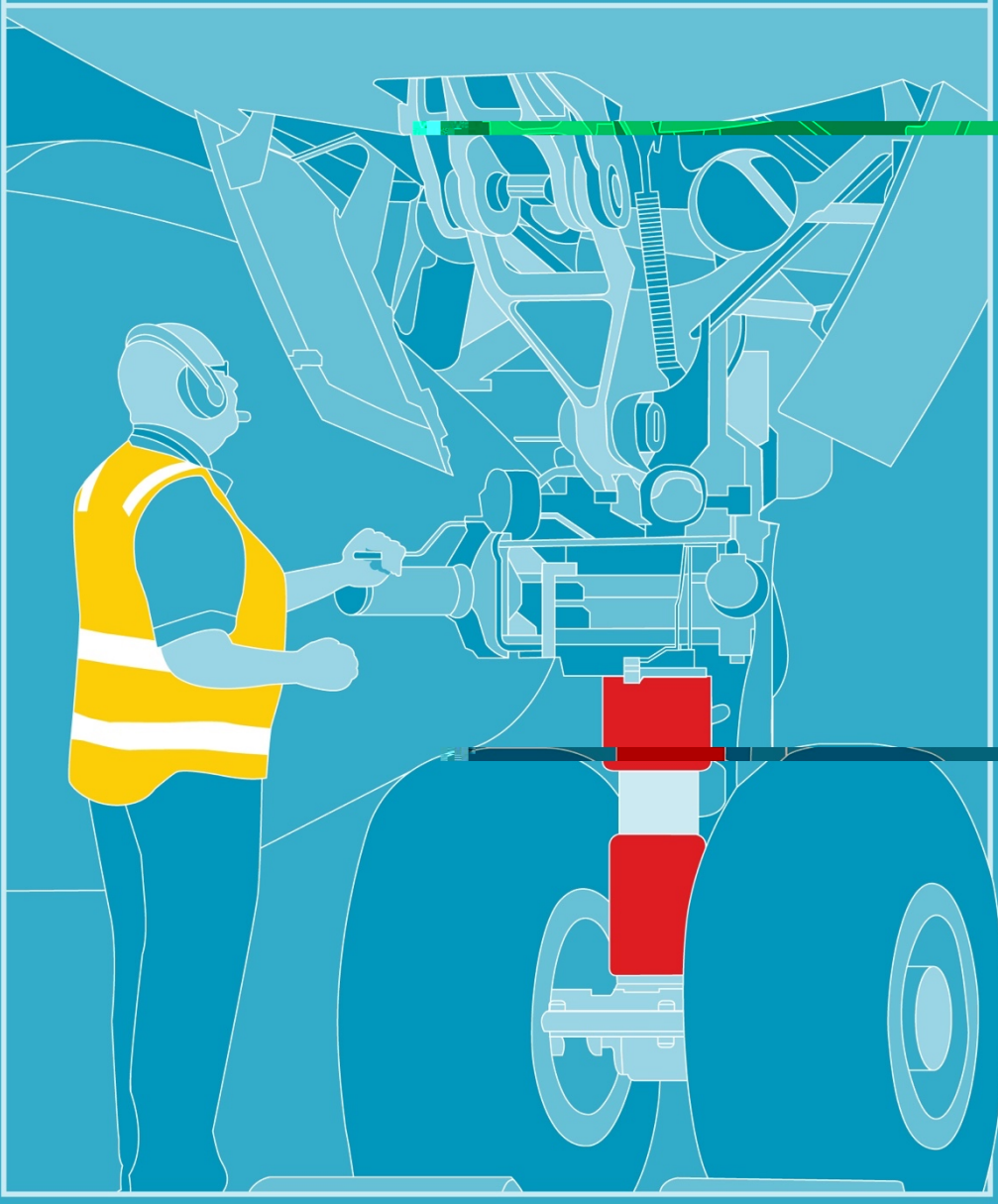
AEROSHELL HYDRAULIC FLUIDS



6. AEROSHELL HYDRAULIC FLUIDS

AeroShell Hydraulic Fluids are used in hydraulic applications on aircraft and consist of:-

AeroShell Fluid 4
AeroShell Fluid 41
AeroShell Fluid 31
AeroShell Fluid 61
AeroShell Landing Gear Fluid (LGF)

AeroShell Fluids 4 and 41 are mineral hydraulic fluids; the latter has superior cleanliness characteristics and is the more widely used grade.

AeroShell Fluid 31 is a synthetic hydrocarbon fire resistant hydraulic fluid. This type of fluid is increasingly replacing mineral hydraulic fluids.

AeroShell Fluid 61 is a preservative synthetic hydrocarbon fire resistant hydraulic fluid.

AeroShell LGF is a hydraulic fluid specifically for landing gear shock struts of some aircraft.

BACKGROUND

For many years, hydraulic systems have been utilised in military and commercial aircraft. They have provided power transfer which has been proven to be reliable, efficient and lightweight compared to mechanical or electrical power transfer services. Since the 1940s, MIL-H-5606 hydraulic fluid, a mineral oil-based fluid, has been one of the most widely used types of fluid. This hydraulic fluid has provided excellent operational properties over the temperature range of –54°C to 135°C (–65°F to 275°F). A major deficiency of MIL-H-5606 fluids, which was recognised early in its use, was its high degree of flammability. The hazard generated by the flammability of the fluid was greatly increased by the high pressure required for hydraulic system operation, 2.07 x 107 Pascals (3000 psi), and the vulnerability of hydraulic lines widely distributed throughout the aircraft.

Recognition of fire hazards associated with MIL-H-5606 (NATO Code H-515) fluids, resulted in the commercial aircraft industry developing hydraulic systems based on

phosphate ester based hydraulic fluids. However, the phosphate ester based fluids were not adopted by the military at that time because they were not compatible with MIL-H-5606 fluids nor with many of the materials (e.g. elastomers) used in MIL-H-5606 hydraulic systems in the aircraft. There was a view that the use of two incompatible hydraulic fluids could cause supply/logistic problems and could result in significant problems if the two fluids were ever inadvertently intermixed as they were not compatible or miscible. The cost of converting a MIL-H-5606 based hydraulic system to a phosphate ester based system was believed to be prohibitive owing to the requirement to change the elastomeric seals as well as many of the other materials used within and also outside the hydraulic system with which the fluid may come into contact (e.g. wiring insulation, paint, etc.). The commercial aircraft industry has found a significant reduction in the number of hydraulic fluid fires since the adoption of phosphate ester hydraulic fluids, and now all big civil transport aircraft use this type of fluid in the main hydraulic system.

Although the military did not move to phosphate ester type fluids they did identify the need for a more fire resistant fluid as a direct replacement for MIL-H-5606. As a result a synthetic hydrocarbon-based fluid, MIL-H-83282 was developed. This fluid is completely compatible with MIL-H-5606 fluids and MIL-H-5606 hydraulic system materials. All physical properties of MIL-H-83282 (now MIL-PRF-83282) were equivalent to or superior to those of MIL-H-5606 (now MIL-PRF-5606) except for low temperature viscosity. In particular all fire resistant properties of MIL-PRF-83282 are superior to those of MIL-PRF-5606.

More recently MIL-PRF-87257 was introduced in order to address the concerns over the low temperature viscosity of MIL-PRF-83282.

APPLICATIONS

Whenever an aircraft is certified, the hydraulic fluids are specified for each application point on the Type Certificate. The Type Certificate will specify, either by specification number or by specific brand names, those hydraulic fluids which are qualified to be used. The U.S. Federal Aviation Administration (FAA) regulations state that only hydraulic fluids qualified for specific applications can be used in certified

aircraft. Therefore, it is the responsibility of the aircraft owner or designated representative to determine which hydraulic fluid(s) should be used.

MAIN REQUIREMENTS

The main requirements for aircraft hydraulic fluids are:

- Low freezing point
- Minimum viscosity change with temperature
- Good corrosion and oxidation stability
- Good seal compatibility
- Shear stable
- Supercleanliness
- Fire resistant
- Good anti-foam properties
- Good low and/or high temperature stability

In addition most aviation hydraulic fluid specifications list other requirements which are either specific to the type of hydraulic fluid or to the intended application.

TYPICAL PROPERTIES

In the following section typical properties are quoted for each hydraulic fluid; there may be deviations from the typical figures given but test figures will fall within the specification requirement.

USEFUL OPERATING TEMPERATURE RANGE

The useful operating temperature ranges are quoted for guidance only and are based on the requirements as quoted in the relevant specification.

COMPATIBILITY

Mineral hydraulic fluids (MIL-PRF-5606, MIL-PRF-6083) are completely compatible and miscible with synthetic hydrocarbon hydraulic fluids (MIL-PRF-83282, MIL-PRF-87257 and MIL-PRF-46170) and vice versa.

Mineral hydraulic fluids (MIL-PRF-5606 and MIL-PRF-6083) and synthetic hydrocarbon hydraulic fluids (MIL-PRF-83282, MIL-PRF-87257 and MIL-PRF-46170) are not compatible with phosphate ester hydraulic fluids and on no account should they be mixed.

CHANGEOVER

Since mineral hydraulic fluids are compatible with synthetic hydrocarbon fluids changeover can be easily accomplished.

Two commonly used methods to convert existing MIL-H-5606 based hydraulic systems to MIL-PRF-83282 have been:

(1) draining the aircraft's hydraulic system or the hydraulic system reservoir of MIL-PRF-5606 and refilling with MIL-PRF-83282, thereafter servicing the aircraft's hydraulic system with MIL-PRF-83282 and

(2) merely topping off the reservoir with MIL-PRF-83282, as needed.

Both methods have been used with great success with no reported problems.

COMPATIBILITY WITH MATERIALS

When using hydraulic fluids containing a synthetic oil the compatibility with sealing materials, plastics or paints has to be examined.

As a general rule Shell Companies do not make recommendations regarding compatibility since aviation applications are critical and the degree of compatibility depends on the operating conditions, performance requirements, and the exact composition of materials. In many cases the equipment manufacturers perform their own compatibility testing or have their elastomer supplier do it for them. Many elastomer suppliers do produce tables showing the compatibility of their products

with a range of other materials. Therefore the information provided can only be considered as guidelines.

Elastomer/Plastic	Mineral Oil Based Hydraulic Fluids	Synthetic Hydrocarbon Based Hydraulic Fluids
Flurocarbon (Viton)	Very Good	Very Good
Acylonitrile	Good	Good
Polyester	Good	Good
Silicone	Poor to Good	Poor to Good
Teflon	Very Good	Very Good
Nylon	Poor to Good	Poor to Good
Buna-S	Poor	Poor
Perbunan	Good	Good
Methacrylate	Good	Good
Neoprene	Fair to Good	Fair to Good
Natural Rubber	Poor to Fair	Poor to Fair
Polyethylene	Good	Good
Butyl Rubber	Very Poor to Poor	Very Poor to Poor
Poly Vinyl Chloride	Poor to Good	Poor to Good

Compatibility Rating:
Very Good – Good – Fair – Poor – Very Poor

TYPES OF HYDRAULIC FLUIDS

Mineral

AeroShell Fluid 4
AeroShell Fluid 41
AeroShell Fluid LGF

Synthetic Hydrocarbon

AeroShell Fluid 31
AeroShell Fluid 61

HYDRAULIC FLUID CLEANLINESS - SUPERCLEAN PROPERTIES

Hydraulic fluid users should be keen to ensure optimum performance of hydraulic equipment and extend equipment life. One way of achieving this is by reducing wear of hydraulic system components. There are many ways in which wear can occur but one of the most common is due to particulates in the hydraulic fluid.

The latest issues of MIL-PRF-5606, MIL-PRF-6083, MIL-PRF-46170, MIL-PRF-83282 and MIL-PRF-87257 require hydraulic fluids to be "Superclean". By superclean it is meant that there is a very tight control on particulates in the fluid. Over the years, hydraulic systems and components have gotten smaller while operating pressures have increased. As a result, particulates in the hydraulic fluid are more likely to cause system failures through valve sticking, erosion by impingement, wear, or blockages of nozzles and tubes. Thus, these specifications include very tight limits on particulates.

Typically for MIL-PRF-5606J and MIL-PRF- 83282D the requirement is of the order:

Particle Size	MIL-PRF-83282D		MIL-PRF-5606J
	Microscopic Count	Automatic Count	Automatic Count
5 to 15 µm	2500	10000	8000
16 to 25 µm	1000	1000	1425
26 to 50 µm	250	150	253
51 to 100 µm	25	20	45
over 100 µm	10	5	8

MIL-PRF-5606J allows automatic method only
MIL-PRF-83282D allows both methods

Shell applies special process controls including multistage filtration, container cleaning just before filling, and 'clean room' packaging conditions in order to manufacture fluids that meet these stringent limits.

However, it would be pointless for Shell manufacturing plants to go to these extreme lengths if customers/operators do not handle the fluids in a manner that ensures that the superclean properties are maintained and enhanced.

Thus it is recommended that operators take extreme care by:

- never opening containers to atmosphere
- using containers of correct size
- using a dispensing device which includes fine filtration
- ensuring hydraulic system is clean and free from metal particles, dust, dirt and other contaminants
- periodically connecting the aircraft hydraulic system to ground hydraulic trolley and circulating fluid through fine filtration.

The latest issues of specifications MIL-PRF-5606, MIL-PRF-6083, MIL-PRF-46170, MILPRF-83282 and MIL-PRF-87257 require approved grades to meet the above levels of particulate contamination. The ISO 4406, BS.5540, NAS 1638 or SAE 749 requirements for cleanliness are NOT required by these specifications and thus AeroShell grades approved to these specifications are not automatically tested against these other cleanliness requirements. However, it has been found that normally AeroShell Fluid 4 is typically between Classes 8 and 9 in NAS 1638, whilst AeroShell Fluid 41 is typically between Classes 4 and 5 in NAS 1638.

AEROSHELL HYDRAULIC FLUIDS IN NON-AVIATION APPLICATIONS

AeroShell Hydraulic Fluids are widely used in non-aviation applications because of their superior performance, particularly at temperature extremes, when compared with standard industrial hydraulic fluids. Many non-aviation equipment manufacturers do permit use of AeroShell Hydraulic Fluids in their equipment and in many cases list the product in the appropriate manuals. Otherwise in selecting an AeroShell Hydraulic Fluid for a non-aviation application the properties of the hydraulic fluid must be examined. This will only give an approximate indication as to the expected performance in the specific application. However, such data must be regarded as guidance only. There is no laboratory test that can give a complete prediction of performance in actual use, and the final stage in any decision must involve performance tests in either the actual equipment or in the laboratory/test house under conditions expected in service.

AEROSHELL FLUID 4

AeroShell Fluid 4 is a mineral hydraulic oil with very good low temperature characteristics and capable of operating over a wide temperature range. AeroShell Fluid 4 is composed of a mineral oil base stock and a complex additive package which results in a product with good low temperature flow properties, anti-wear properties, antifoam characteristics, and oxidation stability.

AeroShell Fluid 4 is dyed red.

The useful operating temperature range unpressurised is –54°C to +90°C (–75°F to +194°F).
The useful operating temperature range pressurised is –54°C to +135°C (–75°F to +275°F).

APPLICATIONS

AeroShell Fluid 4 is intended for use as a hydraulic fluid in undercarriage retraction mechanisms, flap jacks and control mechanisms, brakes, shock absorbers, automatic pilots, oleo legs, tail wheels, servo units, etc. It is also suitable for lubricating de-icing pumps and gearboxes.

AeroShell Fluid 4 should be used in systems with synthetic rubber components and must not be used in systems incorporating natural rubber. The latter systems require castor base fluids with which AeroShell Fluid 4 is not interchangeable. Refer to the General Notes at the front of this section for more information on compatibility.

AeroShell Fluid 4 is compatible with AeroShell Fluids 31, 41 and 61, although it is not recommended that AeroShell Fluid 4 is used in systems which require the use of a superclean fluid nor should it be mixed with superclean fluids for operational reasons.

Chlorinated solvents should not be used for cleaning hydraulic components which use AeroShell Fluid 4. The residual solvent contaminates the hydraulic fluid and may lead to corrosion.

SPECIFICATIONS

U.S.	Meets MIL-H-5606A (Obsolete - see AeroShell Fluid 41)
British	Meets DTD.585 (Obsolete - see AeroShell Fluid 41)
French	Approved DCSEA 415/A
Russian	Analogue to AMG-10
NATO Code	-
Joint Service Designation	-

PROPERTIES		**MIL-H-5606A (Obsolete)**	**TYPICAL**
Oil type		-	Mineral
Kinematic viscosity	mm^2/s		
@ 100°C (212°F)		-	5.30
@ 40°C (104°F)		-	14.1
@ –40°C (–40°F)		500 max	491
@ –54°C (–65°F)		-	2300
Flashpoint	°C (°F)	93.3 (200) min	105 (221)
Pourpoint	°C (°F)	–59.4 (–75) max	–60 (–76)
Total acid number	mgKOH/g	0.20 max	0.01
Relative density @ 15.6/15.6°C (60°F)		-	0.87
Evaporation @ 100°C (212°F)	%m	-	10
Colour		Red	Red
Copper corrosion		-	Passes
Low temperature stability		Must pass	Passes
Shear stability		Must pass	Passes
Foaming characteristics		-	Passes
Phosphorus content	% m/m	0.035 to 0.050	Passes
Oxidation & corrosion stability (168 hrs)			
- metal weight change @ 121.1°C ± 1°C (250°F ± 2°F)		Must pass	Passes
- change in viscosity @ 40°C (104°F)	%	-	+2.0
- change in acid number	mgKOH/g	0.20 max	+0.1
Anti-wear properties, scar diam	mm	-	0.95
Rubber swell 168 hrs @ 70°C (158°F) Vol change	%	19 to 26.5	25

A viscosity/temperature curve is shown at the end of this section.

AEROSHELL FLUID 31

AeroShell Fluid 31 is a synthetic hydrocarbon based aircraft hydraulic fluid with greatly improved fire resistance characteristics when compared with conventional petroleum products.

AeroShell Fluid 31 has a specially designed base stock which imparts a relatively high flash point, excellent low temperature properties and good oxidation and thermal stability. In addition, AeroShell Fluid 31 is formulated with high technology additives to provide oxidation and corrosion resistance, anti-wear, and anti-foaming protection.

AeroShell Fluid 31 is superclean filtered to ensure optimum performance in particulate monitored systems.

AeroShell Fluid 31 is dyed red.

The useful operating temperature range is –40°C to +205°C (–40°F to +401°F).

APPLICATIONS

AeroShell Fluid 31 is recommended for use in aircraft, ordnance, and missile systems operating from –40°C to +205°C (–40°F to +401°F). This fluid should be considered for use in auto pilots, shock absorbers, brakes, flight control systems, hydraulic servo-controlled systems and other systems using synthetic elastomer seals.

An increasing number of aircraft manufacturers now recommend use of this type of fluid in aircraft hydraulic systems in preference to mineral hydraulic oils. This move has been prompted by the need to use fluids with better fire resistant properties.

AeroShell Fluid 31 is also approved for use in the Honeywell (formerly Garrett) cooling turbine (cabin air compressors).

Increasingly this type of hydraulic fluid is being adopted for use in hydraulic systems of military aircraft in place of mineral hydraulic fluids.

AeroShell Fluid 31 is a synthetic hydrocarbon oil and should not be used in contact with incompatible seal materials. Refer to the General Notes at the front of this section for further information.

AeroShell Fluid 31 is compatible with AeroShell Fluids 4, 41 and 61 and can be used in systems designed to operate with MIL-PRF-5606, MIL-PRF-6083, MIL-PRF-87257 and MIL-PRF-46170 fluids.

Chlorinated solvents should not be used for cleaning hydraulic components which use AeroShell Fluid 31. The residual solvent contaminates the hydraulic fluid and may lead to corrosion.

SPECIFICATIONS

U.S.	Approved MIL-PRF-83282D
British	(MIL-PRF-83282D)
French	Equivalent DCSEA 437/B
Russian	-
NATO Code	H-537
Joint Service Designation	OX-19

PROPERTIES		MIL-PRF-83282D	TYPICAL
Oil type		Synthetic Hydrocarbon	Synthetic Hydrocarbon
Kinematic viscosity	mm^2/s		
@ 205°C (401°F)		1.0 min	1.1
@ 100°C (212°F)		3.45 min	3.53
@ 40°C (104°F)		14.0 min	14.2
@ –40°C (–40°F)		2200 max	1937
Flashpoint Cleveland Open Cup	°C (°F)	205 (401) min	225 (437)
Fire point	°C (°F)	245 (473) min	248 (478)
Total acidity	mgKOH/g	0.10 max	0.04
Evaporation loss 6.5 hrs @ 150°C (302°F)	%m	20 max	17
Relative density @ 15.6°C (60°F)		Report	0.850
Pour point	°C (°F)	–55 (–67) max	–78 (–108)
Low temperature stability 72hrs @ –40°C (–40°F)		Must pass	Passes
High temperature stability 100 hrs @ 205°C (401°F)		Must pass	Passes
Gravimetric filtration	mg/100ml	0.3 max	0.1
Filtration time	minutes	15 max	5
Particle count, automatic	per Lt		
5 to 15 µm		10000 max	Passes
16 to 25 µm		1000 max	Passes
26 to 50 µm		150 max	Passes
51 to 100 µm		20 max	Passes
>100 µm		5 max	Passes
Water content	ppm	100 max	Passes
Foam resistance	ASTM Seq 1	Must pass	Passes
Flame propagation	cm/s	Must pass	Passes
Rubber swell, NBR-L	%	18 to 30	Passes

Table continued

Table continued

PROPERTIES	MIL-PRF-83282D	TYPICAL
4-Ball wear, 1 hr @ 75°C (167°F)		
scar dia mm		
1 kg load/1200 rpm	0.21 max	0.20
10 kg load/1200 rpm	0.30 max	0.25
40 kg load/1200 rpm	0.65 max	0.55
Oxidation & corrosion stability		
168 hrs @ 121°C (250°F)		
- metal weight change	Must pass	Passes
- change in viscosity @ 40°C (104°F) %	10 max	Passes
- change in acidity mgKOH/g	0.2 max	Passes
Flammability	Must pass	Passes

A viscosity/temperature curve is shown at the end of this section.

AEROSHELL FLUID 41

AeroShell Fluid 41 is a mineral hydraulic oil manufactured to a very high level of cleanliness, and possesses improved fluid properties. AeroShell Fluid 41 contains additives which provide good low temperature fluidity, anti-wear, oxidation-corrosion inhibition and shear stability. In addition metal de-activators and foam inhibitors are included in this high viscosity index fluid to enhance performance in hydraulic applications. AeroShell Fluid 41 is capable of wide temperature range operation.

AeroShell Fluid 41 is dyed red.

APPLICATIONS

AeroShell Fluid 41 is intended as a hydraulic fluid in all modern aircraft applications requiring a mineral hydraulic fluid. AeroShell Fluid 41 is particularly recommended where use of a "superclean" fluid can contribute to improvements in component reliability, and can be used in aircraft systems operating unpressurised between –54°C to 90°C (–65°F to 194°F) and pressurised between –54°C to 135°C (–65°F to 275°F).

AeroShell Fluid 41 should be used in systems with synthetic rubber components and must not be used in systems incorporating natural rubber. Refer to the General Notes at the front of this section for further information.

AeroShell Fluid 41 is compatible with AeroShell Fluids 4, 31, 61 and LGF.

Chlorinated solvents should not be used for cleaning hydraulic components which use AeroShell Fluid 41. The residual solvent contaminates the hydraulic fluid and may lead to corrosion.

Due to its properties, it is also used in several industrial applications.

SPECIFICATIONS

U.S.	Approved MIL-PRF-5606J
British	Approved DEF STAN 91-048 Grade Superclean* (European production only) Meets DEF STAN 91-048 Grade Normal (European production only) Equivalent to DEF STAN 91-048 Grades Superclean* & Normal (U.S. production only)
French	Approved DCSEA 415/A
Russian	Analogue to AMG-10
NATO Code	H-515* (equivalent H-520 (Obsolete))
Joint Service Designation	OM15* (equivalent OM-18)
COMAC	Approved QPL-CMS-OL-104

*Superclean grades

The British specification DEF STAN 91-048 covers two grades (normal and superclean) of mineral hydraulic fluid which differ only in their cleanliness limits. AeroShell Fluid 41 is manufactured to meet the superclean requirements and thus it also meets the requirements of the normal grade.

PROPERTIES		MIL-PRF-5606J	TYPICAL
Oil type		Mineral	Mineral
Kinematic viscosity	mm^2/s		
@ 100°C (212°F)		4.90 min	4.9 – 5.30
@ 40°C (104°F)		13.2 min	13.2 – 14.3
@ –40°C (–40°F)		600 max	460 – 600
@ –54°C (–65°F)		2500 max	2200 – 2500
Flashpoint	°C (°F)	82 (179) min	90 – 95 (194 – 203)
Pourpoint	°C (°F)	–60 (–76) max	–60 (–76) max
Total acid number	mgKOH/g	0.20 max	0.02 – 0.05
Evaporation loss 6 hrs			
@ 71°C (160°F)	%m	20 max	10 – 15.4
Water content	ppm	100 max	50 – 75
Relative density @ 15.6°C (60°F)		Report	0.868 – 0.873
Colour		Red	Red
Particle contamination, number of particles per 100ml in size range			
5 to 15 µm		8000 max	1200 max
16 to 25 µm		1425 max	1425 max
26 to 50 µm		253 max	253 max
51 to 100 µm		45 max	45 max
over 100 µm		8 max	8 max
Particle count		5	5 max
Copper corrosion		2e max	2b
Steel on steel wear scar diam	mm	1.0 max	0.6 – 0.95
Rubber swell, L rubber			
168 hrs @ 70°C (158°F)	%	19 to 30	Passes
Low temperature stability			
72hrs @ –54°C (–65°F)		Must pass	Passes
Gravimetric analysis	mg/100ml	1.0 max	Passes
Foaming tendency		Must pass	Passes
Barium content	ppm	10 max	Nil

A viscosity/temperature curve is shown at the end of this section.

NOTES

AEROSHELL FLUID 61

AeroShell Fluid 61 is a synthetic hydrocarbon base hydraulic fluid specifically inhibited to provide excellent oxidation stability for the oil and good corrosion preventive protection to the hydraulic system.

AeroShell Fluid 61 has an operating temperature range of –40°C to +204°C (–40°F to +399°F).

APPLICATIONS

AeroShell Fluid 61 is designed for use where a fire-resistant preservative grade hydraulic fluid is required and is suitable for operational use from –40°C to +204°C (–40°F to +399°F) as well as preservation of components during storage and shipment.

AeroShell Fluid 61 is compatible with AeroShell Fluids 4, 31 and 41.

AeroShell Fluid 61 is a synthetic oil and should not be used in contact with incompatible seal materials. Refer to the General Notes at the front of this section for further information.

Chlorinated solvents should not be used for cleaning hydraulic components which use AeroShell Fluid 61. The residual solvent contaminates the hydraulic fluid and may lead to corrosion.

SPECIFICATIONS

U.S.	Approved MIL-PRF-46170E Type I*
British	-
French	-
Russian	-
NATO Code	H-544
Joint Service Designation	-

*The US specification covers two grades, Type I and Type II. The only difference between the two grades is that Type II is dyed red for aerospace use whereas Type I is undyed.

PROPERTIES		MIL-PRF-46170E Type I	TYPICAL
Oil type		-	Synthetic Hydrocarbon
Kinematic viscosity	mm^2/s		
@ 100°C (212°F)		3.4 min	3.71
@ 40°C (104°F)		19.5 min	15.43
@ –40°C (–40°F)		2600 max	2488
@ –54°C (–65°F)		-	15022
Flashpoint Cleveland Open Cup	°C (°F)	218 (424) min	233 (451)
Fire point Cleveland Open Cup	°C (°F)	246 (475) min	248 (478)
Acid or Base number	mgKOH/g	0.2 max	0.07
Evaporation loss			
22 hrs @ 149°C (300°F)	%m	5.0 max	2.39
Relative density @ 15.6°C (60°F)		-	0.859
Pourpoint	°C (°F)	–54 (–65) max	Below –54 (–65)
Water content	ppm	500 max	278
Auto-ignition temperature	°C (°F)	343 (649) min	354 (669)
Colour		Undyed	Undyed
Particle count, automatic	per Lt		
5 to 25 µm		10000 max	1414
26 to 50 µm		250 max	390
51 to 100 µm		50 max	4
> 100 µm		10 max	0
Trace sediment	mg/l	0.005 max	0.001
Rubber swell			
168 hrs @ 70°C (°F)	% swell	15 to 25	21.5
4-Ball wear, 75°C (167°F) - scar dia	mm		
147N load/1200 rpm		0.3 max	0.23
392N load/1200 rpm		0.65 max	0.38

Table continued

Table continued

PROPERTIES	MIL-PRF-46170E Type I	TYPICAL
Galvanic corrosion	Must pass	Passes
Corrosiveness & oxidation stability 168 hrs @ 121°C (250°F) - metal weight change - viscosity change @ 40°C (104°F) % - change in acidity mg/KOH/g	 Must pass ±10 max 0.3 max	 Passes Less than 10 Less than 0.3
Low temperature stability	Must pass	Passes
Rust prevention	Must pass	Passes
Flammability	Must pass	Passes

A viscosity/temperature curve is shown at the end of this section.

NOTES

AEROSHELL LGF

AeroShell Landing Gear Fluid (LGF) is a mineral hydraulic fluid (MIL-PRF-5606) to which additional additives have been added to improve the extreme pressure characteristics and the fluid's natural lubricity. The lubricity agent provides a stable thin film layer to the metal surfaces at mild operating conditions. When severe conditions exist (landing/touchdown), the extreme pressure additive supplies the load carrying needed at the metal-to-metal surfaces to prevent the occurrence of such phenomena as "ladder cracking" and "slip stiction" of the piston component of the landing gear.

AeroShell LGF is AeroShell Fluid 41 plus additives, and is straw yellow in colour.

APPLICATIONS

The better low temperature properties of AeroShell LGF make it particularly suitable in areas of low temperature operations.

AeroShell LGF is compatible with AeroShell Fluids 4 and 41.

EQUIPMENT MANUFACTURERS' APPROVALS

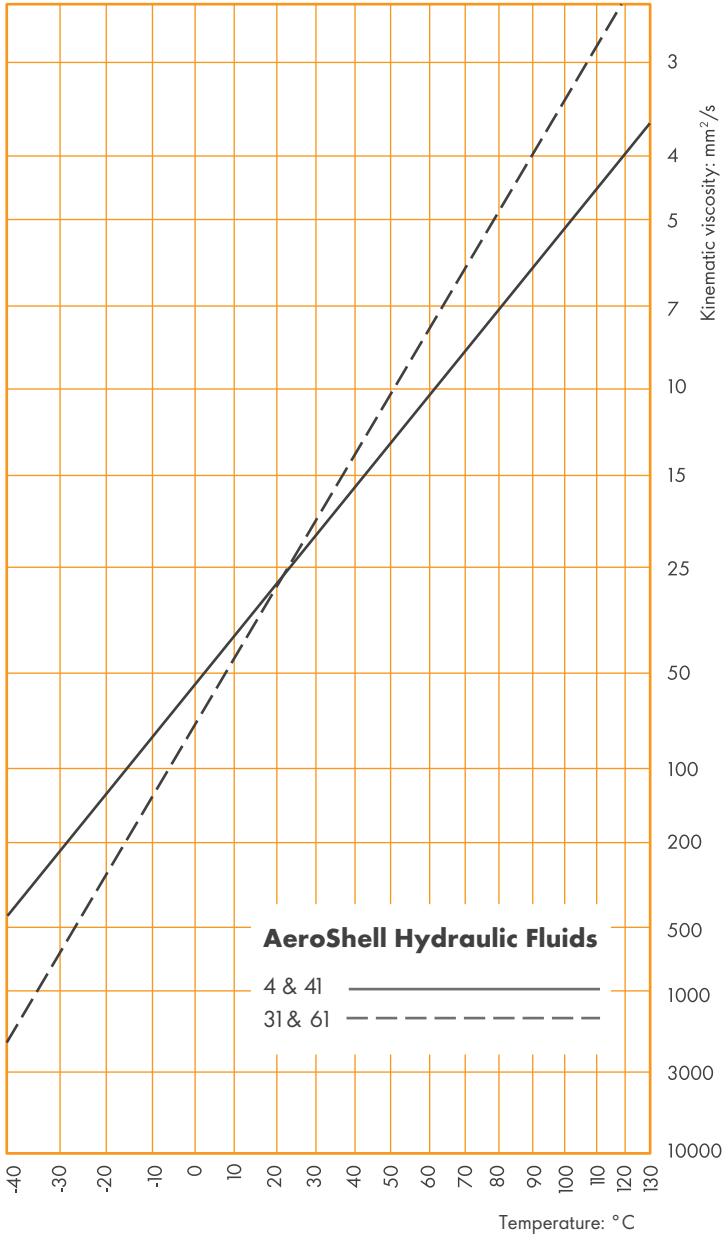
Boeing	Approved BMS 3-32C Type II
Lockheed	L1011 Tristar
McDonnell Douglas	Approved DPM-6177 (DC-8, DC-9, DC-10, MD-80, MD-11

AeroShell LGF is not covered by any military specification.

For use in the landing gear shock struts of other aircraft, operators must check with the respective manufacturer first.

PROPERTIES		BMS 3-32C	LGF TYPICAL
Base hydraulic fluid specification		MIL-PRF-5606J	MIL-PRF-5606J
Colour Yellow		1.0 – 2.0	L1.5
Density @ 15.6°C (60°F)	kg/m^3	-	879
Kinematic viscosity @ 40°C (104°F)	mm^2/s	13.2 min	14.5
Flashpoint	°C (°F)	-	110 (230)
Total acid number	mgKOH/g	1.5 to 5.0	3.1
Evaporation 6 hrs @ 71°C (160°F)	%m	-	18.0
Pourpoint	°C (°F)	-	<–60 (–76)
Foaming tendency		-	Passes
Zinc	ppm	1700 ± 300	1620

TYPICAL TEMPERATURE/VISCOSITY CURVE OF AEROSHELL HYDRAULIC FLUIDS



NOTES

AEROSHELL PRESERVATIVES

7. AEROSHELL PRESERVATIVES

When the winter period comes bringing shorter days and worse weather than is enjoyed during the summer months, many owners decide to hanger their aircraft and not fly until spring. An integral part of the process of preparing an aircraft for storage should be to use a preservation oil to give protection against corrosion, which greatly accelerates the rate of wear in an engine.

When an engine stands idle for long periods, the oil absorbs water from the atmosphere and, combined with condensation on the internal engine components, causes rust to form. Once the rust has formed it remains in the oil and acts as a grinding paste, causing increased wear, reduced engine life and potentially higher maintenance bills.

If an aircraft is flown frequently (at least once every two weeks) then it is not

to the protection given by the compound they contain, these fluids neutralise the acid products of combustion resulting from the use of leaded fuel, e.g. hydrobromic acid.

British and American methods for inhibiting engines differ as is shown by the following specifications prescribing the official procedures:

	American	**British**
Piston engine practice:	MIL-E-6058B (Obsolete)	D.Eng.R.D. 2027 (Obsolete)
Turbine engine practice:	MIL-E-5607F (Obsolete)	D.Eng.R.D. 2028 (Obsolete)

For inhibited engine oils in piston engines the British procedure was to motor the engines cold using a 'storage' oil (DEF STAN 91-040 [Obsolete]) in the engine oil system, followed by spraying of various parts internally with a wax thickened oil/petrol mixture (DTD.791C [Obsolete]).

The U.S. procedure differs according to whether the storage period is short term or for an extended period. For short term protection only one type of product is required and this is a 'flyaway' oil (1 part AeroShell Fluid 2XN mixed with 3 parts AeroShell Oil 100, formerly AeroShell Fluid 2F), which is added to the engine oil system while the engine is run-up under its own power. Immediately before shutdown it is sprayed into various parts of the engine as in the British procedure.

If you intend to carry on flying throughout the year, but may have a few periods of several weeks inactivity, then use the AeroShell Oil W 15W-50 to take advantage of the anti-wear and anti-corrosion additives.

However, if you intend to lay the aircraft up for several months (winter or summer) and perhaps enjoy the occasional flight during this period, then you should use AeroShell Fluid 2XN mixed with AeroShell Oil 100 (formerly AeroShell Fluid 2F). Finally, if you have an engine which will lie idle for an indefinite period, such as a spare engine, then you should use AeroShell Fluid 2XN in its pure form.

By using these simple solutions, no matter how often you fly, you can be sure that you are giving your engine the best protection possible.

Turbine Engine Corrosion Protective Fluids

Corrosion protective fluids to MIL-C-6529C Type III are suitable for the internal protection during storage of turbine engines which normally use mineral lubricating oil to MIL-PRF-6081E.

Corrosion protective fluids to MIL-PRF-8188D are suitable for the internal protection during storage of turbine engines which normally use synthetic lubricating oils to MIL-PRF-7808L.

More recently there has been increasing concern regarding corrosion inside turbine engines which use synthetic oils to MIL-PRF-23699 (formerly MIL-L-23699). In order to address these concerns the specification MIL-PRF-23699G has been revised to include a corrosion inhibited (C/I) grade alongside the standard (STD) grade and high temperature grade (HTS).

AEROSHELL FLUID 2XN

AeroShell Fluid 2XN is a corrosion preventative concentrate from which AeroShell Fluid 2F is blended; the blending proportions are one part AeroShell Fluid 2XN to three parts Aeroshell Oil 100. This blended oil is the inhibited "flyaway" lubricating oil for the internal protection of piston engines during storage.

AeroShell Fluid 2F may be used in conjunction with Shell VPI 260 or VPI 280 if protection for extended periods is required.

APPLICATIONS

AeroShell Fluid 2XN is primarily used as an ingredient of AeroShell Fluid 2F, but can be used undiluted to provide additional protection for piston engines after run-out on AeroShell Fluid 2F, by spraying exhaust ports, rocker arms, accessories. This blend of AeroShell Fluid 2XN and AeroShell Oil 100 can be used in any certified aviation engine, although we do not recommend its use in 2-stroke or automotive derived engines.

A period of 15 minutes engine running under idling conditions is required to ensure adequate distribution of the blended oil throughout the engine. It can also be applied to other parts of the engine and its accessories by spraying. Once the engine has cooled, it is also worth blanking off the intake and exhaust if possible, to reduce the flow of air (and therefore moisture) through the engine. However, remember to placard the cockpit to remind yourself and other pilots that this has been done. The ashless anticorrosion additive package and highly refined mineral base oils protect the engine by minimising the effects of humidity and neutralising the acidic components of engine oil oxidation and combustion by-products.

After storage and before operating the engine, rotate the crankshaft by hand and drain off the preservative oil. An additional optional precaution is to flush the engine with the correct grade of AeroShell oil before draining and re-filling with fresh oil.

Operation of engines containing "flyaway" oils is limited to 50 hours maximum. Note that this is 50 hours during the total TBO cycle, not 50 hours every time you use the oil. This means that if you want to fly then you still can without needing to drain the oil and replace it with your usual AeroShell grade; but remember that this oil is a 100

weight oil and so if the temperature is too low for this weight of oil in your engine then the oil should be preheated. Extensive flying on this oil will not harm the engine, but engine cleanliness may be effected as the preservation oil does not contain an ashless dispersant additive as the AeroShell W series of oils do. Detailed instructions for inhibiting piston engines are given in specifications MIL-E-6058B and MIL-E-6059A and in relevant engine manufacturer's publications.

For aircraft gas turbine engines a mixture of one part of AeroShell Fluid 2XN to three parts of AeroShell Turbine Oil 2 is required. Detailed instructions for inhibiting turbines are given in specification MIL-E-5607F.

SPECIFICATIONS

U.S.	Approved MIL-C-6529C Type I
British	(Has adopted MIL-C-6529C Type I) Meets DTD900/4913A (Obsolete)
French	Equivalent to AIR 1503/B Type B Concentrate (Inactive)
Russian	-
NATO Code	C-608
Joint Service Designation	ZX-21 (Obsolete)

Properties are controlled only for the finished blends using AeroShell Fluid 2XN.

PROPERTIES	MIL-C-6529C Type I	TYPICAL
Oil type	-	Mineral
Kinematic viscosity mm^2/s @ 37.8°C (100°F) @ 98.9°C (210°F)	 Report Report	 285 22
Density @ 15°C (59°F) kg/m^3	-	900
Volatility %	3 max	< 0.52
Viscosity (after elimination of volatile content) mm^2/s	90 – 110	105
Flashpoint Cleveland Open Cup °C (°F)	 204 (399) min	 270 (518)
Pourpoint °C (°F)	–12.2 (+10) max	–17 (1.4)
Carbon residue %m	2.0 max	0.5
Lead corrosion 4 hrs @ 149°C (300°F) mg/in^2	 70 max	 30
Ash %m	0.015 max	0.01
Copper corrosion @ 100°C (212°F)	2A max	Passes
Rust protection (humidity cabinet)	Must pass	Passes
High / Low Temperature Stability	Must pass	Passes
HBr Neutralisation	Must pass	Passes

NOTES

OTHER AEROSHELL FLUIDS

8. OTHER AEROSHELL FLUIDS

ABOUT THE FLUIDS

Other AeroShell Fluids are used for special applications on aircraft, aircraft engines and auxiliary equipment, and can be subdivided under the following headings:

Lubricating oils
Gearbox oils
Calibrating fluids
De-icing fluids
Avionic cooling fluids

Lubricating Oils

AeroShell Fluid 3
AeroShell Fluid 12

AeroShell Fluid 3 and AeroShell Fluid 12 cover the two types of aircraft general purpose and instrument oils in use today i.e. mineral oil (MIL-PRF-7870) and synthetic oil (MIL-PRF-6085) respectively. They are recommended for the lubrication of delicate instruments and general aircraft lubrication by oil can application, etc.

Gearbox Oils

AeroShell Fluid 5M-A
AeroShell Fluid S.8350

AeroShell Fluid 5M-A is of medium viscosity and is recommended for the lubrication of gears where high tooth loadings exist e.g. helicopter gearboxes and constant speed alternator drives.

AeroShell Fluid S.8350 is an extreme pressure gear oil and recommended for lubrication of gears where the use of a 90 EP gear oil is required.

Calibrating Fluid

AeroShell Calibrating Fluid 2

This fluid is used for calibrating the aircraft fuel system components of turbine engines.

De-icing Fluids

AeroShell Compound 07

Various alcohols, or mixtures of these with other materials, are used for de-icing windscreens, propellers, carburettors and wing surfaces. The most common requirement, for de-icers for windscreens and propellers, is met by AeroShell Compound 07. AeroShell Compound 07 is also an approved wing de-icing fluid.

Avionic Cooling Fluids

AeroShell Fluid 602

AeroShell Fluid 602 is a cooling fluid for aircraft avionic systems.

Smoke Oil

AeroShell Smoke Oil

AeroShell Smoke Oil is used in both piston engine and jet engine powered aviation aerobatic flight displays.

NOTES

AEROSHELL FLUID 3

AeroShell Fluid 3 is a general purpose mineral lubricating oil recommended for general lubrication of aircraft parts that require a light oil with good low temperature characteristics and a low freezing point. It is inhibited against oxidation and corrosion. AeroShell Fluid 3 is a relatively low viscosity product with good resistance to evaporation.

APPLICATIONS

AeroShell Fluid 3 is recommended for general lubrication of aircraft parts that require a light oil, e.g. hinges, pivot joints, shaft joints, linkage pins and bearings, pulleys, cables, camera mechanisms, radio and radar gear and instruments. AeroShell Fluid 3 is normally applied by means of an oil can or brush. For this reason it is also described as 'an oilcan lubricant'.

Operating temperature range of AeroShell Fluid 3 is –54°C to +121°C (–65°F to 250°F).

For high temperature applications where no provision is made for frequent re-lubrication the synthetic oil, AeroShell Fluid 12, should be used in place of the mineral oil, AeroShell Fluid 3; however in this case care should be taken to ensure that there is no incompatibility between AeroShell Fluid 12 and seals, paints etc.

SPECIFICATIONS

U.S.	Approved MIL-PRF-7870E
British	Meets DEF STAN 91-047 (Obsolete)
French	-
Russian	-
NATO Code	O-142
Joint Service Designation	OM-12 (Obsolete)

PROPERTIES		MIL-PRF-7870E	TYPICAL
Oil type		-	Mineral
Kinematic viscosity	mm^2/s		
@ 38°C (100°F)		10 min	10
@ –40°C (–40°F)		4000 max	< 4000
Flashpoint			
Cleveland Open Cup	°C (°F)	130 (266) min	155 (311)
Pourpoint	°C (°F)	–57 (–70) max	< –57 (–70)
Evaporation		25 max	19
@ 99°C (210°F), 22 hrs	%m		
Total acid number	mgKOH/g	Report	0.68
Density @ 15°C (59°F)	kg/m^3	-	890
Low temperature stability			
72 hrs @ –54°C (–65°F)		Must pass	Passes
Corrosion & oxidation stability			
168 hrs @ 121°C (250°F)			
- metal weight change		Must pass	Passes
- viscosity change			
@ 37.8°C (100°F)	%	–5 to +20	10
- acid number change	mgKOH/g	0.2 max	0.06
Corrosivity		Must pass	Passes
Precipitation number	ml	0 max	Passes
ASTM colour		-	< 0.5

A viscosity/temperature curve is shown at the end of this section.

AEROSHELL FLUID 5M-A

AeroShell Fluid 5M-A is a highly refined, medium viscosity mineral oil containing an extreme pressure additive as well as additives to provide good oxidation and corrosion protection.

APPLICATIONS

Aeroshell Fluid 5M-A is used for the lubrication of gears where high tooth loadings exist. AeroShell Fluid 5M-A is particularly recommended for the lubrication of translation units of contra-rotating propellers, radar gearboxes, constant speed alternator drives. AeroShell Fluid 5M-A is also used in those helicopter transmissions (gearboxes) which require use of a MIL-PRF-6086 oil.

AeroShell Fluid 5M-A is also suitable as an extreme pressure lubricant for heavily loaded pins, bushes and gear mechanisms.

AeroShell Fluid 5M-A must not be used in engines.

SPECIFICATIONS

U.S.	Approved MIL-PRF-6086F Medium Grade
British	Approved DEF STAN 91-112 Grade M
French	-
Russian	-
NATO Code	O-155
Joint Service Designation	OEP-70

PROPERTIES		MIL-PRF-6086F Medium Grade	TYPICAL
Oil type		-	Mineral
Kinematic viscosity	mm^2/s		
@ 37.8°C (100°F)		60 to 82	72
@ 98.9°C (210°F)		-	8.7
Viscosity index		80 min	102
Flashpoint	°C (°F)	154.5 (310) min	181 (358)
Pourpoint	°C (°F)	–28.9 (–20) max	–39 (–38)
Precipitation number	ml	0.1 max	< 0.05
Total acid number	mgKOH/g	1.0 max	< 0.1
Relative density @ 15.6°C (60°F)		-	0.92
Load wear index	kgf	40 min	47
Colour ASTM		8 max	1.5
Foaming tendency		Must pass	Passes
Copper corrosion			
3 hrs @ 100°C (212°F)		Must pass	Passes

A viscosity/temperature curve is shown at the end of this section.

AEROSHELL FLUID 12

AeroShell Fluid 12 is a low volatility synthetic ester oil used in aircraft instruments and also for the general lubrication of aircraft. It is oxidation and corrosion inhibited, and possesses good high and low temperature characteristics.

APPLICATIONS

AeroShell Fluid 12 is used for general aircraft lubrication as well as for aircraft gyro instrument gimbal bearings, separately lubricated high speed turbines and compressors, aircraft air cycle equipment and electronic equipment. AeroShell Fluid 12 is particularly suitable for use when an oil with a low evaporation rate is required at high and low temperatures.

AeroShell Fluid 12 is a synthetic oil and it should not be used in contact with incompatible seal materials such as neoprene or natural rubber. Suitable seal material include Fluorocarbon (Viton). AeroShell Fluid 12 may also affect certain paints and plastics. It is recommended that components are evaluated for compatibility if there is any question.

SPECIFICATIONS

U.S.	Approved MIL-PRF-6085E
British	Equivalent DEF STAN 91-049
French	Approved AIR 3511/A
Russian	-
NATO Code	O-147
Joint Service Designation	Equivalent OX-14
COMAC	Approved QPL-CMS-OL-204

PROPERTIES		MIL-PRF-6085E	TYPICAL
Oil type		-	Synthetic ester
Colour ASTM		5.0 max	< 1.5
Density @ 15 °C (59 °F)	kg/m^3	-	925
Kinematic viscosity	mm^2/s		
@ 54.4 °C (130 °F)		8 min	9
@ –54 °C (–65 °F)		12000 max	11000
Pourpoint	°C (°F)	–57 (–70) max	< –60 (–76)
Flashpoint			
Cleveland Open Cup	°C (°F)	185 (365) min	> 220 (428)
Total acid number	mgKOH/g	Report	0.20
Relative density @ 15.6 °C (60 °F)		-	0.925
Evaporation loss in 22 hrs			
@ 120 °C (248 °F)	%m	1.80 max	0.6
Corrosion & oxidation stability			
168 hrs @ 121 °C (250 °F)			
- metal weight change	mg/cm^3	Must pass	Passes
- viscosity change	%	± 5	1
- total acid number change			
	mgKOH/g	0.5 max	0.2
- insolubles	mg/100ml	Must pass	Passes
Low temperature stability		Must pass	Passes
72 hrs @ –54 °C (–65 °F)			
Precipitation number	ml	0 max	0
Corrosivity		Must pass	Passes

A viscosity/temperature curve is shown at the end of this section.

AEROSHELL FLUID 602

AeroShell Fluid 602 synthetic base fluid is composed of highly branched, compact and very stable molecules known as polyalphaolefins (PAO), blended with additives to provide long term storage stability.

AeroShell Fluid 602 offers exceptional performance over a wide temperature range between –54°C to 200°C (–65°F to 392°F) and does not react with water, resulting in clean systems and long fluid and component life.

APPLICATIONS

AeroShell Fluid 602 is most widely used as a cooling fluid for aircraft avionic systems, whose benefits include lower initial cost, longer fluid life, lower weight and lower toxicity when compared with other types of avionic system coolants. Since AeroShell Fluid 602 does not react with water, no reclamation equipment is required, adding further to the cost advantage.

SPECIFICATIONS

U.S.	Approved MIL-PRF-87252E
British	-
French	-
Russian	-
NATO Code	S-1748
Joint Service Designation	-

PROPERTIES	MIL-PRF-87252E	TYPICAL
Relative density @ 15.6°C (60°F)	-	0.799
Viscosity mm^2/s		
@ 100°C (212°F)	1.65 min	1.77
@ 40°C (104°F)	5.0 min	5.29
@ –40°C (–40°F)	300 max	280
@ –54°C (–65°F)	1300 max	1094
Flash point °C (°F)	150 (302) min	160 (320)
Fire point °C (°F)	160 (320) min	171 (340)
Total acid number mgKOH/g	0.2 max	< 0.01
Water content, Karl Fischer ppm	50 max	35
Dielectric breakdown Voltage kv	35 min	47
Volume resistivity @ 25°C (77°F) ohm-cm	1.0×10^{10} min	2.9×10^{15}
Particle count, automatic		
5 to 15 µm	8000 max	2664
16 to 25 µm	1425 max	345
26 to 50 µm	253 max	86
51 to 100 µm	45 max	10
< 100 µm	8 max	0
High temperature stability @ 200°C (392°F)	Must pass	Passes
Corrosiveness and oxidation stability	Must pass	Passes

AEROSHELL FLUID S.8350

AeroShell Fluid S.8350 is an SAE 90 extreme pressure gearbox oil.

APPLICATIONS

AeroShell Fluid S.8350 is used for helicopter rotor gears, drive-shafts and pitch control mechanisms and wherever high loads and slow speeds in gears require the use of a 90 EP gear oil. AeroShell Fluid S.8350 is approved for use in various Westland helicopter gearboxes.

AeroShell Fluid S.8350 must not be used in engines.

SPECIFICATIONS

U.S.	-
British	-
French	-
Russian	-
NATO Code	-
Joint Service Designation	OEP-215

PROPERTIES		OEP-215	TYPICAL
Oil type		-	Mineral
Kinematic viscosity	mm^2/s		
@ 40°C (104°F)		-	182
@ 100°C (212°F)		16.26 to 17.42	17.0
Viscosity index		85 min	97
Flashpoint			
Cleveland Open Cup	°C (°F)	177 (350) min	228 (442)
Pourpoint	°C (°F)	–18 (–0.4) max	–21 (–5.8)
Total acid number	mgKOH/g	0.2	0.15
Density @ 15°C (59°F)	kg/m^3	-	895
Evaporation loss @ 150°C (302°F)		5 max	3.0
Precipitation loss	ml	0.05 max	0.01
Copper corrosion		Must pass	Passes
Foaming, sequence I, II, III		Must pass	Passes

AEROSHELL CALIBRATING FLUID 2

AeroShell Calibrating Fluid 2 is composed of Specially Run Stoddard Solvent and is used for calibrating aircraft fuel system components.

APPLICATIONS

AeroShell Calibrating Fluid 2 is intended for the calibration of fuel system components of aircraft turbine engines.

SPECIFICATIONS

U.S.	Approved MIL-PRF-7024F Type II
British	-
French	-
Russian	-
NATO Code	-
Joint Service Designation	-

PROPERTIES		MIL-PRF-7024F Type II	TYPICAL
Oil type		-	Mineral
Relative density @ 15.6°C (60°F)		0.77 ± 0.005	0.766
Colour (Saybolt)		-	30
Kinematic viscosity @ 25°C (77°F)	mm^2/s	1.17 ± 0.05	1.2
Flashpoint	°C (°F)	38 (100) min	43 (109)
Distillation:			
Initial boiling point	°C (°F)	149 (300) min	152 (305)
Final boiling point	°C (°F)	210 (410) max	196 (385)
Recovery	%	98.5 min	99
Total acid number	mgKOH/g	0.015 max	0.003
Copper corrosion 3 hrs @ 100°C (212°F)		Must pass	Passes
Aromatics	% vol	20 max	< 7
Existent gum	mg/100ml	5.0 max	< 5
Olefin content	%v	5.0 max	< 5
Particulate matter	mg/l	2.0 max	< 1
Benzene	%vol	0.01 max	< 0.01
Mercaptan sulfur (Doctor Test)		Sweet	0-29

AEROSHELL COMPOUND 07

AeroShell Compound 07 is a de-icing fluid composed of ethylene glycol, isopropyl alcohol and distilled water.

Specification DTD.406B requires the product to have the following approximate composition:

Ethanediol (BS.2537) 85% volume
Isopropanol (BS.1595) 5% volume
Distilled water 10% volume

APPLICATIONS

AeroShell Compound 07 is used for in-flight de-icing of windscreens, propellers, wings, tailplanes, etc. on suitably equipped aircraft.

AeroShell Compound 07 is also recommended for removing hoar frost and light snow/ice from parked aircraft. AeroShell Compound 07 can be sprayed undiluted or mixed with up to 50% volume of water, depending upon the severity of the icing conditions, the efficiency of the spraying technique and whether it is applied hot or cold.

SPECIFICATIONS

U.S.	-
British	Meets DTD.406B (Obsolete)
French	-
Russian	-
NATO Code	S-745
Joint Service Designation	AL-5

PROPERTIES	DTD.406B (Obsolete)	TYPICAL
Flashpoint Cleveland Open Cup °C (°F)	-	54.4 (130)
Kinematic viscosity @ 20°C (68°F) mm^2/s	11.0 to 13.0	11.4
Cold test @ –40°C (–40°F)	No deposition	Complies
pH value	6.0 to 7.5	6.9
Conductivity micromho/cm	5.0 max	0.5
Density @ 15°C (59°F) kg/l	1.092 to 1.097	1.094
Miscibility with water @ 15°C (59°F)	Must pass	Passes

AEROSHELL SMOKE OIL

AeroShell Smoke Oil is a hydrocarbon fluid based on Shell Gas-to-Liquid Technology. It is fully saturated with a high degree of iso paraffinic structures.

AeroShell Smoke Oil has low viscosity and good low temperature properties. It can be readily vaporized and fulfils the stringent international pharmacopoela purity.

APPLICATIONS

AeroShell Smoke Oil is used in both piston engine and jet engine powered aviation aerobatic flight displays.

PROPERTIES		TYPICAL
Colour (Saybolt)		30
Density @ 15°C (59°F)	kg/m^3	806
Refractive index @ 20°C (68°F)		1.45
Viscosity index		118
Flashpoint Cleveland Open Cup	°C (°F)	200 (392)
Pour point	°C (°F)	–45 (–49)
Kinematic viscosity	mm^2/s	
@ 20°C (68°F)		19
@ 40°C (104°F)		9.8
@ 100°C (212°F)		2.7
Aniline point	°C (°F)	114 (237)
Evaporation loss 22h/107°C (224°F)	%m	0.75
Noack volatility 1h/250°C (482°F)	%m	40
Medicinal white oil		
EU Pharm.		Meet
US Pharm.		Meet
FDA 21CFR172.878		Meet
21CFR178.3620		Meet

TYPICAL TEMPERATURE/VISCOSITY CURVE OF OTHER AEROSHELL FLUIDS