THE GAMGRAM

No. 53 **JET FUEL ADDITIVES PART 2** **FEB. 2002**

Several years ago a new employee asked me if we kept any jet fuel around for testing purposes. I said “yes, of course”. He asked if he could have some, just a few ounces. I said “sure, but asked what for?” His answer was "I thought if I just put an ounce or so in my motorcycle it would really make it go fast."

If you aren't smiling right now, you're fairly new to the industry.

My answer was, "It would be a lot like putting diesel fuel in your motorcycle." It took a long time to convince him that jet fuel was not a wonder product, it is really quite like kerosene. He was thinking of nitro-methane.

But a lot of people do not know what kind of fuel "jet fuel" actually is. Many people in the industry don't know the difference between different jet fuels, so we wrote this GamGram.

Jet fuel was not always a kerosene-like product. The first truly functional jet aircraft was the German ME-262. It was based on an English engineer's (Frank Whittle) turbine engine design. It ran on gasoline. The British development team of the same era was also working with gasoline.

The decision to change to a more kerosene-like product was made for three reasons: safety, space and cost. Gasoline is more flammable, it has fewer BTUs of energy per gallon and was more in demand for use in cars, so kerosene was a better choice as a fuel for jet engines.

Over the years, the industry has developed several different jet fuels in this world, made under these specifications; ASTM-D1655, Mil DTL-83133E, DEF STAN 91-91 (UK military), CG5B-322 (Canadian jet B), GOST 10227 (Russian) and a Chinese specification. There are also U.S. Military fuel standards such as the "JP-" fuels, which (for our purposes here) range from JP-4 (little used now), to JP-8. In addition there are specialty military fuels like JP-10 for cruise missiles. ASTM-D1655 allows for three basic Jet Fuels. The following are the basic specifications.

JET FUELS

SPECIFICATION	JET A ASTM D1655	JET A-1 ASTM D1655	JP-8	JP-4	JP-5	JET B
FLASH POINT MINIMUM	100.4°F 38°C	100.4°F 38ºC	100.4°F 38ºC	140°F 60ºC	N/A	N/A
FREEZE POINT MAXIMUM	-40°F -40°C	-52.6°F -47°C	-52.6°F -47°C	-50.8°F -46°C	-72.4°F -58°C	-58°F -50°C
DENSITY AT 15°C kg/m³	775 to 840	775 to 840	775 to 840	788 to 845	751 to 802	751 to 802

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As you can see, Jet A and Jet A-1 are the same except for freeze point. A point here; freeze point is not the temperature when fuel freezes, as the fuel is warmed from a lower temperature, it is the point where the last apparently frozen fuel melts. (Actually the point when the last crystals of paraffin disappear. Jet B and JP-4 are now used most often only in very cold climates where Jet A type fuels will not vaporize well. It is difficult to start an engine if the fuel will not vaporize easily.

JP-8 is Jet A-1 with three additives: conductivity improver/static dissipater, corrosion inhibitor and anti-icing additive.

JP-5 is much like Jet A fuels, but with a higher flash point (temperature when it vaporizes readily) of 140 ° F (60 ° C). This makes it a safer fuel for use aboard ships. This is not limited to aircraft carriers, there are many smaller ships capable of launching helicopters and Harrier VTOL fighters. In addition, helicopters are fueled in flight (HIFR) from a variety of ships, including destroyers.

Additives are allowed in jet fuels, the most commonly used world-wide is Stadis 450, a conductivity improver (made by Innospec) to help make ground equipment safer by dissipating static electricity in the fuel faster (see GamGram 7).

Other additives are:

1. Corrosion inhibitor (actually used to improve the "lubricity" of the fuel to reduce wear on fuel system components, such as pumps and valves.

2. Anti-icing additive (to prevent condensed water from forming as ice crystals and clogging fuel systems in small aircraft not equipped with heat protection),see GamGram 52.

3. Biocides such as Biobor (to kill microorganisms).

A new additive type is being explored which is designed to allow improvement in the engines. To understand this, you must first understand that fuel breaks down at high temperatures and can clog the injection nozzles. A major requirement in jet engine design is to keep that temperature down, not an easy task since the fuel burns at a very high temperature just as it leaves the injector nozzle. The US military has had great success with an additive (made by Betz Dearborn) most commonly called "+100". This additive permits the fuel to pass the thermal stability test (JFTOT) at a temperature 100° F higher than commercial jet fuel. This margin permits increased engine performance without hazardous deposit accumulation. It is a required additive in the new high performance fighters. Work is proceeding on the benefits of this additive in commercial aircraft, and large scale tests are underway by Betz and Shell Oil Company.

Additives are not used to improve jet fuel performance, but to address the needs of the industry, certain aircraft and certain conditions. They widen the range of use for this simple fuel. It is critical that we don't forget to keep these additives clean and free of contamination before they are added to fuel, and that we add them at the correct levels.