance strategies but occasionally have to be remedial strategies. Obviously the most environmentally efficient and safest strategy is avoidance by "good housekeeping" (e.g. keeping systems clean, and as much as possible free of water).

If however fuel is deemed to be unacceptably contaminated by micro-organisms, active anti-microbial measures are needed. The objectives of these could be one or more of the following:

d. return fuel to a fit for use condition;

e. decontaminate storage tanks, pipelines, transports and, at the point of use, end-user equipment;

f. prevent microbial corrosion, particularly by SRB; or

g. minimize the contamination of facilities downstream.

Incidents vary widely in their severity, urgency, microbial nature and availability of equipment (including spare tanks) waste disposal facilities and chemicals; these factors will control the anti-microbial strategies selected.

G 12  Tanks Inspections

Any indication of bacterial matter in the bottom drain sample should be investigated immediately. This may involve testing of the fuel or the water phase with a proprietary microbial test kit. If contamination is confirmed then the tank should be taken out of service and thoroughly cleaned using high pressure water on the walls and floor. The source of contamination shall be investigated and corrected. This may be poor design of the tank allowing water to accumulate on the tank floor, heavy sedimentation on the floor preventing adequate water drainage or contaminate fuel being delivered into the tank.

G 13  Filter Inspection

The bulk of bacteria, yeasts and moulds are > 1 micron in size and therefore the majority is removed by filtration media. While microfilters and monitors will trap micro-organisms from the flowing fuel, active MICROBIAL growth is not known to occur on these types of filters. However with filter/water Separators under certain conditions such as low flow or infrequent use water droplets can sit underneath the cotton sock and provide an ideal medium for growth of microbes. These can be visually detected by the appearance of brown or grey spots on the outer surface of the filter/coalescer elements. Any level of this "leopard spotting" is grounds for further investigation and the elements should be replaced immediately.

G 14  Defuelling

It is sometimes necessary to off-load fuel from an aircraft for load adjustment or to permit maintenance work to be carried out. Since aircraft tanks are ideal breeding grounds for microbes there is always a risk of passing contaminated fuel on to other aircraft. In addition the aircraft may have been treated with a biocide and this fuel cannot be recycled back into aviation fuel storage. Off-loading of fuel is therefore to be treated with extreme caution and it is strongly recommended that the Fuel Handling Company follow the defuel procedure in Section 8.21 to 8.23.
G 15  Visual Detection Of Micro-Organisms

The test is performed concurrently with routine drainage of storage tanks, filtration equipment sumps and low point drains in piping systems. A sample from these locations is drawn into a white, stainless steel bucket or glass jar and examined visually. Any darkening of the water phase or evidence of growth at the interface is indicative of MICROBIAL activity and further testing using either a water phase or fuel phase microbe test kit is required.

Aviation jet fuel tanks should be visually inspected annually from outside through a suitable manhole. Jet fuel tanks should be internally inspected and cleaned within twelve months of commissioning and subsequently every three years, taking account of the safety precautions outlined in section 11.2.4.

Inspection and cleaning frequencies for jet fuel tanks may be extended to a maximum of 5 years subject to good historical QC data: of previous inspections, routine tank sump drains and an annual microbial test on a tank bottom fuel sample.

More frequent cleaning of jet fuel tanks may be necessary, for example, if short filter life or fuel quality downstream indicates the presence of excessive contaminants, or if the condition of water drain samples suggests the presence of excessive rust or microbial or surfactant contamination.

Photo shows microbial growth

CAUTION: If microbial growth is found in a storage tank then under no circumstances may a biocide be used. Biocides are approved for use in aircraft fuel tanks but are not approved for use in fuel handling equipment. The tank should be taken out of service and cleaned using a high pressure water jet.

G 16  Microbial Testing

Test kits are available for detection of microbial growth, but advice should be sought from a Product Quality Advisor before use since the type of test kit to be used, and the acceptance limits, shall be clearly understood prior to any testing.

Visual Detection test for Microorganisms can be performed concurrently with routine drainage of storage tanks and filtration equipment sumps and low point drains in system piping. A sample from these locations is drawn into a white bucket and examined visually. Microorganisms produce visual evidence, which can be identified by the operator.

Jet fuel tanks should be visually inspected:
- externally on an annual basis from outside through a suitable manhole; and
- internally and cleaned within twelve months of commissioning, and subsequently every three years, taking account applicable safety precautions.

Inspection and cleaning frequencies for jet fuel tanks may be extended to a maximum of 5 years, subject to good historical QC data:
   a. of previous inspections;
   b. routine tank sump drains; and
c. an annual microbial test on a tank bottom fuel sample.

More frequent cleaning of fuel tanks may be necessary, for example, if short filter life or fuel quality downstream indicates the presence of excessive contaminants, or if the condition of water drain samples suggests the presence of excessive rust or microbial or surfactant contamination.

NOTES: For more details on this subject, and test kit information, refer to:
- IATA’s “Guidance Material on Microbiological Activity in Aircraft Fuel Tanks”.
- the Energy Institute’s “Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies”; or
- ASTM D6469 “Standard guide for microbial contamination in fuels and fuel systems”.

DO NOT COPY
NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX H

HYDRANT PIT VALVE TESTING & EMERGENCY FUEL SHUT OFF

H 1 General
Hydrant pit valves shall be inspected and tested in accordance with the following schedule to ensure that the performance of the equipment is within acceptable limits. There should also be a planned maintenance system in accordance with manufacturers recommendations.

H 2 Static Testing/Inspection

H 2.1 Weekly
a. Ensure pit box is clean and free from water, fuel and surface dirt/grit. Clean if required.
b. Examine condition of pit lining.
c. Ensure valve and components are free from fuel leaks.
d. Condition of jacking screws where fitted.
e. Visual examination of operating handle/linkage and lanyard connections.
f. Presence and condition of dust cap and tether.
g. Pit lid condition, seal (if fitted), tether (if required), pit number and grade marking if applicable.

Any defects shall be reported immediately.

H 2.2 Monthly

Every fourth "Weekly Inspection" shall include additional checks to monitor/check the integrity of the valve. This is done by depressing the equalising valve as described below. As a small amount of fuel will be released, a protective shield/cover shall be used to contain any spray of fuel and to protect the operator.

Alternatively, a test coupler equipped with a pressure gauge, may be used. With the main valve in the closed position, the test coupler is attached, thus opening the equalising valve. A continued rise in pressure within the coupler indicates that the pit valve needs to be repaired.

H 2.2.1 Mechanically Operated Valves
a. Ensure that the operating mechanism is free from obstruction, is secure and that no excessive free play is observed.
b. With the valve operating mechanism in the closed position, and using the necessary shield/cover, depress the equalising valve. After the initial release of fuel, a steady flow will indicate a failure of the main seal and the valve shall be removed from service for repair.
If following the initial release of fuel, only a few drops of fuel are observed, the valve is serviceable.

H 2.2.2 Pilot Operating Valves

  a. Ensure that the operating mechanism is free from obstruction, is secure and that no excessive free play is observed.

  b. With the valve operating mechanism in the closed position, and using the necessary shield/cover, depress the equalising valve. After the initial release of fuel, a steady flow will indicate a failure of the pilot valve seals and/or the main valve seal. The valve shall not be used in this condition.

If following the initial release of fuel, only a few drops of fuel are observed, the valve is serviceable.

H 2.3 Six-Monthly Dynamic Testing

The performance of all pit valves shall be tested, under pressure at the highest achievable flow rate, by pulling the lanyard. The valve closure time shall be between 2 and 5 seconds. This test may be performed during aircraft fuelling.

NOTES:

   i) Valves which incorporate a butterfly or flapper valve shall not be tested under flow conditions. Only static testing and inspection for wear should be carried out.

   ii) Certain older mechanically operated pit valves were not designed to meet the more stringent performance requirements currently recognised within the industry, and may not meet all the above requirements. In this situation, and in conjunction with the manufacturer of the valves, accurate performance criteria should be agreed and included in the written testing/operating procedures.

H 2.4 Testing After Repair Or Overhaul

After repair or overhaul, the valve shall be fully tested, preferably on a test rig at the maximum flow to which the valve will operate in service. Closure time by pulling the lanyard (see H 2.3) shall be between 2 and 5 seconds.

H 3 Records

H 3.1 All routine checks and the results of performance tests shall be recorded.

H 3.2 All defects and the required maintenance/repair shall be recorded.
H 4 Training

All appropriate staff shall be fully trained to carry out the above procedures safely and effectively. Written operating procedures shall be readily available and should cover any particular requirements relating to all makes/types of pit valves used in the hydrant system.
NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX I

SAFETY CRITICAL ITEMS

THIS APPENDIX IS UNDER DEVELOPMENT
NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX J

MOBILE FUELLING PLATFORMS

NOTE: The material contained in this Appendix will eventually be superceded by an SAE document specific to mobile fuelling platform design and construction. Until that document is available, this content should be used in conjunction with local design and construction regulations, and should meet all applicable local standards. This Appendix may not detail all of the requirements necessary.

J.1 General

J.1.1 This section describes self-contained towable fuelling platforms that are used in conjunction with a refueller, or hydrant servicing vehicle. These units are used when the primary servicing vehicle being used is not equipped with an integral lift platform. Also included in this section are requirements for rigid and collapsible steps used to refuel small aircraft where overwing refuelling is needed.

J.1.2 Access to fuelling panels shall also be in accordance with applicable Occupational Health & Safety Regulations (regarding working at height), and the use of a mobile fuelling platform meeting the design specifications listed below should be considered.

J.1.3 The unit may have a fixed or a vertically adjustable platform that is mounted on a self contained wheeled chassis with a front steering axle or front swivel casters, a rigid tow bar, and manually operated brake system. If an adjustable type, the lift can be operated mechanically, electro-hydraulically, pneumatically-hydraulically, or with compressed air.

J.1.4 Weight of the unit should be considered and using materials such as aluminum makes the platforms easier to transport, manoeuvre, and properly position. Overall strength and stability of the unit shall not be compromised during design or construction.

J.1.5 The supply hose from the primary vehicle shall not interfere with access or egress from the platform.

J.1.6 The wheel base dimensions shall be such to ensure stability of the platform with the wheels locked. If necessary to improve or ensure stability is achieved, stabilizing jacks should be installed and deployed prior to elevating to its highest point. Maintain separation requirements for equipment while under wing.

J.1.7 A recommended rate of raising/lowering is between 7.5 cm/sec to 10 cm/sec (3 in/sec to 4 in/sec) However, in practice it will be limited by the method of powering the lift and may be as low as 2.5 cm/sec (1 in/sec) for a manually operated system.

J.1.8 The lift mechanism shall include a hydraulic or mechanical lock to prevent risk of accidental lowering of the platform while in use.

J.1.9 Raising and lowering of the platform while fuel is flowing through the hoses is not permissible. If the platform needs to be adjusted, then the flow of fuel shall be stopped, re-position as needed. Then begin the refuel process after proper stabilization of platform. Undue stress on the aircraft refuel manifold and aircraft refuelling adapters shall be considered when attaching hoses from the lift platform or directly from the refuel unit, position for the least amount of stress.
J.1.10 The recommended design for the units with fixed piping and separate hoses should position the hoses on the side of the unit, where it does not interfere with access or egress and avoids tripping hazards. If the hoses are placed outside of the unit then the design should ensure that they cannot be snagged by the platform. Hose connections should be in the front of the platform with the stairs to the rear.

J.1.11 Units of simple design that are used to access the refuel station with the hoses from the primary refuel unit, should consider designs that do not put the hoses in a position where the hoses can be chaffed, kinked or dragged unnecessarily. Consideration for proper access/egress and tripping hazard when using these hoses shall be made to avoid injury.

J.1.12 Where fitted, hoses shall meet API 1529, Grade 2 or BS EN 1361. For Into-Plane connections Type C is recommended. If the position of the supply hose is such that it may be subjected to kinking then Type F (non-metallic reinforced) is recommended.

J.1.13 New fuelling equipment should be suitably designed to allow for in-situ hose pressure testing (e.g. isolating valves to protect lower pressure-rated components).

J.1.14 Fuel piping shall be seamless aluminum or stainless steel. Piping connections may be welded or flanged. All welded joints should be butt welded with full penetration welds. Piping work should be sized so as not to exceed a liquid linear velocity of 7 m/sec (20 ft/sec). Design working pressure of the fuel system is to be 10.34 bars (150 psi) and hydrostatically tested to 15.52 bars (225 psi).

J.1.15 Design of the fuelling platform should incorporate:
   a. provisions to accommodate pressure relief due to thermal expansion of the fuel trapped in the pipework and hose(s);
   b. the ability to drain fuel in the pipework and hose(s); and
   c. reflectors, reflecting tape and warning markers to help prevent collisions.

J.1.16 Identification in accordance with API 1542 (latest edition) should include placards identifying grade of fuel (refer to table in Section 6.2), no smoking, flammable, etc.

J.1.17 The platform shall be fitted with a hand operated mechanical brake, rigid tow bar, front steering axle, or front swivel casters.
J.2 Platform Specifications

J.2.1 Platforms shall provide sufficient space for two persons to work safely. They shall be of sturdy design with a minimum load capacity of 320kg (700 lb) in addition to the weight of the platform and structure plus components whose weight is carried by the platform, such as hoses, nozzle assemblies, and the fuel contained in the system.

J.2.2 In accordance with local regulations, and as a minimum, all platforms shall be fitted with:

   a. fixed handrails with at least one mid-rail;

   b. a platform floor with non-slip material and "open-grate" type (i.e. with drain holes) floor, and a kick plate around its perimeter; and

   c. a placard(s) affixed in a prominent position easily visible by the operators, stating the maximum working capacity (i.e. number of people, load), and showing operating instructions of the mechanical devices (i.e. how to operate hydraulics, pneumatics or electrical devices).

J.2.3 In accordance with local safety regulations, design consideration should be given to have some type of mechanism (i.e. gate, chain) put in place to prevent personnel from potential falls while working on the platform in the raised position.

J.2.4 Design of the equipment will be in such a manner that minimizes the risk of entrapment of the operator's limbs.

J.2.5 The overall maximum height required will be determined by the type of aircraft to be serviced.

J.2.6 A safety brake mechanism that prohibits the movement of the unit while being used is required. The design can restrict the movement of the wheel assemblies directly, or can be retractable pads that contact the ground. These are just two examples of an acceptable brake design.
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NOTE: This Appendix contains additional procedural or informational content relevant to this Standard.

APPENDIX K

EMERGENCY PROCEDURES

K.1 Manager’s Responsibility

K.1.1 It is the Manager’s responsibility to identify all possible emergencies, and to prepare written pre-planned procedures to meet such emergencies. The procedures should include, but not be restricted to, the following:
- specific details of the type and location of the emergency;
- details of actions to be taken;
- responsibilities of specific staff;
- all essential contacts with routine and emergency telephone numbers;
- availability and source of emergency equipment;
- procedure for keeping up-to-date.

K.1.2 The procedures shall be kept in locations where they will be clearly visible and where all staff will have immediate and direct access to them.

K.2 Training

All staff shall be thoroughly familiar with these procedures and instructed in their use, particularly in the location and emergency usage of essential controls. Regular drills shall be conducted so every employee can become proficient in his/her assigned duties. Wherever possible, relevant airport and local authorities should be involved in these drills.

K.3 Emergencies to be considered

The following are examples of emergencies which should be considered:

a. equipment breakdown affecting ability to operate;

b. power failure;

c. fuel spillage;

d. serious injury to staff, contractors or third parties as a result of actions of joint operation;

e. terrorist actions, bomb warning, civil disturbance etc.;

f. fuel quality problems;

g. the occurrence of an aircraft accident/incident;

h. fire.
K.4 Security

K.4.1 It is the Manager’s responsibility to ensure that the security arrangements are adequate to protect the personnel, assets and operation of the facility. Airport Depots shall be secured to prevent the access of unauthorised people to prevent theft of fuel and equipment, contamination of fuel and the use of equipment for illegal activities. Keys should be removed from unattended vehicles. Security measures to be considered include the use of contract guards, perimeter fencing, alarm systems and the locking of valves, etc.

K.5 Environment

K.5.1 Fuel Spillage
Spillage and leakage shall be avoided at all times. Any uncontrolled release of fuel represents a fire hazard as well as an environmental pollutant. Even the smallest of drips from a leaking valve or flange may eventually result in environmental damage unless appropriate action is taken to stop the leak and clean up the affected area. Any testing activity involving the handling of fuel is a potential source of spillage and it is important that care is taken during all fuel handling procedures to avoid spilling any fuel.

K.5.2 It is the responsibility of all employees to report any observed spillage or leakage as a matter of urgency. Each fuel spill presents a different situation involving many variables, such as size of spill, weather conditions and location of spill etc. Action required will depend on particular situations, so no one set of instructions will apply in every case. Prompt action, good judgement and initiative by well-trained personnel is of major importance to prevent hazards arising from fuel spills.

K.5.3 The Manager is responsible for ensuring that the local and national regulations relating to environmental pollution are fully met. This includes keeping the Spillage Emergency Plan up-to-date and ensuring that all staff are aware of the plan and what must be done should a spill occur. The HSE Quarterly Performance Statistics form (see Appendix A6.2) should be used for recording spills.

K.6 Fuel Supply Contingency Plan

K.6.1 The Manager should ensure that a contingency plan for maintaining fuel supplies is available. The contingency plan should include procedures and responsibilities for the allocation of fuel in the event of disrupted supplies and should be agreed with the suppliers and the airport authority. A procedure for regular updating and informing all interested parties should be in place.
### APPENDIX L

**INSPECTION / TEST FREQUENCIES**

#### L.1 REFUELLING VEHICLES

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<td>Yearly App'dx A4.4</td>
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<td>3 years 8.6.12</td>
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<td>Pressure gauge - nozzle &amp; venturi gauge (where fitted)</td>
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<td>Yearly** 8.6.14</td>
</tr>
<tr>
<td>Refueller tank - bottom loaded, entry &amp; cleaning</td>
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<td>2 years *** 8.6.14</td>
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<td>Refueller tank - low point draining</td>
<td>✓</td>
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<td>8.6.14</td>
</tr>
<tr>
<td>Refueller tank - inspection, vents &amp; maniids</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yearly 8.6.14</td>
</tr>
</tbody>
</table>
Refueller tank - high level cut-off devices
Refueller tank - roof area water drains

* May be extended to a maximum of 1 year.
** May be extended to a maximum of 2 years.
*** May be extended to a maximum of seven (7) years [or ten (10) years in the USA].
## L.2

<table>
<thead>
<tr>
<th><strong>AIRPORT DEPOT</strong> Inspection/Test Frequency Table</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>3 months</th>
<th>6 months</th>
<th>Other as specified</th>
<th>AS 6401 reference</th>
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<tbody>
<tr>
<td>Bonding wires (cable &amp; reel, or fixed cable copper)</td>
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<td>Bulk meters</td>
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<td>Conductivity (fuel in storage)</td>
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<td>Double block &amp; bleed valve drains</td>
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<td>Element change - Coalescer</td>
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<td>Element change - Monitor</td>
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<td>Fire extinguishers</td>
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<td>Yearly</td>
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<td>Filter draining</td>
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<td>Filter dp graphs</td>
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<td>App’dx A3</td>
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<td>Filter membrane colorimetric test</td>
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<td>Flush - hydrant low points</td>
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<tr>
<td>Flush - unused hydrant pits/spurs</td>
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<td>7.5.2 &amp; App’dx H2.1</td>
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<td>Tank vents and mesh screens</td>
<td>Yearly</td>
<td>** May be extended to 3-monthly – see A1.2.3</td>
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<td></td>
<td></td>
<td>*** May be extended to a max of 1 year.</td>
<td></td>
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</table>
## Glossary of Terms

The following terms have been compiled from various industry sources, and are listed here alphabetically in table format for ease of use.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>acidity</td>
<td>the presence of any strong acid or more than a trace of weak acid in jet fuel could result in corrosion of critical fuel systems and engine components. Some jet fuels are treated with mineral acid as art of the refining process. Weak “organic acids” may also be generated during certain treating procedures. The acidity test confirms that these substances have been washed out or neutralized.</td>
</tr>
<tr>
<td>additional services</td>
<td>as described in IATA’s “Guidance Material on Standard Into-Plane Fueling Procedures”. additional services are those three (3) Levels of Service over and above “Level 1: Minimum Level of Service”. Level 2: Routine Fueling – Total Fuel Required Level 3: Routine Fueling Distribution Required &amp; Discrepancy Checking Level 4: Non-Routine Fueling</td>
</tr>
<tr>
<td>additives</td>
<td>material(s) (usually chemical products) added to change the existing properties of, or impart new characteristics to, aviation fuels (e.g. anti-icing additives (AIA), fuel system icing inhibitors (FSII), and static dissipater additives (SDA)</td>
</tr>
<tr>
<td>aircraft fueling equipment</td>
<td>mobile or fixed equipment that is used to transfer aviation fuel to an aircraft</td>
</tr>
<tr>
<td>API gravity</td>
<td>degree API = (141.5/relative density) – 131.5. (See “relative density”)</td>
</tr>
<tr>
<td>appearance test</td>
<td>a field test to confirm the acceptability of the fuel (i.e. the correct colour and be visually clear, bright and free from particulate matter and undissolved water at ambient temperature)</td>
</tr>
<tr>
<td>aromatics</td>
<td>aviation fuels are composed of hydrocarbons of four basic types paraffin’s, olefins, naphthalene’s, and aromatics. Of these, aromatics have the least desirable combustion characteristics. They tend to burn with a smoky flame and release a greater proportion of their energy as thermal radiation. This results in a greater carbon deposition and thermal stress on the combustors. Too high a level of aromatics also may cause swelling in the fuel hose lines and other elastomerics such as o-rings and seals. For these reasons, a maximum limit on aromatics is imposed.</td>
</tr>
<tr>
<td>authorized signatory</td>
<td>a qualified person who is delegated the authority to sign documents on behalf of the organisation for which he works. The delegation shall be documented.</td>
</tr>
<tr>
<td>auto-ignition temperature</td>
<td>minimum temperature required in a substance to initiate or cause self-sustaining combustion independently of any sparks or other means of ignition.</td>
</tr>
<tr>
<td>batch</td>
<td>a measured amount of certified fuel that is delivered to an airport fuel storage facility.</td>
</tr>
<tr>
<td>bonding</td>
<td>the process of connecting two or more conductive objects together by means of a conductor.</td>
</tr>
<tr>
<td>bunded area</td>
<td>the spill containment area around a fuel storage tank (i.e. dike, berm).</td>
</tr>
<tr>
<td>calibration</td>
<td>making precise measurements and adjustments to equipment or systems in order to obtain optimum performance and to certify that output data falls within prescribed tolerances.</td>
</tr>
<tr>
<td>cathodic protection or cathodically protected</td>
<td>a method of preventing or reducing corrosion to a metal surface (by using an impressed direct current or attaching sacrificial anodes).</td>
</tr>
<tr>
<td>Certificate of Analysis</td>
<td>a Certificate of Analysis is issued by independent inspectors and/or laboratories and contains the results of measurements made of all the properties included in the approved fuel specifications. It cannot however include details of the additives added previously. It shall include details relating to the identity of the originating refinery and to the traceability of the fuel described.</td>
</tr>
<tr>
<td>certification</td>
<td>written testimony of qualification. (i.e. licences, certifications, etc.)</td>
</tr>
<tr>
<td>certifying authority</td>
<td>the person or persons properly designated to sign certificates on behalf of the employer.</td>
</tr>
<tr>
<td>CIS</td>
<td>Commonwealth of Independent States (former Soviet Republics)</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>clay treatment vessel</td>
<td>a vessel equipped with bulk clay, clay bags or clay canisters used for removing surface-active-agents (surfactants) from fuel.</td>
</tr>
<tr>
<td>clear-and-bright test</td>
<td>when visually examined in a clear glass container, the fuel is visually free from water, sediment and suspended matter producing a bright sparkling appearance (refer to ASTM D4176).</td>
</tr>
<tr>
<td>coalescer element</td>
<td>a device, which removes solid particles and coalesces free water from fuel and is the first stage cartridge in the Filter/water separator vessel. It is upstream of the separator cartridge.</td>
</tr>
<tr>
<td>commingled</td>
<td>two or more batches of fuel mixed together.</td>
</tr>
<tr>
<td>compartment</td>
<td>a liquid-tight division in a cargo tank.</td>
</tr>
<tr>
<td>contaminants</td>
<td>substances that may be present in aviation fuel that detract from its performance.</td>
</tr>
<tr>
<td>contaminated fuel</td>
<td>fuel that, for any reason, does not meet specifications. Examples include water or particulate matter that is in excess of specified limits or mixed with other fuels.</td>
</tr>
<tr>
<td>control check</td>
<td>this is a Visual Check plus fuel density determination. This check is frequently made to confirm the correct grade and unchanged quality of fuel stocks by comparison of the result with the value shown on the documentation. Should these two figures (corrected to standard temperature conditions) differ by more than 3kg/m³ (1º API gravity), contamination should be suspected and the matter should be investigated before the fuel is accepted for use.</td>
</tr>
<tr>
<td>copper content</td>
<td>specifications impose a tight limit on the copper content of jet fuels. Even small quantities of soluble copper in the fuel can greatly affect the thermal stability of the fuel.</td>
</tr>
<tr>
<td>custody transfer</td>
<td>an event where fuel passes from one entity/Operator to another.</td>
</tr>
<tr>
<td>deadman control</td>
<td>a safety device that requires a positive action by the operator to allow the flow of fuel.</td>
</tr>
<tr>
<td>differential pressure</td>
<td>the difference in pressure readings (psi) between the inlet and outlet sides of a filter vessel. Often referred to as Delta P.</td>
</tr>
<tr>
<td>dip stick, aircraft fuel tank</td>
<td>a calibrated measuring device used for determining the amount of fuel in an aircraft tank.</td>
</tr>
<tr>
<td>distillation</td>
<td>the process to separate the components of a liquid mixture by boiling the liquid and then recondensing the resulting vapour.</td>
</tr>
<tr>
<td>distillation range</td>
<td>the overall volatility of a fuel through its entire distillation range is shown by its initial and final boiling points: a factor distinct from the flash point and vapour pressure.</td>
</tr>
<tr>
<td>earthing</td>
<td>see grounding</td>
</tr>
<tr>
<td>electrical conductivity</td>
<td>the property of transmitting electricity by contact.</td>
</tr>
<tr>
<td>filter elements</td>
<td>generic term given to separation media installed in various types of vessels (i.e. filter/coalescers, separators, filter monitors and microfilters) in order to remove suspended water and particulate matter.</td>
</tr>
<tr>
<td>filter monitor</td>
<td>main type of water absorbing filter used for final filtration of jet fuel prior to entering the aircraft.</td>
</tr>
<tr>
<td>filter separator</td>
<td>a filter vessel that removes solids, and coalesces and separates suspended water from fuel. Filter/water separators are equipped with two types of elements filter/coalescer elements (first stage) and separator elements (second stage).</td>
</tr>
<tr>
<td>fixed fuelling system</td>
<td>an arrangement of aviation fuel storage, pumps, piping, and associated equipment, including dispensing hydrants, cabinets, and/or pits at an airport, designed to service aircraft at locations established by the installation of the equipment.</td>
</tr>
<tr>
<td>flash point</td>
<td>the lowest temperature at which a liquid or a solid gives off enough vapour to form flammable air-vapour mixture near its surface.</td>
</tr>
<tr>
<td>floating suction</td>
<td>a suction device that swings on a sealed swing joint under the buoyancy of floats and draws from only the upper layers of the fuel in storage.</td>
</tr>
<tr>
<td>free water</td>
<td>water other than dissolved water, generally in droplets that may cause cloudiness and may settle due to gravity and form a defined layer at the bottom of a container.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>-------------------------------</td>
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<tr>
<td>free water test</td>
<td>an appearance test plus a chemical water detection field test to confirm the acceptability of the fuel. To be acceptable, fuel shall be of the correct colour and be visually clear, bright and undissolved water at normal ambient temperature. Samples for free water test shall be drawn into clean, clear-glass jars, stainless steel buckets or white enamel-lined buckets.</td>
</tr>
<tr>
<td>freezing point</td>
<td>the temperature at which a liquid becomes a solid, at normal atmospheric pressure.</td>
</tr>
<tr>
<td>fuel storage facility</td>
<td>tanks and associated facilities (i.e. tank farm/ fuel fuel storage facility).</td>
</tr>
<tr>
<td>Fuel System Icing Inhibitor (FSII)</td>
<td>approved substances added to fuel to prevent formation of ice crystals in fuel upon cooling</td>
</tr>
<tr>
<td>fueller</td>
<td>refers to an individual performing the fuelling of an aircraft</td>
</tr>
<tr>
<td>fuelling operation</td>
<td>this includes the fuelling, defuelling or load adjustment.</td>
</tr>
<tr>
<td>fuelling cabinet</td>
<td>a fixed, above-ground structure with hose, meters, and auxiliary equipment, from which fuel can be dispensed into an aircraft.</td>
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<tr>
<td>fuelling safety zone</td>
<td>areas with a radius of at least three metres (ten feet), or as specified by local regulations, from filling and venting points on the aircraft, hydrant pits, fuelling vehicle and its hoses in use.</td>
</tr>
<tr>
<td>fungible product</td>
<td>similar fuel where multiple batches have been mixed together and where individual batch identity has been lost.</td>
</tr>
<tr>
<td>grade-segregated system</td>
<td>where the pipelines and equipment used are exclusively reserved for the fuel concerned and any connection with another system is isolated by double block and bleed valves or other means of positive segregation.</td>
</tr>
<tr>
<td>grounding</td>
<td>the process of physically connecting one or more conductive objects to the ground, in order to safely dissipate any electrical charge.</td>
</tr>
<tr>
<td>gum, existent</td>
<td>gum is a non-volatile residue left following evaporation of the fuel.</td>
</tr>
<tr>
<td>hot fuelling</td>
<td>fuelling of an aircraft while the aircraft engine is operating.</td>
</tr>
<tr>
<td>hydrant</td>
<td>an in-ground fixed fuelling system designed to permit the transfer of fuel.</td>
</tr>
<tr>
<td>hydrant pit valve</td>
<td>a mechanism connected to the termination point of each lateral to allow fuel to flow through the hydrant vehicle.</td>
</tr>
<tr>
<td>hydrant vehicle</td>
<td>also known as a hydrant servicer, hydrant cart, hydrant dispenser. a towed trailer or self-propelled vehicle, equipped with filters, meters, hoses, and controls, that is used to transfer fuel between a fuel hydrant and an aircraft.</td>
</tr>
<tr>
<td>incident</td>
<td>an occurrence, associated with the operation of an aircraft, which affects or could affect the safety of operations.</td>
</tr>
<tr>
<td>intrinsically safe</td>
<td>equipment &amp; wiring that is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration.</td>
</tr>
<tr>
<td>ISGOTT</td>
<td>International Safety Guide for Oil Tankers and Terminals</td>
</tr>
<tr>
<td>leak</td>
<td>any loss of petroleum fuel because of a defect in the storage, piping, or delivery system.</td>
</tr>
<tr>
<td>MSEP</td>
<td>microseparometer - a test method for determining water separation characteristics of jet fuel.</td>
</tr>
<tr>
<td>micronic filter</td>
<td>a filter for removing particulate only (not water).</td>
</tr>
<tr>
<td>new vehicle</td>
<td>in the context of this Standard, any vehicle purchased, or refurbished, after the initial date of publication of this standard.</td>
</tr>
<tr>
<td>North America</td>
<td>for the purpose of this Standard, “North America” is intended to reflect the countries of the USA and Canada only.</td>
</tr>
<tr>
<td>particulates</td>
<td>solid contaminants found in jet fuel (i.e., dirt, rust, sand, fibers).</td>
</tr>
<tr>
<td>periodic check</td>
<td>a test that is carried out to certify that jet fuel which has been static in storage for 6 months conforms to the relevant specifications and that the quality of the fuel has not changed significantly since the last test was carried out.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>power take-off</td>
<td>an engine or transmission-powered splined drive shaft used to provide power to a pump, or other auxiliary attachment.</td>
</tr>
<tr>
<td>product - dedicated</td>
<td>dedicated to a single fuel, an independent piping system at a storage facility that has no interconnections (e.g. no chance of intermixing fuel)</td>
</tr>
<tr>
<td>positive sump</td>
<td>a chamber or depression installed at the bottom of a tank or filter vessel to facilitate the collection and removal of contaminants.</td>
</tr>
<tr>
<td>pre-check valve</td>
<td>a device used to check the operation of the automatic high level shut off on refuelling tenders.</td>
</tr>
<tr>
<td>pressure, operating</td>
<td>the pressure against the pump’s maximum no-flow head, existing in a system under flowing conditions or static conditions but excluding surge pressures.</td>
</tr>
<tr>
<td>pressure, test</td>
<td>the pressure at which the system or a component thereof is tested to verify its integrity.</td>
</tr>
<tr>
<td>product</td>
<td>unless the text indicates otherwise, it normally means jet fuel.</td>
</tr>
<tr>
<td>qualification</td>
<td>demonstrated skill, documented training, demonstrated knowledge, and experience required for personnel to properly perform the duties of a specific job.</td>
</tr>
<tr>
<td>Recertification Test Certificate</td>
<td>a re-test carried out to verify that the quality of the aviation fuel concerned has not changed significantly from its original test results, and remains within the specification limits. 8 items tested to ensure fuel hasn’t changed based on initial Certificate of Analysis Test</td>
</tr>
<tr>
<td>Refinery Certificate of Quality</td>
<td>the Refinery Certificate of Quality is the definitive original document describing the quality of an aviation fuel. It contains the results of measurements, made by the fuel originator's laboratory. It also provides information regarding the addition of additives, including both type and amount of any such additives. In addition, it includes details relating to the identity of the originating refinery and traceability of the fuel described.</td>
</tr>
<tr>
<td>relative density</td>
<td>the ratio of the mass of a given volume of a liquid to the mass of an equal volume of water. For aviation fuels, this is sometimes expressed as API (see API gravity).</td>
</tr>
<tr>
<td>relaxation time</td>
<td>the time required to allow any build up of static electricity within the fuel to dissipate.</td>
</tr>
<tr>
<td>refueller</td>
<td>refers to the equipment used for fuelling (e.g. mobile refuelling truck)</td>
</tr>
<tr>
<td>sample - bottom</td>
<td>sample obtained from the material on the bottom surface of the tank or container at its lowest point.</td>
</tr>
<tr>
<td>sample - drain line</td>
<td>a sample obtained from the water draw-off or drain point of a storage or vehicle tank or filter body.</td>
</tr>
<tr>
<td>sample – hose end</td>
<td>a sample obtained from a refueller or hydrant servicer delivery hose-end coupling or nozzle.</td>
</tr>
<tr>
<td>sample - line</td>
<td>a sample obtained from a line sampling point, drawn while the fuel is flowing.</td>
</tr>
<tr>
<td>sample - lower</td>
<td>sample obtained from the middle depth of the lower third of the tank contents.</td>
</tr>
<tr>
<td>sample - middle</td>
<td>sample obtained from the middle depth of the tank contents.</td>
</tr>
<tr>
<td>sample - multiple-tank composite</td>
<td>a mixture of individual composite samples from the several compartments each of which contains the same grade of fuel. The mixture is blended in proportion to the volume of material in each compartment (e.g. ships, barges, etc)</td>
</tr>
<tr>
<td>sample - running</td>
<td>fuel sample taken from a flowing system</td>
</tr>
<tr>
<td>sample - single-tank composite</td>
<td>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</td>
</tr>
<tr>
<td>sample - upper</td>
<td>sample obtained from the middle depth of the upper third of the tank contents.</td>
</tr>
<tr>
<td>separator element</td>
<td>the second-stage cartridge in a filter-separator vessel that allows passage of fuel but rejects fuel water droplets. The separator element is downstream of the filter/coalescer cartridge.</td>
</tr>
<tr>
<td>settling time</td>
<td>the elapsed time that a fuel remains undisturbed before being released</td>
</tr>
<tr>
<td>smoke point</td>
<td>the smoke point test provides an indication of the relative smoke-producing properties. A high smoke point indicates a low smoke-producing tendency.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>static electricity</td>
<td>an electrical potential generally built up by friction (e.g. filter or filter-separator and fuel, and pipelines and fuel). A build-up of static electricity may be great enough to cause sparking or arcing capable of causing combustion.</td>
</tr>
<tr>
<td>sulphur, total</td>
<td>control of total sulphur below a maximum limit ensures that possible corrosion of turbine metal parts by the sulphur oxides formed during combustion is minimal.</td>
</tr>
<tr>
<td>sump fuel</td>
<td>fuel removed from fixed facility tank and filter vessel sumps and mobile equipment sumps while performing routine quality assurance tests or maintenance on equipment.</td>
</tr>
<tr>
<td>sump separator</td>
<td>alternative term for Sample Receiving Vessel</td>
</tr>
<tr>
<td>surfactants (surface-active-agents)</td>
<td>detergent-like compounds frequently found in jet fuel. These compounds are of concern because they have a disarming effect on elements used in Filter/water separators. Clay treatment is one means used in removing surfactants from jet fuel.</td>
</tr>
<tr>
<td>surge tanks</td>
<td>tanks that collect the fuel from high-pressure relief valves on hydrant vehicles.</td>
</tr>
<tr>
<td>tank vehicle</td>
<td>a self-propelled or towed vehicle, equipped with storage tanks, filters, pumps, hoses, and controls, used to transport and deliver fuel to an aircraft</td>
</tr>
<tr>
<td>test, corrosion, copper strip</td>
<td>no more than a slight tarnish on a copper strip after immersion in the fuel for 2 hrs. at 100°C assures that the fuel will not corrode copper or copper alloys in the fuel system.</td>
</tr>
<tr>
<td>thermal stability</td>
<td>Jet Fuel Thermal Oxidation Test (JFTOT) is used to ensure that acceptable thermal stability, at specific temperature, fuel system pressure, and fuel flow rate is maintained. Fuel instability leads to thermal breakdown causing particle formation, either in suspension in the fuel, or as lacquer build-up on heater tubes, causing blocked fuel filter, injection nozzles, and inefficient heat exchanger operation.</td>
</tr>
<tr>
<td>thermohydrometer</td>
<td>a hydrometer with a built-in thermometer used to determine fuel density and temperature using one device.</td>
</tr>
<tr>
<td>ullage</td>
<td>measurement from hatch down to the fuel level (the space remaining)</td>
</tr>
<tr>
<td>uplift</td>
<td>the quantity of fuel transferred to an aircraft.</td>
</tr>
<tr>
<td>vendor</td>
<td>for the purpose of this standard, the term “vendors” includes various providers (e.g. into-plane services, airport fuel storage facility/hydrant operators).</td>
</tr>
<tr>
<td>visi-jar</td>
<td>a clear glass container with a lid, that is permanently connected to a sample point in order to facilitate a visual appearance check, and minimize skin contact with fuel. Also known as a “closed circuit sampler”.</td>
</tr>
<tr>
<td>visual check</td>
<td>an appearance test plus a chemical water detection field test to confirm the acceptability of the fuel. To be acceptable, fuel shall be of the correct colour and be visually clear, bright and free from particulate matter and undisolved water at normal ambient temperature. Samples for Visual Check shall be drawn into scrupulously clean, clear-glass jars, stainless steel buckets or white enamel-lined buckets.</td>
</tr>
<tr>
<td>waste fuel</td>
<td>fuel not suitable for aircraft use, and not to be recycled back into fuel.</td>
</tr>
<tr>
<td>water defense system</td>
<td>A device, which senses a predetermined level of free water in Filter/water separator sumps, and automatically stops the flow of fuel to prevent downstream contamination.</td>
</tr>
<tr>
<td>White Bucket test</td>
<td>in cases where there is a likelihood of dye contamination, an additional visual appearance in a White Bucket test shall also be carried out (refer to , using a bucket whose interior is coated with a white porcelain enamel (e.g. Gammon Technical Products, GTP-1746B or GTP-1746C)</td>
</tr>
<tr>
<td>working tank</td>
<td>the fuel storage tank being used to supply fuel to fuelling trucks or the hydrant system.</td>
</tr>
</tbody>
</table>

END OF AS6401