SHELL AVIATION FUELS

Shell Aviation fuels may be classified into three basic groups : aviation gasoline, for use in reciprocating or piston engines; aviation turbine fuels (jet fuels), for use in turbo-fan, turbo-jet and turbo-prop engines and power boost fluids. The various grades of each type available are described in this section.

All Shell Aviation fuels are produced to stringent manufacturing specifications. At every stage between refinery and aircraft tank, fuel quality is checked by sampling and laboratory analysis, to ensure that the fuel conforms to the requirements specified for the grade when it is delivered to the aircraft. The Shell Aviation Quality Assurance System is organised on a worldwide basis, made easier because Shell Aviation Service is provided directly in many countries of the world; a representation matched by no other supplier of aviation fuel.

AVIATION TURBINE FUEL (JET FUEL)

Today's kerosine 'Jet' fuels have been developed from the illuminating kerosine used in the early gas turbine engines. These engines needed a fuel with good combustion characteristics and a high energy content. The kerosine type fuels used in civil aviation nowadays are mainly Jet A-1 and Jet A. The latter has a higher freezing point (maximum –40°C instead of maximum –47°C) and is available only in North America.

MAJOR CIVIL JET FUEL GRADES

Jet A-1

Jet A-1 is a kerosine grade of fuel suitable for most turbine engined aircraft. It has a flash point minimum of 38°C (100°F) and a freeze point maximum of –47°C. It is widely available outside the U.S.A. The main specifications for Jet A-1 grade (see below) are the UK specification DEF STAN 91-91 (Jet A-1) NATO code F-35, (formerly DERD 2494) and the ASTM specification D 1655 (Jet A-1).

Jet A

Jet A is a kerosine grade fuel, normally only available in the U.S.A. It has the same flash point as Jet A-1 but a higher freeze point maximum (–40°C). It is supplied against the ASTM D 1655 (Jet A) specification. Jet A is used within the United States by domestic and international airlines.

Jet B

Jet B is a distillate covering the naphtha and kerosine fractions. It can be used as an alternative to Jet A-1, but because it is more difficult to handle (higher flammability), there is only significant demand in very cold climates where its better cold weather performance is important. Jet B is specified by ASTM D 6615, but in Canada it is supplied against the Canadian Specification CAN/CGSB 3.23

TS-1

TS-1 is the main jet fuel grade available in Russia and CIS states. It is a kerosine type fuel with slightly higher volatility (flash point is 28°C minimum) and lower freeze point (<–50°C) compared with Jet A-1. It is supplied against the GOST 10227 specification.

No.3 Jet Fuel

No.3 Jet Fuel is the main Chinese export grade which is essentially identical to Jet A-1.

AMERICAN CIVIL JET FUELS

The basic civil jet fuel specification used in the United States of America is ASTM Specification for Aviation Turbine Fuels D 1655, which defines the requirements for the two grades of fuel – Jet A and Jet A-1 (Note: ASTM D 1655 used to include Jet B but this grade is now covered by a separate specification ASTM D 6615).

UK JET FUELS

Although developed basically as a military jet fuel, D.Eng RD 2494, issued by the Ministry of Defence, was adopted as the standard UK civil jet fuel. It is now renamed as DEF STAN 91-91 and defines the requirements for a kerosine type fuel (Jet A-1 grade) having a maximum freeze point of –47°C.

Jet A-1 according to the DEF STAN 91-91 specification is very similar to Jet A-1 defined by the ASTM D 1655 except for a small number of areas where DEF STAN 91-91 is more stringent.

FORMER SOVIET UNION AND EAST EUROPEAN JET FUELS

Russian kerosine type jet fuels are covered by a wide range of specification grades reflecting different crude sources and processing treatments used. The grade designation is T-1 to T-8, TS-1 or RT. The grades are covered either by a State Standard (GOST) number, or a Technical Condition (TU) number. The limiting property values, detailed fuel composition and test methods differ quite considerably in some cases from the Western equivalents.

The principle grade available in Russia (and members of the CIS) is TS-1 (written as TC-1 in Russian script).

The main differences in characteristics are that Russian fuels have a low freeze point (equivalent to about –57°C by Western test methods) but also a low flash point (a minimum of 28°C compared with 38°C for western fuel). RT fuel (written as PT in Russian script) is the superior grade (a hydrotreated product) but is not produced widely. TS-1 (regular grade) is considered to be on a par with Western Jet A-1 and is approved by most aircraft manufacturers.

Eastern European countries have their own national standards with their own nomenclature. Many are very similar to the Russian standards, but others reflect the requirements of visiting international airlines and are similar to Western Jet A-1 in properties and test methods.

CHINESE JET FUELS

Five types of jet fuel are covered by current Chinese specifications. Previously, each grade was numbered with a prefix RP; however, they are now renamed No.1 Jet Fuel, No.2 Jet Fuel, etc.. RP-1 and RP-2 are kerosines which are similar to Russian TS-1. They both have low flash points (minimum 28°C). RP-1 freeze point is –60°C and RP-2 is –50°C. RP-3 is basically, as Western Jet A-1, produced as an export grade. RP-4 is a wide-cut type fuel similar to Western Jet B and Russian T-2. RP-5 is a high flash point kerosine similar to that used in the west by naval aircraft operating on aircraft carriers. Virtually all jet fuel produced in China is now RP-3 (renamed No.3 Jet Fuel).

INTERNATIONAL SPECIFICATIONS - AFQRJOS CHECK LIST

As jet fuel supply arrangements have become more complex, involving co-mingling of product in joint storage facilities, a number of fuel suppliers developed a document which became known as the Aviation Fuel Quality Requirements for Jointly Operated Systems, or AFQRJOS, Joint Fuelling System Check List. The "Check List" embodies the most stringent requirements of the DEF STAN 91-91 and ASTM D 1655 specifications for JET A-1. By definition, any product meeting Check List requirements will also meet either DEF STAN or ASTM specifications.
The Check List is recognised by eight of the major aviation fuel suppliers - Agip, BP, ChevronTexaco, ExxonMobil, Kuwait Petroleum, Shell, Statoil and TotalFinaElf - as the basis of their international supply of virtually all civil aviation fuels outside North America and former Soviet Union.

OTHER NATIONAL CIVIL JET FUEL SPECIFICATIONS

There are many individual national specifications. Typically, these are based on the US, UK or former Soviet specifications with minor differences. There are increasing moves to harmonise the small differences between the ASTM and DEF STAN specifications. This process of harmonisation is also in progress with many national specifications.

MILITARY JET FUEL GRADES

JP-4

JP-4 used to be the primary jet fuel for the USAF but was phased out in the 1990s because of safety problems. A few airforces around the world still use it but there is very little production.

JP-4 is the military equivalent of Jet B with the addition of corrosion inhibitor and anti-icing additives; it meets the requirements of the U.S. Military Specification MIL-DTL-5624T Grade JP-4. The UK Military specification for this grade is DEF STAN 91-88 AVTAG/FSII (formerly DERD 2454), where FSII stands for Fuel System Icing Inhibitor. NATO Code F-40.

JP-5

JP-5 is a high flash point kerosine meeting the requirements of the U.S. Military Specification MIL-DTL-5624T Grade JP-5. The UK Military specification for this grade is DEF STAN 91-86 AVCAT/FSII (formerly DERD 2452). This is primarily jet fuel for use in aircraft carriers. NATO Code F-44.

JP-8

JP-8 is the military equivalent of Jet A-1 with the addition of corrosion inhibitor and anti-icing additives; it meets the requirements of the U.S. Military Specification MIL-DTL-83133E. It is the dominant military jet fuel grade for NATO airforces. The UK also have a specification for this grade namely DEF STAN 91-87 AVTUR/FSII (formerly DERD 2453). NATO Code F-34.

JP-8 +100

JP-8 +100 is JP-8 fuel to which has been added an approved thermal stability improver additive. It meets the requirements of the U.S. Military Specification MIL-DTL-83133E and is widely used by USAF in their fighter and trainer wings. NATO Code F-37.

AVIATION GASOLINE (AVGAS)

Aviation Gasoline (Avgas) is used in small piston engine powered aircraft within the General Aviation community, e.g. private pilots, flight training, flying clubs and crop spraying. Piston engines operate using the same basic principles as spark ignition engines in cars, but they have a much higher performance requirement. In today's General Aviation community there are only two main Avgas grades (100 and 100LL low lead) - a rationalisation that has enabled fuel companies to continue supplying a market that would otherwise have become uneconomic. Worldwide, total Avgas volumes are low, since Avgas-fuelled aircraft, although they outnumber jet-fuelled aircraft, are generally much smaller.

AVGAS GRADES

Avgas 100

This is the standard high octane fuel for aviation piston engines and has a high lead content. There are two major specifications for Avgas 100. The ASTM D 910 and UK DEF STAN 91-90. These two specifications are essentially the same, but differ over antioxidant content, oxidation stability requirements and max lead content.

Avgas 100 is dyed green.

Avgas 100LL

This grade is the low lead version of Avgas 100. Low lead is a relative term. There is still up to 0.56 g/litre of lead in Avgas 100LL. This grade is listed in the same specifications as Avgas 100, namely ASTM D 910 and UK DEF STAN 91-90.

Avgas 100LL is dyed blue.

Avgas 82 UL

This is a relatively new grade aimed at the low compression ratio engines which do not need the high octane of Avgas 100 and could be designed to run on unleaded fuel. This grade is specified in ASTM D 6227.

Avgas 82UL is dyed purple.

History of Avgas Grades

Avgas is gasoline fuel for reciprocating piston engined aircraft. As with all gasolines, avgas is very volatile and is extremely flammable at normal operating temperatures. Procedures and equipment for safe handling of this product must therefore be of the highest order.

Avgas grades are defined primarily by their octane rating. Two ratings are applied to aviation gasolines (the lean mixture rating and the rich mixture rating) which results in a multiple numbering system e.g. Avgas 100/130 (in this case the lean mixture performance rating is 100 and the rich mixture rating is 130).

In the past, there were many different grades of aviation gasoline in general use e.g. 80/87, 91/96, 100/130, 108/135 and 115/145. However, with decreasing demand these have been rationalised down to one principle grade, Avgas 100/130. (To avoid confusion and to minimise errors in handling aviation gasoline, it is common practice to designate the grade by just the lean mixture performance, i.e. Avgas 100/130 becomes Avgas 100).

Some years ago, an additional grade was introduced to allow one fuel to be used in engines originally designed for grades with lower lead contents; this grade is called Avgas 100LL, the LL standing for 'low lead'.
All equipment and facilities handling avgas are colour coded and display prominently the API markings denoting the actual grade carried. Currently, the two major grades in use internationally are Avgas 100LL and Avgas 100. To ease identification the fuels are dyed, i.e. Avgas 100LL is coloured blue, while Avgas 100 is coloured green.
Very recently a new Avgas grade 82 UL (UL standing for unleaded) has been introduced. This is a low octane grade suitable for low compression engines. It has a higher vapour pressure and can be manufactured from motor gasoline components. It is particularly applicable to those aircraft which have STCs to use automotive gasoline.

SHELL AEROJET

Shell AeroJet is a new, premium aviation fuel service, offering major benefits to pilots, operators and owners of turbine powered aircraft. The service is available at selected airports and countries worldwide.
Shell AeroJet minimises or eliminates problems previously associated with the use of Jet A-1 in business jets, turbo-prop aircraft and helicopters.

Anti-Icing
The air inside fuel tanks contains moisture which can precipitate into the fuel as free water. This water has the potential to turn to ice during flight operation or even on the ground. Shell AeroJet contains an anti-icing additive that helps to eliminate this problem and gives added security in case of fuel heater system breakdown.

Anti-Fungal
The formation of water inside a tank creates an environment that allows the growth of bacteria and fungi. Left unchecked this growth can pose a serious danger to plane and passengers. The anti-icing additive in Shell AeroJet acts as a biostat which inhibits the growth of bacteria/fungi and so prevents these dangers occurring. This feature is particularly valuable for aircraft operating in humid conditions.

Assurance
The practice of using aerosol cans to mix anti-icing additive while overwing refuelling often results in an uneven mix and incorrect additive concentration as well as posing health hazards to the user from possible contact with the neat additive. The major advantages of Shell AeroJet over this and other systems is the assurance that the fuel has been dosed with the additive at exactly the correct rate every time without any exposure to liquid splashes or harmful vapours.

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