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Contents

Glossary of terms

additives	Material(s) (usually chemical products) added to change the existing properties of, or impart new characteristics to, aviation fuels (e.g. *fuel system icing inhibitors* (FSII), and *static dissipater additives* (SDA).
Appearance Check	A field check to confirm the acceptability of the fuel (i.e. the correct colour and visually clear, bright and free from particulate matter and undissolved water at ambient temperature).
apron	An area of an airport where aircraft are parked and refuelled
batch	In aviation terms, a batch of product is an identifiable quantity, produced at a refinery, tested and identified as a single entity. If product from two different batches is mixed, it is re-tested and re-identified as a new batch.
bonding	The physical connection of two metal objects by an electrical conductor that equalises the charge or electrical potential between the two objects. Example: bond the fuelling vehicle to the aircraft with a metal cable to equalise the charge and thus reduce the possibility of generating sparks when the fuelling nozzle is connected to the aircraft.
bridger	Tank truck used to supply aviation fuel from one storage area to another, such as refinery to terminal or terminal to airport.
bunded area	The spill containment area around a fuel storage tank.
calibration	Making precise measurements and adjustments to equipment or systems to obtain optimum performance and to certify that output data falls within prescribed tolerances.
cathodic protection	A method of preventing or reducing corrosion to a metal surface (by using an impressed direct current or attaching sacrificial anodes).
Certificate of Analysis(CoA)	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 relevant fuel specification and, for Jet A-1, the requirements of the latest issue of the JIG Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS) Check List. 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 product described. It shall be dated and signed by an authorised signatory.
Certificate of Quality (RCQ) (Refinery Certificate of Quality)	An *RCQ* is raised whenever full certification tests are performed at a refinery. The RCQ normally shows the applicable specification requirements for the products being tested, the date, the test method and the test results. It also includes the amount and type of additives used, the quantity of the batch, the batch number and the number of the tank containing the product. The RCQ is signed by designated personnel.
chemical water detector	*Chemical water detectors* are used to confirm the presence of free or suspended water in Jet fuel. There are types designed to give a positive indication of water in fuel at concentrations of 30 parts per million and above.
clay treater	A treater that uses a medium of a special Attapulgus clay, either in bulk or in replaceable cartridges. The special clay adsorbs and picks up surface active agents, colour bodies and very fine particles in the fuel, not otherwise removable.
coalescer	The first stage of a *filter/separator* is called a *coalescer*. It filters out solid particles and causes small free water droplets in the fuel to form into large droplets, which will settle out by gravity.
colour	In aviation gasolines, colour relates to the appearance of the product as compared to the expected colour, e.g. Avgas Grade 100LL is dyed blue and therefore is checked against this known standard for product identification. In aviation Jet fuel colour indicates a rating against a fixed standard.
commingle	The mixing of the same product grade from two different sources or batches so that each loses its original identity.
compartment	A liquid-tight division in a cargo tank.
contaminated fuel	Fuel that does not meet specifications for any reason. Examples include water or *particulate* matter that is in excess of specified limits or mixed with other fuels.
contamination	Foreign matter, solid or liquid, which gets into any aviation product, e.g., water, rust, dirt, another product grade, etc.
Control Check	The *Control Check* consists of an *Appearance Check* plus density determination.
custody transfer	An event where fuel passes from one entity/operator to another.
deadman	A hand-held control, which starts the flow of product and automatically shuts off flow if released for any reason. The device may be fitted with an intermittent feature that has to be released at regular intervals to prevent it from shutting off.
dedicated	Equipment is *dedicated* to carrying and storing only a single grade of product. For tanks, vessels, tank trucks, tank containers and rail cars, *dedicated* means that at least the previous three cargoes have been the same product as the one being loaded/ stored and change of grade procedures have been followed. See **segregated**.
defuelling	Removal of fuel from an aircraft.
differential pressure	The difference in pressure readings (psi/bar) between the inlet and outlet sides of a filter vessel. Often referred to as *Delta P*.
dipstick	A graduated rod or stick that is inserted into a tank to measure the amount of product in the tank.

distillation	The process to separate the components of a liquid mixture by boiling the liquid and then recondensing the resulting vapour.
drip stick	A graduated rod or tube that drops from the bottom of an aircraft fuel tank and measures the amount of fuel in the tank.
driveaway interlock	A safety device on fuelling vehicles that prevents vehicle movement unless all fuelling hoses are stowed securely on the vehicle and movable fuelling platforms are fully lowered.
fast flush	Refers to an effective water draw-off from storage tanks.
filter elements	Generic term given to separation media installed in various types of vessels (i.e. *filter/coalescers, separators, filter monitors* and *microfilters*) to remove suspended water and particulate matter.
Filter Membrane Test	A test for solid contaminant in a sample of fuel that is passed through a filter membrane, which is then weighed (*Gravimetric Test*), or matched to a colour standard (*Colour Test*) to determine the degree of contamination.
filter monitor	A vessel containing water absorbing elements that will continuously remove solids and free water from aviation fuels. With proper maintenance, it also provides a positive shut-off of flow if the level of free water or solids in the fuel system is unacceptable. Governed by EI 1583 specification.
filter/separator (FWS)	A vessel with two stages of filtration and water separation, through which fuel passes to remove dirt and water. The first stage (*coalescer*) removes dirt and coalesces water; the second stage (*separator*) prevents residual water droplets that have not yet settled from leaving the vessel with the fuel. (See **coalescer**). Governed by EI 1581 specification and EI 1582 Similarity.
fixed fuelling system	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.
flash point	The lowest temperature at which a liquid or a solid gives off enough vapour to form flammable air vapour mixture near its surface.
floating suction	Suction pipe that floats on the top of the liquid surface permitting product withdrawal from the top layer of liquid in the tank, which directionally is the cleanest fuel in the tank at the time.
free water	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.
freezing point	The temperature at which a liquid becomes a solid, at normal atmospheric pressure.
fuel sense line	Small diameter line that typically runs from the hydrant coupler/ in line pressure control valve to a *venturi*.
Fuel System Icing Inhibitor (FSII)	Approved substances added to fuel to prevent formation of ice crystals in fuel upon cooling.
fueller	Refers to the equipment used for fuelling (e.g. mobile refuelling truck).
fuelling cabinet	A fixed, above-ground structure with hose, meters, and auxiliary equipment, from which fuel can be dispensed into an aircraft. (See also **fixed fuelling system**.)
fuelling operation	This includes fuelling, defuelling and may include *additional services* where authorised.
fuelling safety zone	Areas with a radius of at least 3 metres (10 feet), or as specified by local regulations, from filling and venting points on the aircraft, hydrant pits, fuelling vehicle and its hoses in use.
Gravimetric Test	A membrane filtration test using two pre-weighed filter papers to allow a quantitative assessment of particulate in the fuel.
gum, existent	*Gum* is a non-volatile residue left following evaporation of the fuel.
Hazardous Area Classification	A system of classification for electrical equipment to determine requirements for operation in the presence of flammable vapours etc. e.g. in Europe ATEX. (See **intrinsically safe**.)
Hose End Pressure Control Valve (HEPCV)	A spring or air operated internal sensing valve located just upstream of an aircraft fuelling nozzle, which limits normal operating pressure and surge pressures at the aircraft fuelling adapter.
hot fuelling	Fuelling of an aircraft while the aircraft engine is operating.
hydrant	An in-ground fixed fuelling system designed to permit the transfer of fuel.
Hydrant Emergency Stop Button (ESB)	A button that causes the hydrant system pumps to shut down when activated and closes valves to terminate any gravity flow into hydrant. ESBs are normally located near to aircraft stands and they should be accessible and clearly identified.
hydrant pit valve	A mechanism connected to the termination point of each lateral to allow fuel to flow through the hydrant vehicle.
hydrant servicer	A fuelling vehicle that connects to the hydrant system to deliver fuel to an aircraft. Sometimes referred to as simply *servicer.*
incident	An occurrence, associated with the operation of an aircraft, which affects or could affect the safety of operations.
interface cut	A procedure used to isolate or segregate one product from another at the receiving end of a *non-dedicated* pipeline, as the products go into tankage.
intermediate terminal/ storage	A storage terminal or plant situated between the supplying refinery and the airport operating storage. Also includes receipt storage at an airport from which fuel is transferred to airport operating tanks.

intrinsically safe	Equipment and wiring that is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous zone atmospheric mixture in its most easily ignited concentration. See **hazardous area classification**.
isolation	A physical means of separating equipment containing different grades of fuel or certified and uncertified aviation fuel grades. (See **segregated**.)
Joint Venture	Joint ownership or operation of aviation (or other) facilities by two or more companies.
lanyard	A cable that is attached to the *hydrant pit valve* during fuelling operations and which can be used to close the pit valve in an emergency situation.
leak	Any loss of fuel due to a defect in the storage, piping, or delivery system.
low point (designated)	A drain point in a pipeline where significant quantities of *particulate*/water would accumulate if the position was not flushed on a regular basis. The frequency of flushing should be determined by documented experience. Where pipelines are in turbulent flow conditions, it is unlikely that significant quantities of *particulate*/water will accumulate.
master meter	A certified accurate meter used to check flow meters on dispensing equipment or fixed facilities.
meter prover	A volumetrically calibrated tank used to prove the accuracy of the meters used on aircraft fuelling equipment. Also called *meter proving tank* or *calibration tank*.
microfilter (micronic filter)	A filter specifically designed to remove only dirt particles from a fuel stream. Typically used upstream of *Filter Water Separators (FWS)* in high dirt environments to prolong the life of the FWS elements. Governed by EI 1590 specification.
micro-separometer (MSEP)	A test method for determining water separation characteristics of Jet fuel.
non-dedicated	A system of tankage, pipes, vehicles, etc., in which more than one product or grade of product can or does flow through the same system; single valve isolation is considered non-dedicated. Also referred to as a *multi-product* system.
nozzle screen	A screen filter, no coarser than 60 mesh, installed in a fuelling nozzle to catch any solid contaminants that might enter the fuelling system between the last filter and the aircraft.
particulates	Solid contaminants found in Jet fuel (i.e., dirt, rust, sand, fibres).
Periodic Test	A selected set of tests carried out on samples of static stock after 6 months to confirm that fuel meets the relevant specifications and that the quality of the fuel has not changed significantly since the last test was carried out.
power take-off (PTO)	An engine or transmission-powered splined drive shaft used to provide power to a pump, or other equipment
pre-check valve	A device used to check the operation of automatic high level shut-off on fuellers.
pressure, operating	The pressure against a pump's maximum no-flow head, existing in a system under flowing conditions or static conditions but excluding surge pressures.
pressure, test	The pressure at which a system or a component of the system is tested to verify its integrity.
qualification	Demonstrated skill, documented training, demonstrated knowledge, and experience required for personnel to properly perform the duties of a specific job.
ramp	See **apron**.
Recertification Test	A selected set of tests carried out on fuels during or after certain types of movement to verify that the fuel has not been contaminated and that the quality of the aviation fuel concerned has not otherwise changed. Samples tested shall remain within the specification limits. Test results for specified critical properties shall also be within maximum variances of the previous analysis of the same fuel batch.
relaxation time	The time required to allow any build-up of static electricity within the fuel to dissipate. This is calculated by including volumetric capacity in a fuel handling system, which increases the residence time (downstream of any charge generating equipment such as filters) for the purpose of dissipating, or losing, static electricity charge, before the fuel discharges from the fuel system into a tank, truck or aircraft.
segregated	Either the aviation fuel grade is in equipment that is isolated from other systems carrying different fuel grades. Or the certified aviation fuel is in equipment that is isolated from other systems carrying uncertified aviation fuel of the same grade. See **isolation**.
separator element	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 *coalescer* cartridge. See **filter/separator**.
settling time	The time required after receipt and before shipment of product from a storage tank to provide adequate settling of any solids and water.
similarity	The requirement for combinations of *filter /separator elements* and vessels to meet the EI 1581 specification. A similarity data sheet confirms that a specific element and vessel configuration at a designated maximum flow meets the requirements of EI 1581. Governed by EI 1582 specification.
slug valve	An inline valve that is triggered to close and shut off flow, when excess water builds up in a sump and trips a solenoid by means of a float or electrical probe.
smoke point	The *smoke point* test provides an indication of the relative smoke-producing properties. A high smoke point indicates a low smoke-producing tendency.
static dissipator additive	Aviation approved additive for improving fuel conductivity leading to more rapid relaxation of static electricity. Sometimes referred to as *anti-static additive.*

static electricity	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.
static storage	Storage tanks that have had no new fuel introduced in these time periods: Jet fuel – 6 months; Avgas – 6 months.
sulphur, total	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.
sump	The lowest point in a storage tank, vehicle tank or filter, purposely designed to collect water and particulate. When a tank or filter is *sumped* the contaminants are removed as part of routine quality assurance tests or maintenance on equipment.
surfactants (surface active-agents)	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.
test, corrosion, copper strip	No more than a slight tarnish on a copper strip after immersion in the fuel for 2 hours at 100°C assures that the fuel will not corrode copper or copper alloys in the fuel system.
thermal stability test	A *Jet Fuel Thermal Oxidation Test (IP323 / ASTM D 3241)* 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.
thief pump	A small hand- or motor-operated pump with a long suction tube, which reaches to the bottom of a tank to drain off any water collected on the tank bottom, or to collect samples.
ullage	Measurement of the space remaining from the hatch down to the fuel level.
uplift	The quantity of fuel transferred to an aircraft.
vendor	For the purpose of this Standard, the term *vendor* includes various providers (e.g. into-plane services, airport fuel storage facility/hydrant operators).
venturi	A device in the fuel flow stream for providing a reduced fuel pressure for control of secondary pressure control systems.
visijar	A clear glass container with a lid, which is permanently connected to a sample point to facilitate a visual appearance check, and to minimise skin contact with fuel. Also known as a *closed circuit sampler*.
Visual Check	A Visual Check is an *Appearance Check* plus the use of a *chemical water detector* to confirm water-free status.
waste fuel	Fuel not suitable for aircraft or aviation use.
water defence system	A device that senses a predetermined level of free water in *filter/separator* sumps, and automatically stops the flow of fuel to prevent downstream contamination.
working tank	The fuel storage tank being used to supply fuel to fuelling trucks or a hydrant system.

Table of acronyms

Acronym	What it means	Acronym	What it means
AFQRJOS	Aviation Fuel Quality Requirements for Jointly Operated Systems (JIG Check List)	kPa	kilo Pascals (units of measure)
API	American Petroleum Institute	LEL	Lower Explosive Limit
APU	Auxiliary Power Unit	LI	Lubricity Improver (same as CI)
ASTM	ASTM International	MAWP	Maximum Allowable Working Pressure
AVGAS	Aviation Gasoline	MBG	Microbiological Growth
BS	British Standard	MDA	Metal Deactivator Additive
CoA	Certificate of Analysis	MF	Microfilter (Micronic Filter)
CI	Corrosion Inhibitor (same as LI)	MOGAS	Motor Gasoline
CIS	Commonwealth of Independent States (former Soviet Republics)	MSDS	Material Safety Data Sheets
CWD	Chemical Water Detector	MSEP	Micro Separometer
DEF STAN	Defence Standard (UK Ministry of Defence)	MTC	Multiple Tank Composite Sample
DiEGME	Diethylene Glycol Mono Methyl Ether (see FSII)	NDT	Non-Destructive Testing
DLA	Defense Logistics Agency (US)	NFPA	National Fire Protection Association (US)
dP	Differential Pressure	OEM	Original Equipment Manufacturer
EI	Energy Institute	PCV	Pressure Control Valve
ESB	Emergency Stop Button	PPE	Personal Protective Equipment
FIFO	First In First Out	ppm	Parts Per Million
FSII	Fuel System Icing Inhibitor	PQ	Product Quality
FWS	Filter Water Separator	PTO	Power Take Off
GPM	Gallons Per Minute	pS/m	Pico Siemens per Metre
GPU	Ground Power Unit	PSI	Pounds per Square Inch
HEPCV	Hose-End Pressure Control Valve	P-V	Pressure-Vacuum (Vent)
IATA	International Air Transport Association	QC	Quality Control
IBP	Initial Boiling Point	RCQ	Refinery Certificate of Quality
IFQP	IATA Fuel Quality Pool	RPM	Revolutions Per Minute
IGS	Inert Gas Systems	RTD	Resistance Temperature Device
ILPCV	In-Line Pressure Control Valve	RVP	Reid Vapour Pressure
IP	Institute of Petroleum (Test Methods)	SDA	Static Dissipator Additive
IPA	Iso-Propyl Alcohol	STC	Single Tank Composite Sample
ISGOTT	International Safety Guidelines for Oil Tankers and Terminals	TAN	Total Acid Number
JAA	Joint Aviation Authority (Europe)	USG	United States Gallons
JFTOT	Jet Fuel Thermal Oxidation Test	USGPM	Unites States Gallons per Minute
JIG	Joint Inspection Group	UV	Ultra-Violet
JSCL	Joint Systems Check List (See AFQRJOS)	WSIM	Water Separability Index Modified (Test now replaced by MSEP)

List of useful publications

The following standards shall be used where identified within the JIG documents. They should also be used as a source of additional and background information as required.

American Petroleum Institute (API)
API Manual of Petroleum Measurement Standards
API 1543 Documentation, Monitoring and Laboratory Testing of Aviation Fuel during Shipment from Refinery to Airport
API 1595 Design, Construction, Operation, Maintenance and Inspection of Aviation Pre-Airfield Storage Terminals
API 2013 Cleaning Mobile Tanks in Flammable or Combustible Service
API 2611 Terminal Piping Inspection – inspection of In-service Terminal Piping Systems
API 650 Welded Steel Tanks for Oil Storage
API RP 652 Lining of Above Ground Petroleum Storage Tank Bottoms

Energy Institute (EI)
IP Petroleum Measurement Manual
IP 160 Density and API Gravity of Crude Oil and Petroleum Products-Hydrometer Method
IP 274 Determination of electrical conductivity of aviation and distillate fuels
IP 323 Jet Fuel Thermal Oxidation Test
IP 365 Density and Relative Density of Liquids by Digital Density Meter
IP 559 Determination Of Density Of Middle Distillate Fuels – Hand Held Oscillating U-tube Density Meter Method
IP 585 Determination of Fatty Acid Methyl Esters (FAME), derived from Bio-Diesel fuel, in aviation turbine fuel - GC-MS with selective ion monitoring/scan detection method
IP 599 Determination of Fatty Acid Methyl Esters (FAME) in aviation turbine fuel
EI 1529 Aviation fuelling hose and hose assemblies
EI/JIG 1530 Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airports
EI 1540 Recommended Practice, Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities
EI 1541 Performance requirements for protective coating systems used in aviation storage tanks and piping
EI 1542 Identification markings for dedicated aviation fuel manufacturing and distribution facilities, airport storage and mobile fuelling equipment
EI 1550 Filtration Handbook
EI 1560 Recommended practice for the operation, inspection, maintenance and commissioning of aviation fuel hydrant systems and hydrant system extensions
EI 1581 Specification and Qualification Procedures for Aviation Jet Fuel Filter Separators
EI 1582 Specification for Similarity for EI 1581 Aviation Jet Fuel Filters/Separators
EI 1583 Laboratory Tests and Minimum Performance Levels for Aviation Fuel Filter Monitors
EI 1584 Four-inch Hydrant System Components and Arrangements
EI 1585 Guidance in the Cleaning of Aviation Fuel Hydrant Systems at Airports
EI 1590 Specification and qualification procedures for aviation fuel microfilters
EI 1594 Initial pressure strength testing of airport fuel hydrant systems with water
EI 1596 Design and construction of aviation fuel filter vessels
EI 1597 Procedures for overwing fuelling to ensure delivery of the correct fuel grade to an aircraft
EI 1598 Design, functional requirements and laboratory testing protocols for electronic sensors to monitor free water and/or particulate matter in aviation fuel
EI 1599 Laboratory tests and minimum performance levels for aviation fuel dirt defence filters
EI Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies
EI Model Code of Practice – Part 2, Design Construction and Operation of Petroleum Distribution installations
HM 20 Proving of Aviation fuelling positive displacement meters
HM 50 Guidelines for the cleaning of tanks and lines for marine tank vessels carrying petroleum and refined products

ASTM International (American International Standard for Testing and Materials)
ASTM D2276/IP 216 Standard Test Method for Particulate Contaminant in Aviation Turbine Fuel by Line Sampling
ASTM D2624 or IP274 Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels
ASTM D3241 Jet Fuel Thermal Oxidation Test
ASTM D6469 Standard Guide for Microbial Contamination in Fuels and Fuel Systems
ASTM D6986 Standard Test Method for Free Water, Particulate, and Other Contamination in Aviation Fuels (Visual Inspection Procedures)
ASTM D4176 Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels
ASTM D4057 Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4306 Standard Practice for Aviation Fuel Sample Containers for Tests affected by Trace Contamination
ASTM D7566 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons

Comitee Europeen des Normalisation (CEN) and British Standards
EN 12312-5 Aircraft Ground Support Equipment-Specific Requirements - Part 5 Aircraft Fuelling Equipment
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
BS 3492 Specification for road and rail tanker hoses and hose assemblies for petroleum products, including aviation fuels
BS 5842 Specification for thermoplastic hose assemblies for dock, road and tanker use

International Air Transport Association (IATA)
Guidance Material on Microbiologial Contamination in Aircraft Fuel Tanks
Guidance Material on Turbine Jet Fuels Specifications
Guidance Material on Standard Into-Plane Fuelling Procedures
Dangerous Goods Regulations

International Civil Aviation Organization (ICAO)
Technical Instructions for the Safe Transport of Dangerous Goods by Air

International Organization for Standardization (ISO)
ISO 1825 (EI1529) Rubber hoses and hose assemblies for aircraft ground fuelling and defuelling
ISO 3170 (IP 475) Methods of Test for Petroleum and its Products. BS 2000 – 475: Petroleum Liquids. Manual Sampling)
ISO 6789 Assembly tools for screws and nuts – hand torque tools – requirements and test methods for design conformance testing and recalibration procedure

ISO/IEC Guide 43-1:1997 Proficiency testing by interlaboratory comparisons
Part 1: Development and operation of proficiency testing schemes, and
Part 2: Selection and use of proficiency testing schemes by laboratory accreditation bodies

National Fire Protection Association (NFPA)
NFPA 407 - Standard for Aircraft Fuel Servicing

Society of Automotive Engineers (SAE)
AS 1852 Nozzles and Ports – Gravity Fuelling Interface Standard for Civil Aircraft
ARP 5789 Aviation Fuel Facilities
ARP 5818 Design & Operation of Aircraft Refuelling Tanker Vehicles
AS 5877 Detailed Specification for Aircraft Pressure Refuelling Nozzle

International Safety Guidelines for Oil Tankers and Terminals (ISGOTT)

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Carboil Srl
Cenit Transporte y Logistica de Hydrocarburos SAS
Certas Energy UK Ltd
Chevron
China National Aviation Fuel Supply Company
CLH Aviacion, SA
CMD Aeropuertos Canarios SL
Defense Logistics Agency (DLA)
Distributeurs Nationaux SA (DINASA)
EKO Aviation
Emirates National Oil Company (ENOC)
ENACOL SA Empresa Nacional de Combustiveis SA
Energy Institute
Eni SpA
Exel Petroleum (Pty) Ltd
ExxonMobil
GB Energy Ltd
Gulf Energy Ltd
Hansaconsult Ingenieurgesellschaft GmbH
Hoyer Ireland Ltd
International Air Transport Association
Kuwait Aviation Fuelling CompanyKuwait Petroleum International Aviation Company Ltd
Levorato Marcevaggi Srl
Morgan Stanley
NAFTAL Branche Carburants
Oando PLC
OFC Aviation Fuel Services S.A.
Oil and Pipelines Agency
Organizacion Terpel SA
Pacific Energy International Pty Ltd
Penspen
Pertamina Aviation
Petrobras Distribuidora SA
Petrogal (Galp Energia)
Petroleum Association of Japan (PAJ)
Petronas
Phillips 66 Ltd
Phoenix Petroleum Philippines Inc
PPT Aviation Services Ltd
PTT Global Chemical Public Company Ltd
PTT Public Company Ltd (Thailand)
Puma Energy Services South Africa (PTY) Ltd
Qatar Jet Fuel Company (Qjet)

Reliance Industries Ltd
Rubis Energie
SAFCO AE
Sahara Group
Saudi Aramco
Shell Aviation Ltd
Shenzhen Chengyuan Aviation Oil Co Ltd
Sinopec (Hong Kong) Aviation Co Ltd
SKA Energy
Skytanking Holding GmbH
SOCAR Energy Switzerland
Sol Aviation Services Ltd
Statoil Petroleum AS
Supreme Fuels Trading FZE
Swissport Fueling Inc
THY OPET Aviation Fuels Co
UNO Aviation
Valero Energy Ltd
Vitol Aviation BV
Vitol Tank Terminals International BV
Vopak Oil EMEA
Winson Oil Trading Pte Ltd
World Fuel Services Aviation Ltd
YPFB Aviacion SA
Zuva Petroleum

Chapter 1
Introduction

1.1 Purpose

This document is intended for the guidance of members of the Joint Inspection Group (JIG) and companies affiliated with members of JIG and IATA Airlines. It does not preclude the use of any other operating standards, procedures, equipment maintenance or inspection procedures. Neither JIG Ltd, its members, nor the companies affiliated with its members accept responsibility for the adoption of this document or compliance with this document. Any party using this document in any way shall do so at its own risk. For JIG Joint Ventures and locations on the JIG Inspection Programme see also Appendix A17.

The primary purpose of this document is to provide the set of agreed standards that shall be used by a company in preparing the detailed quality control and fuel handling procedures for fuelling services at the specific location.

Mandatory requirements in this Standard are designated by the word "shall." Recommendations and best practices are designated by the word "should." Optional items are designated by the word "may."

Note: Only the latest revision of any document or standard, referenced in this document, shall be considered. A glossary of terms, table of acronyms and a list of useful publications is included at the beginning of this Standard.

1.2 Scope

The following chapters in this document define standards for the design and maintenance of fuelling equipment and the preparation of operating and quality control procedures to be used in into-plane fuelling services.

Corresponding standards applicable to supply and distribution facilities and airport depots may be found in the following companion documents:

(a) Aviation fuel quality control and operating standards for airport depots and hydrants (JIG 2).

(b) Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airports (EI/JIG Standard 1530).

1.3 Application

Companies operating to JIG Standards shall operate to the entirety of this Standard. Detailed procedures based on this Standard shall be prepared and incorporated in, or appended to, the signed operating agreement covering the system to make them formally binding.

The fuel quality specifications shall also be incorporated in all operating agreements, by reference to the current issue of the JIG Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS) Check List, or approved aviation fuel specification.

1.4 Staff responsibilities and inspection requirements

1.4.1 Staff responsibilities

It is the responsibility of the operation's management (i.e. the operating company board of directors or the operating committee) to ensure that the facility design and operating procedures as set out in manuals and other directives, conform to acceptable industry standards and to all the relevant requirements of government authorities with respect to safety, security, fire protection and environmental protection.

The prime responsibility of into-plane fuelling staff is to ensure that on-specification fuel of the correct grade is always delivered to aircraft and that the operations are carried out in a safe and efficient manner. The manager of an into-plane fuelling operation shall have overall responsibility for the fuelling operations under his/her control and shall be responsible for ensuring that all operations are carried out in accordance with the agreed procedures, and with all generally accepted standards of safety and good practice.

The manager shall be fully satisfied with the quality of the fuel stocks being received for delivery to aircraft, and shall be entitled to visit and make any appropriate tests at the airport depot as may be necessary to satisfy himself/herself over any justifiable doubts regarding the quality of the fuel supplies.

1.4.2 Inspection requirements

Inspections to JIG Standards shall be carried out at least once per year to ensure compliance with locally prepared procedures.

The locally prepared (site specific) procedures/operations manual shall include an updated list of any approved variances from the current issue of this Standard (see "Standards Variance Approvals" below).

Before leaving the location, the inspector shall discuss the recommendations to be made in the report with the facility manager. Where these recommendations cover deviations from procedures laid down in the manuals of the system concerned, corrective action shall be implemented by the manager. If issues arise during the inspection that have an impact on another aviation fuelling operation at the airport, the inspector should invite both facility managers to participate in a meeting at the end of the inspection. Items of a serious nature shall be communicated to the location management without delay.

An inspection report shall be finalised and issued as soon as possible by the inspector but not later than six weeks after inspection completion. If the general inspection assessment is less than satisfactory then the report shall be issued not more than three weeks later.

It is the responsibility of the facility management to initiate the required corrective action recommended in the report. The facility management shall continuously update and close out recommendations.

1.4.3 Standards Variance Approvals

Locations which require specific operational variations to the JIG Standards shall have a documented Variance Approval Process. Variances shall be unanimously approved by the Board of Directors or Management Committee of the organisation **("Location Management")** with the approval of each of their organisation's Technical Authority. The **"Technical Authority"** is the office or designated representative providing technical management support to the component members of the Location Management.

The JIG Variance Approval Certificate (see Appendix A2) shall be used as described below for approval by Location Management and review and approval by the Technical Authority. Copies of the form are available to download from www.jigonline.com

1) A Variance Approval Certificate shall be prepared and approved by the Location Management.
2) The Location Manager then circulates the Variance Approval Certificate to the location Technical Authorities for review and approval.
3) The Technical Authorities then respond to the Location Manager indicating approval of the Variance or requesting clarification or amendment of the Variance Approval Certificate.
4) Following the successful review and approval of a Variance Approval Certificate the Location Manager provides the Location Management and any users of the facility with a copy of the Variance Approval Certificate.

It is the responsibility of the Location Manager to inform the Location Management when variances have been closed out and to re-submit variances for a three-yearly review.

It is the responsibility of the Location Management to ensure that all users of the facility are aware of all approved variances.

Variance Approval Certificates

Variance Approval Certificates shall include a description of additional actions taken to mitigate the risk and detail the rectification action(s) that will be taken to close out the variance.

Variance Approval Certificates are not permanent or evergreen and shall show target dates for each rectification action and a target completion date based on the time required for compliance. They shall be reviewed annually by the Location Management and at least every three years by the Technical Authority.

Variance Approval Certificates shall be available for review during inspections. Any variation from JIG Standards noted during an inspection, but not documented by a Variance Approval Certificate, may be the subject of a recommendation by the inspector. The recommendation will either be to comply with the JIG Standard, or, if there is a reason why this is not feasible, to prepare a Variance Approval Certificate for review and approval.

Chapter 2
Sampling and testing

2.1 *General*

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

2.2 *Sampling*

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 material from which it has been drawn.

If an employee cannot correctly identify the colour of aviation fuel and its related identification colour code because of colour blindness, they shall not be engaged in aviation fuel operations.

Sampling shall be in accordance with the latest requirements of the following procedures or other approved standard or equivalent:

- ISO 3170 (IP Petroleum Measurement Manual, Part VI, Sampling Section 1, Manual Methods)
- ASTM International Standard Practice for Manual Sampling of Petroleum and Petroleum Products (D4057)

For detailed sampling procedures, not covered here, reference should be made to the above publications.

Sampling equipment fabricated from copper or its alloys shall not be used for sampling Jet fuels. Refer to ASTM D4306 for suitable materials.

2.2.1 *Basic requirements*

(a) Samples shall be drawn from an appropriate drain point.

(b) Containers shall be as specified in Section 2.2.3, "Sample containers".

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

(d) No sample container shall be completely filled with liquid. Approximately 5% ullage shall always be left to allow for expansion.

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

- Sample no.:
- Date and time:
- Taken by:
- Place:
- Type of sample:
- Tank no./vehicle compartment no. or location:
- Batch no.:
- Grade or specification:

- Test required/performed:
- Airline:
- Aircraft registration:
- Inspector/sampler mark:

(f) Records shall be maintained of all samples taken.

(g) If samples are required by a customer or other authorised party, a duplicate shall be taken and retained until clearance is obtained.

2.2.2 Sampling terminology

Drain-line sample

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

Line sample

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

Hose-end sample

A sample obtained from a fueller or hydrant servicer delivery hose-end coupling or nozzle.

2.2.3 Sample containers

(a) Laboratory sample containers

Glass or metal containers or specially approved plastic containers for laboratory testing or for retention samples shall be new, or provided by the laboratory in a clean condition (see ASTM D4306 for suitable containers).

Metal containers shall be of an approved design, preferably internally lined with a suitable epoxy coating. Plastic containers may be used only after examples of the constructional material have been checked for compatibility with the product(s) to be stored.

Containers, even when new, should be carefully rinsed at least three times with the product to be sampled; this is critical for a number of properties being tested, particularly in the case of Microseparometer (MSEP) testing.

(b) Field sampling containers

Clear, clean glass jars of at least 1 litre capacity with wide necks and screw caps or closed sampling clear glass containers or "visijars" shall be used for product examination in connection with the Appearance Check and Visual Check procedures.

Buckets used for flushing shall be manufactured from good quality stainless steel or lined with white enamel. The enamel lining shall be no thicker than 2mm (0.08") to allow static charges to dissipate. Buckets shall be equipped with an effective bonding cable and clip.

(c) Packaging for air transport

Containers for the transportation of samples by air shall be of an International Civil Aviation Organisation (ICAO) approved design, and shall be dispatched in accordance with the latest edition of the "ICAO Technical

Instructions for the Safe Transport of Dangerous Goods by Air" and "IATA Dangerous Goods Regulations".

2.3 Sample testing

2.3.1 General

Testing shall be accomplished in accordance with the latest requirements of the following approved standards or equivalent:

(a) IP Standard Methods for Analysis and Testing of Petroleum and Related Products

(b) ASTM Standards

The laboratory analyses of aviation fuel shall be carried out only by the company's own approved laboratories, or by an approved third party laboratory. See EI/JIG 1530 Standard for more guidance on laboratories.

2.3.2 Definitions

Certificate of Analysis

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 relevant fuel specification and, for Jet A-1, the requirements of the latest issue of the JIG Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS) Check List. 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 product described. It shall be dated and signed by an authorised signatory.

Note 1: A Certificate of Analysis shall not be treated as a Refinery Certificate of Quality.

Note 2: For blends using synthetic components meeting the requirements of Annex A1 or Annex A2 of ASTM D 7566, refer to Annex D3 and Annex J of Defence Standard 91-91. The Certificate of Analysis shall document the percentage of the synthetic component.

2.3.3 Testing terminology

(a) Certificate of Analysis and Recertification Testing

The Certificate of Analysis covers all tests required by the relevant fuel specification and, for Jet A-1, the requirements of the JIG AFQRJOS Check List. The Recertification 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-product pipelines, etc.

Sample quantity required:

Jet A-1	2 litres minimum.
Aviation gasoline (Avgas)	25 litres (COA) and 4 litres (Recertification).

An approved sample container as specified in 2.2.3 shall be used.

The results of all Recertification Tests shall be checked to confirm that:

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

This check should be made by comparing the recertification results with the corresponding values shown on the last previous analysis made on the fuel (e.g. with a Refinery Certificate of Quality or previous Certificate of Analysis or previous Recertification Test Certificate). It is important to check that the determined properties have not changed. It is the only way to be reasonably sure that the remaining unchecked specification properties have also not changed significantly and remain satisfactory. This test is not normally required in an into-plane operation, but full details can be found in JIG 2 Aviation Fuel Quality Control & Operating Standards for Airport Depots & Hydrants Section 2.3.4 (b).

(b) Appearance Check (Clear and Bright)

This check is a field test to confirm that aviation fuel meets the appearance requirement of the specification.

Aviation fuel shall be of the correct colour and be visually clear, bright and free from solid matter and undissolved water at normal ambient temperature.

Samples for Appearance Check shall be drawn into scrupulously clean, clear glass jars or "visijars" (see 2.2.3 (b), Field sampling containers).

Test requirements are shown in the table below.

	Jet fuel	Avgas
Appearance/Colour	X	X
Particulate contaminant (visual)	X	X
Water – visual	X	X

Sample quantity required: 1 litre after flushing sampling line.

The following should serve as a guide to the Appearance Check of fuel samples:

- Colour. The various grades of Avgas are dyed to aid recognition while the colour of aviation Jet fuels may vary, usually in the range from water white to straw colour.
- Undissolved water (free water) will appear as droplets on the sides, or as bulk water on the bottom of the sample jar. In Jet fuel it can also appear as a cloud or haze (suspended water).
- Solid matter (particulate matter), generally consisting of small amounts of rust, sand, dust, scale etc., suspended in the fuel or settled out on the bottom of the jar.

The terms "Clear" and "Bright" are independent of the natural colour of fuel. "Clear" refers to the absence of sediment or emulsion. "Bright" refers to the sparkling appearance of fuel having no cloud or haze.

If any water/dirt is observed, the sampling procedure shall be repeated until a clear and bright sample is obtained.

(c) Visual Check

A Visual Check is an Appearance Check for Jet fuel with the addition of a chemical water check (see 2.3.3 (h)). Use an IATA recommended Chemical Water Detector.

Samples for a Visual Check shall be drawn into scrupulously clean, clear glass jars or "visijars" (see 2.2.3 (b), Field sampling containers).

(d) Control Check

This is an Appearance 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. If these two figures (corrected to standard temperature conditions) differ by more than 3.0 kg/m^3, contamination should be suspected and the matter shall be investigated before the aviation fuel is accepted for use.

(e) Membrane filtration test

This test shall be carried out and evaluated in accordance with joint ASTM D2276/IP 216 Standard Test Methods and Colour Standards incorporated in these methods. Colour shall be recorded on a wet and dry basis.

Double (matched weight or preweighed) 0.8 micron membranes are used for gravimetric tests. Colorimetric tests are normally performed with a single membrane, but double (unweighed) colorimetric membranes may also be used in certain circumstances as described in Appendix A6.7.

The quantity of fuel passed through the membranes used in both colorimetric and gravimetric determinations shall be 5 litres.

(f) Conductivity test

This test shall be carried out in accordance with ASTM D2624 or IP 274 procedures, using an approved conductivity meter.

(g) Tests for microbiological growth

The fundamental method for assessing the presence of microbiological growth in fueller tanks and fuelling vehicle filters is the daily Clear and Bright test on a sump (or filter vessel drain point) sample. Presence of discoloured water (brown or black), a lacy interface between the fuel and water layers or organic debris in the fuel or water layer are all indications of likely microbiological activity requiring immediate further investigation and appropriate expert advice.

The investigation shall include an assay test for microbiological activity carried out on fueller tank low point (or filter vessel drain point for hydrant servicers) samples of Jet fuel using a recommended test kit (see IATA recommended list) and checking the filter membrane colour test history for any rising trend. Internal inspection and investigation of filter vessels may also be required.

Warning and Action (quarantine) limits should be defined with reference to the IATA guidance material on "Microbiological Contamination in Aircraft Fuel Tanks" and following advice from appropriate experts on the use of field testing kits and the interpretation of results.

Guidance on appropriate sampling and monitoring strategies for control of microbial contamination throughout the aviation fuel supply chain up to point of delivery to aircraft is available in the JIG Information Document – Microbial Monitoring Strategies, available on the JIG Website.

(h) Principle of application of chemical water detectors

The primary field check for suitability of aviation fuel is the Appearance Check. This may be confirmed by the use of a chemical water detector test for Jet fuel to indicate the presence of free water in the sample. The application of the chemical water detector test is mandatory for samples that can be considered representative of into-plane fuel quality, although it may also be used in other sampling applications where it is considered appropriate to have a verification of free water status. (See 2.3.3 (c) for permitted chemical water detectors.)

(i) Table of minimum test requirements

The following table summarises the minimum test requirements for all airport operations.

Operation	**Control Check** [1]	**Visual Check (chemical water detector required)**	**Appearance Check**[1]
Receipts by pipeline (dedicated or multi-product) barge/coastal vessels before and during discharge	X		
Receipts by rail or road tank car	X		
Receipt tank sample for recertification			X
Airport storage tank sump drain before release for service	X	X	
In service airport storage tanks sump drain – daily		X	
Airport storage tanks sump drain not in service (settling or awaiting release)			X
Airport fixed filter vessel sumps (receipt) and strainers			X
Airport hydrant filter, loading filter and vehicle filter sumps – daily		X	
Fueller drain points – routine off-ramp (fueller tank draining after filling)		X	
Sampling during fuelling and defuelling		X [2]	
Hydrant low point servicing vehicle tank sump flushing before use and after use – daily		X	
Hydrant low point flushing – each low point line sample		X	

[1] A chemical water detector test may also be performed to provide verification of free water status.

[2] Requirement for hydrant servicer fuelling samples is detailed in JIG 1 5.3.2. A chemical water detector test shall be performed on at least one of the samples taken during fuelling.

Chapter 3

Fuelling equipment design features

3.1 General

The observance of certain fundamental practices in the design of into-plane fuelling equipment and facilities is considered essential to ensure that product quality is maintained and safety and environmental requirements are met. A summary of the routine test frequencies can be found in Appendix A1.

3.1.1 Design and construction standards

Fuelling equipment shall be designed for use with petroleum products and constructed to acceptable safety standards, incorporating satisfactory tank venting arrangements, appropriate pressure relief valves, hydrostatically tested pumping circuits, electrical components appropriate for the area classification of the location in question, air braking safeguards, externally mounted emergency stop buttons, etc. All new fuelling vehicles should be powered by diesel engines or electric motors. All new fuelling equipment and compatible replacement components for existing equipment shall meet the current requirements of the relevant specifications.

Further information may be found in EN 12312-5 Aircraft Ground Support Equipment – Part 5: Aircraft Fuelling Equipment.

Equipment shall meet the most stringent requirements of this Standard and applicable legislation (national or regional). Where there is a difference between this Standard and applicable legislation these differences shall be documented.

Commissioning procedures shall be in accordance with recognised industry standards. For recommended soak test procedures refer to Appendix A5.

A suitable record for fuelling vehicle details is included as Appendix A8.

3.1.2 Grade identification

All fuelling vehicles shall carry only one grade of product and the grade identification (EI 1542) shall be displayed prominently on each side, at the control panel and at all fill points.

3.1.3 Construction materials

All pipework and accessories shall be of aluminium alloy, stainless steel or mild steel. Mild steel shall be protected internally by hot tinning or by lining with agreed epoxy material, approved as being compatible with aviation fuels. No copper alloys, cadmium plating, galvanised steel or plastic materials shall be permitted for piping. The use of copper-containing materials for other components in contact with the fuel shall be minimised and no zinc or alloy materials containing more than 5% zinc or cadmium shall be used.

3.1.4 Filtration

All fuelling vehicles shall be fitted with at least the following filtration equipment.

(a) For Jet fuel

- Filter monitors qualified to EI 1583, or

- Filter separators qualified to the latest edition of EI 1581 by test or similarity (EI 1582).
- All new filter vessels shall meet the requirements of EI 1596.
- For existing vessels, element conversions shall meet, by test or similarity, the latest edition of EI 1581 requirements.
- New edition elements should be purchased as soon as practicable.

(b) For Avgas:

- A 5-micron (nominal) or finer microfilter meeting EI 1590, a filter monitor or a filter water separator.

(c) General:

Where Jet fuel hydrant servicers are equipped with filter separators they should be fitted with a FWS water detection device in the sump. These devices should also be considered for fitting to FWS vessels on fuellers.

They should have the capability of being function tested externally in accordance with the manufacturer's requirements.

Where it is required to supply Jet fuel containing Fuel System Icing Inhibitor (FSII) filter separators shall be used, and fitted with the correct class of EI 1581 latest edition elements (suitable for use in Jet fuel blended with FSII). However, the injection of the additive (DiEGME) downstream of filtration is the preferred method of supplying FSII-treated Jet fuel to aircraft. Filter monitors shall not be used with Jet fuel containing FSII.

To protect the fuelling operation from a sudden rise in dP, a dP switch shall be installed on all hydrant servicer filter vessels fitted with filter monitor elements to activate if a high dP is reached.

The dP switch shall be connected to the dP gauge and linked in series with the deadman and fuelling control system. The dP switch shall be set to 22 psi (1.5 bar) for filter monitors. The system shall not be capable of being reset by the fuelling operator and it shall be installed so that the deadman override does not reset and reactivate the system.

The system shall also be fitted with a mechanism (eg. a key operated device) to reset the dP switch after installing new filter elements or following dP gauge free movement tests (see 4.10.3).

For flow rate and vessel de-rating requirements for filter monitors, see JIG bulletin 52.

A suitable record form for filtration details is included as Appendix A7.

3.1.5 Hoses and couplings

All fuelling vehicle inlet and delivery hoses shall be of one continuous length, smooth bore synthetic rubber construction complying with the requirements of EI 1529 (grade 2) or ISO 1825 type C (semi-conductive) or type F where needed or in specific applications.

Typical hose applications

- Type C (semi-conductive) – delivery hoses and hydrant inlet hoses.

- Type E (conductive) and F (semi-conductive) – riser (swing) hoses between fixed piping and elevating fuelling decks and trailer connection hoses.
- Type F (semi conductive) – regular high flow rate defueling (may also be used for hydrant flushing).

Type E hoses shall not be used for into-plane delivery or hydrant servicer inlet hoses. Connections to aircraft or hydrant systems shall only be made with Type C or Type F hoses.

Type	Construction
C	A Type C hose is a non-electrically bonded hose incorporating a semi-conductive cover compound having an electrical resistance between 1 x 10^3 and 1 x 10^6 ohms/assembly.
E	A Type E hose is an electrically conducting hose incorporating at least one metallic conducting helical support bonded to the couplings and a conductive cover.
F	A Type F hose is a non-electrically bonded hose that incorporates a non-metallic helix reinforcement and has a semi-conductive cover compound having an electrical resistance between 1 x 10^3 and 1 x 10^6 ohms/assembly.

Pressure fuelling nozzles shall meet the requirements of SAE AS 5877 and hydrant servicer inlet couplings shall meet the requirements of EI 1584. EI 1584 Third Edition break-away type hydrant pit couplers shall not be used in conjunction with pit protection barriers (for example "igloos") that may interfere with this characteristic. If a break-away type hydrant pit coupler is used in conjunction with a rigid pantograph piping assembly or coupler lift assist device (CLAD) then this should be in accordance with the coupler manufacturer's advice.

3.1.6 Hose-end strainers

A hose-end strainer (not coarser than 60 mesh) shall be fitted to pressure fuelling couplings and overwing fuelling nozzles.

3.1.7 Interlock system

(a) General

All motorised/self-propelled 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 the vehicle pump or Power Take Off (PTO) is engaged and when any of the following components are removed from their normally stowed positions:

- delivery hose pressure couplings
- overwing fuelling nozzles
- fuelling cabinet doors
- fueller tank-top hand rails
- moveable fuelling platforms
- hydrant inlet couplers.

Interlock switches shall also be fitted on fueller bottom loading connections and should be fitted at vehicle bonding cable clip stowage. Seat interlocks should not be fitted to driver seats.

The interlock system shall be designed:

- to fail safe (i.e. air operated interlocks apply vehicle brakes if air pressure drops).
- so that no operator action (such as engaging the handbrake) is required to activate the interlock mechanism.
- so that disengaging the handbrake does not deactivate any component in the interlock mechanism (e.g. tank-top handrails). (See EN 12312.)
- so that when the vehicle is in motion, if an interlock is activated inadvertently the brakes are applied progressively and brake lights switch on. Alternatively, a system which de-activates the interlocks when the vehicle speed exceeds 10 km/hour (approximately) may be used.

The electrical circuitry should be designed so that the brake lights switch off when the vehicle parking brake is applied.

Vehicles should also be fitted with a device that either warns the operator to ensure that the brakes are engaged, or a device that automatically engages the brakes, when leaving the vehicle cab. Such devices shall only be installed provided they can be tested safely.

(b) Interlock override

The interlock override allows a vehicle to be moved away from the aircraft in the event of interlock failure. The override switch shall be safety wired and sealed in the interlock operating position. The sealing wire shall be easy to break in an emergency.

(c) Warning lights

The following lights (recommended 50mm diameter) shall be fitted in a prominent position in the vehicle cab and the emitted light shall be clearly visible to the driver when seated in the normal driving position:

- an interlock status warning light – amber in colour – which is alight whenever an interlock protected component is removed from its stowed position
- an emergency override status warning light – red in colour – which is alight whenever the override mechanism is moved from its normal operating position.

The use of LEDs (Light Emitting Diodes) as an alternative to conventional warning lights should be considered because of their reliability and long service life.

(d) Alarms

Audible alarms associated with the above warning lights should be considered. For example, a "bleep" that can be heard within the cab when the interlock status light is on and a louder external alarm to indicate that the interlock system is overridden.

An audible alarm that is activated if the cab door is opened when the handbrake is not engaged should be considered.

3.1.8 Overwing fuelling nozzles

Overwing (trigger) fuelling nozzles shall not have hold-open ratchets. Overwing fuelling nozzles shall be grade marked and colour coded (black handle or body for Jet fuel and red handle or body for Avgas). Nozzle spouts shall not be painted or coated.

a) For Avgas fuelling, nozzle spouts with a maximum external diameter of 49mm, fitted with a dust cap, shall be used.
b) Selective spout – for Jet fuel overwing fuelling, a nozzle with a selective spout having a major axis of 67mm – 70mm shall be fitted.

Jet fuel spouts

Not all Jet fuel aircraft have fuelling orifices that are sufficiently large to accommodate the Jet fuel spout. Where smaller sized spouts (non-selective) have to be used to dispense Jet fuel, either from vehicles or kerbside dispensers, they shall be used under controlled conditions to ensure that they are replaced by the larger selective Jet fuel spout immediately after use (see 6.5.5 and Appendix A10).

On vehicles, the nozzle stowage points shall be connected to the brake interlock system so that the vehicle can only be driven away when:

- the selective spout is attached to the overwing nozzle and stowed. The stowage device shall be designed so that only the Jet fuel selective spout is able to disengage the interlock; and
- if the non-selective spout is stowed on the vehicle, it is held in a designated stowage point which is connected to the interlock system.

3.1.9 Pressure control systems

All Jet fuel delivery equipment (hydrant servicers and fuellers) 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 approved by the company that has undergone a formal approval test procedure to confirm compliance with the requirements detailed in Appendix A15.

The minimum requirements for pressure control equipment are as follows:

(a) Maximum achievable pump/hydrant pressure below 3.5 bar (50lbf/in²)

Not required.

(b) Maximum achievable pump/hydrant pressure 3.5 to 5.5 bar (50 to 80lbf/in²)

Hose end pressure control valve (1) required. In-line pressure control valve (2) required for vehicles with flow rates of more than 1,000 litres/min per delivery hose.

(c) Maximum achievable pump/hydrant pressure above 5.5 bar (80lbf/in²)

Hose end pressure control valve (1) and in-line pressure control valve (2) required.

(1) **Hose end (primary) pressure control valves** are situated at the nozzle at the end of the delivery hose.

(2) **In-line (secondary) pressure control valves** are situated on the vehicle, in the inlet coupler (hydrant servicer) or in the hydrant pit valve.

A second hose end pressure control valve is acceptable in place of an in-line pressure control valve, provided that the maximum inlet pressure does not exceed 6 bar (90lbf/in^2).

Appendix A15 includes an explanation of the function and testing of pressure control valves.

3.1.10 Fire extinguishers

All fuelling vehicles and trailers shall carry at least two 9kg (unless a different size is specified by local legislation) dry chemical type fire extinguishers in quick release housings consistent with local regulations. At least one extinguisher shall be readily accessible from either side of the vehicle. Suitable (BC or ABC) chemical dry powder extinguishers should be used. Extinguishers containing an approved foam suppression material may be used as an alternative. Additional information concerning fire extinguisher media is included in EI 1540 Recommended Practice, Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities.

3.1.11 Bonding reel and cable

A bonding reel and cable with suitable clip shall be provided, electrically bonded to the vehicle chassis.

3.1.12 Emergency engine stop controls

Externally mounted emergency engine stop controls (red coloured), one on each side of the vehicle, shall be provided on all fuelling vehicles and be clearly identified with a label explaining their purpose and shall be accessible from the ground at all times. An additional engine stop control shall be fitted to elevating fuelling platforms.

Operating the engine stop on a mobile fueller/hydrant servicer should also stop the fuel flow. If the cargo pump is powered by an independent source such as an electric motor or separate diesel engine, a separate fuel emergency stop control is required.

3.1.13 Deadman control system

(a) General

All pressure fuelling vehicles shall be fitted with a hand-held deadman control system that allows the operator to stop the fuel flow quickly and easily in an emergency. On fuellers, the deadman should operate on the downstream side of the delivery pump. In hydrant systems, the deadman control shall, where possible, activate valve closure upstream of the hydrant servicer inlet hose.

The deadman control is used to start the fuel flow at the beginning of a fuelling operation and may be used to stop the flow. The control system shall be designed:

- to open the fuel valve slowly and progressively (at least 5 seconds from start of flow to full flow or at least 3 seconds if the maximum flow rate is less than 2,000 litre/min) to avoid imposing pressure on the aircraft fuel system
- to close the valve within 2 to 5 seconds. Closure shall not be so fast that it causes excessive upstream shock pressures that could damage vehicle components.

On all new pressure fuelling vehicles the deadman control system shall be designed to require periodic action by the operator within a predetermined time interval (not exceeding 2 minutes) to prevent automatic close-down. This "timer" (intermittent) deadman should be incorporated into the design of existing vehicles.

Where cordless deadman systems are in use the operator shall remain within 20 metres and line of sight of the fuelling vehicle during cordless deadman operation. In the case of any movement outside of this zone or line of sight within this zone the operator shall release the deadman and stop fuel flow.

The cordless deadman wireless frequency shall not interfere with other frequencies in use at the airport. Some cordless deadman designs include a hose-reel rewind control; this feature should not be used because of the risk of inadvertent activation during fuelling.

(b) Deadman override

Deadman systems may include an override feature that allows the operator to complete a fuelling operation in the event of a deadman failure. Where fitted, the preferred override is a push-button type that requires the operator to push and hold the button in the depressed position to maintain the flow. If not of the push-button type, the override switch shall be sealed.

3.1.14 Delivery pipework

The fuelling system shall be designed so that all fuel which passes through the delivery meter and filter is delivered to the aircraft and cannot be diverted elsewhere. This is particularly relevant to fuellers if they are designed to defuel. For new builds (from January 2014) a meter bypass line is not an acceptable design. Any non-compliant vehicles produced pre-2014 shall have been modified to include a double valve arrangement with a means of positive confirmation (e.g. drain valve between the valves) that no fuel is being diverted to the defuel circuit during normal fuelling. Alternatively, the vehicle shall have the defuel circuit drained and permanently disconnected.

3.1.15 Delivery meter

All fuelling equipment shall be fitted with a product meter capable of metering to the required accuracy (see Section 4.9) and incorporating a rate of flow indicator.

3.1.16 Elevating platforms

Elevating fuelling platform designs need to take account of a number of factors including:

- platform design load capacity

- the platform shall rise and descend fully at a steady rate
- the platform deck shall have a non-slip open flooring securely attached to the support frame. No sharp edges are permitted that may damage fuelling hoses, stability of fuelling equipment and impact of high winds
- safe access and exit ladder/steps
- height of aircraft fuel panels
- manual (hose) handling considerations (hose support/counterbalance devices shall be considered)

Elevating fuelling platforms shall be equipped (as a minimum) with:

- engine/fuel stop controls
- a safe exit route when the platform is in the fully raised position or an emergency lowering system that can be operated from both the platform and ground level. In the case of a hydraulic system the depressurisation line should be dedicated to this function and be routed direct to the oil reservoir, not via a filter. The emergency lowering system shall allow the platform to fully descend at a steady rate (typically within 10 – 15 seconds from full extension) ensuring a safe exit in an emergency and shall not be used for routine operation
- a device to prevent the sudden descent of an elevated platform in the event of a hydraulic fluid leak, for example from a hydraulic hose burst
- a sensing device system to prevent contact with the aircraft during the raising of the platform. Two "wand type" sensors shall be fitted to the platform above the highest level of both the platform and any equipment that may project above the platform in the stowed position, to detect and stop the movement if any part of the platform or stowed equipment that comes too close to the aircraft as the platform is raised. Hinged nozzle covers should be taken into account when setting the wand sensor height. The activation point shall be at least 30cm above the highest projection of the platform when all equipment is stowed. This shall apply to new vehicles since January 2013 and should be a retrofit for existing vehicles. Alternative sensing devices such as electronic beam systems may be used if they provide a similar level of protection and if their performance can be tested.

A system shall be in place to ensure that the platform gate is secured when the platform is in use.

The following warnings shall be affixed permanently:

- on both sides of the vehicle on the fixed part of a moveable platform: "DO NOT WORK UNDER PLATFORM UNLESS PLATFORM IS SECURELY PROPPED"
- at the platform:
  "DO NOT USE LADDER WHEN PLATFORM IS IN MOTION"
- at the access to the platform:
  "MAXIMUM PAYLOAD xx kg" and "NUMBER OF PERSONS x ON PLATFORM"
- on both emergency control devices of the platform and the chassis: "EMERGENCY PLATFORM LOWERING DEVICE".

3.1.17 Programmable Logic Controllers

Some fuelling vehicles are fitted with Programmable Logic Controllers (PLCs) that are designed to control pressure and flow to preset 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 a single selective display is acceptable for electronic readouts.

All vehicles, whether fitted with traditional pressure control equipment or PLCs, shall display as a minimum:

- filter differential pressure
- flow rate
- delivery pressure (pump pressure or venturi)

3.1.18 Spill containment kit

All fuelling equipment should be equipped with a spill containment kit for use as a first response to a spill on the apron. The contents of the kit should comply with local airport regulations and include fuel absorbent pads. Used pads should be disposed of under applicable waste disposal regulations.

3.2 Fuellers

3.2.1 Tanks shall be 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.

3.2.2 The tank shall drain to a low point sump, provided with a drain line and valve. All drain and sample lines should have self-closing valves (e.g. spring-loaded valves). 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.

3.2.3 Tanks shall be fitted with suitably sized vents based on maximum loading and delivery flow rates.

3.2.4 All aviation fuellers shall be bottom loaded through a self-sealing (tight fit) connection.

All new fuellers and trailers shall be equipped with one automatic overfill protection device and one automatic cut-off device (as a minimum the ultimate device shall incorporate a pre-check device – see 5.8.1). Existing fuellers shall have an automatic overfill protection device incorporating a pre-check device. For loading existing fuellers, refer to Section 5.8.1 for minimum overfill protection requirements.

Automatic overfill protection devices shall be set at safe levels, taking account of the maximum flow rate that may be achieved during fueller loading and the time taken to stop the flow.

Where fuellers are filled on the ramp from a hydrant system they shall be equipped with two independent automatic overfill protection devices. As a minimum requirement, for vehicles manufactured pre-2013 only, a single automatic overfill protection device is acceptable, provided that filling from the hydrant is via a pre-set meter.

3.2.5 At locations where more than one fuel grade is bottom loaded, the couplings shall be of a suitable grade selective type.

3.2.6 All main product piping shall be equipped with low point drain plugs located so as to enable complete draining of all product.

3.2.7 The main outlet from the tank shall be fitted with an internal foot valve capable of being shut quickly in an emergency. The foot valve shall be designed to close automatically in the event of a fire.

3.3 Hydrant servicers

3.3.1 Where more than one fuel grade is delivered by hydrant system, all inlet hoses and hydrant pits shall be fitted with the appropriate selective coupling.

3.3.2 Lanyards for hydrant pit valve operation shall be manufactured from fire-resistant material of adequate strength to enable the valve to be operated remotely if an emergency occurs during the fuelling operation and shall be of a highly visible colour, such as red. The selected colour should be in line with any local regulations concerning the recommended colours for emergency systems and shall be different from that of the fuelling vehicle bonding cable.

The lanyard shall be a minimum of 5m (16 feet) in length.

There shall be no electrical connection between the fuelling vehicle and the hydrant pit. If lanyards are attached to vehicle-mounted reels, the reels shall be electrically isolated from the vehicle. Electrical isolation of the reels shall be checked weekly with an electrical continuity meter.

3.3.3 Inlet coupler stowage shall be designed to minimise exposure of the coupling to contamination (e.g. surface dirt and water from the ground and vehicle tyres). Non-compliant existing vehicles shall be modified as appropriate where no protection is currently in place.

3.4 Aircraft fuelling steps and towable fuelling platforms

3.4.1 Only steps and towable platforms designated for fuelling purposes shall be used for fuelling aircraft. The height of the steps and towable platforms used shall be determined by the type of aircraft being serviced.

3.4.2 Steps used for fuelling shall as a minimum:

- be made of suitable lightweight metal alloys to keep the weight below 25kg. Steps should have two wheels to allow them to be moved without dragging. Where fitted these wheels shall be off the ground when the steps are in use
- be in good condition, not bent or with cracked welds
- have a hinge system to lock the steps open when in use
- have treads that are sufficiently wide to support the operator's feet with a non-slip surface. Circular rungs shall not be permitted
- be sufficiently wider at the base than at the platform to provide stability
- enable three points of contact to be possible when climbing and descending the steps (with the exception of hop-up/steps with no more than one step and platform). Restraining bars (e.g. knee bar) or handrails shall be fitted above the platform to minimise risk of overbalancing and provide support to the operator when in use. (These can also serve as a holster on which to

support the hose nozzle to allow three points of contact while climbing and descending the steps)
- have step feet with non-slip pads.

3.4.3 Towable platforms may be fixed or vertically adjustable platforms (with or without steps) mounted on a self-contained wheeled chassis with a simple front steering axle or front swivel casters, and a rigid tow bar. The vehicle tow hitch shall be designed and correctly fitted for use with the platform type.

Towable platforms used for fuelling shall as a minimum:

- be designed to be easily manoeuvrable, preferably by a single person. However, strength and stability shall not be sacrificed
- be fitted with a braking mechanism to prevent roll-away while in use and have a sufficient wheel base to ensure stability
- provide sufficient space for two persons to work in safety, and have a plate stating maximum safe working capacity (number of persons) and load affixed in a prominent position
- be fitted with restraining bars or handrails to minimise overbalancing and provide support to the operator when in use. (In the case of platforms without integral hoses, these can also serve as a holster on which to support the hose nozzle to allow three points of contact whilst mounting and dismounting the steps.) Platforms above 1800mm in height should be fitted with an entry gate which shall open inwards and be self-closing with a latch
- have flooring of a non-slip material, and there shall be a “kick plate” on all sides of the platform (except where the operator enters)
- in the case of towable platforms fitted with steps, the treads shall be sufficiently wide to support the operator’s feet with a surface designed to prevent slipping. Circular rungs shall not be permitted. Three points of contact when climbing and descending the steps shall be possible
- towable platforms fitted with integral hoses shall have thermal/pressure relief which should be connected to a recovery tank to prevent damage to underwing nozzle/hose
- in the case of adjustable step-less platforms, a ladder to provide for emergency escape at any height shall be included in the design. If a lifting mechanism is included to adjust the platform height, it shall include a hydraulic or mechanical lock to prevent accidental lowering of the platform while in use
- for platforms fitted with integral hoses, the platform shall be fitted with a bonding cable to provide bonding between the towable platform and aircraft
- the towable platform shall be fitted with reflectors and hazard warning markings and, if appropriate, lighting.

For fuelling operations with towable platforms fitted with integral hoses:

- Fuelling vehicle hoses shall be connected to the steps such that they do not present a trip hazard when mounting or dismounting the steps.
- Care shall be exercised when positioning steps under aircraft to avoid contact as the aircraft settles during fuelling, and care shall be exercised when towing the steps to and from the aircraft.

Chapter 4

Maintenance and testing of fuelling equipment

4.1 General

Fuelling equipment shall be maintained in sound condition at all times in order to ensure a reliable, safe fuelling service. Maintenance work shall be scheduled so that all units receive thorough attention in accordance with the equipment manufacturer's instructions.

If fuelling equipment is out of service for a period in excess of 1 month it shall be thoroughly checked, flushed and tested to ensure that it is in proper operating condition before being used. All relevant routine checks shall be performed including colorimetric filter membrane tests, monthly hose and hose-end strainer checks, deadman and interlock performance tests and bonding wire continuity.

4.2 Records

A logbook shall be kept for each item of equipment to record details of work carried out, e.g. servicing, repairs and replacements.

4.3 Routine vehicle tests and checks

Routine chassis and engine serviceability checks shall be carried out to ensure that fuelling vehicles operate satisfactorily.

Defects shall be rectified without delay and equipment removed from service if necessary.

4.4 Interlock system and Emergency Engine Stops

Functional testing shall be carried out at least weekly in accordance with written procedures.

Once per week, the complete interlock system shall be tested by attempting to drive the vehicle from standstill while each interlocked component is removed in turn. The interlock override seal shall then be broken and the override function checked to ensure that the vehicle can be moved with a hose coupler removed from stowage. Finally, the override switch shall be reset, resealed and function tested by the removal of one interlocked component. The correct function of the warning lights shall also be observed during the test.

In addition to the complete weekly test, a daily check shall be performed and documented. This daily check consists of removing at least one of the interlocked components (a different one each day in rotation) and checking that the interlock switch and warning light are working. If testing identifies a faulty interlock function, the first action shall be to quarantine the vehicle to prevent use and arrange repair work.

The presence of intact interlock override seals shall be checked daily to ensure that the system has not been overridden. The reason for breaking interlock override seals shall always be recorded.

Note: Attempting to drive a heavy fueller from standstill while performing the weekly check can damage vehicle components. This check should be performed carefully, particularly for fuellers fitted with an automatic gearbox, where the power sent to the wheels cannot be effectively controlled during the test.

The function of the externally mounted emergency engine/fuelling stop system shall be checked monthly.

4.5 Bonding wires

All electrical bonding wires including clips and reels shall be checked:

- daily for general condition and for firm attachment of the bonding clip
- weekly for electrical continuity (there shall be less than 25 ohms resistance) between the bonding wire clip and vehicle chassis. Electrical continuity should be checked over several revolutions of the reel while unreeling or reeling in the bonding wire slowly
- in the case of towable platforms and mobile fuelling steps with integral hoses the continuity shall be tested between the bonding wire clip and the designated bonding point on the towable platform for the fuelling vehicle bonding clip.

4.6 Filtration equipment

Requirements for testing, inspection and maintenance of these units are given in Appendix A6.

4.7 Pressure control and deadman system

4.7.1 Quarterly, the correct operation of pressure/surge control equipment shall be checked under dynamic conditions in accordance with procedures detailed in Appendix A15, as appropriate for the equipment at the location concerned.

4.7.2 Monthly, the correct operation and performance of deadman control systems shall be checked in accordance with the requirements detailed in Appendix A15, Section A15.7. (This may be carried out during aircraft fuelling.) An annual check to confirm the setting of the intermittent timer device shall be conducted.

4.7.3 Whenever hose length or bore is altered, venturi settings on venturi-actuated pressure control valves shall be re-adjusted.

4.7.4 Immediate action shall be taken to repair or replace a defective deadman. The seals on deadman override switches shall be checked daily (where fitted and not of the preferred push-button type).

4.8 Aviation hoses – commissioning, testing and repair

4.8.1 Each hose and flexible joints 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.

4.8.2 The maximum shelf storage life for hoses and flexible joints which use a hose-type material is 2 years and the maximum overall service life is limited to 10 years, both periods from the date of manufacture. See EI 1540 section 7.2.9 for additional guidance regarding the storage of new hoses.

4.8.3 New hoses shall be filled with product and left to soak for a minimum of 8 hours at a temperature of 15°C or higher. Longer soak times are required where product temperatures are lower. Product used for hose soaking shall be drained from the hose and shall be downgraded for non-aviation use.

After soaking and draining, the hoses shall be flushed and checked in accordance with the requirements in A5.3.1 "Hoses".

Before use, new hoses shall be tested in accordance with the 6-monthly pressure test procedure in Appendix A13 and a colorimetric filter membrane test should be performed.

Fuel that remains static in hoses may be subject to colour and thermal degradation. The contents of all in-service fuelling equipment delivery hoses shall be delivered to aircraft, circulated or flushed to product recovery systems at the following frequencies:

- Overwing fuelling hose – weekly with at least twice the hose content.
- Pressure fuelling hose – monthly with at least twice the hose content.

In addition, this requirement shall apply to fuelling steps with integrated hoses and overwing fuelling hose extensions.

4.8.4 All vehicle hoses under pressure and hoses on refuelling steps that may be subjected to pressure shall be inspected and tested routinely in accordance with Appendix A13.

4.8.5 Hoses shall be kept under observation during the fuelling operation and, if a weakness or defect is observed, delivery through the defective hose shall be stopped and the hose replaced.

Damaged hoses may be shortened by removal of the damaged end section, provided that the remainder of the hose is satisfactory. After rectification, by shortening and refitting of couplings, the hose shall be subjected to the 6-monthly test procedure and the venturi re-adjusted if necessary, before being returned to service.

The fitting of re-attachable end fittings to hoses (where agreed by the company) shall only be performed by competent trained staff certified by the hose manufacturer or their authorised distributor.

4.9 Bulk meters

All meters used for inventory control or for measuring product transfers to third parties shall be tested every 6 months in accordance with the calibration criteria detailed below.

4.9.1 Calibration criteria

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 every 6 months. To prevent unauthorised adjustment, meters shall be adequately sealed after calibration and before being returned to service. Meter proving may be performed by means of a calibrated master meter or calibrated prover tank. Master meters shall be of approximately similar rated flow to the meter being tested. The capacity of a volumetric proving tank shall not be less than the volume delivered by the meter under test (MUT) in one minute at maximum design flow rate and shall be of sufficient capacity to meet the requirements in HM20. Master meters shall be recalibrated every 3 years or after a throughput of 15 million litres, whichever occurs first. Master meters that are mobile and service more than one installation should be recalibrated annually or after 15 million litres have passed through them, whichever occurs first. Prover tanks shall be recalibrated by an approved authority after internal painting, and when damaged or moved (unless designed to be movable), and following any structural change. Master meters and associated hoses and fittings shall be dedicated to one grade of aviation fuel and used only for accuracy checks of other meters. They are not operational units**.**

Meter proving shall be performed at a flow rate of between 70 and 80% of the rated flow of the meter under test or normal maximum flow rate in service, if this is less. The meter shall be checked against the master meter or prover tank and adjusted until a minimum of two consecutive results within plus/minus 0.05% of the master meter or prover tank are obtained (taking into account the calibration factors). To check meter performance at low flow rates a further run shall be performed at 20% of rated flow of the meter under test. The error at this flow rate shall not exceed plus/minus 0.20%.

Procedures shall ensure that product used during meter proving shall be returned to a tank of the same grade of fuel to prevent cross-contamination.

Meters with erratic performance (poor repeatability between runs, low flow performance indicating excessive wear, etc) or those not capable of being adjusted to meet these calibration criteria shall be removed from service for repair, overhaul and recalibration, or disposal.

Meter proving shall be carried out in accordance with HM 20 and the EI Petroleum Measurement Manual, the API Manual of Petroleum Measurement Standards or equivalent industry standard.

Meters with pulse transmission from the meter drive to an electronic display meter head generally match or exceed the accuracy of mechanical bulk meters. Different calibration equipment and procedures may be applicable. These should be based on the manufacturer's recommendations and comply with the above calibration criteria.

4.9.2 Records and documentation

Meter testing procedures shall be written in line with paragraph 4.9.1 above. Where meter proving is performed by a third party contractor it shall be verified that the contractor procedures meet a recognised standard as well as JIG requirements in 4.9.1.

A valid certificate of calibration should be available for the master meter or prover tank detailing the meter calibration factors for temperature, pressure and meter error.

Meter proving test records shall be completed for each meter proved. Details of the meter under test shall be recorded including rated flow, start and finish meter totaliser readings and the results of each calibration run.

Meter history records shall be retained for at least 3 years. They shall be kept for each meter, detailing any adjustments and accuracy obtained, problems encountered, instability of adjustment, items requiring maintenance and action taken.

4.10 Pressure and vacuum gauge testing

All critical gauges shall be checked for accuracy and free movement and adjusted, repaired or replaced as necessary. Critical gauges are defined as test rig gauges, fuelling equipment pumps, venturi and delivery pressure gauges and hydrostatic hose pressure test gauges. Non-critical gauges should be identified as "for information only" and calibration dates should be shown on critical gauges.

4.10.1 Critical gauges shall be checked 6-monthly against a master gauge or dead-weight tester. Fuelling equipment venturi gauges and test rig gauges should be accurate to within 2% of full gauge deflection. Hose pressure test gauges and other fuelling equipment pressure gauges should be accurate to within 5% throughout their normal operating range.

4.10.2 Master pressure gauges shall be calibrated every 3 years at a certified test facility or by checking against a certified dead-weight tester. They shall be accurate to within +/- 0.5% of full-scale deflection. The site master pressure gauge shall only be used for accuracy checks of other gauges. It is not an operational unit. Records of current calibration/calibration certificates for master gauges shall be available.

4.10.3 Piston-type differential pressure gauges shall be checked for free movement throughout the full piston travel and visually for correct zeroing. This shall be done every 6 months (see 3.1.4 c). The function of differential pressure switches fitted to filter monitor vessels on hydrant servicer vehicles shall be checked to ensure that the fuelling operation will be stopped if the activation pressure of 22 psi (1.5 bar) is reached. This check shall be performed and recorded every 6 months, at the same time as the differential pressure gauge free movement check.

4.10.4 Programmable Logic Systems that control pressure and flow to preset conditions (see 3.1.17) shall be checked for accuracy in accordance with the manufacturer's recommendations.

4.11 Elevating fuelling platforms

The correct function of emergency platform lowering systems and wand sensors fitted to platform high points shall be checked monthly. The check on the wand sensors shall simulate the failure mode by applying a downward pressure on the wand. The check shall also confirm that the wand activates at least 30cm above the highest level of the platform or any stowed equipment that projects beyond the platform. (See 3.1.16.)

4.12 Pressure fuelling nozzles (underwing nozzle) and hydrant servicer inlet couplers

Nozzles and couplers shall be checked for leaks during every fuelling operation and shall be maintained in accordance with the manufacturer's requirements. Inlet couplers shall be checked for wear at least annually, using the appropriate wear gauge. Repairs shall be performed in accordance with the manufacturer's recommendations by competent trained personnel, using the recommended tools.

4.13 Overwing nozzles

Overwing nozzles shall be checked for general condition and leaks during every fuelling operation. Records of repairs and adjustments shall be maintained.

4.14 Routine fueller tank inspection and cleaning

4.14.1 Inspection

Jet fuelling vehicle tanks shall be emptied and visually checked from inspection hatches for internal cleanliness and condition. This check shall be performed at least annually. Attention should be given to the condition of any internal linings, tank seam welds and evidence of microbiological activity. Internal fittings such as foot valves and high level shut-off mechanisms shall be inspected at the same time and overhauled if necessary.

If there are visible signs of contamination or damage, then the tank shall be drained and tank entry for cleaning or repair may be necessary – see the cleaning section below. If more than 50% of the fueller tank cannot be observed from the inspection hatches then internal inspection by borescope, dismantling or manned entry shall be required. Appropriate safety precautions concerning the entry of personnel into a tank shall be applied (confined space entry). Tank entry shall only take place when all other options avoiding tank entry have been ruled out.

Aviation gasoline fueller tanks shall not be checked internally by visual inspection from the top hatch on a routine basis, due to the risks presented by concentrated aviation gasoline vapours. An annual product quality review shall be performed of the vehicle filtration, daily drains and filter membrane testing history and an Appearance Check carried out on a sample taken from the vehicle to determine if there are any indications that the fueller tank requires cleaning. The vehicle tank shall be cleaned, if required, following this review.

Visual inspections of fueller tanks shall include a check on the condition of tank vents and top hatch/manlid gaskets, ensuring correct controls are in place when working at height (e.g. fall protection when working on the vehicle tank top).

Tank tops shall be checked visually for water at least monthly to ensure that drain lines are not blocked and after exposure to heavy rain (or snow) and vehicle washing. This check can be performed without the need for tank top access.

If drain lines are fitted with valves, they shall be sealed in the open position except when closure is mandated for driving on public roads.

4.14.2 Cleaning

This is a high risk activity and shall only take place by manned tank entry when all other options have been ruled out.

Whenever possible, fueller tank cleaning should take place via top hatches avoiding tank entry. Water or steam cleaning equipment should be used without the use of chemical cleaning materials. Dirt, rust or other debris should be removed by mopping. Fuellers shall be fully drained of cleaning water before being returned to service.

4.15 Product recovery tanks (vehicle sample tanks/stand-alone trailers)

Product recovery tanks used for recovery of samples taken from fuelling equipment shall be emptied and visually inspected quarterly, without entry, for cleanliness and condition. Cleaning and repairs to internal lining shall be carried out as necessary.

4.16 Hose-end strainers

Wire mesh strainers fitted to pressure couplings (underwing nozzles) and overwing nozzles shall be removed and inspected monthly. Refer to Appendix A13.4 for further detail. Where the hose-end coupling has to be disassembled to remove the strainer for inspection, the integrity of the coupling shall be checked by pressurising the hose to working pressure after reassembly.

4.17 Fueller overfill protection devices

In addition to the requirements for fueller loading checks (see 5.8.1) the correct operation of all high level alarms and cut-off devices including those fitted to vehicle sample tanks shall be function-tested at least quarterly. High-high alarms shall be "wet tested" (or fully tested for correct function in accordance with the manufacturer's recommendations) at least annually.

4.18 Overhauled or new equipment

New or transferred fuelling equipment and equipment after major repair or overhaul shall be thoroughly checked, flushed and tested to ensure that it is in proper operating condition before being brought into service. All relevant routine equipment checks shall be performed, including a double filter membrane test (gravimetric test for new vehicles), and the results recorded.

4.19 Hydrometers and thermometers

4.19.1 The applicable standard for hydrometers is BS 718: 1991 (types M50SP and L50SP) and for thermometers it is IP 64C/ASTM E1 No. 12C. For reference purposes, each location should retain, or have easy access to, at least one hydrometer and thermometer meeting these standards. Alternative instruments meeting the accuracy requirements of these standards are also acceptable.

Where alternative types of instruments are used for field tests, the thermometers should have scale increments of no greater than 0.5°C and hydrometers of no greater than 0.0005kg/litre.

The accuracy of all in-service instruments shall be checked at least once every 6 months against reference instruments meeting the above standards or in accordance with the other options given in 4.19.4. Resistance Temperature Devices (RTDs) shall be checked 6-monthly against a reference thermometer.

Electronic densitometers should meet the requirements of IP 559.

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

4.19.3 Before each period of use, hydrometers should be carefully examined to ensure that:

(a) the etched line on the hydrometer stem corresponds to the arrow (or line) at the top of the paper scale. A fingernail can be used to detect the etched line position

(b) the bitumen weighting material has not flowed. This would cause the hydrometer to float in a non-vertical plane

(c) the glass is intact.

Before each period of use, thermometers should be carefully examined 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.

4.19.4 Every 6 months, or more frequently if a measurement of temperature or density is suspected as being inaccurate, the accuracy of the thermometer and hydrometer shall be checked. These checks should be carried out by means of one of the following options:

(a) sending the thermometer/hydrometer to a laboratory

(b) checking against a reference thermometer/hydrometer on site

(c) checking against a reference fluid provided by a laboratory

(d) checking by comparison with other thermometers/hydrometers.

Accuracy requirements are +/- 0.5 degrees C and +/- 0.001 kg/litre.

4.20 Fire extinguishers

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

Fire extinguishers shall be maintained in accordance with the manufacturer's recommendations. All extinguishers shall be serviced at least once per year by the manufacturer or by competent trained staff certified by the manufacturer or their authorised distributor. The maintenance dates shall be recorded on a label or tag attached to each extinguisher.

Inspections of the condition of all extinguishers shall be carried out every month. These inspections shall ensure that extinguishers are in their specified places and are readily accessible. The condition of the hose and nozzle (sound and visually free of blockages) should be checked. Permanently pressurised extinguishers should be fitted with a pressure gauge, which shall be tapped to check that the pointer is not stuck and is within the safe zone.

4.21 Electrical equipment

All electrical equipment, both fixed and portable, and wiring shall be of a suitable type for the hazardous area of classification in which it is used and shall be checked and maintained by a trained and competent person(s). Hazardous area classified electrical equipment (e.g. ATEX marked and certified) shall only be maintained by trained personnel.

4.22 Other measurement equipment

Conductivity meters should be calibrated according to the manufacturer's recommended frequency. As a minimum they shall be calibratedat least 3-yearly by an approved test facility or against a certified standard.

Continuity meters shall be calibrated in accordance with the manufacturer's requirements.

A "click type" torque wrench shall be used, where the clutch slips, signalling that the correct torque is reached at the desired torque setting. The beam type torque wrench is not an appropriate type for the required functions in aviation fuel operations.

Torque wrenches shall be calibrated in ft-lbs or Nm in a range including 0-50 ft-lbs/0-68 Nm. Torque wrenches may also be required in a wider range to accommodate other applications. Torque wrenches shall be calibrated according to the manufacturer's recommended frequency, but at least 5-yearly. Guidance can be found in BS EN 26789. (Note that the torque wrench should be reset to zero to release the tension on the spring when not in use.)

4.23 Vehicles used for defuelling

For designated defuel vehicles with double valve arrangement in the defuel pipework, the valves shall be tested 6-monthly by pressurising with the deadman and checking for movement of the delivery meter to provide assurance that they are not bypassing.

Where the fuel between the two valves is not removed via a bleed valve, the pipework shall be flushed every 6 months.

4.24 Fuelling steps and platforms

All stepladders and towable platforms shall be visually inspected daily before use, when in service, for any loose, cracked, damaged or missing parts and any spills/drips shall be cleaned. In addition, they shall also be subjected to quarterly serviceability checks by maintenance staff.

4.25 Equipment calibration

All monitoring and measurement devices which are critical to safe operations shall be calibrated on a regular basis to ensure accuracy to within required tolerances. Each location shall establish a list of such equipment and maintain records for each device. See Appendix A16 for more details.

Chapter 5
Fuel quality control requirements

5.1 Aviation fuel grades

For reasons of fuel quality, cleanliness and traceability, only aviation fuel grades (Jet fuel and Avgas) shall be delivered to aircraft fuel systems. The supply of motor gasoline or diesel fuels to aircraft is strictly prohibited.

5.2 Draining and sampling – routine off ramp

5.2.1 Fuellers

(a) Equipment shall be drained of water and sediment as follows:

- daily at the start of the morning shift
- after every filling operation (vehicle tanks only)
- after defuelling
- after heavy rain or snowfall (vehicle tanks only)
- after vehicle washing or maintenance of tank, filter or fuelling system.

(b) Draining shall be carried out at full flow from the low point of vehicle tanks, and under pressure from filter separator and microfilter sumps and the inlet side of filter monitors, into clean, clear glass jars, stainless steel buckets or white enamel buckets. The quantity drained shall be sufficient to ensure that an amount in excess of the line content has been displaced. A minimum 1-litre sample shall then be taken for a Visual Check. If the sample does not provide a satisfactory Visual Check, additional draining and sampling shall be performed until a sample is obtained that provides a satisfactory Visual Check. The approximate quantity of any free water or sediment found shall be recorded.

(c) If abnormal quantities of free water or sediment are found, or if it is not possible to obtain a clear and bright sample that provides a satisfactory Visual Check, the vehicle shall be withdrawn from service and an investigation shall be carried out immediately to determine the source of the contamination.

5.2.2 Hydrant servicers

(a) Equipment shall be drained of water and sediment as follows:

- daily at the start of the morning shift
- after maintenance of filter or fuelling system.

(b) Draining shall be carried out from filter separator and microfilter sumps and the inlet side of filter monitors until the line content has been displaced. A sample of at least 1 litre shall then be taken for a Visual Check. Where it is not possible to obtain a 1-litre sample under pressure off-ramp, this check shall be performed under pressure at the start of the first fuelling of the day. If the sample does not provide a satisfactory Visual Check, additional draining and sampling shall be performed until a sample providing a satisfactory Visual Check is obtained.

(c) If abnormal quantities of free water or sediment are found, or if it is not possible to obtain a Clear and Bright sample that provides a satisfactory Visual Check, the vehicle shall be withdrawn from service and an investigation shall be carried out immediately to determine the source of the contamination.

5.2.3 Procedures for recovered aviation fuel

Product obtained by draining and sampling shall be returned to the depot for removal of any water and sediment, on a daily basis, before return to storage or downgrading as appropriate. A sample collecting procedure that ensures no mixing of grades shall be established for this purpose.

Where aviation fuel is returned directly to fuelling vehicles from product recovery tanks, there shall be an approved written procedure to ensure absence of contamination. Many hydrant servicers have an automatic pump-out function of the product recovery tank activated by a high level switch, which returns the fuel from an elevated suction into the vehicle delivery pipework before the filter during a fuelling. These systems are considered to provide an acceptable means of product return. Product recovery tanks shall be checked at least daily for water and sediment.

5.3 Sampling procedures during fuelling operations

The following checks shall be performed as a minimum requirement. Additional sampling may be required to satisfy customer and company requirements.

5.3.1 Fuellers

After the fuel contained in the vehicle delivery pipework and filter vessel has been displaced, a 1-litre sample shall be taken downstream (outlet side) of the filter for Visual Check. Where this volume is not fully displaced, i.e. for small volume uplifts, this check shall be performed after fuelling. 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, 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 have been determined and remedial action taken.

This sampling procedure shall apply as follows:

- the first fuelling of the day
- the first fuelling after the fueller leaves the depot
- the first fuelling after loading or topping-up the fueller
- the first fuelling following exposure to heavy rain or snowfall.

5.3.2 Hydrant servicers

The following samples shall be taken at every fuelling operation.

Sampling	(a) During fuelling	(b) After fuelling
Hydrant servicers with FWS	After 1,000 litres from downstream of FWS	From FWS sump
Hydrant servicers with monitors	After 1,000 litres from downstream of monitor	From inlet side of monitor

(a) During fuelling sample

After the fuel contained in the vehicle delivery pipework and filter vessel has been displaced (typically 1,000 litres), a 1-litre sample shall be taken downstream (outlet side) of the filter for an Appearance (or Visual*) Check. If water is found in the sample, a second sample shall be drawn immediately.

(b) After fuelling sample

A 1-litre sample shall be drawn from the filter separator sump (FWS) or inlet (upstream) side of the monitor vessel under pressure immediately after each fuelling for an Appearance (or Visual*) Check. 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.

* A chemical water detector test shall be performed on at least one of (a) or (b) above.

If a hydrant servicer is withdrawn from service or is reassigned to another aircraft before the fuelling operation is completed, this procedure shall be followed before leaving the aircraft.

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

5.3.3 *Sample disposal and retention*

Fuel samples shall not be spilled onto the apron. They shall be disposed of into a suitable container on the vehicle or returned to the depot in securely closed sampling containers and recovered as described in 5.2.3. Procedures shall ensure that product samples that have failed an Appearance Check or Visual Check are not delivered to aircraft but are retained, for investigation if necessary.

Where required, retained samples should be suitably labelled and retained for at least 24 hours.

5.4 Fuel samples required by airlines

Where an airline representative requests a fuel sample for testing purposes other than an Appearance Check or Visual Check, the following actions shall be taken:

- Ascertain the reason for the test.
- To determine the size of sample required, ascertain details of the test the airline is going to carry out.
- Record the details in the sample records.
- The sample size should be twice the quantity required by the airline. Half the sample should be retained until advised by the supplying company. The sample given to the airline and the retained sample should be labelled properly with identical information and signed by the airline representative and the manager.

5.5 Sample containers

An adequate stock of approved sample containers shall be maintained at the airport.

5.6 Filter membrane fuel monitoring – Jet fuels

Filter membrane samples for colour rating and gravimetric determination shall be taken from fuellers and hydrant servicers as specified in Appendix A6.

5.7 Change of grade –fuelling vehicles

5.7.1 General

All fuelling vehicles shall be assigned to a single grade of product. Under no circumstances shall Jet fuel and Avgas be handled alternately in the same equipment.

When it is necessary to change fuelling equipment from permanent service on one product to permanent service on another, the following grade-changing procedures shall be followed. Satisfactory compliance with the procedures shall be checked by supervisory personnel and recorded. This record shall show specifically the action taken in respect of grade identification and coupler selectivity features.

Caution: After draining a vehicle system, the system shall be refilled at a slow rate to ensure that excessive pressure is not created in the filter vessel that could damage the filter elements. Additionally, all high points within the system shall be vented to ensure the removal of all entrapped air before starting full flow through the system.

5.7.2 Fueller changes between Jet fuel and Avgas

(a) Drain fueller tank and inspect internally for absence of liquid. Open all drain valves and drain all low points (filters, pumps, etc) to clear pipelines and components of previous grade.

(b) Fill vehicle to capacity with new grade (observing all safety precautions relating to switch loading) and deliver 1,000 litres at maximum flow rate through all hoses to an empty bridger and downgrade to bulk motor gasoline or heating kerosene storage as appropriate.

(c) Draw 4-litre samples from all drain points to ascertain that all previous product has been flushed.

(d) Change grade identification and any bottom-loading selectivity features.

(e) Filter elements shall be changed.

5.8 Fueller loading

5.8.1 Procedures and equipment used for loading fuellers should ensure that there is no possibility of a fuel spillage. 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. A deadman of the type that requires periodic action by the operator within a predetermined time interval to control the operation should be used. If a cordless deadman control is used, it shall be released if the operator is more than 10 meters from the loading point, or is out of line of sight of the loading point.

Adequate spill protection measures shall be provided (e.g. fuel containment barriers).

Fuellers shall be bonded to the loading pipework at all times during the loading operation. (Fuellers shall not be bonded to the hydrant pit when loading directly ex-hydrant.) Fuellers shall not have the engine running during loading operations, to reduce ignition sources in the fuel transfer area. Where loading is controlled by an electronic level control a separate bonding cable is not required providing the following is in place:

1. The system ensures electrical continuity between the vehicle and loading pipework; and
2. Bonding to the fueller is required to activate the loading pump.

Fuellers, as a minimum, shall be equipped with overfill protection from one of the following combinations (Option A shall apply for all **new vehicles** and is preferable for existing vehicles. Options B or C are only permissible for all vehicles manufactured before the publication of JIG 1 Issue 12):

A: A combination of one automatic independent overfill protection device and one independent cut-off device. This can be two internal vehicle devices (i.e. two sensors, one connected to the foot valve and one connected to the line valve) set to stop the flow at predetermined levels (see 3.2.4). The higher of the two devices provides the ultimate automatic overfill protection, commonly referred to as the "high-high" level. Alternatively, this can be a single internal device activating the vehicle foot valve at a pre-determined level together with an electronic sensor system set up to shut down the loading pump at a predetermined level. As a minimum the ultimate device shall be fitted with a pre-check function that shall be activated shortly after the start of each loading.

For existing vehicles, either

B: One vehicle internal automatic overfill protection device connected to the foot valve. There shall be an automatic cut-off device pre-check that shall be activated shortly after the start of each loading operation. Additionally, there shall be a loading meter (preferably pre-set type) to limit the loaded quantity to a pre-calculated amount.

or

C: One vehicle internal automatic overfill protection device connected to the footvalve. There shall be an automatic cut-off device pre-check that shall be activated shortly after the start of each loading operation. Additionally, there shall be a fueller contents gauge marked with a safe fill level that shall be observed during loading and the loading stopped when this level is reached.

Note: Fuellers equipped with a single automatic overfill protection device **shall not** be filled to the level at which the device is activated, except when testing the system (see 4.17).

Where fuellers are equipped with two high-level control devices (i.e overfill device and cut-off device) they may be filled to the level at which the first device is set to shut down the flow.

Where fuellers are filled on the ramp from a hydrant system, additional precautions shall be observed to avoid the possibility of a fuel spillage. Two automatic overfill protection devices shall be fitted for new vehicles; but, for equipment manufactured before 2013 only, a single automatic overfill protection device is acceptable provided that filling from the hydrant is via a meter equipped with a preset and provided that the pre-calculated amount is controlled by the meter preset. This operation shall be subject to a risk assessment that shall take account of flow rates, pressures, spill prevention and spill consequences.

All fueller loading hoses shall meet a recognised industry standard suitable for aviation fuel. Hoses meeting the requirements of EI 1529 or ISO 1825 are preferred, but hoses meeting BS 3492 or BS 5842 or equivalent may also be acceptable subject to an approved variance. (Note: BS 3492 limits maximum operating pressure to 10 bar.)

5.8.2 On completion of fueller loading, the product shall be allowed to settle for at least 10 minutes. The fueller tank sump shall then be drained of any water and sediment and a sample taken for a Visual Check. Vehicles may be moved from the loading area to a designated parking area for settling after loading before sampling.

5.9 Testing for microbiological growth

Where microbiological growth has been confirmed as being above acceptable levels (see 2.3.3 (g)) in a fuelling vehicle, remedial action is required. As a minimum, this shall include on-site assay tests for microbiological activity carried out on fueller tank low point (or filter vessel drain points for hydrant servicers) samples of Jet fuel, using an IATA recommended test kit at least every 3 months for a period of 1 year. Where 3 successive on-site assay tests have shown that microbiological growth levels are at a satisfactory level the testing intervals can be relaxed or even discontinued, provided there are no other contra-indications of microbiological activity.

An investigation into the source of the contamination of the fuelling vehicle(s) shall take place and this shall include on-site assay testing of the airport fuel storage.

Vehicles routinely used for defuelling (see 6.6) shall be subject to on-site assay testing on a 6-monthly basis, or more frequently if daily sump samples indicate the likelihood of microbiological activity.

Note: Fuel samples for on-site assay testing shall be drawn from fueller tank low points and allowed to settle to remove any traces of water. To ensure consistency of test results, sampling should be performed after the fueller has been filled and settled. For hydrant servicers, samples should be drawn from the filter vessel drain point under pressure during maximum flow conditions. Contamination of the sample for testing shall be avoided by strict observance of the test kit manufacturer's guidance on cleanliness. Alcohol wipes should be used to clean sample points before sampling. The sample point shall then be flushed with Jet fuel to remove traces of alcohol before taking the sample for testing. If a positive result is obtained the test shall be repeated. If the result is confirmed, seek guidance.

Chapter 6
Fuelling operations

6.1 *Fuelling personnel*

Fuelling operations shall be carried out by competent personnel who are thoroughly trained in aircraft fuelling procedures, the operation of fuelling equipment, and the action to be taken in the event of an emergency. Manning shall be adequate to ensure safe operation and to enable effective action to be taken in the event of an emergency. Personnel shall be familiar with the location and operation of emergency stop controls and switches on fuelling equipment and on the apron.

6.2 *Driving and positioning of vehicles*

6.2.1 *Driving and approach to aircraft*

Vehicles shall not be driven at excessive speeds and speed limits imposed by the airport authorities shall not be exceeded. Where no regulations exist, a limit of 25 km/h shall be enforced on the apron. As soon as practicable after leaving the vehicle parking stand, brakes shall be tested to ensure satisfactory operation.

The use of a mobile phone while driving a fuelling vehicle is strictly prohibited. Calls shall not be made or received while driving.

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

The approach to an aircraft shall be such that collision will be avoided in the event of vehicle brake failure. Vehicle brakes shall be safely tested on approach to the aircraft parking stand (approx 15m from the stand).

6.2.2 *Stand plans*

Stand plans, drawn to scale, should be developed with the airport authority for every aircraft parking position. These stand plans provide guidance for the fuelling operator in the safest approach and exit route to/from the aircraft fuelling position. Similar parking positions may be consolidated into a single plan. These shall show as a minimum:

- stand number and location
- aircraft types (include all aircraft likely to use the stand)
- location of hydrant pits and hydrant emergency stop buttons (if applicable)
- fuelling vehicle access/exit routes (shown by colour-coded arrows)
- fuelling vehicle parking position during fuelling
- fuelling vehicle standby position while waiting to fuel.

Stand plans should be prepared in a suitable format for retention in fuelling vehicle cabs.

An example of a suitable stand plan is shown at Appendix A14. In developing stand plans every effort shall be made to eliminate the need for reversing manoeuvres. Priority should be given to developing stand plans for parking stands where access difficulties exist.

6.2.3 Positioning for fuelling

Fuelling vehicles should move forward into the fuelling position and in accordance with any stand plan such that there is a clear forward exit path. Minor repositioning of hydrant servicers is acceptable when moving into the fuelling position, provided that there is adequate rearward visibility.

If a fuelling vehicle has to be reversed into or out of the fuelling position, the manoeuvre shall be performed with the assistance of a competent guide person positioned behind the vehicle and visible to the driver at all times. Reversing speed shall not exceed slow walking pace. Wherever possible, reversing should be performed in a straight line.

Fueller and (drawbar) trailer combinations shall not be reversed.

Reversing aids (e.g. rear-facing cameras with a screen inside the cab and reversing sensors/proximity switches) may be used in addition to a guide person (banksman). The use of mirrors and a guide person shall remain the primary means of reversing guidance.

Vehicles shall be positioned safely, taking account of the following:

(a) Extreme care shall 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.

(b) For fuellers (including trailers and fuellers equipped with hydrant couplers), a clear exit path shall be maintained throughout the fuelling operation to allow the fuelling vehicle to be driven away quickly in the event of an emergency. If the exit path becomes obstructed by vehicles or equipment then the fuelling operation shall be stopped until the vehicle/equipment is moved clear of the fueller exit path.

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

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

(c) Aircraft vent pipe safety zones (minimum 3 metre radius), APU exhaust efflux or other danger areas should be avoided.

(d) Vehicle delivery hoses and hydrant servicer inlet hoses should be positioned to minimise the risk of baggage handling equipment or other aircraft servicing vehicles driving over them and causing damage.

(e) If underwing deck hoses are to be used, it shall be possible to connect hoses to the aircraft fuelling point without exerting any sideways pressure that could damage the aircraft adapters. Once connected, hoses should hang freely and vertically from the fuelling point.

(f) Special precautions shall be taken to ensure that vehicles used for underwing fuelling have sufficiently low profile for this purpose.

(g) When positioning vehicles underwing, full account shall be taken of the potential aircraft settlement so as to avoid the possibility of the aircraft wing, fuelling panel cover or other surfaces bearing down onto the vehicle as the aircraft settles under increased fuel load.

Note: For certain aircraft types, wingtip settling could exceed 1 metre during fuelling. Detailed clearances can be found in the JIG Aircraft Fuelling Data Sheets. Other factors such as wind conditions should also be considered.

(h) All fuelling staff should be aware that the extension of slats or flaps on certain aircraft types may result in insufficient clearance for the fuelling vehicle. Clearance between the fuelling vehicle and aircraft wing components shall be considered during initial positioning of the fuelling vehicle. It is the responsibility of the airline to inform the fuelling operator if the slats or flaps are extended once fuelling has started. It is preferable that the aircrafts slats and flaps are fully retracted for the duration of the fuelling operation. If this is not the case then the airline representative shall provide assistance (if needed) when the fuelling equipment is positioned and when it is moved clear of the aircraft.

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

The location manager shall ensure that fuelling vehicles can be positioned safely relative to the aircraft as described above and shall take action with the airport authority or airport safety committee in writing if it is not possible to meet all of these requirements. If the location manager is not satisfied that fuelling vehicles can be positioned safely, he/she may decide not to allow fuelling operations to proceed.

6.2.4 De-icing of aircraft

De-icing of aircraft shall not take place during fuelling operations and should be performed after the fuelling operation whenever possible. If de-icing is required when fuelling is taking place, the fuelling operation shall be suspended until the de-icing is completed.

De-icing fluid is a hazardous material and skin contact should be avoided. Operators should take care to ensure that drips of de-icing fluid, for example from a recently treated aircraft wing, do not fall into their eyes. Any spillage of de-icing fluid is likely to create a very slippery area on the apron. For these reasons, fuelling vehicles shall not approach an aircraft if de-icing procedures are in progress. In icy conditions, fuelling operators should assume that the aircraft has just been de-iced, take appropriate care to avoid eye and skin contact and be alert to slippery conditions on the apron.

6.3 Hydrant pit/inlet hose identification and protection

Hydrant servicer 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 during the hours of darkness.

To improve the visibility of the hydrant pit valve area at all times:

(a) A high visibility hazard marker shall be displayed above the pit opening. A four-winged flag constructed from high visibility material is preferred but alternative designs/equipment providing a similar degree of all-round visibility may be used.

(b) During the hours of darkness the hydrant pit valve and inlet hose shall be illuminated. Red or orange safety lamps or vehicle-mounted searchlights (intrinsically safe) may be used for this purpose.

Additional methods of protecting and increasing the visibility of the hydrant pit and hydrant servicer inlet hose should be considered. This may include a risk assessment at the location. Examples of such additional methods include the use of high visibility road cones, inlet hose collars and warning signs.

6.4 Bonding – aircraft and fuelling equipment

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

Bonding between the fuelling vehicle and aircraft shall be completed before any hoses are connected or tank filler caps opened. Bonding shall be maintained until all hoses have been disconnected or, for overwing fuelling, tank filler caps replaced.

For fuelling operations with towable fuelling platforms fitted with integral hoses, the following bonding requirements shall be followed:

- The towable fuelling platform shall be bonded directly to the aircraft using the bonding cable on the platform. The fuelling vehicle shall be either separately bonded directly to the aircraft or bonded to the platform using the bonding cable on the vehicle.

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 before the fuelling operation, they should be replaced and vapour in the vicinity allowed to disperse before starting the fuelling operation. The procedure may vary with aircraft type, but the following is considered best practice:

- Open the fill point cover flap.
- Attach a nozzle bonding jack or clip to the bonding point or cover flap (if a suitable bonding point or cover flap is available on the aircraft), with the filler cap still closed.
- Open the filler cap.
- Insert the fuelling nozzle and keep the nozzle in contact with the neck of the fill point throughout the fuelling operation.

6.5 Fuelling procedures

6.5.1 General

(a) Fuelling is not permitted during severe local electrical storms. Into-plane fuelling services should work with the local airport authority to define the procedure for suspension of all fuelling operations when electrical storms are in the immediate vicinity.

Fuelling operations should not be performed during very high wind conditions. The stability of fuelling platforms when fully extended may be affected by high winds, so fuelling at height should not be permitted if wind speeds in excess of 40 knots are expected.

(b) "NO SMOKING" signs or symbols shall be displayed in prominent positions near the aircraft and fuelling vehicles throughout the fuelling operation. These symbols may be painted onto both sides of the fuelling vehicles.

(c) Ascertain fuelling requirements. In the case of overwing (trigger nozzle) fuelling, the grade of fuel required shall be confirmed (see 6.5.5).

(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-opening fastenings.

(e) Hoses shall be run out on selected routes that will prevent them from being run over by aircraft-servicing vehicles. Kinking and twisting of hoses shall be avoided. Pressure fuelling couplers and overwing nozzles shall not be dragged over the ground. Dust caps shall be fitted at all times while couplers are not in use.

(f) During fuelling, check the vehicle for leaks and check the correct action of pressure control equipment by observing a reading of appropriate pressure gauges on the vehicle. For underwing pressure fuellings, record differential pressure (dP) and flow rate once during the fuelling on the vehicle log sheet and compare to the reading on the previous fuelling. The differential pressure reading shall be recorded shortly after fuelling begins, once the maximum flow rate for the fuelling is reached. If there is a difference (positive or negative) in dP from the previous fuelling that cannot be explained by the change in flow rate, fuelling shall be stopped and an investigation shall be conducted, including taking samples from downstream of the filter. (Note: This should be recorded on the vehicle log sheet or separate record.)

Action in event of dP switch activation

Following any activation of a dP switch, the fuelling vehicle shall be removed from the fuelling operation for investigation, and the fuelling operation management and the depot/hydrant operator shall be notified immediately. Other fuelling operations at the airport should be notified by the depot/hydrant operation management.

The fuelling vehicle filter elements shall be replaced before the vehicle is returned to service. A second fuelling vehicle may be used to complete the fuelling, provided that the dP is monitored closely during the remainder of the operation and fuel sampling requirements are carried out (see JIG 1, 5.3).

Investigations following dP switch activation

For investigative purposes the following list, which is not exhaustive, should be used by the into-plane operation:

- What is the cause of the high dP? (Check fuel samples and condition of monitor elements)
- Is the dP switch circuit functioning correctly?
- Are there other fuelling vehicles experiencing an increase in dP? (particularly in the case of hydrant servicers operating close to the affected servicer)
- If a second fuelling vehicle is in use to complete the fuelling, is there any indication of increasing dP?
- Was the dP increase a sudden change from a low value, indicating a problem, rather than a "normal" increase?

The hydrant operator should investigate the following:

- Has the hydrant pit in question been used recently?
- Have there been any changes in the hydrant flow rate or direction?
- Has there been any engineering work carried out on the hydrant?
- Have the into-hydrant filters shown an increase in dP? (Check sump samples.)

Overall, the hydrant operator will need to respond appropriately and proportionately. Guidance for the optimum response cannot be prescriptive but in the event of a small number of dP switch activations, hydrant pit valve flushing and sampling may be required. In the worst case, where a significant number of dP switches have been activated and there is other strong evidence of fuel quality problems in the hydrant system, the hydrant operator should consider the suspension of hydrant use.

(g) During fuel delivery, the operator shall position himself/herself at a point where he/she has a clear view of the vehicle control panels and aircraft fuelling points. Deadman control shall always be used and shall never be wedged or blocked open. Whenever possible, the operator should control the fuelling from ground level. Where access to the aircraft fuelling points is from a vehicle platform, it shall not be raised or lowered while fuel is flowing. Frequent observation of aircraft vents should also be carried out to ensure no spill is occurring. Monitoring of the wing vents on the opposite side of the aircraft and at the tail should take place to the extent possible, without the operator leaving the fuelling area.

(h) During fuelling operations, no aircraft maintenance shall be conducted that could provide a source of ignition for fuel vapours.

(i) General aircraft servicing such as baggage handling and catering services etc. may be carried out during fuelling operations. However, in the event of obvious defects developing in equipment operating within 6 metres of fuelling operations, the units shall be stopped and no attempt made to restart them during fuelling operations.

(j) Fuel spills are fire hazards and cause environmental damage. Aircraft engines can be a fire ignition source when hot; 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. If a spillage occurs, fuelling operations shall stop and action shall be taken in accordance with local airport regulations.

(k) Operational problems can be caused by unsuitable location of the aircraft, caused by misalignment of the aircraft in the parking bay, or by an inappropriately located hydrant pit for the aircraft type. Operator access to the hydrant pit shall not be obstructed by the aircraft engine. The rear of the aircraft engine shall not be located directly in front of the pit. In such cases the hydrant pit shall not be used and steps should be taken to arrange for the aircraft to be moved.

(l) Fuelling personnel should not operate aircraft fuel system controls except as provided in 6.5.6. It is the responsibility of the airline personnel/pilots to determine the volume of fuel to be loaded and to instruct fuelling personnel accordingly. It is also the airline's responsibility to determine the density (specific gravity) of the fuel being delivered and to make any associated calculations. Furthermore, it is their responsibility to manipulate aircraft tank valves and switches, drip and dip sticks and to check the security of tank fill caps, covers and components.

(m) Using a mobile phone on the apron during fuelling operations is strictly prohibited. Where for operational reasons it is necessary to use mobile phones, they shall remain in the vehicle cab at all times and be contained in tight-fitting covers to avoid the possibility of the battery falling out if dropped. If it is necessary for the operator to respond to a call, the fuelling operation shall be stopped.

(n) Before leaving the aircraft at the completion of the fuelling, the operator shall make a final check, including a complete "360 degree" walk around the vehicle, to ensure that aircraft fuel caps have been re-fitted, that the fuelling vehicle is properly disconnected from the aircraft and that all equipment is stowed correctly. Fuelling vehicles shall be driven away from the aircraft slowly in a forward direction.

6.5.2 Hydrant systems – underwing

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

(a) The grade of the hydrant pit and hydrant servicer shall be checked before the connection is made to the pit.

(b) Hydrant pit identification shall comply with section 6.3.

(c) Appendix A9 shows two sequences for hydrant servicer fuelling as follows:-

- Sequence 1: Connection: Pit to Aircraft; Disconnection: Aircraft to Pit
- Sequence 2: Connection: Aircraft to Pit; Disconnection: Aircraft to Pit

Each company shall have only one agreed sequence, endorsed by the management and incorporated into a written procedure. Where possible, a single procedure shall be agreed across all into-plane operators at the airport. When considering which sequence shall be adopted the following risks shall be included in the risk assessment:

- fuel spill from the hydrant
- fuel spill from the aircraft
- drive-away
- spark creation and other ignition sources
- trip hazard and manual handling hazard.

Site-specific task development should focus on:

- the workflow (to eradicate functional isolated steps where possible) taking into consideration factors such as predominant aircraft types, configuration of parking stands and risks associated with other operations around the aircraft during fuelling

- the current sequencing/procedures adopted by different fuelling companies and the risks associated with changing these
- the need to carry out a Management of Change (MOC)
- the creation of a single procedure for an into-plane operation, extending this where possible for a single procedure at an airport
- the need for a consultation process with fuelling operators to seek their opinions
- the potential that existing task breakdowns are too lengthy and complex
- additional measures (use of a tag or flag attached to the aircraft nozzle).

(d) Extend the lanyard on the apron such that it is free of obstructions and readily accessible for use in an emergency.

(e) Whenever the servicer is left unattended (e.g. for airline signature of delivery receipt) the hydrant pit valve/ hydrant coupler shall be closed.

(f) Dust caps shall be fitted to the pit valve adapter and service couplings at all times when not in use.

(g) Draw samples and carry out checks as described in Section 5.3.

6.5.3 Fuellers – underwing

In addition to the procedures in Section 6.5.1 and Section 6.5.2(g), the following shall be applied.

Ensure that the following sequence is observed:

- Bond the fueller to the aircraft.
- Check the condition of aircraft fuel adaptor(s) – see 6.5.4.
- Connect all delivery hoses to the aircraft.
- Activate the deadman control to start delivery.

At the conclusion of fuelling:

- Stop fuel flow with the deadman or manual delivery valve.
- Disconnect hoses
- Check the underwing aircraft fuelling adapter cap (if fitted) is replaced and the fuelling panel is closed.
- Remove the bonding cable from the aircraft.
- Conduct a "360 degree" walkaround before driving away from the fuelling position.

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

6.5.4 *Aircraft fuel adaptor condition check*

In addition to the aircraft fuelling procedures detailed in sections 6.5.2 and 6.5.3, the following checks and actions shall be taken:

(a) Immediately before connection of the fuelling vehicle delivery nozzle(s), the aircraft fuel adaptor shall be checked visually to ensure that it appears to be in good condition with no missing or damaged lugs, loose or missing securing screws, cracks, excessive wear or other obvious damage or contamination.

Adaptors affected by any of the above shall be brought to the attention of the airline staff for correction before the fuelling can begin. Fuelling staff shall not attempt to tighten loose adaptors or other aircraft fuelling bay components themselves.

No connection shall be made to an adaptor with a missing lug or any other defect, including excessive wear. A wear gauge shall be available on site to check the amount of wear to the adapters.

(b) After connection and before starting fuel flow, rotate the nozzle handle to the locked position and open the poppet actuation lever. The aircraft adaptor shall be checked that it is secure by attempting to remove the nozzle with the nozzle handle in the locked position.

(c) On starting of fuel flow the nozzle to aircraft adaptor connections shall be checked to ensure that there are no leaks. Fuelling shall not be carried out from an adaptor to which the coupler does not connect securely, or which leaks.

(d) At the end of each fuelling operation the aircraft fuel adaptors shall be checked again to ensure that there are no obvious signs of damage, contamination or missing lugs. Any damage found shall be brought to the attention of the airline representative. It is the airline's responsibility to ensure that aircraft fuel adaptors are in good condition and to take appropriate action when damage is reported.

6.5.5 *Overwing fuelling*

a) In addition to the procedures for underwing fuelling by fuellers, further measures are required to ensure that the correct grade of fuel is delivered when using an overwing (trigger) nozzle. Delivery of incorrect grade of fuel to an aircraft can have severe consequences that may result in engine failure.

<u>Fuelling personnel shall never make an assumption about the grade of fuel required.</u>

(i) Fuel request. Misfuelling prevention begins with the fuel request process when the fuel grade and aircraft registration shall be clearly established, ensuring the vehicle with the correct grade of fuel is dispatched.

(ii) Fuel grade confirmation. Before fuelling can start the operator **SHALL** ensure at least two (2) out of the following three (3) controls are in place:

Control 1:

The aircraft is marked with a fuel grade decal that clearly and without doubt corresponds to the grade of fuel marked on the fuelling vehicle, trailer or fixed (kerbside) delivery equipment. (See examples in EI 1597.)

Control 2:

The fuelling nozzle spout and the aircraft fuel tank orifice correspond to the norm for the fuel grade, i.e. for Jet fuel a wide, selective nozzle spout (with a major axis of at least 67mm) and large aircraft orifice; and for Avgas, a small circular spout (49mm external diameter or less) and a narrow aircraft orifice.

Control 3:

A Fuel Grade Confirmation Form (refer to Appendix A10), completed, signed and dated by the aircraft pilot or agent, has been received by the fuelling operator.

If only **ONE** of controls 1, 2 and 3 is met then the fuelling **SHALL NOT** proceed and the fuelling operator shall immediately inform their fuelling service manager, supervisor or other designated management personnel. In these circumstances <u>the following are required before the fuelling may</u> proceed:

- an acceptable written explanation from the aircraft operator
- approval in writing from the fuelling service management that the fuelling may take place.

(iii) Post delivery fuel grade confirmation. Before leaving the aircraft at the completion of the fuelling the fuelling operator shall make a final check of the accepted controls (2 out of 3) as shown above.

If an anomaly is discovered after completion of fueling, the aircraft pilot and fueling service supervisor shall be informed immediately.

(iv) Additional misfuelling risk scenarios:

- Some aircraft types are equipped with engines that may be powered by Jet fuel or diesel fuel. These engines are being installed on aircraft that typically had previously been fitted with engines using Avgas. These aircraft represent a serious risk of misfuelling by the delivery of Avgas to an engine designed for diesel fuel.

  Note: Although some aircraft engines may be certified for use with diesel fuel or motor gasoline, **it is not permitted to refuel aircraft with diesel fuel or motor gasoline (Mogas).**

- There are a growing number of aircraft which are equipped with engines capable of running on unleaded (UL) Avgas. UL-91 is currently available in some markets but is not suitable for all types of piston engine aircraft. Misfuelling of UL-91 into an engine designed to run only on a higher octane fuel (e.g. Avgas 100LL) is of particular concern as it could have severe consequences.

(v) The Fuel Grade Confirmation Form (Appendix A10) **shall** also be required for:

- overwing fuelling during air shows.

(b) The following additional precautions are applicable for overwing fuellings:

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

(ii) 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. 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 product is being loaded.

(iii) Overwing nozzles shall be held open manually and shall never be wedged open.

(iv) Overwing nozzles shall be in continuous electrical contact with the fill point neck during fuelling – see section 6.4.

Note: Overwing fuelling out of a hydrant with a hydrant servicer should not be performed, because of the possible exposure to high pressures and increased risk of spillage.

Where hydrant servicers have been designed for overwing fuelling they may be used, subject to agreement of the company management, provided that they are not fitted with a deadman override.

All overwing fuellings by suitable hydrant servicers shall be performed as a two-person operation in accordance with written procedures with one person holding the deadman and hydrant lanyard throughout the fuelling.

(c) Self-service fuellings

Self-service fuellings are situations where the fuelling is performed by the pilot or customer without a representative of the fuelling company being present. The 2 out of 3 controls in section 6.5.5 cannot be enforced for such types of fuelling for a number of reasons, including:

- When the selective spout is fitted to the Jet fuel nozzle, and if a customer requires the use of a non-selective spout for their aircraft, it may not be practical to provide one. At Avgas facilities fitted with the narrow diameter spout the aircraft orifice is not checked, so this control is not completely effective for self-service fuellings.
- The control to verify the grade labels match the aircraft and fuelling unit can only be carried out by the pilot, which is not sufficient to assure this confirmation.
- The control requiring the completion of a grade confirmation form cannot be fulfilled, as the supplier is not in attendance to check that the signature and form are correctly completed.

In view of the above a different set of controls is required to manage the risks related to the correct fuel grade delivery during fuellings at self-service stations. The requirements in such circumstances are that either (a) or (b) below shall be in place together with 2 of (c), (d) and (e).

(a) A fuel grade-dedicated customer fuelling card, achieved by either having the grade coded into the magnetic strip of the fuelling card (checked by the payment terminal software, thus preventing the wrong grade selection). Or the grade would be checked at the payment terminal (via the internet) against the customer account details. For payment by credit card this check would be made via the PIN verification and system check on the credit card.

(b) At the payment terminal the pilot/customer is asked by the system to select the grade of fuel required, followed by a second question to confirm the grade just selected.

(c) A fuelling card is used with the fuel grade written on the front of the card.

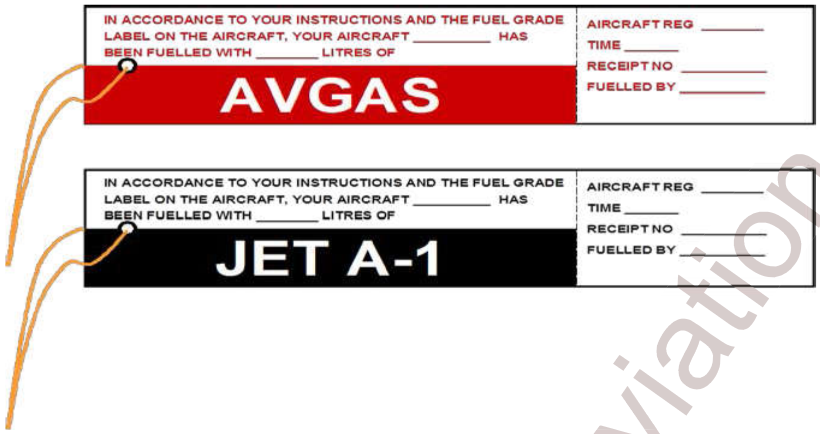
(d) A large sign is displayed at the self service unit showing a large EI grade identification decal(s) along with a clear set of instructions for use of the self-service unit, with emphasis on the requirements for selecting the fuel grade.

(e) A warning to the customer explaining the risks of incorrect fuel grade delivery. This may be by means of a flyer/letter sent to the customer when issuing the fuel card or invoice, or a fixed sign (based on the flyer/letter) at an obvious location near the self-service unit. For credit card payments the latter requirement in (e), of a sign, shall be applied.

All locations shall have emergency protocols in place for operating the pump if the outside payment terminal fails.

(d) Unattended fuelling

Unattended delivery (i.e. when the aircraft pilot or representative is not present) of fuel overwing is discouraged. Where unattended fuelling is unavoidable then controls 1 and 2 in section 6.5.5 shall both be satisfied before fuelling can start. On completion of the fuelling, the fuelling operator shall attach a colour-coded fuel tag to a suitable position on the aircraft, the position to be agreed with the aircraft operator (see example tags below). The tag shall be visible to the pilot upon return to the aircraft and shall clearly state the fuel type and quantity of fuel delivered to the aircraft.



6.5.6 *Additional services*

(a) When a company is requested by an airline customer to carry out additional services, the company shall obtain from the airline a written request detailing the extent of the work required. This may include extracts from or references to the IATA Standardised Into-plane Fuelling Procedures. A summary of the IATA service levels extracted from this document is included as Appendix A11.

The company shall also obtain written details of any applicable additional safety precautions to be observed and details of appropriate training and certification that will be provided by the airline.

(b) Where agreement is reached for the company to provide additional services, the company management will decide on how best to meet the operational requirements of the additional services, including fuelling vehicle modifications and the effect on manning levels.

(c) 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.

(d) To assist in the provision of a safe and efficient service of single person operation, fuelling vehicle platforms should be equipped, as a minimum, with deadman operation facility, sight of meter readout and an engine stop switch on fuellers. However, whenever possible, the operator should control the fuelling from ground level (see 6.5.1 (g)).

6.6 *Defuelling procedure*

Defuelling shall take place into a mobile fueller or static tank. Defuelling directly into a hydrant system is not permitted. Defuelling aircraft directly into joint use fuelling equipment shall not be authorised unless all participants have unanimously approved a joint use procedure.

Before defuelling begins, the fuelling equipment hose-end regulator shall be locked in the fully open position using a block-out or bypass device and, where possible, the nozzle strainer should be reversed. It is important that the hose-end regulator is locked open as, if left operational, it will reduce the defuel flow rate and could cause surge pressures if the aircraft booster pump is used. Confirm with the airline representative the maximum permissible defuelling rate of flow and vacuum acceptable for the aircraft.

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 A12) used for the acceptance of defuelled Jet fuel. Fuelling vehicles that are routinely used for maintenance defuelling shall be checked for microbiological growth (see 5.9).

To protect the quality of the fuel in the fuelling equipment from being contaminated by the defuelled product from the aircraft, the following procedures shall be adopted *before* defuelling begins:

Note: Differences to the defuelling requirements below may be negotiated as a separate contractual arrangement.

(a) The quality and grade of fuel contained in the aircraft tank shall be established by:

- the airline taking samples for a Visual Check (check performed by or witnessed by the fuelling operator); and
- checking the grade of fuel uplifted on the two previous fuellings. (The airline engineer or mechanic should perform this check, from information available in the electronic Aircraft Technical Log.)

Note: If fuel tank drain water is found with an appearance other than clear, a check shall be performed to determine if microbiological activity is present.

(b) If there is any reason to suspect the quality of the fuel, the off-loaded fuel shall be segregated and subjected to a Certificate of Analysis test that shall be successful before the fuel may be returned to the airline.

(c) If the quality of the fuel is not suspect, or if it passed the applicable tests in (a) and (b) above, it may be delivered to an aircraft of the same airline or to an aircraft of another airline with their written permission.

(d) Where fuel is contaminated or there is no possibility to return it to the airline from which it was removed and no other airline will accept it (written permission required), the fuel shall be downgraded and removed from the airport as waste fuel, subject to the approval of the airline that has been defuelled.

Notes:

- Defuelling of any fuel mixture containing wide-cut fuel is not permitted in a hangar.
- When a fueller has contained defuelled product of suspect quality, it shall be drained and inspected internally for cleanliness and the absence of any remaining fuel. All drain points shall be purged to clear pipework and components (filters, pumps etc.) of fuel. The filter elements shall be replaced. The fueller shall be filled to capacity and 1,000 litres be delivered at maximum flow rate through each hose back into a storage tank containing at least 20,000 litres of the fuel grade.
- Fuel containing FSII additive shall not be redelivered via filter monitor elements because of the possibility of filter media migration.

6.7 Fuelling/defuelling with passengers on board or embarking or disembarking

Fuelling/defuelling in these circumstances may be carried out provided:

6.7.1 Such fuelling/defuelling is permitted by the airline and local airport regulations.

6.7.2 The airline accepts sole responsibility for ensuring that:

(a) the provisions of the local airport regulations relating to fuelling/ defuelling are carried out

(b) instructions are issued to its employees for the safety of all passengers during fuelling/defuelling and these instructions are strictly observed

(c) passengers joining or leaving the aircraft via the apron are moved without delay under the supervision of a responsible person over a safe route. Passengers shall be kept at a safe distance from the fuelling operation and other hazardous areas such as aircraft engines, APU exhausts and fuel tank vents. "No Smoking" regulations shall be strictly enforced.

6.7.3 Before fuelling/defuelling starts, the fuelling operator shall be assured that fuelling/defuelling with passengers on board (including embarking/ disembarking) can begin.

Fuelling/defuelling shall be stopped if a hazardous situation arises – for example, spillage or fire and the airline captain or airline representative/engineer is informed. The airline should inform the fuelling operator of other circumstances that require fuelling operations to stop.

Notes:

- Passengers shall not be allowed to remain on board helicopters during routine fuelling operations.
- Fuelling of any Avgas aircraft while passengers are on board is not permitted.

6.8 Fuelling while aircraft-mounted Auxiliary Power Units (APUs) are in operation

6.8.1 APU exhaust discharging outside fuelling zone (see Note)

(a) Fuelling units shall be located as far from the APU exhaust as practicable.

(b) The APU may be started and stopped during the fuelling operation without notification.

(c) In the event of fuel spillage, the APU shall be stopped immediately; it shall remain stationary until spillage is removed and there is no danger from inflammable vapours.

6.8.2 APU exhaust discharging into fuelling zone

(a) If the APU is started during fuelling the operator shall immediately release the deadman and stop fuelling. Fuelling can start again once the running of the APU is established.

(b) If the APU is stopped during the fuelling operation, it shall not be started until the flow of fuel has stopped.

(c) When the APU discharges from the side of the aircraft, if possible, the fuelling unit shall be positioned on the opposite side of the aircraft to the discharge. If this is not possible, then the fuelling unit shall be positioned out of the exhaust stream, and at the maximum practicable distance from it.

(d) In the event of fuel spillage, the APU shall be stopped immediately; it shall remain stationary until spillage is removed and there is no danger from inflammable vapours.

(e) Where the APU exhaust is directly across the upper surface of the aircraft wing, overwing fuelling shall not be carried out while the APU is running.

6.8.3 APU in engine nacelle on fuelling side of aircraft

Some aircraft are not equipped with a dedicated APU and use one of the nacelle engines (known as "Hotel Mode", e.g. ATR 42) instead. Fuelling of such an aircraft while in "Hotel Mode" is strictly forbidden.

Note: Fuelling zone: this is comprised of areas with a radius of at least 3 metres, or more if specified by local authorities, from filling and venting points on the aircraft, hydrant pits, fuelling vehicle and its hoses in use.

6.9 Fuelling while Ground Power Units (GPUs) are in operation

6.9.1 GPUs shall be positioned at least 6 metres away from fuelling vehicles and clear of wing tank vents.

6.9.2 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.

6.9.3 In the event of fuel spillage, the GPU shall be stopped immediately; it shall remain stationary until the spillage is removed and there is no danger from flammable vapours.

6.10 Fuelling with air conditioning units in operation

Fuelling operations may be carried out subject to the same conditions as those applicable to general aircraft servicing. The exception is that the engine of the unit shall be stopped in the event of fuel spillage. This is to prevent the possibility of flammable vapours being passed into the aircraft passenger compartment.

6.11 Fuelling with one aircraft engine running

Fuelling of an aircraft that has one propulsion engine running is a non-routine, emergency operation and requires very strict safety precautions. The procedure outlined below applies specifically to underwing fuelling. The procedure should be used only when an aircraft engine cannot be restarted because of inoperative ground aircraft starting equipment. **Overwing fuelling with one engine running is not permitted under any circumstances**.

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

6.11.1 Procedure

(a) Fuelling with one engine running shall not be performed unless the airline's authorised representative requesting this kind of operation accepts complete responsibility for the operation, in writing.

(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 away from the passenger loading area of the terminal and any other building or other aircraft.

(e) The aircraft should be headed into the wind.

(f) Where one-man fuelling would normally be carried out, an additional supervisor or senior fuelling hand should also be present.

(g) With the exception of air ambulance aircraft, fuelling is not to be started until all passengers have vacated the aircraft and are kept at a distance of at least 50 metres.

(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 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. The fuelling equipment should be positioned a maximum distance from the running engine.

(k) When additional fuel is required on the other side of the aircraft the operation should be carried out in the following order:

- Remove fuelling equipment from the side where the fuelling has just been completed. Position fuelling equipment at least 50m from the engine to be started.
- *Airline personnel* start the engine on the side that has just been fuelled.
- *Airline personnel* shut down the engine of the side to be fuelled.
- Position fuelling equipment adjacent to the wing to be fuelled at a maximum distance from the running engine.
- Load fuel.

Note: Under no circumstances shall fuelling take place on the same side of the aircraft as that where an engine is running.

6.12 Fuelling/defuelling in hangars

Fuelling/defuelling is not permitted in hangars or similar enclosed buildings, except by special agreement with the airlines and the airport authorities and in accordance with special procedures agreed with them, which have been approved by the management of the company head office.

Satisfactory liability/indemnification protection shall be obtained from the airlines.

The following procedures shall be included as a minimum:

- Fuelling vehicles shall always be positioned outside the hangar.
- Testing of aircraft tank overspill/dump valve testing is not permitted as part of any fuelling/defuelling operation.
- Technical supervision of the operation shall be maintained by a nominated airline supervisor in charge of the aircraft.
- Adequate firefighting equipment and spill containment equipment for spillage shall be available and readily accessible.

- Hangar doors shall always be opened fully to provide ventilation and allow clear and immediate passage of firefighting personnel and their equipment.
- All maintenance activities in the hangar should be suspended for the duration of the fuelling/defuelling operation.
- Only essential staff shall be permitted in the vicinity of the fuelling/defuelling operation within the hangar.
- Only hoses supplied and maintained by the fuelling/defuelling operator shall be used.

6.13 Notes on fuelling of hijacked aircraft

Conditions and situations will vary greatly when there is a hijacking. For instance, historically these have lasted from several hours to 5 days' duration. Furthermore, the reaction of the controlling government authorities (whether civil, military or other) and the concerned airline or aircraft owner or operator will vary from incident to incident, and during an incident. Consequently, it is not possible to plan for all eventualities. However, a plan of action shall be available at airports to cover those circumstances over which the operator could have some control or influence.

The plan should recognise situations in which the aircraft would not normally be fuelled by the company. This plan should be drawn up and agreed by location management committees and airport/local authorities and kept at the airport.

The plan should be reviewed annually by the committee and authorities and annotated accordingly.

In locations where government authorities' detailed contingency plans exist, these should be reviewed by the company in relation to the items below. Where relevant, the following items should be covered by the plan:

6.13.1 No company of its own volition should become involved in fuelling the hijacked aircraft. A company should only become involved if:

(a) Compelled by the controlling government authorities and requested by the airline or aircraft owner/operator to fuel the hijacked aircraft.

(b) Compelled by the controlling government authorities without the agreement of the airline or aircraft owner/operator. It is the responsibility of the location management to decide if it would be prudent to resist government pressure and to what extent.

(c) The government wishes to commandeer the company's fuelling equipment for its own use. Under these circumstances no staff shall be involved in fuelling the aircraft.

6.13.2 If involvement is unavoidable, the foremost concern shall be to protect the lives of employees, aircraft passengers and crew.

6.13.3 It should be assumed that the hijackers are thoroughly familiar with airport operations and aircraft fuelling procedures. Consequently, all work should be carried out in a normal manner.

6.13.4 It is essential that only one person acts as the fuelling "event co-ordinator". If the incident is of short duration, the co-ordinator will probably be the senior person on duty at the time. He/she should inform his/her immediate superior of the incident as soon as possible. For incidents of long duration, this person should be appointed by the management and should be relieved of all other responsibilities during the emergency. All communications to staff and government authorities should be through the co-ordinator. The mechanism for appointing the "event co-ordinator" should be defined.

6.13.5 A statement of the conditions under which joint facilities can provide fuelling services to the hijacked aircraft should be prepared, so that it is available to give to government authorities as soon as it becomes apparent they are likely to request fuelling of the aircraft. The more notice given of these conditions, the easier it will be to respond rapidly to an emergency situation with a minimum of confusion.

6.13.6 It is essential that the utmost effort is made to obtain in writing any order to fuel a hijacked aircraft. This should be signed by the highest ranking government and airline officials available. A draft letter, or letters, covering this situation should be available in the hijack instructions and agreed between the company and airport authorities.

The letters should indemnify the company and employees for fuel costs and any losses, liabilities and expenses incurred, and for any claims which may be brought against the company, or any employee, by passengers, crew or any other person for any reason arising out of, or related to, the fuelling or attempted fuelling of the aircraft.

6.13.7 Hijack instructions shall give consideration to the possibility of non-routine circumstances occurring, particularly as it is possible that the aircraft may be parked in a remote part of the airfield. For instance, at hydrant installations this may cause problems with fuelling if fuellers are not available, or are not of sufficient capacity to complete the fuelling in one operation.

6.13.8 If fuelling proceeds:

(a) The minimum number of fully briefed, non-coerced volunteer employees should be used. If the operators are not fully familiar with the operation of the aircraft's fuelling control panel, a competent ground engineer should accompany the fuelling crew. The hijackers should be made aware of this requirement.

(b) The "event co-ordinator" should ensure through the Government Incident Officer that the fuelling procedure is in accordance with the demands of the hijackers and that the hijackers are aware of, and agree to, the volume to be fuelled, the time fuelling will begin, its approximate duration, the number of operators involved, the registration number, route and final location of the fuelling vehicle and the clothing that will be worn. Every effort shall be made to ensure that no confusion occurs due to language differences. Hijackers should issue any instructions to the fuelling crew through the Government Incident Officer. Radios, if available, should be in good order.

(c) The "event co-ordinator" will fully brief the employees engaged in the refuelling and meticulously check that they understand their instructions. Where possible, to minimise confusion, instructions should be in writing.

(d) Every effort should be made to ensure that all operations by the fuelling crew are wholly visible to the hijackers. At night, operator(s) should approach the aircraft by walking in front of the fueller, illuminated by the headlight with only the driver in the cab. During the fuelling, all operators should stand at the vehicle control panel and not walk about the aircraft. The control panel should be in full sight of the hijackers.

6.13.9 Fuel samples shall be taken in the safety of the fuelling depot and not at the aircraft. Sealed duplicate samples should be retained for the company and the airline.

The fuel delivery document should also be completed at the depot. Signatures should be obtained immediately after the fuelling from the accompanying ground engineer, the airline representative or the authorities incident co-ordinator.

6.13.10 The company should refuse to participate in fuelling if the government wishes to include law enforcement or military personnel in the fuelling crew, or the fuelling operation, and if practicable such objections should be made a matter of record and witnessed.

6.13.11 A detailed written log should be maintained of all activities. This should be completed as soon as possible after each event. A recording should be kept of all conversations with the hijackers and, if possible, a video recording made of the fuelling.

6.13.12 No employee should give any information to the media during or after the hijack without it first being cleared by management and government authorities.

6.13.13 Operational training courses should contain procedures to be followed during a hijack situation.

6.14 Fuelling/defuelling aircraft during maintenance to landing gear

Fuelling and defuelling is not permitted during maintenance to landing gear under any circumstances. Maintenance to landing gear can introduce variables (such as metallic equipment) that may create a spark and can also compromise safety requirements during fuelling/defuelling.

6.15 Fuelling with inoperative hydrant fuel Emergency Stop System

No fuelling shall take place from a stand or section of a hydrant where the ESB (fuel hydrant emergency shut-down) system is inoperative, unless an alternative temporary emergency stop procedure has been agreed by all parties. All apron users shall be alerted to the non-operational ESB and shall be made aware of the temporary emergency stop procedure. This temporary procedure shall only be allowed for the absolute minimum timeframe whilst the ESB system is repaired and returned to service.

6.16 Aircraft incidents/accidents

Any damage to aircraft caused during the fuelling operation shall be reported immediately to the airline representative. If a fuelling operator has noted damaged or leaking aircraft fuelling adaptors during a fuelling operation, the airline representative shall be notified as soon as possible, preferably in writing, giving details of the aircraft registration and flight number.

The location manager has the responsibility of notifying the head office/ shareholders as follows.

In the case of aircraft accidents/incidents where fuel could be a contributory factor:

(a) No further fuelling should be carried out until cleared by the management technical authority.

(b) Notify immediately the company whose customer is involved and ensure that any written instructions to be followed in the event of an accident provided by that company are followed.

(c) Notify the fuel supply organisation/hydrant operator (as appropriate). At joint venture into-plane operations it may also be necessary to inform all shareholders.

Information to be reported should include:

- name and location of the airport
- date and time of the incident
- name of the airline involved
- type of aircraft and registration number
- flight number(s)
- facts of the accident – describe briefly but clearly
- nature and extent of any personnel injuries
- details of the aircraft fuelled before and after incident.

(d) In the presence of the representative of the airline concerned:

- Draw four nominal 10-litre fuel samples from the fuelling equipment downstream of the filter vessel. The containers, of suitable design, agreed by participants, shall be readily available. Containers, even when new, should be carefully rinsed at least three times with the product to be sampled; this is critical, particularly in the case of MSEP testing. Allow space for possible expansion of fuel. Sets of samples should be drawn from fuelling vehicle(s) and storage tank(s) etc. depending on circumstances.
- If power augmentation fluids or oils were provided, four samples of the fluid and/or oil should be obtained. The sample containers, tin for oil and epoxy-lined tin for power augmentation fluid, should be properly flushed before obtaining sample. The sample sizes should be as follows:
    - Oil: 2 litres each
    - Power augmentation: 1 litre each

See above for sampling.

Seal all samples in the presence of the representative of the airline concerned. Attach a tag to each container with the following information:

- name of airline representative
- signature of airline representative
- airline involved
- date and location where sample taken
- product grade
- vehicle or storage tank number and sampling point (filter or tank drain line) etc.

Chapter 7

Documentation

Details of all fuelling vehicles shall be recorded (Appendix A8).

The results of all checks and testing shall be recorded on documents that are readily available, kept up-to-date and retained for a minimum of 1 year. Records may be held on computers provided that a secure back-up system (at least weekly) is in place. The records shall include, but not be limited to, the following:

- quality control
- maintenance
- accidents/incidents.

Note: All mandatory checks detailed in this standard shall be recorded.

7.1 Records – quality control

7.1.1 Daily water drain record.

7.1.2 Filter membrane test results including membranes.

7.1.3 Fuel sample records.

7.1.4 Filtration equipment – differential pressure record and graphs.

7.1.5 Change of fuel grade – selective settings check record.

7.2 Records – maintenance

7.2.1 Logbook to record work carried out on each item of equipment.

7.2.2 Mobile equipment serviceability checks.

7.2.3 Hose stowage/brake interlocks.

7.2.4 Emergency/Engine Stops

7.2.5 Pressure/surge control systems and deadman checks (Appendix A15).

7.2.6 Hose inspection and testing (Appendix A13).

7.2.7 Meter test record.

7.2.8 Pressure and vacuum gauge test record.

7.2.9 Coupler inspection and repair record.

7.2.10 Nozzle inspection and repair record.

7.2.11 Fueller tank inspection and cleaning record.

7.2.12 Filtration equipment – inspection and maintenance records (Appendix A6.4 and Appendix A7).

7.2.13 Hose-end strainers inspection/replacement record.

7.2.14 Fire extinguisher check record.

7.2.15 Equipment calibration programme (Appendix A16).

7.3 Records – accident/incident

A detailed record of accidents/incidents should be maintained for at least 5 years.

7.4 Signature/filing

All records should be signed by the person who carried out the checks. For computer-generated records, a password-protected access system, traceable to the individual person, is acceptable as an alternative to a signature.

7.5 Document retention requirements

Aviation quality control documents shall be kept for certain minimum periods to provide adequate history and reference. The following guidelines below indicate minimum retention times, but local regulations or external quality assurance requirements may require longer retention periods. Records of all daily, weekly and monthly checks shall be retained for at least 1 year. Records of all less frequent routine checks, filter membrane test results and logbooks on all non-routine matters shall be retained for at least 3 years.

The following document retention requirements shall apply.

- Mobile fuelling equipment quality control records – 12 months from last dated record.
- Laboratory quality control and product testing records and laboratory certificates – 7 years.
- JIG inspections – 3 years or until all recommendations have been closed out if longer.
- Filtration differential pressure and filter membrane test records – a minimum of either 3 years or current and previous change-out if longer.
- Depot design, modification and major maintenance – life of depot + 10 years.
- Underground pipeline design, modification and testing records – life of installation + 10 years.
- Vehicle chassis design, modification and major maintenance – life of vehicle.

Chapter 8

Health, safety, security, environment, training and emergency procedures

Any operating entity handling aviation fuels is expected to implement and maintain an HSSE Management System that seeks to proactively improve HSSE performance in preventing injury, ill-health, environmental and security impacts.

The JIG HSSE Management System Standard describes the minimum expectations with which HSSE systems shall be managed. Entities that operate to the JIG Standards are expected to meet the requirements of the JIG HSSE MS and regulatory requirements.

Locations inspected in accordance with the JIG Inspection Programme shall be externally audited against the standard at least every 3 years.

Appendices

Appendix A1	Summary of routine test frequencies
Appendix A2	Variance Approval Certificate
Appendix A3	PPE requirements
Appendix A4	Lost time incident form
Appendix A5	Soak testing procedures
Appendix A6	Filtration equipment – routine maintenance and checks
Appendix A7	Filtration details
Appendix A8	Fuelling vehicle details
Appendix A9	Hydrant connection and disconnection sequences
Appendix A10	Fuel Grade Confirmation
Appendix A11	IATA levels of service
Appendix A12	Jet fuel Request for Defuel form
Appendix A13	Hose inspection and testing procedures
Appendix A14	Example of a stand plan
Appendix A15	Pressure control systems and deadman control valves
Appendix A16	Equipment calibration programme
Appendix A17	JIG Joint Ventures and locations on the JIG Inspection Programme

Appendix A1: Summary of routine test frequencies

	TEST FREQUENCY						
Fuelling vehicles	**Daily**	**Weekly**	**Monthly**	**3-monthly**	**6-monthly**	**Other**	**Reference**
FWS Water Detection device				x		Yearly	3.1.4
Interlock override seals	x						4.4
Interlock function, override switch and warning lights	x	x					4.4
Engine Emergency Stops			x				4.4
Bonding wires	x	x					4.5
Deadman override seals	x						4.7.4
Deadman performance			x	x		Yearly	4.7.1 4.7.2 A15.7
Pressure/surge control test				x			4.7.1
Aviation hoses and hoses integral on fuelling steps	x		x		x		4.8.4 A13
Aviation hose flush 2x hose contents Overwing fuelling hose Underwing fuelling hose		 x	 x				4.8.3
Hose-end strainers			x				4.16
Bulk meters					x		4.9.1
Master meters						3 years	4.9.1
Critical pressure gauges					x		4.10.1
Master pressure gauges						3 years	4.10.2
Piston differential pressure gauges and switches (where fitted)					x		4.10.3 3.1.4 c
Programmable Logic Systems						Per Manuf	4.10.4
Elevating platform lowering			x				4.11
Elevating platform wand sensors			x				4.11
Hydrant pit coupler wear check						Yearly	4.12
Fueller tank low point draining	x						5.2.1
Fueller tank (not Avgas) and fueller vents/manlids inspection						Yearly	4.14
Fueller roof area water drains			x				4.14
Fuellers routinely used for defuelling Assay test					x		5.9
Product recovery tanks				x			4.15
Fueller high level cut-off devices				x		Yearly high/high wet test	4.17
Hydrometers and thermometers Resistance temperature devices					x		4.19
Electronic densitometers					x		4.19
Fire extinguishers			x			Yearly	4.20
Electrical equipment						Yearly	4.21
Conductivity meters						3 years	4.22
Torque wrench						5 years	4.22
Continuity meters						Per Manuf	4.22
Defuel vehicles – isolation valves					x		4.23
Fuelling steps and ladders	x			x			4.24
Lanyards on reel (isolation check)		x					3.3.2
Filter vessel air eliminators						Yearly	A6.1
Pressure relief valves						Yearly	A6.1
Filter draining	x						A6.2.1
Filter differential pressure	x						A6.2.2
Filter dP graphs		x					A6.2.2
Filter membrane colorimetric test			x				A6.2.3
Double membrane or gravimetric					x		A6.2.3
Filter internal inspection						Yearly	A6.2.4
Filter water slug checks				x			A6.2.6
Micro filters						3 years	A6.3.1
Coalescer element change						3 years	A6.3.2
Monitor element change						Yearly	A6.3.4
Flexible joints					x		A13.5

Appendix A2: Variance Approval Certificate

Requested by:		**Position:**		**Operating company:**	
Phone:		**Email:**			
Shareholders:		**Users/throughputters:**			
Variance title: (Brief description of the Variance)					
JIG Standards reference affected: (JIG Standard – JIG 1, 2 – and relevant section numbers)					
Comprehensive details of deviation from the JIG Standards referenced above: (Attach any additional documents/photos)					
Risk mitigation action during variance: (Detail additional actions to ensure risk from the variance is mitigated)				**Target completion date:**	**Actual completion date:**
Rectification action: (Detail future actions that will be taken to ensure variance closure and withdrawal)				**Target completion date:**	**Actual completion date:**
Variance expiry: (based on maximum time permitted to complete rectification actions)					**Date:**

Name:	**Variance approval by location management (eg. Chairman of Board/Management Committee)** Any conditions of approval:	**Approval date:**
Name:	**Local review comments:** (review at least annually) Detail additional mitigation and/or rectification actions if required	**Review date:**
Name:	**Variance closure comments** (all rectification actions completed)	**Closure date:**

Variance review by Technical Authority Detail additional mitigation and/or rectification actions if required			
Company name:	**Reviewed by:**	**Company name:**	**Reviewed by:**
Variance Number: **Operation name:**		**Technical Authority Review date:** (3-yearly)	

Appendix A3: PPE requirements

It is important from a health and safety perspective that site-specific risks are identified and the correct PPE is identified, provided maintained and used – this is normally a legal requirement.

JIG has identified minimum requirements for PPE to be worn in routine operational situations, recognising that site-specific requirements may be more stringent, taking into account local legislation, airport authority requirements and local safety committee recommendations.

Activities controlled under Control of Work systems which require an activity specific risk assessment and the provision of specific PPE for that non-routine activity are not considered in the minimum requirements.

The following table represents the minimum JIG PPE requirements expected for operators on any JIG site. Visitors are covered under Note 10 below.

	Uniform/ overalls (note 1)	**Safety boots (note 2)**	**Gloves (note 3)**	**Hearing protection (note 4)**	**Eye protection (note 5)**	**Bump cap (note 6)**	**Safety helmet (note 7)**	**High visibility clothing (note 8)**
Tank farm	Y	Y	Risk based	Risk based	Y	Risk based	Risk based	Risk based
Fueller loading	Y	Y	Y	Risk based	Y	Risk based	N	Risk based
Apron	Y	Y	Y (outside fuelling vehicle)	Y (outside fuelling vehicle)	Y (outside fuelling vehicle)	Y	N	Y
Workshop	Y	Y	Risk based	Risk based	Y	Risk based	N	Risk based

Notes: "Y" = expected

"Risk based" recognises that operations risk and exposures may vary between sites. Each site should assess the specific risks on site and specify minimum requirements appropriate to the activity and risk.

Minimum PPE requirements:

1. **Uniforms/overalls** should have good anti-static properties e.g. be more than 50% natural fibres.
2. **Safety boots** should have ankle support, oil resistant soles and uppers, toe protection and be anti-static/static dissipative.
3. **Gloves** should be appropriate to the tasks being performed. Appropriate barrier creams are to be worn at all times when gloves are not worn and the operator is exposed to skin hazards.
4. **Hearing protection** should be appropriate to the noise levels in the work area. Ear protectors are required for air-operated tools.
5. The primary purpose of **eye protection** is to prevent hydrocarbon product entering the eyes. A secondary benefit is to prevent grit/dirt entering the eye. Local climatic conditions may affect site-specific requirements.
6. **Bump caps** are designed to prevent minor bumps/bangs causing bruising or laceration to the head. They normally consist of a baseball cap with a plastic insert.
7. **Safety helmets** are "hard hats" worn to prevent severe head trauma due to falling objects. They shall be worn where that risk exists, which is normally within tank farms with overhead walkways/ladders.
8. **High visibility clothing** shall comply with local legal and civil aviation requirements. To minimise the risk of a static discharge, high visibility clothing shall have good anti-static properties where required (e.g. in Europe, certified to EN 1149-3 or equivalent). Avoid loose fitting/ flapping high visibility clothing.
9. **Workshops** often contain hazards that may require additional PPE rules due to the nature of the tasks being performed. For example, loose clothing should not be worn when working with rotating equipment, and goggles rather than safety glasses should be worn when operating grinding wheels. Additional PPE controls may also be required for certain tasks.
10. **Visitors** are required to wear the appropriate PPE for the area they are visiting, subject to any risk based deviations authorised by the site manager e.g. safety shoes are allowed in place of safety boots if the visitor is not exposed to foot damage risks or not climbing in/out of vehicles.
11. All personnel shall obey any mandatory **PPE signs** in special areas such as compressor or plant rooms.

Appendix A4: Lost time incident report

A lost time incident (LTI) is defined as a work related incident resulting in a member of the workforce not being available for work on the next calendar day, whether they were due to work it or not. Details of injuries to personnel while on duty shall be recorded and investigated (see JIG HSSE-MS Standard). This form may be used for this purpose.

Location	
Date and time of incident	
Description of incident Include timings and details of people involved	
Investigation Analysis of incident	
Cause of incident	
Potential consequences Future/long-term effect of injury	
Corrective action taken	
Recommendations To reduce the risk of future similar incidents	
Report prepared by	**Date**
Report reviewed by	**Date**
Incident closed out Recommendations implemented	**Date**
Total LTI days lost	

Appendix A5: Soak testing procedures

A5.1 General

Soak testing shall be carried out after construction work or repairs on fuel systems and vehicles to ensure that there are no potential contaminants present in the form of solvents from coatings/linings, welding flux, valve grease or other general debris. Soak testing is necessary even if the systems are constructed of aluminium or stainless steel.

A soak test consists of filling the system being commissioned with the appropriate fuel grade and leaving it to stand for a soak period. A retention sample of the fuel used is taken before filling, as a control. At the end of the soak period, fuel samples are taken from the system being commissioned and submitted for laboratory testing. Test results are compared to the fuel specification limits and to the original certification or recertification test report to look for differences and to establish whether the system is suitable for use. If there is any doubt that the test certificate results are representative of the fuel used, it is recommended that the retention (pre-soak) sample is analysed in parallel with the post-soak sample.

A5.2 Application of soak testing

A5.2.1 New systems and equipment

Site-specific soak test plans should be reviewed and approved by the technical representatives of the operation before commissioning begins.

Once the system has been filled with the correct grade of fuel, all components in the system that contain moving parts in contact with the fuel should be exercised to help "wash out" any contaminants, for instance by opening and closing each valve a few times.

A5.2.2 New fuelling vehicles

New vehicles are sometimes delivered with the remains of product, used by the supplier for performance testing, trapped in the fuel circuit together with small amounts of debris. Vehicle manufacturers should use filtered kerosene for this purpose but airport operators shall assume that any product remaining in the vehicle is contaminated. It is important that pockets of test fuels are thoroughly drained to the point that the internal surfaces contain no more than a wet film of product. Ideally they should be completely dry before filling with the appropriate grade of fuel for the soak test.

The requirement to soak test new vehicles can be eliminated if the manufacturer provides evidence that the vehicle has successfully passed a soak test in line with these requirements before delivery. However, if the condition of the vehicle indicates possible contamination upon initial inspection, then a soak test shall be carried out before placing the vehicle into service.

A5.2.3 Existing systems and equipment

Soak testing is applicable following repair work or modifications to existing systems. As a general rule, if new lining material is applied to an existing tank or pipe then soak testing shall be undertaken if the new lining material covers more than 5% of the coated surface area of the tank or surface area of existing piping. This is a general rule and the company may agree different criteria depending on local circumstances. Each entity (tank or pipework) shall be treated as a separate element for the purposes of defining the percentage area. Minor spot repairs to internal tank lining can be recommissioned after a field cure test without soak testing.

Replacement or repaired equipment (pumps, filter vessels, valves etc.) does not generally require soak testing before use because of the small internal fuel-wetted surface areas compared to the total system. However, some equipment (e.g. fuel pumps) may be stored and shipped with preservative oil or lined with a rust inhibitor to prevent corrosion. Small amounts of these materials can result in the contamination of large volumes of fuel. Confirmation that no undesirable materials are present on the internal surfaces, which come in contact with the fuel, shall be obtained from the equipment supplier or repairing service before installation.

Fuelling vehicles arriving at an airport location that are without records, have been through a contractor repair facility involving fuel system repairs and vehicles that have been out of service for an extended period shall be treated as new equipment and soak tested accordingly.

A5.3 Soak test procedures

A5.3.1 Soak periods

Tanks, pipelines and ancillary equipment

Due to the stringent test requirements contained in *EI 1541 Standard, Performance Requirements for Protective Coating Systems used in Aviation Storage Tanks and Piping*, there is little risk of fuel contamination from a lining meeting these requirements if the lining is properly applied and allowed to fully cure as per the manufacturer's recommendations. Other contaminants that may be present, such as rolling oils, welding flux or valve grease, will dissolve into the fuel rapidly or may be removed by flushing and draining of the system or by filtration.

To ensure sufficient contact time is achieved, a minimum 4 day and maximum 7 day soak period shall be allowed after construction work or major repairs to a fuel system provided that the lining used meets the following criteria:

- The lining meets the performance requirements specified in EI 1541.
- The lining is properly applied and allowed to fully cure as per the manufacturer's recommendations.
- The lining is covered by a 10-year application and material warranty.

If the lining material has not been successfully evaluated to meet the requirements of EI 1541 and/or is not covered by a 10-year application and material warranty, additional soak times and sampling and testing shall be applied to demonstrate suitability. The soak time shall be agreed by the company management represented at the location where the work is to be performed.

Vehicles

For fuellers and hydrant servicers with tanks and piping of aluminium or stainless steel, the product shall be left after circulation to soak for at least 1 hour before representative samples are taken and subjected to laboratory testing. During this test period, all product used for soaking and flushed through a hydrant servicer into storage or circulated through a fueller shall be quarantined awaiting the laboratory test results.

Hoses

New aircraft fuelling hoses (meeting EI 1529 or ISO 1825) shall:

A: Be filled with product and left to soak for a minimum of eight hours at a temperature of 15°C or higher. Longer soak times are required where product temperatures are lower.

B: A sample shall be taken of the soaked product and subjected to an appearance check. Product used for hose soaking shall not be used as aviation fuel and shall be downgraded.

C: If the appearance check shows no evidence of manufacturing residue or discolouration then the hose shall be flushed with at least twice the hose content followed by an inspection of the hose-end strainer.

D: If the appearance check is unsatisfactory then steps A, B and C shall be repeated.

Soak testing is not required for suction hoses and hose assemblies for road or rail delivery.

A5.3.2 Soak quantities

The general principle is to maximise contact of the fuel with the surface area of the system under test. In most cases this means filling the system with a large quantity of fuel. Although increasing the fuel volume could result in a large amount of contaminated product, it offers the best assessment of the fuel system.

Pipelines and fuelling hoses

Pipelines and hoses shall be filled completely.

Vehicles

Filling vehicles completely is recommended for soak testing. However, as a minimum, the level shall be sufficient to cover the inlet and outlet foot valves to allow for circulation of product through the entire fuel circuit, e.g. piping, filter vessel, hose reel, valves and meters, without pump cavitation. Vehicles should be driven (stop/start) to promote movement of the product in the tank to wash off any contaminants from the tank walls before circulation of product.

A5.4 Sampling and testing procedures

At the end of the soak period representative samples shall be obtained from appropriate locations as outlined below and submitted for laboratory testing.

Pipework

Small piping configurations that can be circulated into a tank may be tested as part of the tank soak test and not sampled/tested separately.

Sampling – general

In all cases it is important to ensure that the sampling point is clean and flushed before taking the sample. Any accumulated solid matter (particulate) and/or free water should be removed until the fuel is clear and bright. Only approved sample containers shall be used and the container shall be flushed and rinsed thoroughly with the product to be sampled and allowed to drain before use. This is very important because sampling lines on tanks may be forgotten in the commissioning.

At the end of the soak period a representative sample is taken from the fuel system and a selection of laboratory tests are carried out to determine the quality of the fuel used in the soak test. The fuel properties tested shall be compared with the specification limits for the grade of fuel used and with the pre-soak test results for the fuel used (either from the original batch certificate or from testing a pre-soak sample). A successful result requires that all tested properties are within the specification limits and within the tolerance limits established for recertification. If any test result does not fully comply with the applicable specification or falls outside the allowable variances, the product shall be re-sampled and re-tested. If the fuel is found to be unsuitable for use, then the reason shall be investigated and the fuel removed and downgraded to non-aviation use, the system re-filled with on-specification fuel and the soak test repeated until a satisfactory result is obtained.

The laboratory tests are shown in the table below.

	Jet fuels	Avgas	Test method	
			ASTM	IP
Appearance	X	X	D4176	
Existent gum	X	X	D381	540
Water reaction		X	D1094	289
MSEP	X		D3948	
Conductivity	X		D2624	274
Saybolt colour	X		D156	
Thermal stability (JFTOT) *	X		D3241	323
Distillation **	X	X	D86	123
Flash point	X		D56	170

* It is recommended that the thermal stability of the fuel used for soak testing has a break point of at least 275°C to allow for test precision.

** Distillation by simulated distillation (ie IP406/ASTM D2887) is preferred because this test is more sensitive to residues/contamination.

The following table and accompanying notes provide a summary of the soak test requirements for storage tanks, piping, ancillary equipment and vehicles.

	Vehicle storage tanks **(Note 3)**		Vehicle ancillary equipment		Pipelines
	Fully lined	Aluminium or stainless steel	Pumps, valves, meters etc.	Filter vessels	Fueller loading systems
Duration	4-7 days **(Note 1)**	1 hour	**(Note 2)**		4-7 days
Minimum fuel volume	Enough product to cover the suction and the inlet connection to allow circulation of product without pump cavitation	See section A5.3.2			Fill lines completely
Laboratory testing	**Jet fuel**: Appearance, Existent Gum, MSEP, Conductivity, Saybolt Colour, JFTOT, Distillation and Flash Point **Avgas**: Appearance, Existent Gum, Water Reaction and Distillation				
Sample volume	**Jet fuel**: 4 litres or 1 USG **Avgas**: 4 litres or 1 USG (20 litres or 5 USG required for a full specification test)				

Note 1: Applies to lining material meeting EI 1541 and covered by a 10 year joint material and applications warranty from the manufacturer.

Note 2: Newly installed ancillary equipment (e.g. pumps, filter vessels, valves, pit valves, control valves, meters, sense tubing, water drain lines, etc) should be soak-tested during the vehicle system soak test.

Note 3: New vehicles delivered directly from the manufacturer or vehicles arriving at an airfield location without records or after repairs at a contractor facility or vehicles that have been out of service for an extended period.

Appendix A6: Filtration equipment – routine maintenance checks

A6.1 General

All filter and strainer vessels shall have a drain connection at the lowest point of each chamber. The main sump drain line shall be fitted with a sample valve to facilitate regular checks. All drain and sample lines should have self-closing valves (e.g. spring loaded valves).

All filters shall be equipped with direct reading differential pressure gauges to indicate the pressure loss across the unit. These shall be checked every 6 months (see section 4.10.3) and serviced in accordance with the manufacturer's recommendations.

All filters shall be fitted with air eliminators at the highest point in the filter vessel, and thermal pressure relief valves. Air eliminators shall be inspected annually for proper functioning of the air release mechanism or whenever the filter/separator is opened up, following the procedures outlined in the manufacturer's manuals. Air eliminators that cannot be inspected, e.g. types of welded construction, shall have a visual flow indicator device installed to indicate correct operation. Thermal relief valves are set at a predetermined setting that shall be tested in accordance with the manufacturer's recommendations but at least annually.

Air eliminators and thermal relief valves shall be fitted with outlet pipework routed to suitable spill containment. Isolation valves, where fitted, shall be sealed in the open position.

All filters shall have a plate confirming compliance with the relevant specification and showing the correct designation of the elements installed. The dates of internal inspection and element changes shall be marked on the body of the vessel.

The maximum achievable flow rate through each filter vessel in fuelling service shall be calculated and compared to the rated flow as shown on the manufacturer's plate. The maximum achievable flow rate shall be marked on the vessel or a suitable area close to the vessel and noted in the filter records. If the rated flow is significantly greater than maximum achievable flow then the possibility of de-rating the vessel shall be discussed with the manufacturer.

Stacked elements are no longer acceptable. Where stacked elements are being used, the stacked elements shall be replaced by full-length single elements at the next internal inspection. This applies to all element types (monitors, coalescers, separators and microfilters).

New filter elements shall be stored in the manufacturer's original packaging in a cool dry place. Elements shall be used on a first-in first-out basis and subject to the manufacturer's recommended maximum shelf life.

All filter water separators shall have similarity certificates in accordance with EI 1582 confirming compliance of the installed elements and vessel to EI 1581.

Additional information on aviation filters can be found in EI 1550.

A6.2 Routine checks on all filters

A6.2.1 Daily, at the start of the morning shift, 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 (loading filters and vehicle filters.)

A6.2.2 During each pumping/fuelling operation, the differential pressure (dP) gauge shall be observed and the dP and flow rate shall be recorded during every underwing pressure fuelling.

At least daily, the differential pressure and flow rate shall be recorded for every vehicle in service and the records checked to ensure that the dP at maximum achievable flow rate for the vehicle does not exceed the limits of 22 psi for monitors and 15 psi for filter separators.

Weekly graphs of dP shall be prepared, corrected to, or recorded at, maximum achievable flow rate. The correction to maximum achievable flow shall be established by using a conversion graph, table or calculator supplied or endorsed by the filter manufacturer.

The conversion from observed dP to corrected dP at maximum achievable flow is not accurate when dP readings are taken at low flow rates and is not valid where a reading is taken at less than 50% of rated flow. For this reason, dP readings used for the preparation of weekly graphs should be recorded when the filter is operating at, or as close as possible to, maximum achievable flow.

If the corrected dP is 5 psi or more below the previous corrected dP reading, an investigation shall be conducted and the filter vessel should be opened for inspection and elements replaced if necessary.

A6.2.3 Samples for filter membrane testing shall be taken from the downstream side of the filter.

Filters on vehicles supplying Jet fuel shall be checked by filter membrane testing. A colorimetric test shall be carried out on each vehicle monthly and after changing filter elements.

Either a double membrane colorimetric test or a gravimetric test shall also be carried out on each vehicle at least every 6 months, with tests staggered over the year. Unless routine gravimetric testing is required by the company, double membrane colorimetric testing may be carried out as an alternative to gravimetrics provided that fuelling equipment meets the filtration requirements of section 3.1.4, that the airport depot receipt and delivery filtration meets EI 1581 requirements and that airport depot tankage meets the design requirements of section 3.2 of the Standards for Airport Depots and .

The tests may be carried out on the test rig using a sample point at the hose end or a sample point on the rig, immediately downstream of the delivery nozzle. The tests may also be carried out during aircraft fuelling using a sample point in the vehicle pipework, downstream of the filter.

If the test results are unsatisfactory (see A6.7) 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 the colorimetric membranes retained for 3 years.

A6.2.4 Every 12 months all filters shall be opened and inspected internally for cleanliness of vessel, element appearance, proper fitting of elements and condition of internal lining and cover seal. The cover seal shall be replaced after a maximum of three compressions. The tightness of coalescer and separator elements (and other elements where appropriate) shall be checked with a calibrated torque wrench that positively confirms torque setting (click stop type) and adjusted in accordance with the element manufacturer's recommendations. Elements found to be damaged or showing signs of microbiological growth (such as leopard spotting) or surfactant contamination shall be investigated and shall be replaced if growth/contamination is confirmed. Teflon-coated and synthetic separator elements shall be inspected and tested in accordance with the manufacturer's recommendations.

If blanking plates/ elements have been fitted to reduce flow, these shall be checked in accordance with the manufacturer's recommendations at least annually for correct fit/torque and absence of leakage/ bypass.

The results of the inspection shall be recorded.

After opening for inspection or filter element change-out, procedures should ensure that the vessel is refilled very slowly to allow entrapped air to vent and to ensure that no damage is caused to the installed elements.

A6.2.5 Additional filter inspections may be necessary, to check for element seal leakage, etc., if abnormal amounts of solids or water are found downstream of the filter.

A6.2.6 The function of water slug detection devices (where fitted to filter vessels) shall be checked at least quarterly in accordance with manufacturers' recommendations.

A6.3 Element change criteria

A6.3.1 Micro-filters (MF)

MF elements shall be replaced:

- if the differential pressure reaches the manufacturer's recommended maximum at (or corrected to) the maximum achievable flow rate through the filter vessel as currently installed. The maximum achievable flow rate will usually be less than the design or rated flow of the vessel
- if flow rate falls to unacceptably low levels
- if filter membrane tests are carried out and abnormal results are obtained (see 2.3.3 (e))
- if unusual sediment is found downstream of the filter
- if there is a sudden drop in differential pressure without any obvious cause being found
- after 3 years.

A6.3.2 FWS coalescer elements (first stage)

Coalescer elements shall be replaced:

- if the differential pressure reaches 15 psi (1.0 bar) at (or corrected to) the maximum achievable flow rate through the filter vessel as currently installed. The maximum achievable flow rate will usually be less than the design or rated flow of the vessel
- if filter membrane tests are carried out and abnormal results are obtained (see 2.3.3 (e))
- if there is a sudden drop in differential pressure without any obvious cause being found

- if unusual sediment or traces of free water are found downstream of filter
- after a maximum of 3 years. It is not mandatory to perform routine single element tests. However, if a test is carried out and the element fails, all the coalescer elements in the vessel shall be replaced.

A6.3.3 FWS separator elements (second stage)

Teflon-coated and synthetic elements shall be:

- inspected and tested annually in accordance with the manufacturer's recommendations and/or when coalescer elements are changed
- changed if washing in accordance with the manufacturer's instructions fails to restore them.

Note: The separator(s) needs to be completely wet with aviation fuel to perform a valid test. Ideally, the test should be performed immediately after removing the element(s) from the vessel.

A6.3.4 Monitor type elements

Monitor type elements shall be replaced:

- if the differential pressure reaches 22 psi (1.5 bar) at (or corrected to) the maximum achievable flow rate through the filter vessel as currently installed. The maximum achievable flow rate will usually be less than the design or rated flow of the vessel
- if flow rate falls to an unacceptably low level
- if filter membrane tests are carried out and abnormal results are obtained (see 2.3.3 (e))
- if unusual sediment or more than a trace of free water is found downstream of the vessel
- if there is a sudden drop in differential pressure without any obvious cause being found
- after a maximum service life of 12 months.

A6.3.5 General

When new elements have been installed in fuellers and hydrant servicers, approximately 4,500 litres of product shall be circulated through the unit, preferably back to storage, at maximum flow to remove small fibres, etc., before the unit is returned to service.

A6.4 Records

A6.4.1 Records shall be kept of:

- all daily drainings
- differential pressure readings and weekly graphs.

A6.4.2 A record 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

- reason for change and any relevant details.

An example of a suitable form is included as Appendix A7.

A6.5 Gauze strainers

All fine mesh strainers used for product quality purposes shall be drained, opened and cleaned at least every month. Other strainers (e.g. pump protection) shall be checked annually for cleanliness and damage to the strainer mesh.

A6.6 Differential pressure gauges

All differential pressure gauges shall be tested as per the requirements of 4.10.

A6.7 Filter membrane monitoring – Jet fuels

Membrane preparation, testing and final evaluation should be in accordance with the ASTM D2276/IP 216 Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling. 5-litre samples shall be taken for all tests.

A record shall be maintained, showing clearly the month-by-month test results for each filter. In addition, the exposed colorimetric test membranes shall be retained. All results shall be checked and compared carefully with previous values, and appropriate action taken if high dirt levels are indicated (see below).

The test should be carried out with the unit on test delivering at a steady flow rate via suitable test facilities (example – see Figure 15.1 or 15.2) back into bulk storage, or alternatively into another fueller or trailer. The flow rate should be at least 50% of the rated flow of the equipment. These tests are normally performed via a test rig but may also be performed during fuelling.

A6.7.1 Colorimetric test

Test monitors containing one unweighed membrane shall be used. These may be prepared at the airport.

After test, the wet exposed membranes should be colour rated against the ASTM Colour Standards in the recommended manner. They should then be 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. Typically the ratings are one or two points lower after drying (although exceptionally the difference between wet and dry ratings may exceed 2). If a value of 4 (dry) or more, or an increase of 2 (dry) above the previous month's colour rating is obtained, a double membrane colorimetric membrane test should be performed as a first step in an investigation.

To provide a visual record of any changes in fuel quality, the used membranes should be retained for a minimum of 3 years.

A6.7.2 Double membrane colorimetric test

Test monitors containing two unweighed membranes shall be used. These may be prepared at the airport. 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. To provide a visual record of any changes in fuel quality, both used membranes should be retained for a minimum of 3 years.

Colour ratings shall be assessed as follows:

If the difference between the rating of the upper and lower membranes is 3 (dry) or more, the fuel may not be acceptable. To determine whether there is a problem, an immediate investigation, including a gravimetric filter membrane test and filter vessel inspection shall be carried out until the cause of the problem has been identified and a further double membrane or gravimetric test result is satisfactory.

A6.7.3 Gravimetric test

Test monitors containing 2 pre-weighed membranes (or a matched weight pair) shall be prepared by an approved laboratory in strict accordance with the recommended procedure and sent to the airport.

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 0.20mg/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.

Appendix A7: Filtration details

The following details shall be recorded and kept up to date.

Type (MF/FWS/Monitor)

Location	
Filter no.	
Vessel - make - model - rated flow	
Microfilter/coalescer/monitor elements - make - model - quantity	
Separator elements - make - model - quantity	
Last change of elements - date - throughput - differential pressure	
Previous change of elements - date	
Last change of cover seal (replace every 3 compressions)	
The following details were updated On ……………(date)	
Current throughput (since last change)	
Current differential pressure	
Latest filter membrane tests - Colorimetric (wet and dry) - Gravimetric (mg/litre, into-plane)	
Other data/comments	

Appendix A8: Fuelling vehicle details

The following data shall be recorded and kept up to date.

Fuellers Fleet number Product grade	
Manufacturer/Year Chassis (R) rigid/(T) tractor Fuelling equipment Overall length/width/height (m) Low profile (LP)	
Tank Capacity (litres) No. compartments Material/internal lining Loading connections Auto overfill device(s)	
Delivery rate (litre/min) Deck hoses Reel hoses Overwing hose	
Piping material Product lines	
Copper alloys, copper plating, galvanised steel or plastic material shall not be used.	
Cargo pump Type Power unit	
Meters Reel hose right/left Deck hoses Overwing hose	
Hoses (make/grade/length/diameter) Reel hoses right/left Deck hoses Trailer connecting hose Overwing hose Hose end strainers (mesh)	
Couplers (make/type) **Underwing** **Hydrant** **trailer connection**	
Overwing nozzle (make/type)	
Bonding reels	
Emergency engine stop (position)	
Defuelling facility	

Fuelling vehicle details (continued)

Pressure regulation Primary (HEPCV) Secondary (ILPCV)	
Filtration (FWS/Monitor, make)	
Interlocks Type Acting on (brake) Override fitted	
Deadman Type (elec/pneumatic/intermittent) Override fitted?	
Platform Type (fixed/movable)	
Fire extinguishers No./size Active material	
Paint livery	

<u>Trailers</u> Fleet number Product grade	
Manufacturer/Year Capacity (litres) No. compartments Material/internal lining Low profile (LP) Auto overfill device(s)	
Piping material Product lines Copper alloys, copper plating, galvanised steel or plastic material shall not be used.	
Bonded to fueller	
Interlocks Type Acting on	
Fire extinguishers No./size Active material	
Paint livery	

Fuelling vehicle details (continued)

Hydrant servicers/carts Fleet number Product grade	
Manufacturer/Year Chassis Fuelling equipment	
Delivery rate (litre/min) Deck hoses Reel hoses	
Piping material Product lines	
Copper alloys, copper plating, galvanised steel or plastic material shall not be used.	
Meters Reel hose right/left Deck hoses Rate of flow meter	
Hoses (make/grade/length/diameter) Reel hose right/left Deck hoses Inlet hose Platform connection Hose end strainers (mesh)	
Couplers (make/type) Underwing Hydrant	
Lanyard (material)	
Bonding reels	
Emergency engine stop (position)	
Pressure regulation Primary (HEPCV) Secondary (ILPCV/hydrant Coupler/pit valve)	
Filtration (FWS/monitor, make)	
Sampling Closed sampling system Dump/recovery tank(material)	

Fuelling vehicle details (continued)

Hydrant servicers/carts (continued) **Interlocks** Type Acting on (brake) Override fitted	
Deadman Type (elec/pneumatic/intermittent) Override fitted	
Platform Type (fixed/moveable)	
Fire extinguishers No./size Active material	
Paint livery	

Extension hose (fuelling steps) rig

Fleet number

Product grade

Manufacturer/year	
Max delivery rate (litres/min)	
Piping material Copper alloys, copper plating, galvanised steel or plastic materials shall not be used.	
Couplers (make/type) Incoming Underwing	
Bonding	
Pressure regulation	
Platform Height adjusted by:	
Paint livery	

Appendix A9: Hydrant connection and disconnection sequences

Each company shall have one agreed sequence for connection and disconnection. Either of the following options is acceptable for hydrant servicer fuelling connection / disconnection sequences (see 6.5.2).

Sequence 1	**Sequence 2**
Connection – pit to aircraft	**Connection – aircraft to pit**
Bond to aircraft	Bond to aircraft
Attach lanyard, pull to ensure pit valve is closed and extend lanyard on apron	Connect delivery hose(s) to aircraft
Remove pit valve adaptor cap and clean dirt/moisture from pit valve adapter and hydrant coupler	Attach lanyard, pull to ensure pit valve is closed and extend lanyard on apron
Connect hydrant pit coupler and air line to pit valve and position pit marker	Remove pit valve adaptor cap and clean dirt/moisture from pit valve adapter and hydrant coupler
Open hydrant pit coupler	Connect hydrant pit coupler and air line to pit valve and position pit marker
Connect delivery hose(s) to aircraft	Open hydrant pit coupler
Get confirmation of fuel figure to start fuelling from airline representative	Get confirmation of fuel figure to start fuelling from airline representative
Open pit valve (if manually operated)	Open pit valve (if manually operated)
Open delivery valve and activate deadman control to start delivery	Open delivery valve and activate deadman control to start delivery
Check hydrant pit coupler for leakage	Check hydrant pit coupler for leakage
Disconnection – Aircraft to pit	
Release deadman and close delivery valve	
Pull lanyard to close pit valve (May not be required for airports which only have Dual Air/lanyard operated systems)	
Disconnect delivery hose(s) from aircraft	
Replace the aircraft fuelling adapter cap (if fitted) and close the fuelling panel.	
Close hydrant pit coupler	
Disconnect hydrant coupler (and replace pit valve adaptor cap), air line, lanyard and pit marker; and stow on vehicle	
Remove bonding cable	
Complete delivery documentation	
COMPLETE THE 360^0 WALKAROUND CHECK – REMEMBER TO LOOK UP TO AIRCRAFT COUPLINGS	

Note: If the sequence of connection and disconnection is broken due to distraction the operator shall begin the sequence again from the start.

Appendix A10: Fuel grade confirmation form

This form shall be completed before each fuelling when one of the following applies:

(Tick the box which applies)

☐ a) The aircraft is **not marked** with a fuel grade decal which clearly and without doubt corresponds with the grade of fuel marked on the fuelling vehicle, trailer or fixed (kerbside) delivery equipment.

☐ b) The fuelling nozzle spout or the aircraft fuel tank orifice **do not** correspond to the norm for the particular fuel grade, i.e. for Jet Fuel, a wide selective nozzle spout and large aircraft orifice, and for Avgas, a small circular spout and narrow aircraft orifice.

☐ c) Overwing fuelling during air-shows

TO BE COMPLETED BY AIRLINE/AIRCRAFT AUTHORISED REPRESENTATIVE

To: .... (Into-plane service)

At: ....(Airport)

Aircraft Registration Number: ....

The aviation fuel requirements for this aircraft are as follows:

	FUEL GRADE (*)	QUANTITY
JET FUEL (Jet A-1 or Jet A)		
AVGAS (AVGAS 100LL)		

(*) Write either Jet A-1, Jet A or Avgas 100LL in the appropriate box

Note: Where unleaded Avgas (UL 91) is available, the fuel grade confirmation forms shall be modified to include Unleaded Avgas as a separate grade.

I confirm that the above fuel grade is suitable for use in the aircraft referred to above

Name .... Signature..

Position .... Date............................... Time................

TO BE COMPLETED BY FUELLING OPERATOR IF JET FUEL WAS DELIVERED BY NON-SELECTIVE SPOUT

I confirm that the grade-selective spout was reattached to the nozzle after completion of fuelling

Name .... Signature................................

Appendix A11: IATA levels of service

There are four levels of into-plane fuelling service described in the IATA document, ranging from the least complex service, Level 1 requirements, to the most complex, Level 4.

LEVEL 1: MINIMUM LEVEL OF SERVICE

A. The fuelling personnel of the contracted company are to provide up-to plane service that includes:

(1) Operating a fuel vehicle, making necessary nozzle connections to fuel hydrant pit and aircraft

(2) Operating the deadman control

(3) Opening aircraft fuelling panel and removing fuelling adapter caps

(4) Providing density of fuel when requested

(5) Performing all routine fuelling activities as described in JIG 1

B. An airline authorised operator will perform all other into-plane fuelling procedures and is responsible for all fuel servicing requirements.

LEVEL 2: ROUTINE FUELLING – TOTAL FUEL REQUIRED

A. Level 2 service includes all the items listed in Level 1 plus all the items listed in the following procedures below:

(1) Obtain total fuel figure from airline representative before fuelling.

(2) Perform gauge and system tests as appropriate for aircraft type.

(3) Fuel aircraft to the total fuel requirement using the aircraft automatic fuelling mode as determined by an airline representative.

(4) Complete kilo/pounds or litre/gallons conversion, when required.

(5) Set wing panel switches and gauges and control the amount of fuel being added to the aircraft using aircraft automatic loading settings.

(6) Communicate with opposite wing fuelling operative when two fuelling vehicles are used to fuel the aircraft.

(7) Communicate with cockpit via airline representative, if required.

(8) Monitor wing panel gauges, vehicle pressure gauges and fuel tank vents for spills during fuelling.

(9) Deliver completed fuel service form (where supplied) to operations or cockpit crew.

LEVEL 3: ROUTINE FUELLING – DISTRIBUTION REQUIRED AND DISCREPANCY CHECKING

A. Level 3 service includes all the items listed in Levels 1 and 2 plus all the items listed in the following procedures below:

(1) Obtain Aircraft Refuel Sheet from airline or fuelling company representative before fuelling.

(2) Read refuel panel gauges before and after fuelling and enter readings on to Aircraft Refuel Sheet.

(3) Fuel aircraft per fuel uplift calculations as determined and entered on the Aircraft Refuel Sheet.

(4) Set refuel panel switches and gauges and control the amount of fuel being added to the aircraft using aircraft manual or automatic loading settings.

(5) When fuelling various fleet types, be qualified to interpret Fuel Manual distribution charts and follow fuel distribution procedure in accordance with the specific fleet type.

(6) Calculate fuel weight in kilos/ pounds (from density) at aircraft on designated flights using hydrometer.

(7) Calculate fuelling discrepancy and compare with maximum allowable. If it is outside limits, contact an airline authorised operator to check fuel levels as required.

LEVEL 4: NON-ROUTINE FUELLING

A. At this level of service, the fuelling personnel of the contracted fuel supplier provide full into-plane fuelling capability that includes all routine and alternate fuelling requirements for aircraft scheduled for that station.

B. Level 4 service includes all the items listed in Levels 1, 2 and 3 plus all the items listed in the following procedures below:

(1) Be qualified to interpret Fuel Manual dripstick tables and dripstick conversion charts.

(2) Operate and read measuring stick measurements to determine tank quantity:

a) When requested by the flight crews.

b) When quantity added exceeds tolerance (discrepancy).

c) For tank with an inoperative gauge.

d) To verify pre-service differences.

(3) Perform non-routine fuelling procedure when any one cockpit gauge is inoperative, using measuring sticks and fuel vehicle meter or measuring sticks and operative aircraft gauges, to provide a known quantity in the tank with the inoperative gauge.

(4) Enter cockpit when a refuel panel gauge is inoperative and direct fuelling, via headphone, using operative cockpit gauge to determine tank quantity.

(5) Perform tank-to-tank transfer or defuel aircraft using boost pumps, override pumps, and crossfeeds when required.

(6) Carry out overwing fuelling of pressure fuelled aircraft when required.

Appendix A12: Jet Fuel Request Form for Defuelling

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.

If any answer is given in a shaded cell, the defuel shall not take place without first seeking supervisory guidance. Once it is agreed that the defueling can proceed, the requirements of the JIG 1 defuelling procedure (6.6) shall be followed.

Section 1, to be completed by customer	Date *(dd-mm-yyyy)*		Time	
Airline				
Customer representative (Name)				
Department (if applicable)	Phone			
A/C type	A/C tail #		Fuel volume	

Check (☒) one of the following each question

1) To confirm fuel quality before defuelling, a satisfactory Visual Check, witnessed by the fuelling operator, has been obtained from the drain points of all aircraft tanks to be defuelled. In addition, the fuel to be defuelled is within the "negligible" range outlined in IATA's " Guidance Material on Microbiological Contamination in Aircraft Fuel Tanks" as indicated by the certified test kit results.		
☐ **Yes**	☐ No	
2) The Aircraft Logbook indicates that the fuel on board has **<u>NOT BEEN TREATED</u>** with biocide or FSII (Fuel system icing inhibitor) within the previous two (2) refuellings.		
☐ **Yes**	☐ No	
3) The defuelled fuel can be used to refuel an aircraft of this airline		
☐ **Yes**	☐ No	If no, please specify what is required?
4) The fuel uploaded at the previous two (2) locations was (specify both locations and fuel grade).		
Location 1: & Grade: ☐ JET A1 ☐ Other Specify :	Location 2: & Grade: ☐ JET A1 ☐ Other Specify :	
5) In the event that the defuelled fuel cannot be returned to the same aircraft, or other aircraft of this airline, and no other airline will accept it (written permission required) by the date given below (to be agreed with the fuelling company), the fuelling company shall agree with the airline to either store the fuel on the vehicle for a longer period or to downgrade and /or dispose of.		
Storage required ☐ Yes ☐ No	Dates from; to;	
Fuel to be downgraded ☐ Yes ☐ No	Disposal/downgrade method	

Customer name (print)	Customer signature	Date *(dd-mm-yyyy)* and location

Section 2, to be completed by the refuelling/ defuelling company on return of the defuelled fuel.

Fuel delivered to: Airline / Customer Name:			
Date: *(dd-mm-yyyy)*	Delivery Ticket No.	Date: *(dd-mm-yyyy)*	Delivery Ticket No.
Fuelling Vehicle ID:		Fuelling Vehicle ID:	

Appendix A13: Hose inspection and test procedures

A13.1 Monthly inspection

A13.1.1 Fully extend the hose and apply normal operating pressure with the delivery nozzle or coupling closed.

A13.1.2 While under pressure inspect for external damage, leakage and other signs of weakness.

The inspection (under operating pressure) of long delivery hoses should be 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.

Note: Kinking of the hose (especially repeated kinking) may damage the internal structure of the hose and should be avoided. If the internal lining in the hose becomes damaged, the fuel may travel along the carcase and appear some distance from the source of the damage.

Note: It is not necessary to remove wheel fittings and hose protection beads. However, spiral wraps shall be removed before testing or moved during the test so the full length of the hose is inspected.

A13.1.3 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.

A13.2 Pressure testing

A13.2.1 A pressure test, using a hydrostatic test pump, shall be carried out when commissioning new hoses, whenever couplings are attached or re-attached to hoses and routinely every 6 months.

Required test pressures are shown in the table below.

Pump output pressure/ hydrant inlet pressure	**6 monthly hydrostatic test/pressure.**	**Commissioning new hoses with factory fitted couplings**	**Attaching/ reattaching couplings**
Less than or equal to 5.5 bar (80psi)	No requirement	15 bar	20 bar
Greater than 5.5 bar (80psi)	15 bar test	15 bar	20 bar

A13.2.2 The test procedure is to connect fully extended hose to a suitable hydrostatic test pump and fill with the appropriate grade of fuel. It is not necessary to remove the hose from the vehicle if suitable isolating valves are provided to protect vehicle components and parts of the system not designed to accept the test pressure (*).

The hose shall be pulled out from any stowage position and be tested in a straight position without bends or kinks.

Appropriate PPE including eye protection shall be worn.

Gradually apply test pressure and bleed any trapped air from the hose and test equipment. 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 (50lbf/in^2) and examine the hose as described in A13.1.2. Finally, release pressure and drain the test pump to prevent possible contamination of product 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.

(*) If a delivery hose is tested with the hose end coupling attached, the procedure and equipment used should ensure that the full pressure is applied to the hose without damaging the internal components of the nozzle.

Note: Hose beads and spiral wraps shall be removed before testing. Wheel fittings should be removed or loosened (**) for each pressure test. As a minimum they shall be removed or loosened (**) for the test at least every two years.

(**) Where wheel fittings are loosened (but not removed from the hose) they shall be moved so that the whole length of the hose can be inspected. Wheel fittings shall be returned to their original position at the conclusion of the test.

A13.3 Damaged hoses

Any of the following abnormalities noticed during daily operations or monthly or 6 monthly tests requires immediate hose replacement:

- soft spots, kinks/deformities, bulges or blisters, excessive abrasion or cracking exposing the carcass textile reinforcement, or
- any cut in the hose structure which has damaged the carcass textile fabric, or
- if the hose has been run over by any vehicle.

However, small cuts do not justify replacement unless the rubber in the immediate area is loose and could allow liquid to enter between the cover and carcass. If the defect is close to the hose end, then it is acceptable to cut the damaged section and re-attach the couplings (see 4.8.5). A hydrostatic pressure test is required before the hose is returned to service.

A13.4 Fuelling nozzle (hose-end) strainers

Wire mesh strainers fitted to pressure couplings (underwing nozzles) and overwing nozzles shall be removed and inspected monthly. Equipment as illustrated in Figure A13.4 should be used when carrying out this procedure on pressure couplings to ensure that any contaminant that may be present is not dislodged from the strainer before examination. Damaged strainers shall be replaced. If significant particulate is found during the monthly examination, an investigation to identify the source shall be undertaken. Where the hose-end coupling has to be disassembled to remove the strainer for inspection, the integrity of the coupling shall be checked by pressurising the hose to working pressure after reassembly.

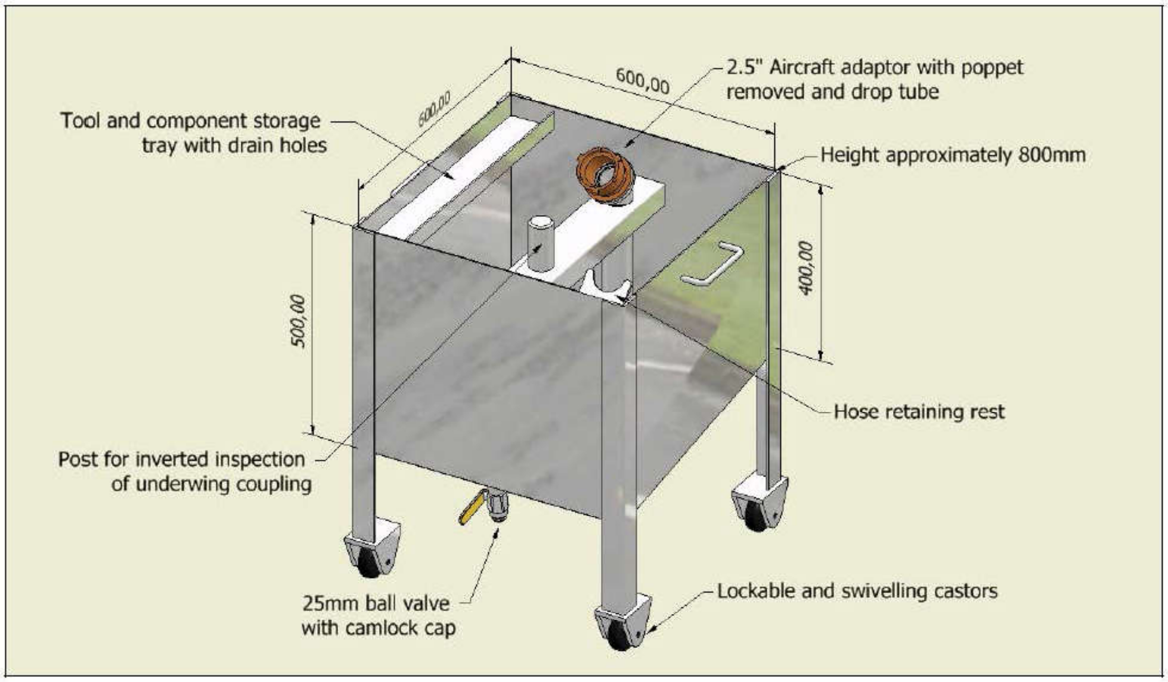
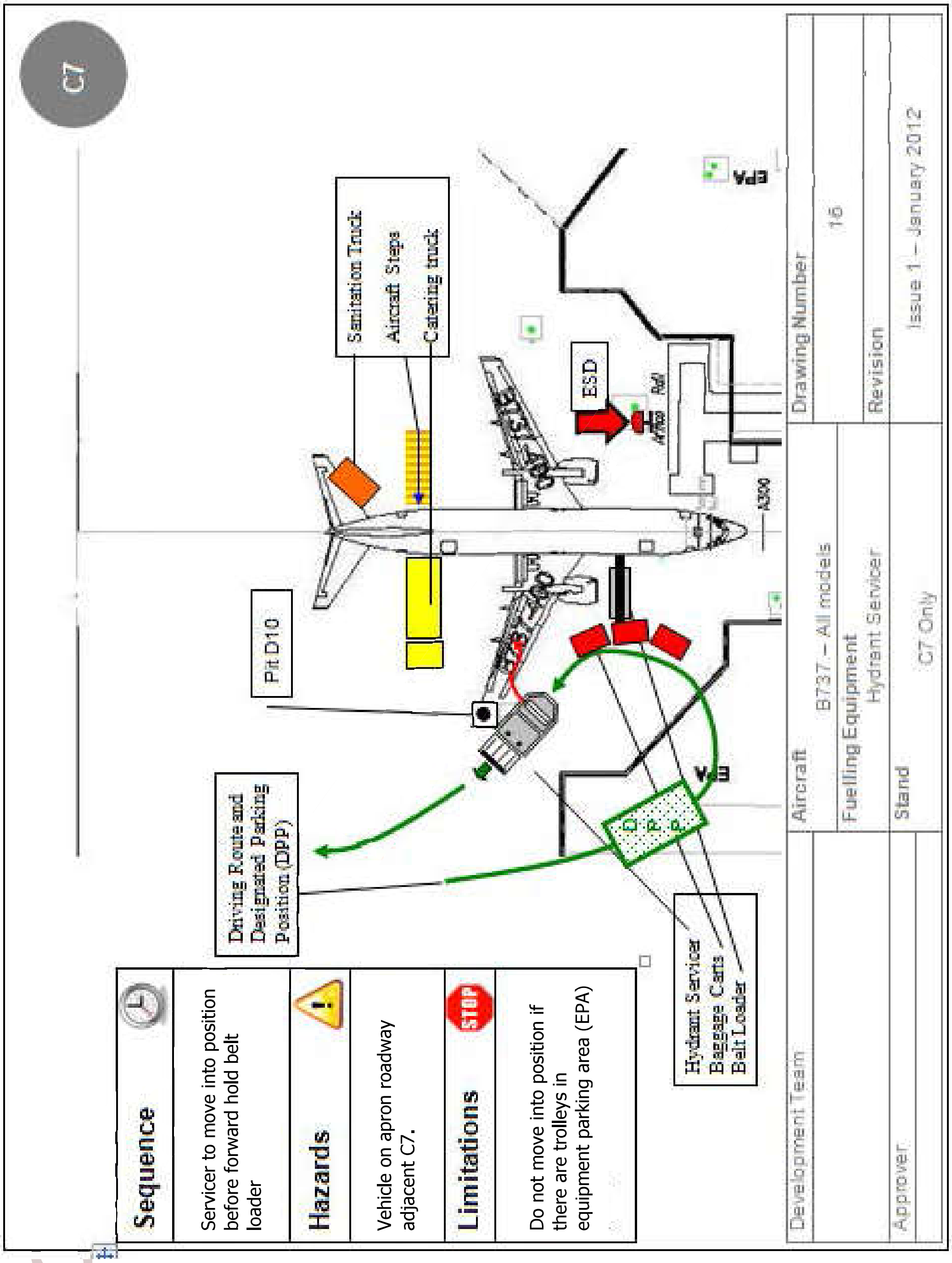


Figure A13.4 – Suitable equipment for hose-end nozzle strainer checks

A13.5 Flexible joints

The condition of flexible joints made of hose material shall be checked visually (under normal use) 6 monthly. These joints shall not be painted.

Appendix A14: Example of a stand plan



Appendix A15: Pressure control systems and deadman control valves

A15.1 Pressure control requirements

The fuel system components in aircraft are made of lightweight materials and are only able to withstand pressures up to certain limits. Generally aircraft fuelling systems are designed for flow not exceeding the maximum pressure of 3.5 bar (50 psi) in the vehicle delivery nozzle and to withstand a maximum shock or surge in the range 6.9 to 8.3 bar (100 psi to 120 psi). Since fuelling equipment may be capable of delivering fuel at much higher pressures, a reliable pressure control system is required.

Table A15.1 indicates the general pressure control requirements for commercial aircraft refuelling. The primary pressure control is specified as the hose end pressure control valve (HEPCV) and this shall meet the requirements of SAE AS 5877. This device controls pressure and also limits flow, effectively controlling surge. For commercial fuelling, all HEPCV springs shall be specified at a nominal 45psi (3.2 bar).

Pressure control component	**Maximum pressure under flow conditions psi/ bar**	**Maximum pressure under static conditions psi/ bar**	**Permitted creep 30 seconds from static shut down psi/ bar**	**Maximum surge pressure with 2 second closure psi/ bar**
Primary (HEPCV)	50 / 3.5	55 / 3.8	5 / 0.35	120 / 8.3
Secondary (ILPCV/ Pump bypass/ Second HEPCV)	55 / 3.8	60 / 4.2	5 / 0.35	Not applicable

Table A15.1 General pressure control requirements for commercial aircraft refuelling

A15.2 Introduction

The hose end pressure control valve has been shown to be both reliable and robust. A secondary control element is present to provide pressure control back-up in the event of failure in the primary system. The secondary control system may be a second hose end control unit, an in-line control valve on the vehicle or an in-line unit integrated into the inlet coupler of a hydrant servicing vehicle. The inlet coupler shall comply with EI 1584. Venturi systems are frequently fitted to vehicles to provide the secondary pressure control system with a fuel sense pressure that simulates the hose end pressure. The venturi operation is effectively checked during the secondary control valve test and only requires separate detailed testing during vehicle commissioning, equipment change or for troubleshooting secondary pressure control system defects.

Changing the pressure control systems on vehicles and static fuelling systems from the manufacturer's design requires a Variance Approval Certificate.

Vehicles are also equipped with a system to stop fuel flow quickly in an emergency using a deadman control valve. (See 3.1.13.)

A15.3 Test objectives and requirements

All the components associated with the pressure control and deadman control equipment shall be flow tested quarterly over the full range of operating flow rates for compliance with the limits in Table A15.1. The test protocol is designed to simulate specific refuelling operating conditions.

Testing shall be carried out by a trained, competent person who fully understands the operation of the pressure control valves, the purpose of the tests and the failure conditions that may occur.

If any of the test requirements cannot be met then the equipment shall not be put back into service until the problem is corrected.

The following test sequence shall be used. After the test preparation steps (A15.4) the primary (hose end) pressure control valve(s) shall be checked (A15.5), followed by the secondary (in-line) pressure control valve(s) (A15.6). The deadman control valve shall then be checked (A15.7). Finally the end of test checks (A15.8) shall be conducted before returning the vehicle to service. Where required, venturi troubleshooting tests shall be conducted (A15.9).

The highest risk test element is the surge test or 2-second closure that is performed on the primary pressure control system. It is important to avoid closure in less than 2 seconds, as this can significantly increase the surge pressure. Note that while the rapid close scenario does occur in the field, this is not frequent. If specifically requested by the company, the secondary control system surge may be evaluated using the same test protocol as detailed in the HEPCV test.

For testing a hydrant servicer a test rig is required that should simulate the conditions (pressure and flow rate) that would be experienced when actually fuelling from the airport hydrant system. This is typically between 8.3 bar (120 psi) and 10.3 bar (150 psi), but at least 80% of normal hydrant operating pressure, whichever is the lower, subject to a minimum of 4.8 bar (70 psi). The facility shall be capable of simulating both gradual and rapid termination of fuel flow and be capable of accepting simultaneous full flow deliveries from all combinations of deck and/or reel hoses likely to be used.

Pressure fluctuations from the hydrant can alter the accuracy of the pressure control test. Testing should either be scheduled when this is least likely (minimum fuelling activity) or other means established, to either warn of low pressure (i.e. pressure transducers) or maintain pressure to the test rig (manual override of hydrant pumps/separate test rig pump).

Significant back pressure on the outlet line from the test rig can also affect pressure control testing by limiting maximum achievable flow rates. High back pressures can result from pumping into nearly full tanks with a high static head, very long return lines between the test rig and the receipt tank, or small diameter return lines.

In addition, deadman overrun testing can be affected by siphoning. Where return lines are very long or routed to an underground receipt tank a suction breaker/anti-siphon device may be needed.

It is preferable to conduct pressure control testing of fuellers on a dedicated test rig where fuel can be pumped to a receipt tank. (See Figure A15.1 for an example of a suitable rig) However, fueller pressure control testing may also use a loop system discharging back into the vehicle. Where testing is performed by recirculation, this should use a dedicated inlet connection for pressure control testing, although on older vehicles the only inlet connection available may be through the loading connection. Using the loading connection will impose a slightly higher back pressure and therefore restrict maximum achievable flow rates during the test. To minimise the back pressure, testing should be conducted with the vehicle between 30 and 50% of maximum fuel load to provide a sink for the re-circulating fuel but with no risk of interference from the high level cut-off system. The pump outlet pressure should be at least 4.8 bar (70 psi) to ensure an effective test of the pressure control equipment. The vehicle manifold shall be capable of accepting the simultaneous full flow deliveries from all the combinations of deck and/or reel hoses likely to be used. This may require the use of an adapter to allow both deck hoses to be connected. (See Figure A15.2 for an example of a suitable test trolley for conducting pressure control by recirculation.)

Any repair, alteration or adjustment to the pressure control equipment, or any other changes such as the replacement or shortening of a vehicle hose, shall be followed up with a full re-test.

A15.4 Preparation

The connection and disconnection sequence of the vehicle to the test rig shall be the same as that used for connection and disconnection to aircraft by the into-plane operation.

Test rigs shall be designed to ensure that all testing shall be performed with operators at ground level while fuel is flowing and not on the vehicle fuelling platform.

The into-plane operator shall preferably supply and verify that the test rig gauge is in calibration and fit for service or shall confirm that the test rig gauge supplied by the test rig owner is in calibration and fit for service.

Before starting the test, the operator shall check the system pressure is sufficient to ensure a valid test can be run as follows:

1. Break seal/unlock and raise the air reference pressure/fuel sense on the secondary system 100 psi (or maximum setting if less).
2. Connect a single hose for product flow and block out the hose end control valve.
3. Establish maximum flow and then slowly close the test rig valve over 10 to 15 seconds. Note the pressure at zero flow.
4. The test pressure should be at least 4.8 bar (70 psi) for an optimum test of the various pressure control systems. Where 4.8 bar (70 psi) cannot be achieved then the site shall investigate before continuing with the test. Where the investigation confirms 4.8 bar (70 psi) can never be achieved then the maximum achievable pressure shall be recorded and the test performed.

When using a test rig supplied by the airport hydrant system, check the hydrant operation. Busy fuelling periods can lead to low pressure on the test rig. Manual intervention to start hydrant pumps may be needed to maintain pressure for test work. Significant reduction in available flow in the test rig during the test will require repeat testing. Consideration should be given to installing a system pressure alarm if the inlet pressure drops below minimum requirement.

If it is not possible to obtain/maintain sufficient pressure during the testing, the pressure control equipment cannot be adequately tested. (Note: For fueller vehicle checks, confirm if a pump bypass system has been fitted. This may be a third "pressure control" system and may be set too low. Fuel pump wear would also be a potential cause of low output pressure.)

The test rig pressure gauge is one of the most important pieces of equipment for the pressure control test. Digital pressure gauges or Bourdon gauges (10-15cm diameter (4-6 inch) face) filled with glycerine/silicone/oil fluids shall be used.

For vehicles fitted with electronic meter heads, there may be no separate flow rate indicator. It is important to set up the display screen so that flow rate can be observed during certain parts of the test. This may require two-man operation for some equipment designs.

The vehicle under test shall be in good condition and free from known defects before testing.

A15.5 Hose end pressure control valve test procedure – HEPCV (primary)

To test the HEPCV in isolation from the secondary pressure control system, the secondary system control range needs to be moved out of the range of the HEPCV. This is done by increasing the air reference pressure or fuel sense adjustment to the maximum setting or 6.9 bar (100 psi). Before increasing the air reference pressure the value shall be recorded for resetting after the test.

Air reference pressure can drop during testing and bring the ILPCV back into the control range; this invalidates the HEPCV test. Air reference pressure should be monitored during the test. The vehicle needs to maintain full system air pressure during the test. Any air system leaks should be corrected before the test.

There are four elements to the HEPCV test:

1. Surge control, controlled closure in 2 seconds once a small back pressure has been established by partial closure of the test rig valve until flow just starts to decrease
2. Pressure control under normal flow from maximum flow to zero during closure of the test rig valve over approximately 30 seconds
3. Static or shut-down pressure
4. Seal integrity or pressure creep after 30 seconds from shut-down

Maximum surge pressure with 2 second closure psi/ bar	**Maximum pressure under flow conditions psi/ bar**	**Maximum pressure under static conditions psi/ bar**	**Permitted creep 30 seconds from static shut down psi/ bar**
120 / 8.3	50 / 3.5	55 / 3.8	5 / 0.35

Table A15.2 HEPCV test procedure

The surge test is carried out first since this will impose the greatest stress on the HEPCV and the subsequent tests will prove that the operation of the unit has not been adversely affected.

The slow closure test is designed to check that the HEPCV is operating correctly across the range of flow. The HEPCV should control pressure smoothly during test rig valve closure. Any unusual pressure fluctuation shall be investigated. The time to close the test rig valve is approximate; it is important to monitor the test rig pressure gauge throughout the valve closure.

The HEPCV shall control the pressure such that it does not exceed 3.5bar (50 psi) except at very low flow rates (just before shut-down) where pressures between 3.5 and 3.8 bar (50 to 55 psi) are possible.

At zero flow the pressure shall not exceed 3.8 bar (55 psi). Failure to achieve the limits can be due to either a faulty spring or seal failure in the HEPCV.

The seal integrity or 'creep' test is performed by observing whether the final pressure increases after closure of the test rig valve over a 30 seconds period by more than 0.3 bar (5 psi). If this occurs, then this is an indication that the seals in the unit under test may have failed. This can be from a cut skirt seal or a failing piston seal. For new units or maintained units, repeating the creep test two or three times may help to bed the skirt seal in and allow the test to pass. Dry (overhauled) or brand new units may also need fuel wetting to help initiate the seal.

If the final observed pressure falls over the 30 seconds then the isolating valve on the test rig is not sealing; there is a system leak. Where a pressure drop is observed, the test is invalid. The cause shall be determined and corrected and then the test repeated.

At all stages check for leaks from the HEPCV and the test rig since any leakage may also invalidate the test. Leakage from the nozzle vent ports or swivel joints above a slight dampness shall require overhaul of the nozzle before the unit is returned to service. Under no circumstances shall the vent port plug be replaced by a solid plug.

A15.5.1 Dual HEPCV systems

Vehicles fitted with dual HEPCVs shall have each tested separately with the other unit deactivated using a block-out pin or by-pass connection.

A15.6 In-line pressure control valve test procedure – ILPCV check (secondary)

Air reference pressure shall be reset to the value recorded before HEPCV test (see 15.4) for this test.

There are three elements to the ILPCV test:

1. Pressure control under normal flow from maximum flow to zero during closure of the test rig valve over approximately 30 seconds
2. Static or shut-down pressure
3. Seal integrity or pressure creep after 30 seconds from shut-down.

Maximum pressure under flow conditions psi/ bar	Maximum pressure under static conditions psi/ bar	Permitted creep 30 seconds from static shut-down psi/ bar
55 / 3.8	60 / 4.2	5 / 0.35

Table A15.3 ILPCV test procedure

The ILPCV limits the delivery pressure even if the HEPCV does not function correctly. The in-line pressure control valve should be set at approximately 0.35 bar (5 psi) above the HEPCV setting, subject to a maximum of 3.8 bar (55 psi) under flow conditions for both venturi compensated systems and also for non-compensated systems.

To fully test the ILPCV, the downstream HEPCV(s) shall be blocked out/ bypassed. The hose(s) configuration should be selected that gives the highest operational flow rate for the flow circuit under test. This may include a combination of ILPCV, pump bypass and venturi.

Some vehicles may have more than one in-line pressure control valve. In this case each ILPCV shall be tested separately, with the highest operational flow rate achievable with the hose(s) controlled by each valve.

As each venturi fitted to the fuelling unit provides a separate fuel sense signal to the ILPCV, each flow circuit shall be tested to confirm compliance with the pressure limits. Thus, where a fuelling unit has three venturis, three separate ILPCV tests shall be run.

Having deactivated the HEPCVs by means of by-pass or block-out device, the ILPCV system is tested for the control of pressure in the same way as the HEPCV.

The slow closure test is designed to check that the ILPCV is operating correctly across the range of flow. The ILPCV should control pressure smoothly during test rig valve closure. Any unusual pressure fluctuation shall be investigated. The time to close the test rig valve is approximate; it is important to monitor the test rig pressure gauge throughout the valve closure.

The ILPCV shall control the pressure such that it does not exceed 3.8 bar (55 psi) except at very low flow rates (just before shut-down) where pressures between 3.8 and 4.2 bar (55 to 60 psi) are possible.

At zero flow the pressure shall not exceed 4.2 bar (60 psi). Failure to achieve these limits can be due to either a faulty spring or seal failure in the ILPCV.

The seal integrity or 'creep' test is performed by observing whether the final pressure increases after closure of the test rig valve over a 30 seconds period by more than 0.35 bar (5 psi). If this occurs, then this is an indication that the seals in the unit under test may have failed. This can be from a cut skirt seal or a failing piston seal. For new units or maintained units, repeating the creep test two or three times may help to bed the skirt seal in and allow the test to pass. Dry (overhauled) or brand new units may also need fuel wetting to help initiate the seal.

If the final observed pressure falls over the 30 seconds then the isolating valve on the test rig is not sealing there is a system leak. Where a pressure drop is observed, the test is invalid. The cause shall be determined and corrected and then the test repeated.

A15.6.1 In-line pressure control valves without pressure loss compensation (direct sensed)

JIG permits an alternative test protocol for existing non-compensated systems to permit pressure at the pump outlet or entry to the delivery hoses to be limited to a preset maximum of 5.5 bar (80psi). While this system is simple to test and adjust, it 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 the fuel sense line. The ILPCV should control pressure smoothly during test rig valve closure. Any unusual pressure fluctuation shall be investigated**.** For a non-compensated ILPCV system, the recorded pressures indicated on the fuel sense gauge should not exceed 3.8 bar (55 psi) over the full flow range and shall not exceed 5.5 bar (80 psi) at shut-down.

A15.7 Deadman check

A hose configuration shall be connected that gives the maximum operational flow rate (i.e both deck hoses on vehicles with elevating work platforms). This test checks the controlled rapid shut-down in the event of an emergency and the controlled opening of the system for fuelling. Only a maximum permitted overrun defined in the table below shall be allowed to pass following release of the deadman handle/button.

A minimum opening time is specified for the deadman system to avoid severe surge through the vehicle supply system. Historically, this has been 5 seconds minimum from the initiation of flow (as indicated by the flow meter) to the achievement of full flow. However, surge is related to the maximum fuelling flow rate and it is acceptable to allow a 3 second minimum opening time for low flow rate vehicles with a fuelling rate of less than 2000 lpm maximum.

Annually, a check shall be made to confirm the intermittent feature of the deadman initiates shut-down of the flow in less than 2 minutes.

Maximum vehicle flow rate (lpm)	Deadman opening time minimum/s	Deadman closing time range/s	Permitted maximum fuel overrun (litres)
< 2000	3	2 - 5	100
>2000 but < 4000	5	2 - 5	200
>4000	5	2- 5	5% of flow rate

Table A15.4 Deadman check

A15.8 End of test

After the end of the test a number of checks shall be performed before returning the fuelling unit to service. These checks shall be performed when the vehicle is under flow/pressure conditions.

1. Confirm air reference pressure is set correctly and re-sealed/locked, all block-out devices have been removed and all vent port plugs have been replaced.
2. The filter differential pressure under maximum flow conditions shall be recorded.
3. Confirm the filter sump is clear and bright and free of undissolved water and particulate. Run an approved chemical water test.
4. Depressurise the vehicle system and then disconnect the vehicle from the test rig (as per aircraft sequence)
5. Ensure all equipment is correctly stowed and conduct 360° walk-around before driving the vehicle away from the test facility.

A15.9 Venturi set-up and validation checks

There are different pressure control design philosophies – fully compensated, partially compensated and non-compensated. In all circumstances the equipment on the vehicle is designed to control the pressure to the aircraft. The advantage of a venturi compensated system is that it controls the in-line pressure control valve (ILPCV) more smoothly due to lower fuel sense pressure and lower air pressure requirements that are better suited to the ILPCV equipment design.

Venturi tubes (if fitted) may be used to indicate the pressure at the aircraft adapter by simulating pressure drop through the lines, hoses and nozzles downstream of the venturi position (fully compensated) or simply to provide a lower fuel sense pressure to the in-line system allowing a lower air compensation and hence a smoother operation (partially compensated).

Venturis come in two types: non-adjustable venturis and adjustable venturis. However, venturis do not generally require routine adjustment and hence this test segment does not form part of the routine quarterly check.

Venturi tubes are not subject to significant wear rates and most problems are due to blocked sense lines/sense line valves, loose component parts or changes in downstream equipment such as hose length or diameter changes, or change of nozzle or nozzle screen mesh size. Adjustment may therefore be required when downstream equipment is changed.

There are three situations where venturi checks shall be conducted:

1. Fuelling unit commissioning
2. Change of equipment downstream of venturi sense point (e.g. different hose length/ diameter, different HEPCV, different nozzle screen mesh size, etc.)
3. Failure to achieve the ILPCV pressure control limit values

Note: Where the venturi is only used to provide a lower fuel sense pressure, rather than simulating the pressure drop, no venturi gauge is needed on the fuelling panel. Where venturi adjustment is required, this may need input from the vehicle manufacturer or the technical authority for the into-plane fuelling unit.

Where the venturi simulates the pressure drop in the fuelling unit, the fuelling unit venturi panel pressure gauge shall be checked against a calibrated gauge before the start of the test.

The accuracy of the venturi simulation shall be checked at a minimum of two points under flow conditions, giving an indication of operation across the control range and gauge accuracy. These shall be in the range 2.4 to 3.8 bar (35 to 55 psi). One check shall be approximately 2.0 to 2.4 bar (30 to 35 psi) close to the maximum flow conditions just after the flow rate has started to reduce with a minimum pressure of 30 psi on the test rig gauge. The second check shall be close to zero flow 3.2 to 3.5 bar (45 to 50 psi). An additional check shall be performed at shut down (zero flow). The zero flow test confirms that the venturi selection system on the vehicle is correctly functioning.

The hose arrangement used during the test shall be that for which the venturi is designed (e.g. if the venturi is designed for two deck hoses then both these deck hoses shall be connected and both HEPCVs blocked out). Frequently the vehicle will have two, three or even four venturis and each shall be checked. For fuellers with deck hoses where the test is conducted by re-circulation back to the fueller tank, a manifold shall be used to allow duel hose operation capable of achieving at least 80% of maximum fuelling rates.

Check the venturi gauge is correctly calibrated. If the pressure on the panel gauge varies by more than +/- 0.35 bar (5 psi) of the adapter pressure, as measured by the test rig pressure gauge, then the venturi shall either be adjusted/repaired or replaced. This may require advice from the vehicle manufacturer.

If the venturi is adjustable, then reset to the correct reading. If the venturi is non-adjustable, but is reading higher than the test rig gauge, the unit is safe, but fuelling rates will be lower than optimum. A replacement venturi may be justified in certain circumstances, but it may be operationally acceptable to tolerate the lower maximum flow rates. This should be documented by the location manager.

If the venturi is non-adjustable, but is reading lower than the test rig gauge, the unit is not safe, as the secondary pressure control system will allow a higher than permitted pressure to the aircraft in the event of failure of the primary system. A replacement venturi will be needed in this case before the fuelling unit is returned to service.

Note: Venturis requiring ongoing adjustment shall be maintained or replaced.

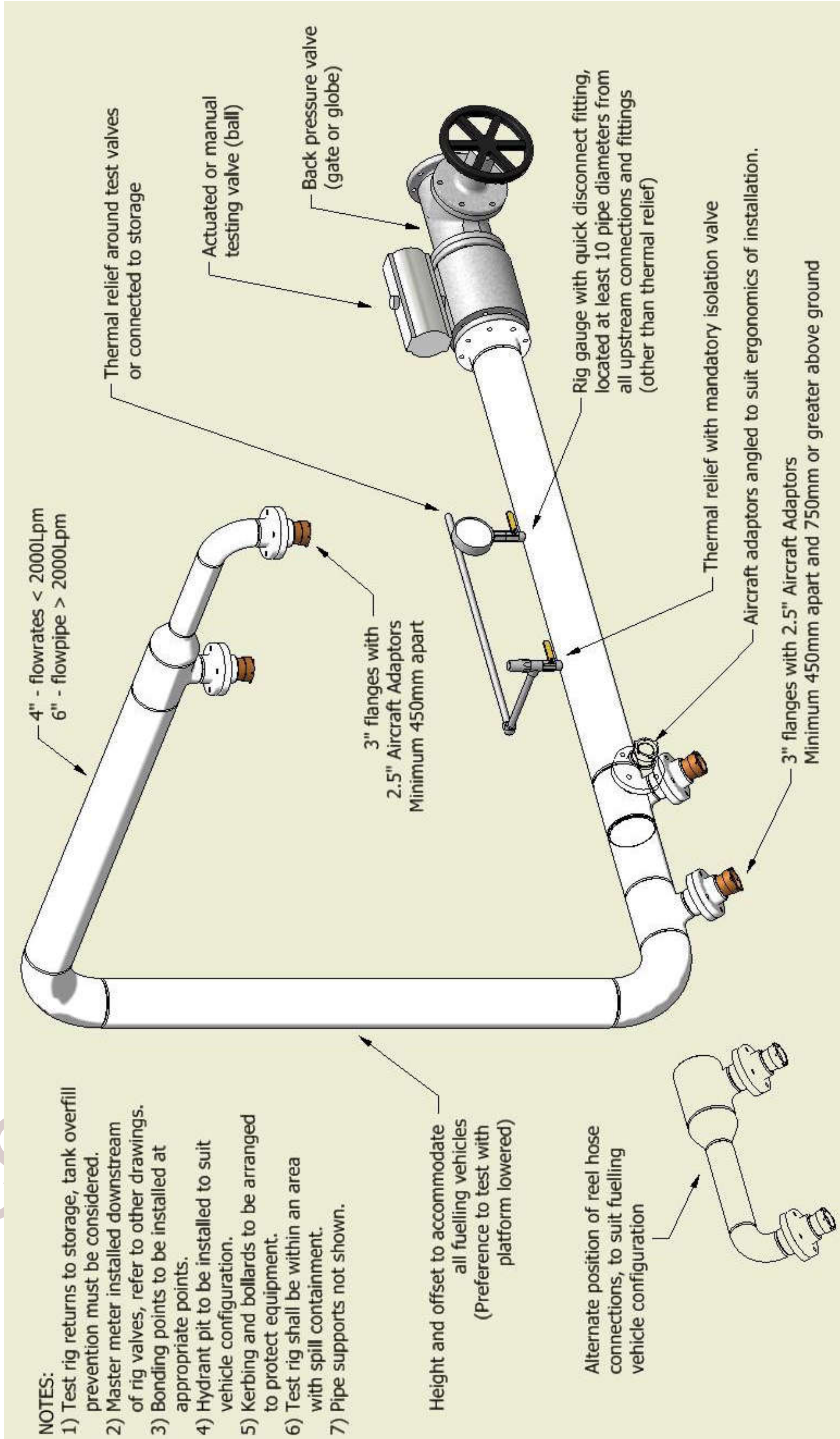


Figure A15.1 – An example of a suitable test rig

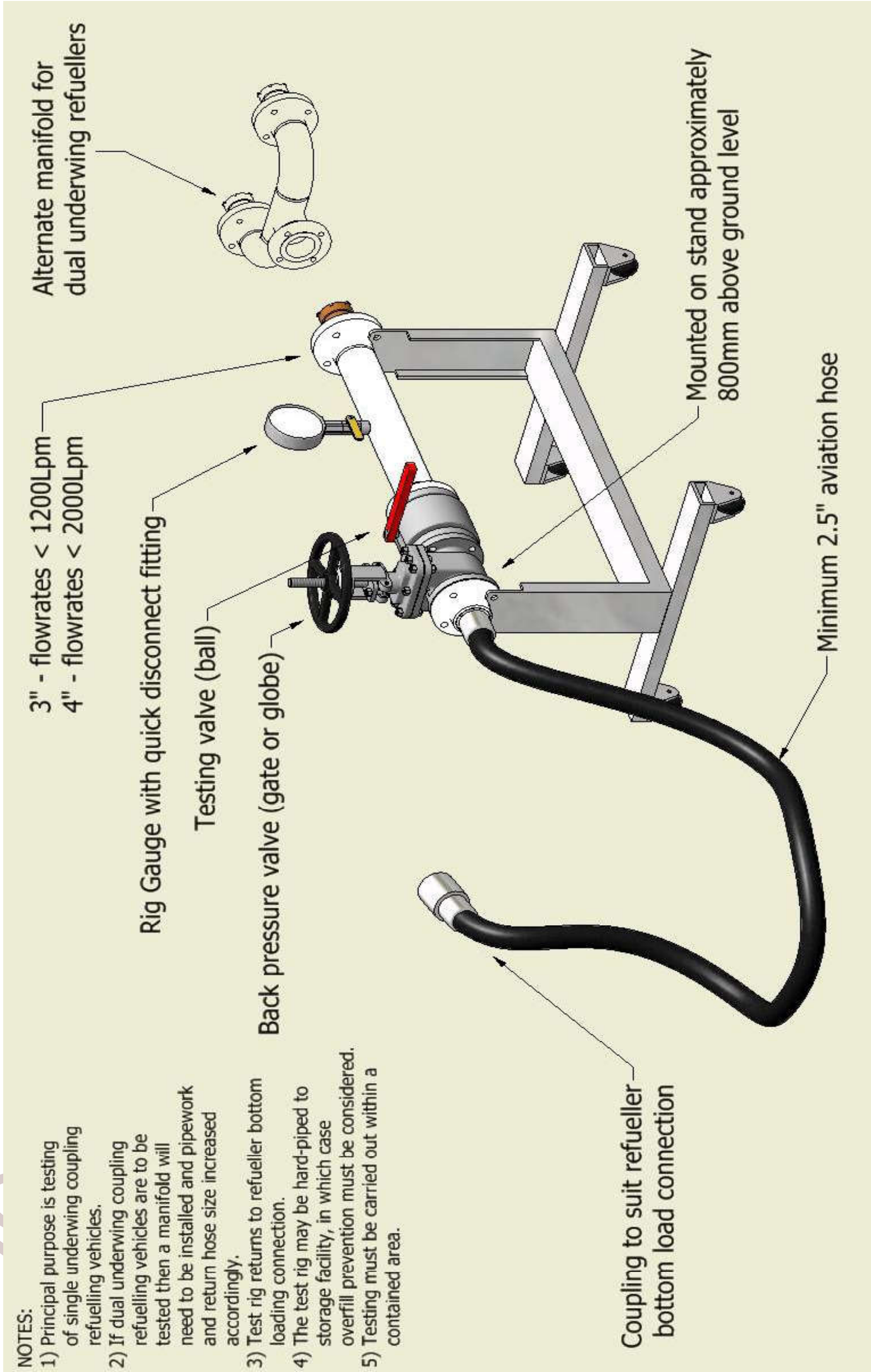


Figure A15.2 – An example of a suitable test rig for fuellers by circulation or tank return

Appendix A16: Equipment calibration programme

All monitoring and measurement devices shall be calibrated on a regular basis to ensure accuracy to within required tolerances. Each location shall establish a list of such equipment and maintain records showing for each device:

- Identity/reference number of equipment
- Frequency of required calibration (in line with manufacturer's recommendations)
- Date of calibration and next due date for calibration
- Signature of the individual responsible for the calibration
- Certificate of calibration if performed by third party
- Details of adjustments and repairs carried out

The following table shows examples of the type of equipment requiring calibration, the required frequency and the section reference where more detail can be found.

Equipment	**Calibration frequency**	**Reference**
Bulk meters	6 months	4.9.1
Master meters	3 years	4.9.1
Fuelling equipment pressure gauges	6 months	4.10
Hose pressure test gauges	6 months	4.10
Test rig gauges	6 months	4.10
Master gauges	3 years	4.10.2
Thermometers	6 months	4.19
Hydrometers	6 months	4.19
Electronic densitometers	6 months	4.19
Conductivity meters	3 years	4.22
Continuity meters	Manufacturer recommendation	4.22
Torque wrenches	Manufacturer recommendation (maximum 5 years)	4.22

Appendix A17: JIG Joint Ventures and locations on the JIG Inspection Programme

A17.1 JIG Joint Ventures

At many airports, fuelling facilities, including into-plane delivery equipment, are owned and operated jointly by more than one company. In these cases the equipment standards, quality control and general fuel handling standards and procedures followed shall be agreed by and be acceptable to each of the participants, to ensure that their contractual commitments to airlines or other customers are being met.

A JIG Joint Venture is an aviation fuel handling operation where there is a minimum of two Guarantor Member companies from the list below, operating to this Standard.

BP	Kuwait Petroleum
Chevron	Shell
Eni	Total
ExxonMobil	

A17.2 Application to Joint Ventures

A JIG Joint Venture as described above shall operate to the entirety of this Standard. Detailed procedures based on this Standard shall be prepared and incorporated in, or appended to, the signed operating agreement covering the system to make them formally binding to all participants. If company participation is different between the airport depot and the into-plane fuelling operations, separate agreements and procedures shall be prepared for each independent operation.

The fuel quality specifications shall also be incorporated in all operating agreements, by reference to the current issue of the JIG Aviation Fuel Quality Requirements for Jointly Operated Systems (AFQRJOS) Check List, or approved aviation fuel specification.

A17.3 Staff responsibilities and inspection requirements

A17.3.1 Staff responsibilities

It is the responsibility of the operation's management (i.e. the operating company board of directors or the operating committee) to ensure that the facility design and operating procedures as set out in manuals and other directives, conform to acceptable industry standards and to all the relevant requirements of government authorities with respect to safety, security, fire protection and environmental protection.

The prime responsibility of into-plane fuelling staff is to ensure that on-specification fuel of the correct grade is always delivered to aircraft and that the operations are carried out in a safe and efficient manner. The manager of an into-plane fuelling operation shall have overall responsibility for the fuelling operations under his/her control and shall be responsible for ensuring that all operations are carried out in accordance with the agreed procedures, and with all generally accepted standards of safety and good practice.

The manager shall be fully satisfied with the quality of the fuel stocks being received for delivery to aircraft, and shall be entitled to visit and make any appropriate tests at the airport depot as may be necessary to satisfy himself/herself over any justifiable doubts regarding the quality of the fuel supplies.

A17.3.2 Inspection requirements

Inspections to JIG Standards shall be carried out at least once per year to ensure compliance with locally prepared procedures. JIG inspections shall be carried out at into-plane fuelling services at least once per year. However, the frequency of these JIG inspections may be increased or decreased at certain locations by unanimous agreement of the participant companies.

Inspections shall be conducted to ensure compliance with the locally prepared procedures. The locally prepared (site specific) procedures/operations manual shall include an up to date list of any approved variances from the current issue of this Standard (see "Standards Variance Approvals" in section 1.4.3), and a copy of this manual (in English language) shall be made available to JIG inspectors.

Before leaving the location, the JIG inspector shall discuss the recommendations to be made in the report with the facility manager. Where these recommendations cover deviations from procedures laid down in the manuals of the system concerned, corrective action shall be implemented by the manager. If issues arise during the inspection that have an impact on another aviation fuelling operation at the airport, the JIG inspector should invite both facility managers to participate in a meeting at the end of the inspection. Items of a serious nature shall be communicated to all participants as well as to the local manager without delay. If matters of a controversial nature arise during the inspection, the inspector may call an immediate meeting of all participants to resolve the issue(s).

An inspection report shall be finalised in the JIG Inspection Tracking System and issued as soon as possible by the inspecting company but not later than six weeks after inspection completion. If the general inspection assessment is less than satisfactory then the report shall be issued not more than three weeks later.

It is the responsibility of the facility management to initiate the required corrective action recommended in the report. The JIG Inspection Tracking System shall be used by the facility management to monitor and address any related inspection report recommendations. The facility management shall continuously update and closeout recommendations directly in the JIG Inspection Tracking System without delay. Any matters of contention shall be referred to the international participants for resolution.