CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Advisory Circular
AC91-22

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Aircraft Fuelling—Fire Prevention and Safety Measures

General

Civil Aviation Authority advisory circulars contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

An acceptable means of compliance is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate advisory circular.

An advisory circular may also include **guidance material** to facilitate compliance with the rule requirements. Guidance material is not to be regarded as an acceptable means of compliance.

Purpose

This advisory circular provides guidance material about fire prevention measures in respect of aircraft fuelling and safety measures to be observed by a person involved in fuelling (or defueling) an aircraft

It is intended for general information, and does not override those procedures developed by recognised and certificated fuel company suppliers.

Related Rules

This advisory circular relates to Civil Aviation Rules 91.15, 121.91, 125.73, 135.73 and Part 139. It would also be of interest to adventure aviation aeroplane and helicopter operators, agricultural aircraft operators, and aerodrome operators.

Change Notice

This is the original issue.

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Table of Contents

1. Introduction

Any person engaged in the fuelling of aircraft is advised to take account of the guidance material set out in this advisory circular.

An airport authority is responsible for providing a safe environment for the fuelling of aircraft at its airport.

This advisory circular incorporates many of the provisions of Civil Aviation Safety Order (CASO) No. 5, (repealed in April 1997) which prescribed rules for fuelling of aircraft, and JIG 1 ‘Aviation Fuel Quality Control and Operating Standards for Into-Plane Fuelling Services’, endorsed by IATA technical fuels group, and recommended as an additional reference.

The fuel supply companies also have jointly agreed guidelines for fuel handling procedures to be used for into-plane fuelling services and many of the provisions of these guidelines have been included into this advisory circular.

Other sources for this advisory circular include the Guidelines for Aviation Fuel Quality Control and Operating Standards for Joint Into-Plane Fuelling Services, the fuel quality control regulations of the fuel supply companies, Civil Aviation Authority of New Zealand (CAA) publications (GAP and Vector) and aircraft manuals.

2. Applicability

This advisory circular provides advisory material/guidelines or information regarding safe practices/procedures, in respect of aircraft fuelling as per Parts 91, 121, 125, 135 and 139 requirements for aircraft fuelling and ground fire precautions. Applicable regulations made under the Hazardous Substances and New Organisms Act 1996 also apply (refer to Rule 91.15).

Coverage of the different aspects of aircraft fuelling and ground fire precautions is not exhaustive in this advisory circular. This advisory circular sets out the main elements.

3. Definitions

For the purposes of this advisory circular, the following definitions are provided as follows:

Fuelling includes refuelling and defueling aircraft, and the draining of aircraft fuel tanks[1].

Fuel has the same classification as those classified by the Hazardous Substances and New Organisms Act 1996 as listed in Appendix 1.

Fuelling safety zone means any area within 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.

Overseer means a person appointed by an operator to ensure that the fuelling procedures are complied with.

Approved handler means a person who is competent and certified by Test Certifiers appointed under the Hazardous Substances and New Organisms legislation[2] to handle certain hazardous substances. This person is only required for the most hazardous substances. This is determined by the hazard classifications of the substance and the amount being used. [3]

[1] Aircraft fuel tank calibration, aircraft fuel flow tests, and the draining of aircraft fuel tanks which are normally conducted within hangars at engineering bases, are not deemed to be fuelling. Special procedures determined by the aircraft operator, the airport authority, the fuel company, and the maintenance agent should be promulgated for the protection of these operations.

[2] Test certification requirements are described in the Hazardous Substances and New Organisms (Personnel Qualifications) Regulations 2001. For further information visit: http://www.ermanz.govt.nz.

[3] EPA New Zealand has produced quick guides for Approved Handlers, when required and when not needed www.epa.govt.nz

To become an approved handler you must meet the requirements of the Hazardous Substances and New Organism (Personnel Qualifications) Regulations 2001. The Hazardous Substances and New Organism (HSNO) Act 1996 covers the safe management of all hazardous substances. This includes those that are explosive, flammable, corrosive, toxic and harmful to the environment.

4. General

4.1 General precautions

Personnel engaged in the fuelling of aircraft should not carry matches, cigarette lighters, mobile phones, two-way radios, personal CD players or any other item which may cause a fire during the fuelling or defueling of an aircraft.

Do not carry out fuelling during an electrical storm.

Do not operate a cell phone, radiotelephone device, pager device, portable electronic device (PEDs), electronic flash equipment, or photographic flash bulb within 8 metres of the fuelling tanker or 3 metres from aircraft fuel points and vents unless certified intrinsically safe or flameproof.

Maintain a clear path from the aircraft for quick removal of aircraft fuelling equipment in an emergency. This may not apply to aircraft fuelling dispensers if agreed by the fuelling agency, aircraft operator and airport authority.

Fuelling equipment access to and exit from fuelling operations should also be kept free of power units and associated cabling.

Vehicles and equipment should be kept clear of the aircraft to allow for quick evacuation of passengers and crew members in an emergency.

Trolleys, handcarts or any vehicle used within 15 metres of the aircraft or the fuelling equipment should be fitted with non-metal tyres/wheels.

In-ground power units located within 5 metres of an aircraft vent should have electrical compliance certificates, or meet the requirements of a class one, zone one installation, or both.

Electrical hand lamps or flashlights used directly in the fuelling operation should be flame proof and safe for use.

Hoses should be run out on selected routes which will prevent them from being run over by aircraft-servicing vehicles. Kinking and twisting of hoses should be avoided. Pressure fuelling couplings and overwing nozzles should not be dragged over the ground. Dust caps should be fitted if required or the coupling stowed so as to reduce the risk of damage or the entry of dirt and water into the nozzle. Fuelling hoses and bonding wires should not be allowed to come into contact with a fixed ground power unit or in-ground power unit (IGPU) or associated electrical cables and should be kept as far away from them as practicable.

Before fuelling, the fuelling vehicle system should be checked for leaks, the filter differential pressure should be observed as normal, and any pressure control equipment should be checked for correct action by observing the reading of the appropriate pressure gauges on the vehicle.

Clear lines of communication should be established between the operator delivering the fuel, and any other person(s) directly associated with the fuelling operation. For example: pilot/maintenance personnel monitoring cockpit fuel contents gauges.

When delivering fuel, the operator should be positioned at a point where a clear view of the vehicle control panels and aircraft fuelling points is available. Deadman control should always be used for pressure refuelling and should never be wedged open.

During fuelling, do not perform any aircraft maintenance which may cause a fire with fuel vapours.

Fuel spills are fire hazards and cause environmental damage. Aircraft engines when hot can be a fire ignition source. Therefore take extra care not to spill fuel when an aircraft engine is hot, particularly when fuelling equipment is close to the aircraft.

If fuel spills, fuelling should stop and the spillage covered immediately with materials such as sand, sawdust, dry earth, or an agent such as foam or dry chemical extinguisher powder, to reduce the fire hazard. The aircraft should be moved clear of the contaminated area before any engine is started. Local airport regulations may also be applicable.

4.2 Bonding/grounding

The fuelling company's published procedures on bonding or grounding must be strictly followed. The aircraft and fuelling equipment should be electrically bonded together throughout the fuelling operation to ensure that no difference in electrical potential exists between the units.

Bonding or grounding requirements and electrical continuity checks should be in accordance with New Zealand electrical code of practice NZECP 24 "Safety of Electricity in Hazardous Places".

Bonding or grounding leads should be examined for security of connections and damage prior to use. Clips should be intact and undamaged.

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

Grounding of aircraft is generally not recommended. However, if authorities do require grounding, and earthing points exist for this purpose, the fuelling equipment and aircraft should be grounded by means of a "Y" grounding cable and not through the fuelling vehicle, following agreement of the local procedures by the airline, fuel company and airport authority. Hydrant pits or hydrant pit internals should not be used as grounding connections. Where grounding is carried out, it should be completed before connecting hoses or opening filler caps.

When overwing fuelling, make sure to follow the correct procedure for inserting the nozzle into the tank filler. If the filler caps have been previously removed to dip check the tank contents, the caps should be replaced and any vapour allowed dispersing before starting any fuelling operation. The fuelling procedure may vary with aircraft type, but the following additional steps are recommended—

(a) equalise the electrical potential by touching the nozzle to the metal wing surface, taking care to protect the wing from damage; and

(b) open the fill point cover flap; and

(c) attach the nozzle bonding jack or clip, where fitted, to the bonding point or cover flap, with the filler cap still closed; and

(d) open the filler cap; and

(e) insert the fuelling nozzle - avoid damaging the aperture, or 'bottoming' the nozzle which could possibly damage the internal structure and/or protective coatings; and

(f) start fuelling.

4.3 Fuelling personnel

Personnel engaged in the fuelling of aircraft should be dressed in protective clothing that does not cause static electricity build-up to prevent a flashback.

Personnel should wear non-slip semi-conductive footwear and safety glasses.

Personnel should be instructed in the procedure for alerting local fire services in an emergency.

4.4 Fuelling personnel training requirements

Fuelling operations should be carried out by competent personnel, thoroughly trained in aircraft fuelling procedures, the operation of fuelling equipment, the action to be taken if an emergency occurs, and safety procedures for storing, handling, and dispensing fuel, lubricants, and oxygen. Training of personnel should also include—

(a) identifying, explaining the major characteristics of, and distinguishing between, the various types of fuel (using flammability, colour, odour, and feel); and

(b) the use of fire extinguishers; and

(c) bonding requirements and methods; and

(d) knowing the location of and operation of the following—

(i) emergency stop controls; and

(ii) switches on fuelling equipment and on the apron, as applicable, for controlling the flow of any flammable products; and

(iii) closing valves in the piping system which may release product to the fire area; and

Note: *Operational knowledge of system components such as self-closing valves, internal valves, and vents will reduce uncertainty and avoid delay and error*

(e) the aircraft refuelling or defueling panel, switches and associated procedures; and

(f) methods for alerting every person associated with the fuelling operation; and

(g) summoning the nearest available fire services; and

(h) safety measures set out in this advisory circular, if applicable.

4.5 Driving and positioning of vehicles

Drive carefully near an aircraft to avoid crashing into the aircraft. Therefore make sure that the vehicle brakes are tested regularly to ensure that they are working well.

When driving a vehicle, always move forward into the fuelling position and exit in a forward direction, without reversing, if practicable. If the vehicle has to be reversed into position, a guide should be stationed at the rear of the unit to direct the manoeuvre.

Truck and trailer combinations should not be reversed into position. Once the vehicle is in position, the driver should not leave the cab until the parking brakes have been applied and locked in position.

The vehicle should be positioned at a safe and convenient distance from the fuelling points on the aircraft to permit—

(a) minimum hose length; and

(b) maximum visual and manual control; and

(c) speedy connection and disconnection of fuelling hoses; and

(d) avoidance of aircraft vents pipe safety zones (3m radius), APU exhaust efflux or other danger areas.

Special precautions should be taken to ensure that vehicles used for underwing fuelling have a sufficiently low profile for this purpose. Vehicles should be positioned so as to avoid the aircraft wing or other surfaces bearing down onto the vehicle as the aircraft settles under increased fuel load. The position of aircraft flap tracks in case of unheralded flaps extension should be taken into account.

Aircraft servicing vehicles must not be driven at excessive speed around fuelling operations and care must be taken to avoid contact with the fuelling vehicle, hoses and couplings, bonding wires, and any associated appliances.

The operator or the overseer should ensure that such vehicles should not be driven at excessive speeds and speed limits imposed by the airport authorities should not be exceeded. If no regulations exist, a limit of 25km/h should be enforced on the apron.

The fuelling vehicle - either a hydrant dispenser or a tanker/fueller - should be positioned so that it can be driven away quickly in an emergency. For this reason it is imperative that other ramp users do not obstruct the exit route of a fuelling vehicle.

4.6 Fuelling or defueling in hangars

Fuelling or defueling is generally not permitted in hangars or similar enclosed buildings, except by special agreement with the respective operators and the appropriate airport authorities, and in accordance with relevant and approved special procedures which should include satisfactory liability or indemnification protection.

Fuelling vehicles involved in such operations should remain outside the hangar.

4.7 Fuel Contamination

Contaminants (especially water) in the fuel have been known to cause engine failures – usually just after the aircraft has become airborne. Fuel contamination could also be in the form of solid contaminants such as sand, corrosion products, or other debris. Water contamination in fuel continues to be a major source of fuel related incidents. To minimise the risks of this happening, a fuel sample should always be taken from the refueller and tested for solid particle contamination, undissolved water and appearance of fuel at the time of fuelling. A water detector capsule is generally used for JetA1 fuel, whereas water finding paste is generally used for Avgas. A fresh capsule or paste should be used for each check. In cases where fuel contamination persists frequently then the source of the contamination needs to be investigated.

Fuel drain checks from the aircraft should always be carried out by the aircraft operator before the first flight of the day – and after refuelling. Refer to the appropriate operator's manual and manufacturer information for the correct fuel draining procedures.

The following general considerations apply to taking a fuel drain sample when required—

(a) After fuelling, allow the fuel to settle for as long as possible (a minimum of 15 minutes per 30 cm depth of fuel for avgas, and 60 minutes per 30 cm for Jet A-1 are recommended) before taking a sample. This gives any impurities a chance to settle into the drain sump of each tank.

(b) At an intermediate stop, it is recommended to fuel the aircraft first, before attending to other business. This will normally allow enough time for any water in suspension to settle out.

(c) Ensure that the drain vessel is clean before taking a sample. Hold the sample to the light and inspect it for water (normally indicated by small globules sitting on the bottom, or a 'cloudy' appearance) and sediment. Check that it is the correct colour and smell for the

intended grade of fuel. This will also confirm that a sample of just pure water has not been drained (it has been done).

(d) Know how many drain points the aircraft has. Some aircraft have belly or cross-feed selector drain points. Know where these are and drain them daily. Other aircraft have long fuel lines meaning that contaminants may take some time to reach the drain point.

Always confirm that each spring-loaded drain valve shuts securely afterwards, as any leaks will result in higher than normal in-flight fuel consumption. Take care with remotely-operated fuel drains, and make sure that they also close properly after operation.

If the sample tests positive for water or other contaminants, empty the vessel and continue draining until a clean sample is obtained. Be sure to empty the sample into a fuel disposal container as fuel can also degrade bitumen surfaces. Never tip the sample back into the aircraft tank, even if it is clean.

5. Fire Hazards

5.1 Fire or explosion risk

During fuelling operations, air and fuel vapour are displaced from the aircraft fuel tanks. This potentially explosive mixture is expelled via tank vents and the fill point. This combined air (oxygen) and fuel vapour forms an explosive mixture quite capable of causing fatalities or destroying an aircraft or hangar.

An explosive fuel-air mixture can also be formed by splashing a volatile fuel in an open container, as in washing oily components, or by pouring fuel from a sample container into another open container. All it takes to initiate a fuel explosion is just a small spark or a hot surface - not necessarily in the immediate vicinity, given the ability of fuel vapour to flow long distances. If a fire breaks out, extinguish using dry powder, foam or carbon dioxide extinguishers, or a water fog. Do not use a water jet, as this will spread the burning liquid and may make matters worse. Fires in confined spaces should be dealt with by trained personnel wearing appropriate breathing apparatus. Ensure an escape path is always available from a potential fire.

5.2 Static electricity

Commonly referred to as ‘static’, this is one of the most hazardous sources of ignition. Fuel is an extremely flammable liquid and explosive fuel/vapour mixtures may form at ambient temperatures. The presence of an ignition source can spell disaster. So static and aviation fuel is a bad mix. The risk is always present, and must be managed, even in seemingly innocuous situations. The considerations apply equally to gasoline fuels and Jet A-1.

Static can be generated from a number of sources, typically by the flow of fuel from the fuelling equipment to the aircraft, and by the wearing of synthetic clothing (high-visibility vests can be a hazard in this case). A resultant electrical charge can build up on an aircraft, the fuelling equipment, or a human body, and when two unequally-charged objects are brought close enough together, the charge will equalise by means of a spark. Static sparks can be of the order of thousands of volts and combined with the presence of fuel vapour of sufficient concentration will result in a potentially catastrophic explosion. This can be avoided by the use of the proper bonding leads or cables, coupled with procedures to equalise any electrical potential, before any hazardous vapour is introduced into the surrounding areas.

Note: *The grounding of helicopter skids does not necessarily equalise the electrical potential between fuelling equipment and the helicopter. The use of a bonding lead or cable is still recommended.*

5.3 Preventing static hazards

The most important thing to do before fuelling is to correctly bond the pump or fuelling equipment to the aircraft. When fuelling from drums, always ensure that there is a bonding lead connected to both the aircraft and the drum in use and make the necessary connections before removing any fuel caps. Additionally, it is good practice to keep the fuelling nozzle in physical contact with the filler aperture at any time fuel is being pumped. This also applies to the filling of portable containers – place the container on the ground, and maintain contact between the fuel nozzle and the container. Containers complying with Australian/ New Zealand standard 2906:2001 have this instruction on the label. Also check the bonding to the aircraft of any stands or ladders used to gain access to any overwing fuelling point.

Note: *Should the bonding cable be accidently disconnected during the fuelling process, stop fuelling immediately and wait for any static to dissipate before reattaching the bonding cable.*

Despite the traditionally accepted practice of filtering fuel through chamois leather, this is now not recommended. Studies have found that the use of a chamois can be a static hazard in itself, synthetic chamois even more so. Any drum pump should be more preferably fitted with an

appropriate in-line filter, and the delivery hose must be fuel-specific. The fuel supplier should be able to advise on the correct equipment, and it is very important that the correct equipment is used.

5.4 Spillage of fuel

Spillage and leakage of fuel should be avoided at all times. Every spill is a fire hazard as well as an environmental pollutant, and should be dealt with immediately. Each spill presents a different situation involving many variables, such as size of spill, weather conditions and location of spill.

Action required will depend on each particular situation, so no one set of instructions will apply in every case. Prompt action, good judgement and initiative by well-trained personnel are important to prevent hazards arising from fuel spills.

The overseer is responsible for ensuring that the local and national regulations relating to environmental pollution are fully met. This includes keeping an up-to-date spillage emergency plan and ensuring that all staff are aware of the plan and what must be done if fuel spills.

The following general procedures should be adopted into the plan for any significant spillage (covering an area greater than 2 metres in any dimension)—

(a) fuelling should be stopped immediately; and

(b) eliminate all sources of ignition in the vicinity of the spill (or released vapour); and

(c) notify the appropriate local fire services without delay; and

(d) evacuate unauthorised persons and vehicles to a safe area and prevent further movement until the hazard is removed; and

(e) restrict the running of engines and reduce any risk of ignition.

Smaller spills should be immediately soaked up using non-combustible absorbent material, such as sand or dry earth while someone stands by with a dry powder or foam extinguisher in case a fire breaks out. This also applies to places where fire services are not stationed. Be sure to dispose of the contaminated material in a safe place afterwards and any tools used for this purpose should, if practicable, be non-flammable.

CAUTION: If any fuel spills onto your body or clothing, do not remove your clothing except under shower. If you take off your clothing without first dousing under water, you could create a static spark and set yourself on fire.

In any case, take great care to prevent the spillage, as far as possible, from entering into the drainage system.

5.5 Fire extinguishers

Appropriate fire extinguishers should always be readily available. They may remain on the fuelling vehicle, if they are carried in open housings or in racks with quick opening fastenings.

The recommended fire extinguisher is a 9kg BC dry powder extinguisher – sodium or potassium bicarbonate powders. These are the most suitable for liquid and gas fires and are therefore recommended for most fuelling applications.

Note: *ABC type multi-purpose mono ammonium phosphate powders are not recommended for aviation fuelling operations, as they can leave an unwelcome sticky and corrosive residue on surfaces when discharged.*

Extinguishers should be maintained and certified serviceable in accordance with the relevant recognised standards. Fuelling personnel should be trained on how to use extinguishers effectively and know where they are located.

5.6 Safety zones

Safety zones around hydrant pits and pit couplings are to be maintained whilst in use.

6. Fuelling Procedures

Any published procedures by the fuelling company and any manufacturer's manual instructions on fuelling must be strictly followed.

6.1 Precautions

The operator or the overseer should ensure that the following precautions are observed during the fuelling of any aircraft—

(a) Except for the provisions of subsection 8.5, aircraft engines should be stopped, with the ignition and starter switches placed on the "OFF" or "SAFE" position, before fuelling starts. Fuelling with engines running (hot fuelling) should not be conducted unless otherwise approved by the CAA. If such a procedure is approved, the location and/or timing of the fuelling process are to be agreed in writing between the aircraft operator, the fuelling company, and the airport authority if appropriate.

(b) No smoking, or the use of a naked flame, should be permitted on the apron or within 15 metres of the aircraft, the fuelling system or equipment at any time. This safety distance is extended to 50 metres during any fuelling process. If any naked flame device has to be used in these circumstances (outside these recommended distances), its use should be strictly controlled in accordance with locally approved safety procedures.

(c) "No Smoking" signs or symbols should be displayed in prominent positions near the aircraft and fuelling vehicles throughout the fuelling operation. These symbols may be painted onto the sides of the fuelling vehicles.

6.2 General procedures

Personnel responsible for fuelling aircraft should take into account the following general procedures—

(a) Ascertain fuelling requirements – quantity and grade required.

(b) General aircraft servicing such as baggage handling and catering services and any other associated services may be carried out during fuelling operations. However, if obvious defects develop in motorised units operating within 6 metres of fuelling operations, the faulty units should be stopped immediately during fuelling operations.

(c) Operational problems can arise through the unsuitable location of the aircraft, due to mis-alignment of the aircraft in the parking bay, or by inappropriately located hydrant pits. In these cases steps should be taken to arrange for the aircraft to be realigned or relocated.

(d) Fuelling personnel should not operate aircraft fuel system controls (except as provided in subsection 4.2.).The aircraft operator is responsible for determining the volume of fuel to be loaded and to instruct fuelling personnel accordingly. The operator is also responsible for manipulating aircraft tank valves and switches, drip and dip sticks and to finally check the security of tank fill caps, covers and components. If requested, the fuel company may advise on the density (specific gravity) of the fuel being delivered to enable any associated calculations to be made.

6.3 Hydrant systems – underwing

In addition to the 'general procedures' in subsection 6.2, the following sequence is recommended when the hydrant pit cover is removed—

(a) the grade of fuel from the hydrant pit and dispenser should be checked before the connection is made to the pit; and

(b) the visibility of the hydrant pit and dispenser should be improved by the use of a high visibility flag, safety cones or other acceptable method, during daylight hours; and

(c) the hydrant pit and dispenser should be suitably illuminated – usually via local tarmac lighting, when dark or at night; and

(d) follow the sequence set out below in respect of hydrant dispensers or servicers—

(i) if grounding is required, follow the procedure set out in subsection 4.2; and

(ii) bond the hydrant dispenser to the aircraft; and

(iii) if required, attach a lanyard to the pit valve, and extend the lanyard away from the fuelling position and the aircraft; and

(iv) remove any dirt or moisture on the pit valve adaptor and hydrant coupler; and

(v) connect the hydrant coupler to the hydrant pit valve, and the delivery hose(s) to the aircraft. Each joint operation should have only one sequence which will be agreed by all participants and incorporated into a written fuelling procedure; and

(vi) open the hydrant coupler and adaptor if it is manually operated; and

(vii) activate the deadman control to start delivery; and

(viii) follow the above sequence in reverse when fuelling ends.

(e) whenever the dispenser is left unattended (e.g. for signing the fuel receipt) the hydrant pit valve or hydrant coupler should be closed; and

(f) dust caps should be fitted to the pit valve adaptor and dispenser couplings at all times when not in use.

6.4 Fuellers – underwing

In addition to the general procedures in subsection 6.2, the following sequence is recommended—

(a) if grounding is required, follow the procedure set out in subsection 4.2; and

(b) bond the fueller to the aircraft; and

(c) connect all delivery hoses to the aircraft; and

(d) activate the deadman control to start delivery; and

(e) at the conclusion of fuelling, the reverse sequence should be followed.

6.5 Overwing fuelling

In addition to the procedures for underwing fuelling, the following further measures are required to ensure that the correct grade of fuel is delivered when using an overwing (trigger) nozzle—

(a) Personnel responsible for fuelling should never assume what the fuel grade is. Confirm the grade between you and the customer. Whenever possible, have in writing what the grade of fuel that should be provided; and

(b) Before fuelling starts, fuelling personnel should check that the grade requested is the same as the grade marked on the aircraft, adjacent to the tank filler cap, and the same as the grade marked on the overwing fuelling nozzle; and

Note: *(i) if there is no grade marking on the aircraft, fuelling should not start until the pilot or responsible ground servicing personnel has confirmed the grade of fuel required; and*

(ii) if the grade marking on the aircraft is different to that of the fuelling equipment, fuelling should not start until the discrepancy has been fully investigated and resolved.

(c) for avgas overwing fuellings, nozzles with a maximum external diameter of 40mm should be used; and

(d) for Jet A-1 overwing fuellings, nozzles with a minimum external diameter of 67mm should be used.

Note: *Certain jet fuel aircraft types may have filling orifices which are too small to accept the standard diameter Jet A-1 nozzle, necessitating the use of a smaller diameter nozzle adapter. Written procedures should be prepared to ensure that after fuelling such aircraft, the smaller nozzle adapter is removed and replaced by the standard larger Jet A-1 nozzle.*

The following additional precautions are applicable for overwing fuelling—

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

(b) Hoses should 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 whilst product is being loaded. Wing mats should be positioned so that the fuel grade identification remains visible at all times.

(c) Overwing nozzles should be held open manually and should never be wedged open.

6.6 Refuelling from drums

Take care to correctly identify the type and quality (fuel does go stale) of the fuel before refuelling from drums. Ensure that the pump is fitted with a clean and serviceable filter (one that will filter particulate matter, as well as absorbing water). Corrosion products (rust), water and dirt can all be a problem when fuel is stored in drums.

Note: *A chamois cloth, once traditionally used as a filter, should not be used, as it can be a potential source of static charge. Fuel drums should be stored on their side with bungs and vents at three o'clock and nine o'clock positions, with the top of the drum (with the openings) lower than the bottom. This will minimise any 'breathing' (air and moisture exchange from outside) through the bungs and vents. A partly filled drum is more likely to contain moisture because of increased 'breathing'.*

When opening a drum—

(a) Stand the drum upright but tilted slightly, and chock it with the high side positioned at 12 o'clock, the bung at 3 o'clock, and the vent at 9 o'clock. This minimises water or dirty fuel on the outside of the drum from reaching the openings.

(b) Allow the drum to stand undisturbed for at least 10 minutes prior to fuelling to let any internal contaminants settle out.

(c) Proper bonding is critical. Connect the bonding lead from the drum to the aircraft before opening any fuel caps, and leave it in place until all fuel caps have been replaced.

(d) Open the pumping bung and vent.

(e) Ensure that the pump standpipe cannot reach the lowest point in the drum - any small amount of water or dirt will thus remain in the drum. The last few litres of fuel should not be needed badly enough to risk using it.

Some fuelling practices are likely causes of contamination, particularly when carried out on helicopters whilst the main rotor is turning, as under this condition particles of foreign material (dust and grass) are likely to be introduced into the fuel system through the tank filler.

The practice of using bleed air from the compressor of an aircraft turbine for the purpose of pressurising the fuel drum can only be considered safe if the following points are observed—

(a) any plumbing and other permanent attachments to the aircraft designed and fitted to achieve such pressurisation, must be properly authorised as such by an approved modification; and

(b) there should be a means of filtering all contaminants, removing moisture and regulating the pressure of the compressor bleed air prior to its entry to the drum; and

(c) the bleed air pressure to the drum should be reduced by an acceptable means to below 2.5 psi.

When refuelling from drums it is most important that the fuel delivery line incorporates a filter of five microns or less with the ability to separate both water and other contaminants. Fuel suppliers can provide or recommend suitable filters for this purpose. Such filters will normally meet Energy Institute Standard EI 1583 or EI 1583 as an alternative (formerly American Petroleum Institute Specification API 1581/1973).

Take care not to exceed the allowable maximum differential pressure across the filter element so that the excessive pressure does not render the filter ineffective. It must also be noted that the filter will only separate out water which is in suspension - straight water will pass through the filter. It is therefore important to ensure that the stand pipe is positioned clear of water deposits which may be presented in the bottom of drums.

Fuel suppliers are well aware of the problems of refuelling from drums in remote areas and have indicated their willingness to assist operators in the adoption of safe refuelling practices. Technical information in the form of bulletins and leaflets is readily available from most suppliers.

6.7 Refuelling from jerrycans

Use only jerrycans specifically manufactured as fuel containers. The traditional metal jerrycans are preferable to the plastic versions available on the market. Plastic jerrycans intended for use with fuels will have been manufactured to a recognised standard. In New Zealand, this is Australian/New Zealand standard 2906:2001, and this identification is embossed permanently on the side of the container.

Do not use plastic containers not designed for fuel, as their deficiencies may pose hazards such as—

(a) a tendency to accumulate a static charge (refer subsection 5.2); and

(b) fuel could degrade the container material; and

(c) inadequate structural strength and impact resistance; and

(d) lack of a proper fuel grade label and other required markings; and

(e) insufficient resistance to ultraviolet radiation and heat; and

(f) cap gaskets inadequately retained.

In particular, the cap gaskets have been identified as an actual hazard. The standard requires that these be physically restrained in the cap by a retaining ring, or other means of preventing accidental loss. Obviously, the gasket itself should also be fuel resistant.

Apart from simply falling out of the cap and preventing proper sealing, two ways in which the gasket can be hazardous are—

(a) Embrittlement and subsequent disintegration. The fragments can then be tipped into the aircraft fuel tank along with the fuel, and, over time, can either clog the tank outlet or the fuel system filter(s); and

(b) Progressive degradation /disintegration by turning to 'mush' (possibly more likely in jet fuel), also resulting in filter clogging.

6.8 Maintenance and servicing of aircraft during fuelling operation

During the fuelling operation, the pilot-in-command or overseer, as appropriate, should only permit maintenance, testing, servicing or cabin replenishment within the fuelling area subject to the following conditions—

(a) Ground power units should not be started, connected, their switches operated, or disconnected during fuelling. These actions must be completed either before refuelling or after the refuelling process is completed.

(b) The operation of aircraft combustion heaters, integral cabin heaters, wing, tail and surface heaters should not be permitted.

(c) The operation of aircraft radar transmitters should not be permitted.

(d) Maintenance, repair, or testing of the aircraft radio, radar and electrical equipment should not be permitted when the aircraft is being fuelled with class 3.1A fuel, except that switches necessary for the fuelling operation and lighting may be used.

(e) Functional checks may be carried out on aircraft radio, radar receivers and electrical equipment when class 3.1C fuelling is being carried out, but maintenance should be limited to the exchange of complete units.

(f) Maintenance, testing and functional checks other than those already detailed in paragraphs (b), (c), (d) and (e) may be carried out when class 3.1A or class 3.1C fuelling is being carried out, except that work which may create sources of ignition, especially in the vicinity of aircraft fuel tanks or fuelling equipment, may not be carried out.

(g) Electric hand lamps or flashlights used in the immediate vicinity of the fuelling operation should be of a flame proof or safe design.

The operators, pilots-in-command or overseer of any aircraft in the vicinity of fuelling operations should ensure that aircraft transmitters are not operated within 25 metres of fuelling equipment or aircraft fuel vents.

The operators of ground radar transmitters should ensure that transmitters are not operated within 30 metres of fuelling equipment or aircraft fuel vents.

7. Defueling Procedures

Any published procedures by the fuelling company and any manufacturers' manual instructions must be strictly followed.

7.1 Defueling procedure

It may be necessary either to off-load fuel from an aircraft after completing fuelling for subsequent aircraft fuel load adjustment, or to completely off-load all fuel, usually at the airline overhaul base, to permit maintenance work to be carried out.

Both operations are designated defueling and the procedures to be followed during defueling are similar to those which apply to fuelling.

To protect the quality of the fuel in the fuelling equipment from being contaminated by the fuel off-loaded from the aircraft, the following procedures should be adopted before defueling begins—

(a) The grade of fuel contained in the aircraft tank should be established by—

(i) taking samples for a visual check and, if jet fuel, water check by chemical detector; and

(ii) identifying the grade of fuel uplifted on the two previous supplied fuelling.

Note: *The aircraft operator representative should be able to supply this information.*

(b) If there is any reason to suspect the quality of the fuel, any fuel off-loaded should be segregated and subjected to a certificate of analysis test that must be successful before returning the fuel to operating storage or another aircraft.

(c) If the quality of fuel is not suspect, or it has passed the applicable tests, it may be delivered to an aircraft of the same airline/operator or to another airline/operator with or written permission.

(d) If the aircraft contains a mixture of Jet A-1 with Jet A or Jet B or Jet Fuel of East European origin or fuel of unknown origin or specification, the fuel should be disposed of, unless the airline/operator concerned agrees that the fuel can be returned to the aircraft. The product which has been defueled for load adjustment purposes should, whenever possible, be returned to an aircraft of the same airline.

(e) Defueled fuel may be received into segregated storage until redelivery to the aircraft concerned or to an aircraft of the same airline. Defueled stock can only be returned to airport operating storage after appropriate tests as above have been made on the fuel and results show it is acceptable for aviation use.

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

(g) Fuel containing FSII additive shall not be redelivered via filter monitor elements due to the possibility of filter media migration.

8. Fuelling Procedures under Certain Situations

8.1 Fuelling while aircraft mounted auxiliary power units (APU) are in operation

An APU exhaust discharging outside fuelling zone[4]—

(a) fuelling unit should be located as far from the APU exhaust as possible; and

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

(c) if fuel spills, the APU should be stopped immediately and remain stationary until spillage is removed and there is no danger from inflammable vapours.

An APU exhaust discharging into fuelling zone—

(a) The APU should be started before the covers of the fuelling connections and hydrant caps are removed or any fuelling connections made.

(b) If the APU is stopped during the fuelling operation; it should 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 should be positioned on the opposite side of the aircraft to the discharge. If this is not possible, the fuelling unit should be positioned out of, and at the maximum practicable distance from, the exhaust stream.

(d) If fuel spills, stop the APU immediately and 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, do not carry out overwing fuelling while APU is running.

An APU in engine nacelle on fuelling side of aircraft—

(a) The fuelling company should develop their own specific procedures with regard to fuelling this type of aircraft.

8.2 Fuelling while ground power units (GPU) are in operation

Position the GPU and associated cabling at least 6 metres away from fuelling vehicles and clear of wing tank vents.

Do not start, connect, switch on, or disconnect the GPU during the refuelling process. These actions must be completed either before refuelling or after the refuelling process is completed.

If fuel spills, the GPU should be stopped immediately and should remain stationary with all electrical circuits and switches left untouched until the spillage is removed and there is no danger from inflammable vapours.

[4]Fuelling zone: This is made up 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.

8.3 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, with the exception that, if fuel spills, the unit should be switched off. This is to prevent the possibility of flammable vapours being drawn into the aircraft passenger compartment.

8.4 Fuelling with one aircraft engine running

Fuelling of an aircraft, which has one propulsion engine running, is a non-routine, emergency operation and requires very strict safety precautions[5].

The following procedure applies specifically to underwing fuelling—

(a) fuelling with one engine running should not be performed unless the operator's authorised representative requesting this kind of operation accepts, in writing, complete responsibility for the operation; and

(b) a qualified representative from the operator should then supervise the fuelling operation; and

(c) due to its non-routine nature, the operation should be reviewed ahead of time by the operator and the fuelling company representatives; and

(d) the aircraft should 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; and

(e) the aircraft should be headed into the wind; and

(f) where one-man fuelling would normally be carried out, an additional supervisor or senior fuelling hand should also be presented; and

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

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

(i) properly manned mobile fire-fighting equipment, with the engine running, should be standing by the aircraft; and

(j) fuel will be loaded on the side opposite to that of the running engine with the fuelling equipment positioned a maximum (sensible) distance from the running engine; and

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

[5] **Overwing fuelling with one engine running is not permitted under any circumstances**. The procedure should be used only when an aircraft engine cannot be restarted because of inoperative ground aircraft starting equipment.

The overseer should ensure that the fuelling operation with one engine running, as requested by the operator, is within the scope of the current airport regulations.

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

(i) remove the fuelling equipment from the side where the fuelling has just been completed; and

(ii) reposition the fuelling equipment at least 50m from the engine to be started; and

(iii) operator aircraft personnel to start the engine on the side which has just been fuelled; and

(iv) operator aircraft personnel to shut down the engine of the side to be fuelled; and

(v) position fuelling equipment adjacent to the wing to be fuelled at a maximum (sensible) distance from the running engine; and

(vi) load fuel.

8.5 Operation of aircraft engines and APU within the fuelling area

The pilot-in-command and/or overseer as designated by the aircraft operator should ensure that no hazard is presented to fuelling equipment, its operation or to fuelling personnel during the starting of engines or taxiing of aircraft, especially due to the efflux from turbine engines. In the case of the fuelling equipment or personnel to the rear of, and within a 15° arc either side of the exhaust outlet axis, the engines should not be operated unless the engine is at a minimum distance (listed in Appendix 2).

As aerodromes or airports serve a large variety of aircraft types, depending on prevalent aircraft engine type, the minimum distances may be increased or decreased if agreed by the affected parties.

The operation of aircraft engines including aircraft-borne APUs within the fuelling area is not permitted, except when the engines (or APUs) are tail-mounted and the fuel to be uplifted is class 3.1C, or the express approval of the relevant fuelling agency and aircraft operator has been granted.

In addition, if the aircraft-borne APU is not tail-mounted, it may be operated within the fuelling area when the fuel to be uplifted is class 3.1C providing the APU is started before the filler caps are removed and fuelling connections made.

If an aircraft-borne APU is stopped for any reason during fuelling, it should not be restarted until the fuel has stopped flowing, the refuelling vehicle is disconnected and moved away, and there is no risk of igniting fuel vapours.

Operators are responsible for the following—

(a) ensuring that personnel concerned with the starting of aircraft engines near fuelling operations are fully conversant with correct operation of the aircraft's fire extinguishing system; and

(b) ensuring that during the starting of aircraft engines, an approved fire extinguisher is available for immediate use; and

(c) ensuring that during the starting of aircraft engines using class 3.1A fuel with passengers aboard the aircraft, equilibrium of the aircraft is maintained. Maintaining the equilibrium is ideal especially if an emergency arises and passengers need to leave by one exit. A manned passenger loading ramp should be readily available in an emergency.

8.6 Fuelling/defueling with on board/embarking/disembarking passengers

Fuelling or defueling involving passengers may be carried out following the accepted procedures in an aircraft operator's exposition. Refer to Civil Aviation Rules 121.91, 125.73, and 135.73 provided the conditions listed below are satisfied—

(a) Such fuelling or defueling is permitted by the local airport regulations and is requested by the aircraft operator, preferably in writing.

(b) The aircraft operator accepts sole responsibility for ensuring that—

(i) The local airport regulations relating to fuelling or defueling are carried out.

(ii) Instructions are issued to its employees for the safety of all passengers during fuelling or defueling and that these instructions are strictly observed.

(iii) Passengers joining or leaving the aircraft are moved under the supervision of a responsible person employed by the operator over a safe route, and are not allowed to smoke, linger, use mobile phones, cameras, or any other non-intrinsically safe devices, and are kept at a maximum distance from the fuelling operation.

(c) [6]Fuelling or defueling should stop immediately in a hazardous situation, such as spillage, or if the procedures set out in this advisory circular are not followed correctly which could result in a dangerous incident.

(d) The following special safety measures should be observed when passengers are to remain on board during aircraft fuelling—

(i) Where passenger loading stairways are used they should be positioned at each passenger door normally used at that airport and these doors should be kept open, except these doors may be closed during inclement weather, but they should be kept unlocked and free to open, with the stairways remaining in position. Where aerobridges are used, only those doors served by the aerobridges at that location need be opened.

(ii) Access to exit doors and gangways in the aircraft should be kept unobstructed and any doors between passenger compartments kept open.

(iii) One cabin attendant or a suitably trained person should be presented at each passenger main exit door in use and additionally in each other occupied compartment.

(iv) Cabin attendants should advise passengers that fuelling will take place and that proper precautions are being taken to ensure their safety. The attendant will ensure that the "No Smoking" sign is displayed in each compartment, all exits are clearly indicated by a reflective marker or lights, and all exit lights are illuminated or armed.

(v) If an abnormal concentration of fuel vapour is detected in the cabin, or any other condition that may constitute a hazard occurs, the cabin attendant should advise the fuelling personnel immediately.

[6] Passengers should not be allowed to remain on-board helicopters during fuelling/defueling operations. Fuelling of any avgas aircraft while passengers are on board is not permitted

(vi) Cabin attendants are to assist the evacuation of passengers in the event of fire or when any other hazard exists and when necessary should utilise appropriate emergency evacuation slides on their own initiative.

(vii) The equilibrium of the aircraft should be maintained if all passengers leave by one exit; and

(viii) For a marine aircraft not moored to a pontoon or jetty, adequate means of water transport should be stationed at the cabin exit door.

(e) When passengers are to embark or disembark during fuelling the following special additional safety measures should be observed—

(i) Passengers should be warned not to smoke.

(ii) Passengers should be routed by a roped off or clearly marked track, clear of the fuelling equipment, or supervised by a responsible person employed by the operator on their journey to and from the aircraft.

(iii) Suitable measures should be taken to prevent spark hazard from passengers' shoes within the fuelling area.

8.7 Auxiliary plant, vehicles and electrical equipment

Internal combustion engines used in association with auxiliary plant and vehicles powered by internal combustion engines should not be operated within the fuelling area unless—

(a) when refuelling with class 3.1A fuel or 3.1C fuel, the spark plugs of these engines have been encased in an approved screening device and effective flame traps are fitted on air intakes and exhaust systems; and

(b) the equipment is subject to regular inspection and maintenance, or the entire exhaust system (excluding exhaust valve gear) inspected at not greater than 90 day intervals and the integrity of the complete system verified.

Do not start, connect, switch on, or disconnect a GPU during refuelling. These actions must be completed before or after refuelling is completed.

Where an electric motor, portable electrical appliance or ground supply unit is operated within the fuelling area, all electrical apparatus on the unit should be flame proofed in accordance with New Zealand electrical code of practice NZECP 24 "Safety of Electricity in Hazardous Places".

Operators should make sure that vehicles and fuelling equipment are maintained to satisfactory safety standards.

Do not start ground equipment engines during fuelling until the flow of fuel has ceased and there is no risk of igniting fuel vapours.

Ground equipment engines should not be operated within 3 metres horizontal radius of an aircraft fuel venting system. The area also includes all that space encompassed vertically below the horizontal exclusion zone.

8.8 Fuelling on aircraft having fuel tanks with inert gas system (nitrogen generation system)

Modern generation transport category airplanes may be fitted with fuel tanks having a nitrogen generating system. This nitrogen generating equipment is dangerous as nitrogen is colourless and odourless. The generated nitrogen decreases the oxygen in the air remaining within the tank, safeguarding against the likelihood of an explosive mixture. However, the resultant gaseous

mixture when vented is unhealthy and may cause hypoxia, dizziness, nausea, and in extreme cases unconsciousness and possible death.

While fuelling or defueling aircraft which have fuel tanks fitted with nitrogen generating equipment, make sure that any warning instructions associated with such systems (typically in the main wheel well, centre fuel tank and air conditioning bay) are read and obeyed by fuelling operators. The aircraft operator should be approached to assist in identifying any hazards and procedures to be followed when dealing with such systems.

An aircraft operator is responsible for educating and training fuellers regarding features of the aircraft used by the operator relating to fuelling/defueling operations and special precautions to be taken during fuelling operations.

Appendix 1

Categories of fuel - Hazardous Substances and New Organisms Act 1996

Class 3.1A: Flammable liquid means a liquid that has a flashpoint of below 23°C and has an initial boiling point (IBP) of a maximum of 35°C and includes petrol based products. This includes—

- AVGAS (Aviation gasoline – all grades)
- AVTAG (Jet B, JP-4 turbine fuel)

Class 3.1C: Flammable liquid means a liquid that has a flashpoint at or above 23°C but at or below 60°C and includes kerosene based products. This includes—

- Jet Fuel (Jet A, Jet A-1, and various other kerosene grades)

Class 3.1D: Flammable liquid means a liquid that has a flashpoint of above 60°C but at or below 93°C and includes diesel based products. This includes—

- Diesel based products

Appendix 2

Minimum distance from refuelling activity for engine operation

Engine Type	**Power Conditions**	**Metres**
Turbo-prop (based on ATR)	At or below normal slow taxiing power At power used to initiate movement of a stationary aircraft	30 40
Turbo-jet (based on B737)	At or below normal slow taxiing power At power used to initiate movement of a stationary aircraft	45 60