

PROCEDURES FOR OVERWING FUELLING TO ENSURE
DELIVERY OF THE CORRECT FUEL GRADE TO AN AIRCRAFT

API/IP RECOMMENDED PRACTICE 1597

First edition
December 2006



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FOREWORD

This Recommended Practice has been prepared jointly by the API Aviation Technical Services Sub-committee and EI Aviation Committee, and is intended to provide guidance on the prevention of aircraft misfuelling.

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

The guidance contained in this publication is primarily intended for overwing fuelling operations of civil aircraft.

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

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This publication is intended to assist those involved in overwing fuelling of civil aircraft to ensure the correct fuel grade is delivered. Every effort has been made by the American Petroleum Institute and the Energy Institute to assure the accuracy and reliability of the data contained in this publication; however, API make no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaim any liability or responsibility for loss or damage resulting from its use or for the violation of any local or regional laws or regulations with which this publication may conflict.

Suggested revisions are invited and shall be submitted to the director of standards, API, 1220 L Street, N.W., Washington, D.C. 20005 or The Energy Institute, 61 New Cavendish Street, London, W1G 7AR.

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Shell Aviation Ltd.
Shell Oil Products US.

1

GENERAL

1.1 PURPOSE

This publication is intended to provide a system for use by aircraft fuelling ground staff to assist with the delivery of the correct fuel grade to an aircraft during overwing fuelling. This system consists of procedures as well as specific equipment that shall be used to comply with this recommended practice.

1.2 REASONS FOR A MISFUELLING PREVENTION PROGRAM

Delivering the incorrect grade of fuel into an aircraft is termed a misfuelling. The risk of delivering the wrong grade of fuel exists because most General Aviation (GA) aircraft and some airline type aircraft are overwing fuelled and can therefore be potentially fuelled with avgas or jet fuel fuelling equipment.

The serious consequences of misfuelling include:

- Total engine failure due to knock damage if jet fuel is delivered into a spark ignition piston engine powered aircraft that requires avgas.
- Ignition failure if avgas is delivered into a compression ignition (diesel) piston engine powered aircraft that requires jet fuel.
- Vapour lock and engine failure due to fuel starvation if avgas is delivered into a turbine engine powered aircraft that requires jet fuel. Many turbine engines are capable of operating on avgas, but such operation is strictly controlled as described in the Pilot Operating Handbook.

There are many documented cases of misfuelling and a variety of causes have been identified. In the majority of these incidents there was a lack of grade confirmation, meaning that the fuelling staff did not confirm with the customer the grade of fuel required. There are many similar looking aircraft in operation internationally. Examples include – Piper Mirage (avgas) and Piper Meridian (jet fuel), Cessna 404 Titan (avgas) and 441 Conquest (jet fuel) – where visual appearance alone cannot be relied on to identify which grade of fuel the aircraft requires.

Greater numbers of diesel powered aircraft are now being manufactured and in some cases existing aircraft with spark ignition piston engines are being converted to diesel engines. Aircraft fitted with diesel engines are very similar in appearance to aircraft fitted with spark ignition piston engines making visual identification very difficult. In addition, the filling ports on modified aircraft may not have been replaced with the larger diameter airframe fuelling port associated with aircraft requiring jet fuel. The consequences of fuelling these aircraft with avgas can be catastrophic.

In some cases, grade confirmation did occur and wing decals were fitted on the aircraft, but the refuelling vehicle/dispenser cabinet used contained the wrong grade of fuel.

Clearly there is a need for a comprehensive set of procedures to address the many possible causes of misfuelling.

PROCEDURES FOR OVERWING FUELLING TO ENSURE DELIVERY OF THE CORRECT FUEL GRADE TO AN AIRCRAFT

2

PROCEDURES AND EQUIPMENT

2.1 SUMMARY

Refuelling staff shall obtain verbal confirmation of the fuel grade from the pilot for all overwing fuellings. In certain situations (sections 2.3 to 2.5), written confirmation is required. Under no circumstances shall refuelling staff assume what grade of fuel is required. Instructions to or between refuelling staff relating to overwing fuelling shall always include a reference to the grade of fuel required. This shall apply at all stages: receipt of orders, transferring orders onto notice boards and in all verbal communications. Overwing nozzles shall be colour-coded; black for jet fuel and red for avgas (see section 2.8). Jet nozzles shall be fitted with selective spouts (see section 2.5). Where wing decals are not present on the aircraft, the fuelling shall not proceed unless a Fuel Order Form is completed by the customer. For full details of these procedures, refer to sections 2.2 to 2.10.

2.2 GRADE CONFIRMATION

2.2.1 Verbal orders

Orders received verbally shall be repeated back to the customer for confirmation. However, in all circumstances the grade of fuel required shall be confirmed. The essential information is:

- Fuel grade.
- Quantity of fuel to be delivered into each fuel tank.
- Aircraft registration.

Any orders received without specifying the grade, e.g. where a pilot places an order for "200 US Gallons/litres a side" or "fill it up", shall be clarified to confirm the grade required and then repeated back to the customer for confirmation.

Orders for overwing fuellings can be received verbally (personally or by telephone) only when the refuelling is completed immediately following. All other instances shall require the order to be recorded after verbally being received from the pilot.

Refuelling staff shall not attempt to fuel an aircraft purely on their knowledge of the aircraft type. For such a critical activity, all staff shall comply with the grade confirmation procedures and not assume the grade required.

2.2.2 Written records

All verbal orders shall be recorded, including grade, quantity of fuel to be delivered into each aircraft fuel tank and aircraft registration information. The only exception is for verbal orders received on the apron with the fuelling completed immediately following. The recording of verbal orders and their transmission within the refuelling and associated site staff is critical in ensuring that the correct fuel grade and quantity are delivered. The use of customer confirmation records (i.e. meter tickets and other documentation that are used routinely to initiate normal fuelling or billing processes) shall not be confused with the use of the Fuel Order Form. The Fuel Order Form is used only under certain conditions (see section 2.4). The use of the Fuel Order Form shall be on an exception basis and not used

routinely so as to highlight the importance of this non-routine task in delivering the correct grade of fuel to the aircraft.

2.2.3 Grade/product names

Standard product names shall be used by all site staff to avoid confusion. It is not uncommon for customers to use unusual or abbreviated product names which can lead to confusion. This is particularly apparent where customers have operated internationally¹ or may only use one grade of fuel in their fleet and may not be aware of the importance of grade confirmation.

Orders received from customers (or from instructions relayed via other members of staff) which do not use these product names shall be clarified. Orders such as "aviation fuel" or "gasoline", etc., have the potential to cause the delivery of the incorrect grade of product.

Refuelling staff shall only accept verbal fuel grade notification from the customer when there are wing grade decals fitted adjacent to the fuelling point of each aircraft fuel tank to be filled.

2.2.4 Use of wing decals

Grade confirmation also occurs at the time of fuelling via the use of wing grade decals. The refuelling staff shall confirm, prior to commencement of fuelling, that the aircraft wing grade decal is the same grade as in the refuelling vehicle/equipment by observing the grade decal on the refuelling vehicle/equipment. Fuelling shall not commence unless they are the identical grade.

Where wing grade decals are not fitted, the fuelling shall only progress when either:

1. The customer fits the wing decals or
2. The customer completes a written Fuel Order Form – refer to sections 2.3 and 2.4.

2.3 WING DECALS

Wing decals should be designed as shown in Annex A and shall be readily available at all airport locations.

Customers should be encouraged to fit and regularly replace wing decals.

The use of wing decals provides an additional barrier against misfuelling by providing a form of grade

confirmation immediately prior to the fuelling. The wing decals are colour-coded as are the overwing nozzles (section 2.8).

- Red background with white lettering – avgas.
- Black background with white lettering – jet fuel.

Wing decals should be supplied to customers for application by the customer. Refuelling staff shall not apply the decals because this could compromise the grade confirmation step.

2.4 FUEL ORDER FORMS

Fuel Order Forms are used to obtain written confirmation from the pilot/aircraft representative of the grade of fuel, quantity of fuel to be delivered into each aircraft fuel tank and the aircraft registration information. They are used in circumstances where verbal grade confirmation is not considered adequate.

Fuel Order Forms shall be required where:

- The aircraft to be fuelled (overwing) is not fitted with wing decals.
- The wide jet nozzle spout is removed and replaced with a narrow spout to complete a fuelling of certain jet fuel type aircraft where the fuelling port will not accept the wide jet fuel spout.
- Fuelling of compression ignition piston (diesel) powered aircraft.

An example of a Fuel Order Form is contained in Annex B.

If customers provide written advice of grade requirements on their own order documentation, this shall not be considered sufficient as a replacement for the site Fuel Order Form. Fuel Order Forms should be designed so they cannot be confused due to any loss of colour-coding when photocopied.

2.5 SELECTIVE NOZZLE SPOUTS (OVERWING FUELLING)

Grade selective nozzles use different sized spouts for avgas and jet fuel. Jet fuel nozzles utilize a large (wide) diameter spout while avgas nozzles utilize a smaller diameter spout. See SAE Aerospace Standard AS 1852 *Nozzles and ports - Gravity fuelling interface standard*

¹ * CAUTION - Confusion can be caused by language differences. The local name for jet fuel in one country may be similar to the name for avgas in another. e.g:

- Spain: The local name for jet kerosene can be "petroleo"- very similar to petrol as used for gasoline (more like avgas), in many countries.
- Greece: Kerosene is called by a derivative of the word for benzene, which is usually associated with gasoline.

for civil aircraft for details on both fuelling nozzle spout and aircraft filler port design requirements.

Grade selective nozzle spout dimensions are as follows:

- **AVGAS** - Maximum nozzle spout diameter is 50 mm or 1,97 inch.



— **JET FUEL**

- Minimum nozzle spout length is 67,6 mm or 2,66 inch.
- Maximum nozzle spout width is 29,7 mm or 1,17 inch.



Using the wide jet nozzle spout creates a physical barrier to prevent insertion of the wider jet spout into the avgas fuelling orifice: this is only the case if the correct airframe fuelling port per SAE AS 1852 is installed. Unfortunately, some avgas aircraft still have large diameter fuel ports which can accommodate the wider jet nozzle spout. Pilots and aircraft owners should be encouraged to fit the selective fuel port modification kits which are available for most avgas powered aircraft.

Additionally, some jet aircraft have fuelling orifices too small to accept the wider jet spout and hence the wide jet nozzle spout has to be removed and a smaller nozzle spout fitted. When fuellings take place where the wide jet nozzle spout is replaced by a smaller spout the following steps shall be taken:

- Written procedures shall be prepared to ensure that after fuelling such aircraft, the smaller spout is removed and replaced by the larger spout. These small jet fuel nozzle spouts shall be kept in a secure

place and returned after each use. It is recommended that the small jet nozzle spouts be signed out when used and their return recorded.

- A Fuel Order Form is used to obtain written confirmation of the grade of fuel required from the pilot.

2.6 CONTROL OF UNATTENDED FUELLINGS

During unattended fuellings, the absence of the customer at the time of fuelling shall be managed to ensure grade confirmation can still occur.

As with all fuellings, grade confirmation commences when the customer telephones, sends a fax or personally places an order for an overwing fuelling. These orders shall be documented (e.g. partial completion of a delivery ticket) to ensure the grade is confirmed and recorded. On all occasions that information is transferred verbally or in writing (e.g. onto a whiteboard), grade information shall be included.

At the time of fuelling, grade confirmation is further supported by wing decals; hence unattended fuellings shall not proceed if the aircraft is not fitted with wing decals.

Unattended fuellings on jet aircraft that will not accept the wide jet nozzle spout shall not proceed unless the pilot completes a Fuel Order Form and a wing grade decal is present.

A delivery ticket with grade and quantity shall be left with the fuelled aircraft where unattended fuellings occur. This provides the customer with the opportunity to confirm the grade supplied prior to operating the aircraft after fuelling.

2.7 CONTROL OF STANDING ORDERS

Standing Orders are usually arranged for repetitive customer fuellings at the same location. It is convenient for both the refuelling staff and customer to agree an ongoing fuelling schedule (e.g. fixed times, each evening, etc).

Such Standing Orders are permitted on the following basis:

- These orders shall be documented in writing between the pilot and the refuelling staff. They shall include a register/list detailing aircraft registration, the grade of fuel required for each aircraft and the total quantity and quantity delivered into each aircraft tank. The register/list shall be held by the refuelling staff where it is readably accessible for all staff to consult.

- Wing decals shall be fitted.
- All overwing jet fuel nozzles are equipped with the wide jet nozzle spout.
- The customer shall be advised to notify the refuelling staff of any change in the standing order requirement if the aircraft type or grade fuel requirement changes.
- A delivery ticket with grade and quantity shall be left with the fuelled aircraft where unattended fuellings occur. This provides the customer with the opportunity to confirm the grade supplied prior to operating the aircraft after fuelling.

At locations where it is impractical to have the jet fuel wide nozzle spout fitted because of the high number of aircraft unable to accept them (more than five overwing fuellings per shift requiring the small jet nozzle spout) then the following procedure shall be adopted:

- The smaller diameter jet nozzle spout shall be permanently fitted.
- A Fuel Order Register of jet aircraft that cannot accept the wide jet nozzle spout shall be developed. The Fuel Order Register requires a historical log with dates for any revisions and it shall be reviewed at least every six months for correctness. In addition to sighting the grade decals in order to obtain written confirmation of the grade required, the refuelling staff shall also verify whether the aircraft is on the Fuel Order Register. Aircraft not identified on this Fuel Order Register must have a normal Fuel Order Form completed. Aircraft identified on the Fuel Order Register but without decals must also have a Fuel Order Form completed. Any aircraft NOT on the register shall only be fuelled by confirmation of aircraft decal and completion of a Fuel Order Form.

2.8 GRADE DECALS FOR REFUELLING EQUIPMENT

Often airports will have similar looking fuelling vehicles or other fuelling equipment supplying both jet fuel and avgas. While grade confirmation procedures ensure identification of the correct grade, it is still possible to incorrectly identify the equipment and hence deliver the wrong grade into aircraft.

The use of large and clearly visible colour-coded grade decals (see EI Standard 1542 *Identification*

markings for dedicated aviation fuel manufacturing and distribution facilities, airport storage and mobile fuelling equipment) on all fuelling storage and handling equipment shall be applied to assist in grade recognition. As a minimum the following shall be adhered to:

- Aviation fuel dispensing vehicles

The identifying product grade labels (see EI 1542) shall be applied to the front, back, sides, and prominently displayed inside the driving compartment. In addition the grade decals should be visible from each fuelling hose reel and fueller bottom load adapter.

- Stationary/curbside fuelling cabinets

Fuelling cabinets, which cover piping, filters, pumps, valves and hose reels, should bear grade identification labels (see EI 1542). Labels for the specific grade should be installed on all sides, tops, and inside main access doors to stationary fuelling equipment.

- Dispensing nozzles

Overwing nozzles shall be colour-coded or use colour-coded handles in the product grade colour (i.e. jet fuel – black; avgas - red] which will assist in identification of the correct grade when fuelling aircraft. The use of small grade decals in addition to painting the nozzle or using colour-coded handles can be an additional safeguard. It is also recommended components of the nozzle, such as the spout, which come in contact with fuel or aircraft connectors, should not be painted.

2.9 QUALITY CONTROL OF SITE FUEL SUPPLY AND SELECTIVITY

Adherence to the quality control procedures required at each site will assist in identifying that the correct grade of fuel has been received and that fuel remains uncontaminated at the airport prior to delivery to the customer. Such quality control checks shall include:

- Ensuring the API gravity or density measurement falls in the appropriate range for the grade of fuel being delivered.
- The API gravity or density checks are compared to receiving quality documentation and fall within the acceptable tolerance limits.

- Visual examination for dirt, water and correct colour (blue for avgas 100LL; red for avgas 80; green for avgas 100) for the specific grade of avgas and water (white to straw/pale yellow for jet fuel) is carried out on all samples inspected from the system.

The use of grade selective couplings shall be extended as far upstream as possible. This establishes a physical barrier to prevent the loading of the incorrect grade of product into fuelling vehicles or other product transfers. Airport fuelling vehicles shall be loaded through grade selective nozzles to prevent the inadvertent loading of the incorrect grade into a fuelling vehicle.

The use of grade selective unloading for road transport deliveries to airport fuel farms/depots should be considered where possible. Even where grade selective offloading nozzles are used the quality control check described in this section shall be followed.

EI 1542 also addresses fuel grade identification for fuel handling facility/equipment requirements which will assist in identifying the correct equipment when transferring fuel into the site.

2.10 FUELLING PROCEDURES/TRAINING

It is essential that all personnel involved in overwing fuelling understand the consequences of any lapse in maintaining correct procedures. It is therefore essential that personnel are fully trained to undertake overwing fuelling of aircraft to prevent misfuelling.

Local staff shall develop a written, risk assessed, Job Task (see Annex C for an example of a Job Task) which contains a step by step procedure on how to overwing fuel an aircraft. This Job Task shall also

address health and safety issues and any legally required Personal Protective Equipment required when performing such work.

New personnel shall be thoroughly trained in how to fuel overwing aircraft prior to being allowed to fuel aircraft without direct supervision.

Existing personnel who are called upon to undertake overwing fuelling shall be similarly trained. An employee training record for overwing fuelling shall be maintained for every employee which indicates:

- (i) job task training has been given and the date of such training, and
- (ii) the signature of the trainer, and
- (iii) a "yes/no" assessment of whether the trainee demonstrated satisfactory understanding of the training, and
- (iv) the signature of the trainee.

Where necessary, training records for existing personnel shall also be established.

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

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

Training aides such as posters or bulletins describing the requirements contained in this Recommended Practice which can be located on wall/doors/bulletin boards are useful reminders to refuelling staff of the need for vigilance in preventing misfuelling.

PROCEDURES FOR OVERWING FUELLING TO ENSURE DELIVERY OF THE CORRECT FUEL GRADE TO AN AIRCRAFT

ANNEX A

OVERWING FUEL GRADE DECALS

A.1 INTRODUCTION

In addition to other measures adopted to reduce the risk of misfuelling general aviation aircraft, wing decals have been designed to clearly indicate the proper fuel type for use in the aircraft. The correct decal should be placed adjacent to all fuel filler ports on civil aircraft by the pilot or aircraft owner such that it is clearly visible, but does not interfere in any way with aircraft operation.

Three decals are described in this annex. Decals #1 and #2 are for use on aircraft approved to use avgas conforming to ASTM D 910 or Defense Standard 91-90.

Decal #3 is for use on aircraft approved to use jet fuel conforming to ASTM D 1655 or Defense Standard 91-91.

WARNING: The pilot/aircraft owner is usually very knowledgeable regarding the approved fuel for the aircraft. However, if there is any doubt, the decal should only be placed on the aircraft after contacting the original equipment manufacturer.

A.2 DESIGN

The preferred design/size for the wing decals recommended are shown below. Other designs / sizes may be acceptable; however, the colour scheme, i.e. white text on a red background for avgas and white text on a black background for jet fuel is mandatory. Recommended font is Univers 45 Light and text size is 54 point.

A.2.1 Decal #1

To be used on aircraft fitted with engines approved to use avgas with no grade identification displayed:



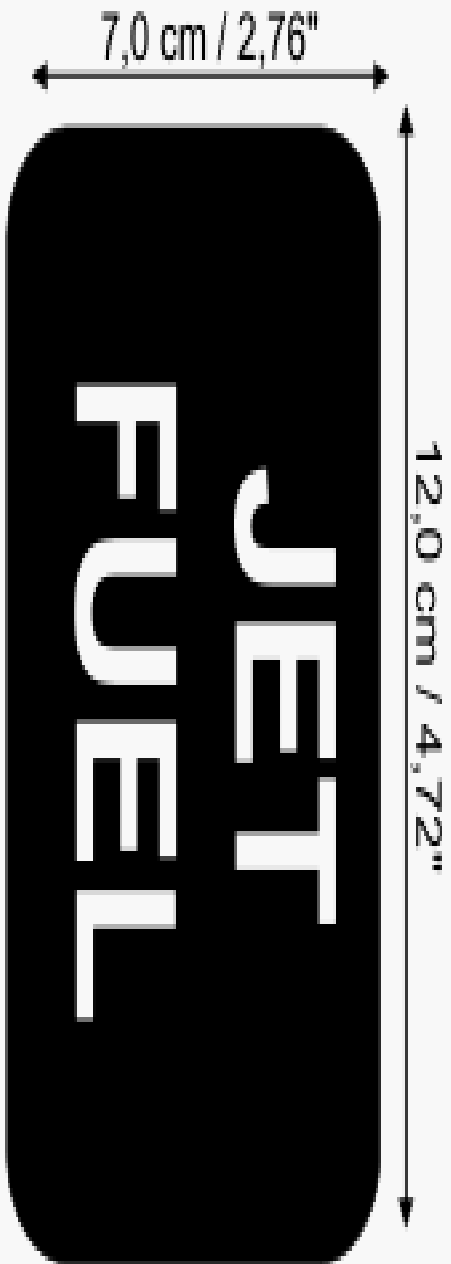
A.2.2 Decal #2

To be used on aircraft fitted with engines approved to use avgas, grade 100LL:



A.2.3 Decal #3

To be used on aircraft fitted with engines approved to use jet fuel:



A.3 MATERIAL SPECIFICATION

A.3.1 Overview

Decals should conform to the detailed requirements of General Aviation Manufacturers Association (GAMA) Specification #3 to ensure satisfactory performance. Decals meeting this specification were developed to withstand the extreme conditions aircraft are exposed to such as temperature, moisture, ultra-violet radiation and fuel spillage without excessive deterioration to provide years of functional service.

A.3.2 Composition

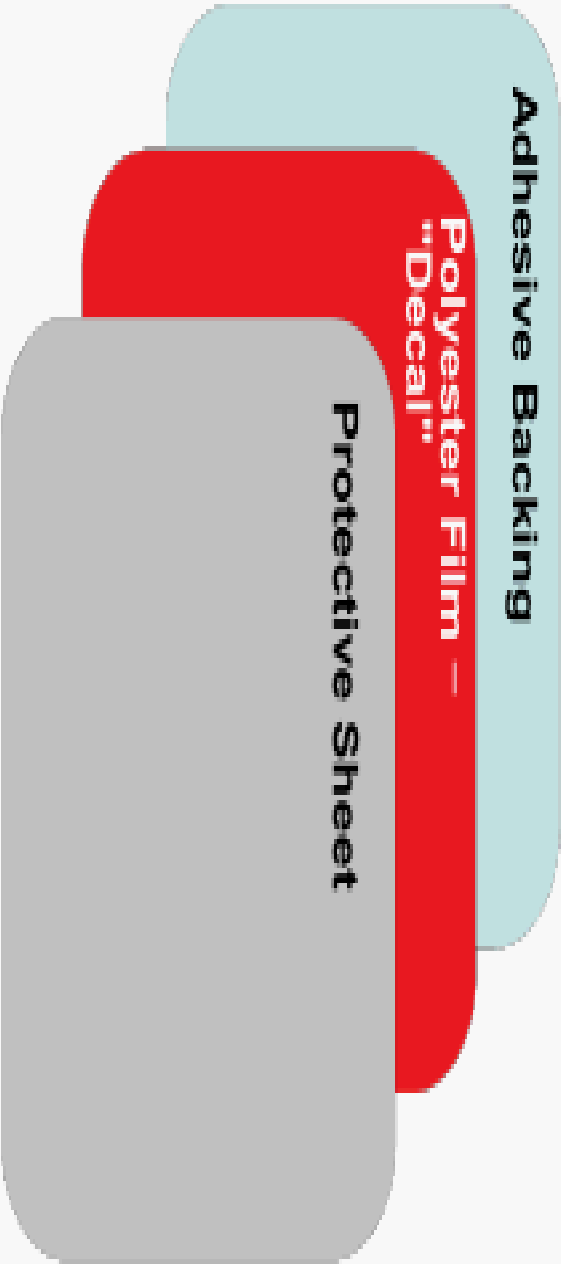
The material shall consist of a smooth, uniform, pigmented polyester plastic film without pinholes or other defects in the film surface. A pressure sensitive adhesive shall be applied to the unmarked side of the film.

A.3.3 Colour

The colour of the pigmented plastic marking material shall be either inherent in the basic film or overlaid on the base film. The decal background shall be red for avgas and black for jet fuel. All text is white. PMS #200 is the preferred red colour; however, equivalent colours may be used. No PMS number is available for black or white.

A.3.4 Configuration

A protective transfer sheet shall be applied to the marked side of the polyester film. The transfer sheet shall be paper suitably treated with a low tack, pressure sensitive adhesive on the surface in contact with the face side of the decal. The adhesive backing shall be protected by a suitable liner, treated paper or other material, which shall be easily removed without the use of water or other solvents for fast, distortion-free application of the decal.



A.3.5 Film thickness

Finished markings, including adhesive but not including backing paper, shall not be thicker than 0,0125 cm/0,005".

A.4 DECAL STORAGE

The shelf-life of the decals is not known. Therefore, to preserve the decals in good condition during long term storage, keep the decals in a clean, dry location away from extreme heat or cold and direct sunlight. Inspect every decal carefully for any sign of deterioration or manufacturing flaw before giving to a customer, especially if the decals have been in storage for an extended period.

ANNEX B

EXAMPLE FUEL ORDER FORM

This form to be used when:

Tick box

- ☐ 1. No decals are visible adjacent to the aircraft tank orifice; or
- ☐ 2. Selective spout will not fit aircraft tank orifice;
- ☐ 3. Aircraft equipped with a Diesel Engine; or
- ☐ 4. Use of non-selective spout is necessary to refuel majority of aircraft

Aircraft Information and Confirmation of Requirements:

Pilot/Aircraft Operator to complete this section

Registration

Aircraft

Fuel Requirements

Fuel Grade

Jet Fuel
Aviation Turbine Kerosene



BLACK

Avgas
Aviation Gasoline



RED

Quantity

Litre

USG

Litres

USG

Aircraft Pilot/Operator

Name

Date

Signature

Time

Selective Spout Replacement Confirmation:

Operator to complete this section

If you are using this form because of situation '2' above

**PLEASE CONFIRM THAT YOU HAVE REPLACED THE SELECTIVE SPOUT
ONTO THE NOZZLE**

Signature

ANNEX C

TASK BREAKDOWN SHEET

C.1 AIRCRAFT FUELLING USING A FUELLER – OVERWING

PURPOSE

Essential precautionary procedures are required to prevent the incorrect grade of fuel being delivered to aircraft.

FREQUENCY

As required.



PERSONAL PROTECTIVE EQUIPMENT (The trainer should describe the PPE required for this task, why it is needed and its correct use and maintenance)

Gloves, safety boots, safety glasses, protective uniform, hearing protection and bump cap.

STAGES Go through the task or subject. Select suitable portions for the learner to master.	KEY POINTS Anything in a stage which might: – Affect the results of the task or test – Cause personal injury or affect safety – Result in a product spillage – Make performance of the task easier or more efficient	OTHER INFORMATION These tips are provided for the help of trainers and trainees. This should not preclude the trainer from using his own key tips commensurate with his experience at the specific work-site.
1. Processing fuel orders (establish the grade of fuel required)	<ol style="list-style-type: none"> Verbal or written orders from customers should state the grade of fuel required. For orders that <u>do</u> state grade reference - repeat the details of the order back to the customer to confirm that they are correct. For orders that <u>do not</u> state the grade of fuel required, ask the customer "what grade do you require?" and then repeat the grade back to the customer. Notes: <ol style="list-style-type: none"> <i>This process is mandatory for all overwing fuellings.</i> Grade confirmation is required regardless of how well fuelling operators know the customer or the aircraft type. Also confirm the quantity of fuel required and if relevant the quantity required in particular aircraft tanks. 	It is essential that extra precautions are carried out to ensure that correct grade of fuel is delivered to light aircraft. These aircraft can be powered by turbine, diesel or piston engines and many serious accidents have resulted because the wrong grade of fuel has been supplied.

PROCEDURES FOR OVERWING FUELLING TO ENSURE DELIVERY OF THE CORRECT FUEL GRADE TO AN AIRCRAFT

STAGES	KEY POINTS	OTHER INFORMATION				
Go through the task or subject. Select suitable portions for the learner to master.	Anything in a stage which might: <ul style="list-style-type: none">– Affect the results of the task or test– Cause personal injury or affect safety– Result in a product spillage– Make performance of the task easier or more efficient	These tips are provided for the help of trainers and trainees. This should not preclude the trainer from using his own key tips commensurate with his experience at the specific work-site.				
	<ol style="list-style-type: none">Orders received verbally should be written down onto a suitable form (the Fuel Order Form should not be used for this purpose), which captures key information - including the grade of fuel required.Include the grade required when passing on fuel orders to other fuelling personnel. Include the grade required when recording fuel orders onto daily work schedules.					
2. Inspection and checks prior to driving	<ol style="list-style-type: none">Walk around the vehicle to check that the fueller is operational and ready for use.Check that fire extinguishers are correctly stowed.Carry hearing protection.Check all of the sampling equipment carried on the vehicle.Check the unit for leaks, defects, obstructions and that hoses are correctly stowed away.Check that there is a sufficient quantity of fuel in the fueller to meet the requirements of the expected fuelling.Confirm that the vehicle is water free (tank has been sumped and is free of water and particulate) and ready for use.Check that the vehicle has the correct grade for the expected fuelling.Check that the larger diameter spout is attached to the nozzle for jet fuel fuelling (67 mm diameter). If the larger jet nozzle is not in place contact supervisor and have it installed prior to using the vehicle.Check that you have the following:Fuel Order Forms.Grade decals for the grade carried by the specific vehicle<ul style="list-style-type: none">– Wing mat– Calculator– Posted airfield prices– Delivery certificate– Forms showing various wording for jet and avgas in different languages (if applicable)	Note colour coding on the nozzle: <table><tr><td>Jet Fuel</td><td>BLACK</td></tr><tr><td>Avgas</td><td>RED</td></tr></table>	Jet Fuel	BLACK	Avgas	RED
Jet Fuel	BLACK					
Avgas	RED					
3. Vehicle start up	<ol style="list-style-type: none">Move the battery master switch to the "on" position.Start the vehicle.Check the air pressure prior to moving.Check that brake interlock seals, if fitted, are locked in the normal operating position.	Do not drive the vehicle with the interlocks unsealed. If the interlocks are not sealed report the matter to the Supervisor.				
4. Drive away	<ol style="list-style-type: none">Test the brakes as soon as possible and before leaving the depot.Observe and obey the depot and airport speed limits.	If the first time you use the brakes is when you are approaching the aircraft, it may be too late to avoid an accident. Even at low speeds, seat belts are compulsory and can save lives. Vehicles shall not be driven faster than 25 km/h (15 mph) on the apron. Where airport or local authorities specify a lower limit this shall be obeyed. Driving at 10/15 mph in a				

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		head-on collision can result in a higher combined speed. Beware of vehicle and road characteristics and risk of rollover during ALL cornering manoeuvres.
5. Approach aircraft and park	<ol style="list-style-type: none"> 1. A second brake check shall be made some 15 m (50 feet) before reaching the aircraft. 2. Check that the aircraft engines have stopped, that the anti-collision lights are switched off and that you can see the aircraft wheels have been chocked before you approach. 3. Approach the aircraft and park in stand off position from the aircraft. 4. Standoff fuellings must be made with no part of the fueller under aircraft tank vents and the vehicle engines and exhausts shall be at least 3 m (10 ft) away from the aircraft vents. 5. Reversing to or from aircraft shall be avoided unless no other alternative is available. If reversing has to be undertaken a guide man shall be present during vehicle manoeuvring. 6. Park the fueller ensuring that there are no obstructions in front of the vehicle, which may prevent it from being driven away in the event of an emergency. 7. Apply the vehicle handbrake. 	Perform brake check in such a manner as not to cause danger to other apron traffic. Venting from aircraft tanks can be potentially hazardous if the fuel spray comes into contact with hot surfaces. Always avoid creating the fire triangle (fuel, oxygen, ignition source) by keeping a good clearance from the vents and hot surfaces of the fueller.
6. Establish grade (and quantity) of fuel required	<ol style="list-style-type: none"> 1. Fuelling shall not commence on the assumption that a particular grade of fuel is required. 2. Confirmation, by the methods noted below, shall always be obtained from the pilot or representative of the airline/operator. Grade confirmation immediately prior to fuelling shall be achieved by either: <ul style="list-style-type: none"> – Sighting the aircraft's grade decals Walk around the aircraft and look carefully at each fuelling port to check to see if there is at least one decal signifying the grade, before you get ready to refuel the aircraft. If a decal is present, check that it is the same grade as in the refuelling vehicle to be used for the refuelling. Note: If the decal is different from the grade of fuel in the refuelling vehicle, STOP what you are doing until the correct grade of fuel to be delivered is confirmed with the pilot. Fill out a Near Miss Report. – OR – If there is no grade decal, a Fuel Order Form shall be completed by, and then signed by, the pilot or an airline representative. 	<p>Jet Fuel Black background with grade lettering marked in white.</p>  <p>Avgas Red background with grade lettering marked in white.</p>  <p>Diesel aircraft engines:</p> <p>Several companies are now producing aircraft engines that are powered by jet fuel or diesel. These engines are being installed on aircraft that typically had previously been fitted with engines that used avgas.</p> <p>These aircraft represent a serious risk of misfuelling by the delivery of avgas to an engine designed for diesel fuel. Also, because these aircraft were originally designed for use with avgas, most will have filling orifices that are too small for the normal 67 mm jet fuel nozzle.</p>

PROCEDURES FOR OVERWING FUELLING TO ENSURE DELIVERY OF THE CORRECT FUEL GRADE TO AN AIRCRAFT

STAGES Go through the task or subject. Select suitable portions for the learner to master.	KEY POINTS Anything in a stage which might: <ul style="list-style-type: none"> – Affect the results of the task or test – Cause personal injury or affect safety – Result in a product spillage – Make performance of the task easier or more efficient 	OTHER INFORMATION These tips are provided for the help of trainers and trainees. This should not preclude the trainer from using his own key tips commensurate with his experience at the specific work-site.
	<p>Request the pilot to complete a Fuel Order Form stating the correct grade required before starting the fuelling operation. See Annex B for an example form.</p> <ul style="list-style-type: none"> – Then <p>Offer the correct grade decals to the pilot if none are seen on the aircraft.</p> <p><i>Note: Airport site staff shall not apply decals to aircraft.</i></p> <p><i>Note: Always ensure sufficient stocks of grade decals (avgas and jet fuel) are held at airfield depots for distribution to pilots free of charge.</i></p> <p>If there is no decal and no signed Fuel Order Form, you must not put fuel on the aircraft.</p> <p>3. Confirm the quantity of fuel required and if relevant the quantity required in particular aircraft tanks.</p>	<p>Although the engines fitted to certain aircraft types may be certified for use with jet fuel and diesel, DIESEL FUEL SHALL NOT be supplied to aircraft.</p>
<p>7. What to do if there is difficulty in establishing grade</p>	<p>1. Particular care is also required whenever:</p> <ul style="list-style-type: none"> – There are language difficulties between the pilot and the fuelling staff. Use only standard product names to avoid additional confusion. Show the form of wording for avgas and jet fuel in various languages to assist in this process. – The aircraft is transiting and is not well known at the airport. – It is known that the customer operates both piston and turbine engined aircraft of similar size and type. <p>2. If doubt still exists draw a sample from the fuelling vehicle and show it to the pilot for examination and acceptance.</p>	
<p>8. What to do if the larger diameter jet nozzle will not fit the fuelling orifice</p>	<p>If the aircraft will not accept the larger diameter jet fuel nozzle, a smaller jet fuel nozzle shall be available. These are to be kept in secure containers on the vehicle and only fitted for those fuellings where they are required and returned to their containers/storage site when fuelling is complete.</p> <p>Whenever it is necessary to remove the selective spout and fit the smaller diameter spout, the operator shall complete a Fuel Order Form.</p> <p>If the spout has to be changed see detailed procedures below:</p> <ol style="list-style-type: none"> 1. Ensure the meter valve is closed. 2. Remove the large diameter spout. 3. Ensure the spout and quick connect surfaces are clean before fitting the replacement spout. 4. Fit the small diameter spout. 	

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	<ol style="list-style-type: none"> Place the large diameter spout in the secure container. Continue with the fuelling procedure. After fuelling is complete ensure the large diameter spout is refitted to the hose; first repeating step 3 above. Replace the small diameter spout in the secure container. Complete the bottom section of the Fuel Order Form to confirm that the selective spout has been replaced. <p><i>Note: At some locations it may be considered impractical to have the jet fuel selective spout fitted because of the high number of aircraft unable to use them. In this case, the small diameter spout may be permanently fitted. However in such circumstances Fuel Order Forms shall be completed for all (jet fuel and avgas) overwing fuellings, this is regardless of decals being in place.</i></p>	
9. Bond vehicle	<ol style="list-style-type: none"> Always bond to a designated point on the aircraft (usually located on the undercarriage). The clip shall not be attached to propellers, radio antennae, pilot tubes, the exhaust of a piston engine or turbine engine tail pipes. Ensure that the bonding point is located on an unpainted metal surface. 	Painted surfaces may not provide electrical continuity. Poor electrical continuity may lead to static electricity build-up which may provide an ignition source and could result in an aircraft fire.
10. Position auxiliary equipment and prepare to fuel	<ol style="list-style-type: none"> If a ladder is necessary, it shall be positioned such that the fuelling orifice can be accessed whilst ensuring there is no risk of damage to the aircraft. <p><i>Note: Ladders shall never be placed against the leading edge of a wing fitted with a de-icing boot.</i></p> <ol style="list-style-type: none"> Unwind the hose. Position the hose so as to minimise the potential of a trip hazard when using steps/ladders. Place wing mat. If the filler caps have been removed prior to the fuelling operation, they should be replaced and vapour in the vicinity allowed to disperse before continuing the operation. 	During windy conditions the hose should be run out before setting up the steps to prevent them being blown away or into an aircraft.
11. Safety precautions	<ol style="list-style-type: none"> Exercise extreme care in order to prevent damage to wing surfaces. <p><i>Note: Whenever possible the fuelling hose should be supported to prevent damage to wing surfaces.</i></p> <ol style="list-style-type: none"> Hoses shall not be routed over the wing trailing edge. Hose trigger nozzles shall be held open manually and shall never be wedged open. The weight of the nozzle and hose shall be supported at all times in order to prevent damage and distortion to the tank filler neck. The nozzle spout diameter must be small enough to 	

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	enter the aircraft tank filler orifice whilst leaving sufficient space to allow displaced air to escape to prevent pressurisation of the tank. 6. Care should be taken to stand upwind of the tank filler if possible in order to avoid inhaling fumes and to protect the tank opening during rain. 7. Care shall be taken not to step on areas marked "No Step". 8. Loose articles shall not be carried in caps, shirts or jackets as they might fall into aircraft tanks. 9. Bonding clips, dust caps etc. should be examined to ensure that they are securely attached and cannot fall into the aircraft tanks. 10. Should any article be dropped into an aircraft tank this shall be reported to the customer immediately.	
12. Fuel aircraft	1. Engage vehicle power take-off (PTO). 2. Open the fuelling vehicle's foot valve(s). 3. Ensure that the vehicle meter reads zero, also ensure that the totaliser meter figure matches the figure on the flight delivery ticket. 4. Open the vehicle meter valve. <i>Note: Be aware that if using "pre-set meters" fuelling may not start if they are not set correctly. The use of pre-set meters can be of great assistance when carrying out single operator fuellings.</i> 5. Equalise electrical potential by touching nozzle to metal wing surface. 6. Open filler cap. 7. Where possible, bond the nozzle bonding clip to the bonding lug (or use a "Jack Plug" if fitted). On some light aircraft, bonding of the nozzle may not be possible and in this case the nozzle should be kept in continuous contact with the aircraft filling orifice. 8. Open the trigger nozzle slowly and regulate the flow rate in order to limit splash back. 9. Release the trigger nozzle when the desired quantity of fuel has been delivered to each tank and ensure that the filler cap is replaced correctly before the bonding clip is removed. 10. Repeat from step 5 for any other aircraft tanks to be filled.	
13. Close valves	1. Close the delivery meter valve. 2. Close the foot valve to the vehicle tank.	
14. Rewind hose	1. The nozzle may be laid on the ground next to the vehicle during rewind until the hose is nearly fully rewound (at which time it should be lifted and held). 2. Slowly activate the hose rewind system of the fueller to pull in hoses, ensuring the rewind is carried out in a safe and controlled manner. Stand clear of the hoses during rewind. 3. At the point when the hose is fully rewound, stop the rewind system and ensure that the large	

ANNEX C

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	diameter nozzle spout is fitted to the hose nozzle and the small diameter nozzle spout is in the secure container then place the nozzle in its stowage point. 4. Place the coupling in its stowage point.	
15. Clear equipment and complete delivery certificate	<ol style="list-style-type: none"> 1. Remove and stow auxiliary equipment such as sample bottles, portable ladders etc. 2. Remove the bonding cable and stow. 3. Complete the Delivery Certificate, aircraft registration, quantities and grade of fuel, and obtain the pilot's/airline representative's signature. 4. Walk completely around the vehicle in order to check for obstructions and to ensure that all auxiliary equipment has been correctly stowed away. 5. Disengage the power take-off, release the handbrake and drive the vehicle away. 	The walk around must be a conscious, deliberate step at the completion of every refuelling. A complete circuit must be made around the vehicle to ensure all hoses are stowed and no obstacles impede egress. Ensure seat belts are worn at all times vehicle is in motion.

ANNEX D

REFERENCES

The following publications are referenced in this publication:

ASTM D 910 Standard specification for aviation gasolines

ASTM D 1655 Standard specification for aviation turbine fuels

Defense Standard 91-90 Gasoline, Aviation: Grade 80/87, 100/130 and 100/130 low Lead

Defense Standard 91-91 Turbine Fuel, Aviation "Kerosene Type", Jet A-1

EI Standard 1542 *Identification markings for dedicated aviation fuel manufacturing and distribution facilities, airport storage and mobile fuelling equipment*

General Aviation Manufacturers Association (GAMA) Specification #3¹

The Pilot Operating Handbook

SAE Aerospace Standard AS 1852 *Nozzles and ports - Gravity fuelling interface standard for civil aircraft*

¹ Available from General Aviation Manufacturers Association, 1400 K Street NW, Suite 801, Washington, DC 20005, Telephone: +1 (202) 393-1500

Global aviation fuel handling publications

The Energy Institute is the provider of the following portfolio of equipment standards and operational recommended practices to facilitate the safe and efficient handling of aviation fuel, particularly at airports. They are available for use internationally. The titles include those that were developed jointly with the API.

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General			
Title		Ed.	ISBN
EI 1540	Design, construction, operation and maintenance of aviation fuelling facilities	4th	978 0 85293 565 1
EI 1541	Performance requirements for protective coating systems used in aviation fuel storage tanks and piping	1st	978 0 85293 566 8
EI 1542	Identification markings for dedicated aviation fuel manufacturing and distribution facilities, airport storage and mobile fuelling equipment	8th	978 0 85293 567 5
EI 1585	Guidance in the cleaning of aviation fuel hydrant systems at airports	2nd	978 0 85293 568 2
EI 1594	Initial pressure strength testing of airport fuel hydrant systems with water	2nd	978 0 85293 569 9
EI 1597	Procedures for overwing fuelling to ensure delivery of the correct fuel grade to an aircraft	1st	978 0 85293 570 5
EI HM 20	Meter proving: Aviation fuelling positive displacement meters	1st	978 0 85293 302 2
Equipment (excluding filtration)			
EI 1529	Aviation fuelling hose and hose assemblies	6th	978 0 85293 571 2
EI 1584	Four-inch hydrant system components and arrangements	3th	978 0 85293 572 9
EI 1598	Considerations for electronic sensors to monitor free water and/or particulate matter in aviation fuel	1st	978 0 85293 573 6
EI Research report	Review of methods of bonding a hydrant dispenser (servicer) to an aircraft for refuelling	1st	978 0 85293 475 3
Filtration equipment			
EI 1550	Handbook on equipment used for the maintenance and delivery of clean aviation fuel	1st	978 0 85293 574 3
EI 1581	Specification and qualification procedures for aviation jet fuel filter/separators	5th	978 0 85293 575 0
EI 1582	Specification for similarity for EI 1581 aviation jet fuel filter/separators	1st	978 0 85293 576 7
EI 1583	Laboratory tests and minimum performance levels for aviation fuel filter monitors	5th	978 0 85293 527 9
EI 1590	Specifications and qualification procedures for aviation fuel microfilters	2nd	978 0 85293 577 4
EI 1596	Design and construction of aviation fuel filter vessels	1st	978 0 85293 578 1
EI 1599	Laboratory tests and minimum performance levels for aviation fuel dirt defence filters	1st	978 0 85293 579 8
EI Research report	Electrostatic discharges in 2-inch fuel filter monitors	1st	978 0 85293 388 6
EI Research report	Electrostatic discharges in 2-inch aviation fuel filter monitors Phase 2: Properties needed to control discharges	1st	978 0 85293 408 1
EI Research report	Investigation into the effects of lubricity additives on the performance of filter/water separators	1st	978 0 85293 395 4
North American fuel handling			
API 1543	Documentation, monitoring and laboratory testing of aviation fuel during shipment from refinery to airport	1st	A154301
API 1595	Design, construction, operation, maintenance, and inspection of aviation pre-airfield storage terminals	1st	A159501

