COPYRIGHT STATEMENT

The copyright of this document is vested in Shell Aviation Limited, London, England. All rights reserved. Neither the whole nor any part of this document may be reproduced, stored in any retrieval system or transmitted in any form or by any means (electronic, mechanical, reprographic, recording or otherwise) without the prior written consent of the copyright owner.

Throughout this publication the words ‘Shell’ and ‘Group’ are used collectively in relation to companies associated together under the name of the Royal Dutch/Shell Group of Companies.

CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>General Notes on AeroShell Products</td>
<td>6</td>
</tr>
<tr>
<td>Product Reference &amp; Classification of AeroShell Products</td>
<td>12</td>
</tr>
<tr>
<td>Discontinued Grades</td>
<td>14</td>
</tr>
<tr>
<td>Environmental Notes</td>
<td>16</td>
</tr>
<tr>
<td>Quality Control, Storage, Handling and Retesting</td>
<td>18</td>
</tr>
<tr>
<td>Shell Aviation Service</td>
<td>26</td>
</tr>
<tr>
<td>Shell Aviation Fuels</td>
<td>30</td>
</tr>
<tr>
<td>Shell AeroJet</td>
<td>40</td>
</tr>
<tr>
<td>Power Boost Fluids</td>
<td>42</td>
</tr>
<tr>
<td>AeroShell Performance Additive 101</td>
<td>44</td>
</tr>
<tr>
<td>Shell Water Detector</td>
<td>50</td>
</tr>
<tr>
<td>AeroShell Piston Engine Oils</td>
<td>52</td>
</tr>
<tr>
<td>AeroShell Turbine Engine Oils</td>
<td>74</td>
</tr>
<tr>
<td>AeroShell Greases</td>
<td>134</td>
</tr>
<tr>
<td>AeroShell Hydraulic Fluids</td>
<td>180</td>
</tr>
<tr>
<td>AeroShell Preservatives</td>
<td>214</td>
</tr>
<tr>
<td>Other AeroShell Fluids</td>
<td>226</td>
</tr>
<tr>
<td>Conversion Tables</td>
<td>258</td>
</tr>
<tr>
<td>Aviation Specifications Guide</td>
<td>264</td>
</tr>
<tr>
<td>Contents</td>
<td>266</td>
</tr>
<tr>
<td>British Aviation Specifications</td>
<td>270</td>
</tr>
<tr>
<td>U.S. Aviation Specifications</td>
<td>290</td>
</tr>
<tr>
<td>NATO Code Numbers</td>
<td>310</td>
</tr>
<tr>
<td>British Joint Service Designations</td>
<td>324</td>
</tr>
<tr>
<td>French Aviation Specifications</td>
<td>338</td>
</tr>
<tr>
<td>Russian Aviation Specifications</td>
<td>346</td>
</tr>
<tr>
<td>AeroShell Grades</td>
<td>362</td>
</tr>
</tbody>
</table>
Shell companies manufacture, and distribute throughout the world a full range of aviation products required for the operation and maintenance of aircraft of all types. This range includes:

Aviation Turbine Fuels
Aviation Gasolines
Methanol Mixtures
AeroShell Performance Additives
AeroShell Turbine Engine Oils
AeroShell Piston Engine Oils
AeroShell Greases
AeroShell Hydraulic Fluids
AeroShell Fluids
AeroShell Preservatives

This manual contains information on the characteristics and specifications of these products and offers guidance on their application.

The Specification information provided is correct as known at the time of going to press. Due to the fact that commercial and military specifications for aviation products are subject to frequent changes, it is advisable to consult the local Shell company, whose representative will also give advice on availability (not all grades are always available worldwide), prices and packaging and will be glad to answer any other queries.

All reasonable care has been taken in the preparation of this publication; however, no responsibility can be accepted for the consequences of any inaccuracy which it may contain.
GENERAL NOTES ON AEROSHELL PRODUCTS

The notes contained in this section apply to the complete range of AeroShell products. Additional notes specific to each product group are given in the notes at the front of each chapter.

NOTATION

The brand names chosen for the range of AeroShell products comprise three parts: the name ‘AeroShell’ followed by the words ‘Turbine Oil’, ‘Fluid’, ‘Grease’, etc. and finally a number and/or letters designating each product. The numbers do not always follow a sequence. In the case of turbine and piston engine oils the number relates to the oil viscosity; for greases, fluids and compounds the numbers merely differentiate between products and gaps occur in the sequence due to obsolescence. Consequently an up-to-date version of this book should always be used for reference purposes.

APPLICATIONS

Under this heading the more important and known representative aviation uses have been named for each AeroShell Grade, and these are intended to serve as a general indicator of the type of application for which the grade is normally suitable. Further consultation with the component manufacturer is recommended in case of doubt.

Whenever an aircraft is certified, all of the oils, greases and hydraulic fluids used on that aircraft 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 grades which are qualified to be used. The U.S. Federal Aviation Administration (FAA) regulations state that only grades 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 grades should be used.

Many AeroShell products are used in non-aviation applications especially where the operating requirements or properties are at the extreme for industrial lubricants (for example, high or low temperatures). Details are not included in this publication but further information is available from local Shell companies.

In selecting an AeroShell Grade for a non-aviation application the properties of the grade 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 the 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.

SPECIFICATIONS

The majority of AeroShell products are manufactured to comply with British or U.S. Government Specifications because these are acceptable to most aircraft manufacturers and airline operators. In certain cases where no suitable specification exists, Shell products have been developed to meet specific performance requirements.

Many of the British and U.S. Government Specifications (as well as those of other NATO countries) are interchangeable, although the specifications are not identical. The words ‘approved’, ‘meets’, ‘equivalent’ and ‘corresponding’ have been used in the text to define the relationship between products and specifications; the precise meaning of these terms is as follows:

Approved indicates that the product has been manufactured to meet the requirements of the specification, and against which it has been approved (where type approval is required).

Meets indicates that the product complies with the requirements of the specification and, either type approval is being obtained, or because the specification is now obsolete, it is not possible to obtain type approval (where type approval is required).

Equivalent indicates that the product complies with the major requirements of the specification but has not necessarily been manufactured to the specification.

Corresponding indicates that the product has not been manufactured to meet the specification and that it is the nearest product available.


Currently major changes are taking place to both U.S. and British Specifications. The U.S. authorities have decided to eliminate MIL specifications as they are currently known and replace them with performance specifications. These will be labelled MIL-PRF- followed by a number. Many MIL-PRF- specifications have now been issued and others will follow until all current MIL specifications have been converted. The numeric part of the MIL-PRF- designation is the same as the numeric part of the MIL specification it replaces; however, the letter which denotes the Revision level has also changed. MIL specifications which are cancelled or obsolete will not be changed. A small number of MIL Specifications have been converted to MIL-DTL- specifications, where DTL represents ‘detail’.
For certain products, the U.S. authorities have decided to no longer maintain military specifications; in these cases, they have been converted to civil specifications by the SAE (Society of Automotive Engineers).

Recent examples of these changes include:
- MIL-H-5606G has become MIL-PRF-5606H
- MIL-L-23699E has become MIL-PRF-23699F
- MIL-T-83133D has become MIL-DTL-83133E
- MIL-G-4343C has become SAE-AMS-G-4343

British specifications are being standardised on Defence Standards (commonly referred to as DEF STAN). The changeover is virtually complete and all current DERD, DTD, CS and TS specifications have now been converted to DEF STAN specifications; in doing so, the numeric part has also been changed. Obsolete or Cancelled British Specifications will not be changed.

The British MoD has also moved away from "qualifying" or "approving" products and no longer issues Qualified Products Lists (QPLs). Instead, the onus is put on the supplier under the new PCC (Product Conformity Certification) scheme to demonstrate that the product supplied is fit for purpose. Instead of QPLs, the MoD now holds TAPLs (Technically Acceptable Products Lists).

**OBSOLETE OR CANCELLED SPECIFICATIONS**

Where specifications have been cancelled and superseded by another, the word "Obsolete" is shown after the specification. Even though the specification is obsolete, Shell may still manufacture the grade to meet the requirements of the obsolete specification and tests each batch of product against these requirements. In the majority of cases, test reports and product containers which normally include the specification number will also carry the annotation "(Obs)" or "(Obsolete)" after the specification.

**COMPATIBILITY OF AEROSHELL GRADES WITH MATERIALS**

Considerable care has to be exercised during selection of metals, paints, varnishes, insulation materials, plastics and elastomers, etc. to ensure that they are compatible with the chosen lubricant whether it be an oil, fluid or grease. This is particularly important if the product has a synthetic oil component.

Since compatibility also depends upon the operating environment, it is impossible for lubricant suppliers to be aware of all possibilities of use. Therefore, it is most important that material or equipment manufacturers are consulted regarding compatibility of oils, fluids and greases with specific materials. Most elastomer manufacturers produce comprehensive tables of compatibility of their elastomers with a large range of products and these tables should therefore be consulted.

Where appropriate, more information on compatibility is given at the front of each product section in this book.

**RATIONALISATION**

For many years aircraft operators have been seeking to rationalise the oils and greases used on aircraft and to reduce the number of different products in their inventories.

It is possible to achieve this providing either the equipment manufacturer’s approval has been obtained or the alternatives have been listed in the relevant manuals.

In some cases equipment manufacturers (e.g. Boeing) are taking steps to reduce the number of different grades required in support of their aircraft.

**USE OF ALTERNATIVE PRODUCTS**

Apart from those products which are used for the same applications, but under different operating conditions, alternative grades should not be used as a substitute for grades which are not available.

**PACKAGES**

Consumers are encouraged to obtain supplies of AeroShell products in the smallest packages commensurate with their use. Small packages which can generally be used as dispensers reduce the risk of product contamination. With larger containers it is usually necessary to decant the contents into smaller containers or jugs which may not always be perfectly clean. In addition, there is a possibility of contamination occurring through the lid or cap being left off or not being replaced properly.

**STOCKS**

Every Shell company holds adequate stocks of those grades known to be in demand, based whenever possible on the offtake of the previous six months. For grades not in regular demand, special supply arrangements have usually to be made in advance.
TEMPERATURE AND VISCOSITY

All temperatures are quoted in Celsius. Whilst the more recent British and U.S. Specifications are now based on Celsius temperatures, the earlier specifications are still based on Fahrenheit temperatures. In such cases, whilst it is acceptable to use and quote temperatures in degrees Celsius, the Fahrenheit temperature remains the reference temperature.

All viscosities are now shown as mm²/s, (millimetres squared per second).

This unit is related to centiStokes as follows:

1 centiStoke (cSt) = 1 mm²/s

SUBSTITUTES FOR RUSSIAN AVIATION LUBRICANTS

A number of AeroShell substitutes for Russian Grades are available for use in aircraft of Russian origin. Full details of these are included in the Specification Section of this publication and where appropriate the Russian equivalent is shown on each grade page. Further information is available from local Shell companies.

SUBSTITUTES FOR CHINESE AVIATION LUBRICANTS

For information on AeroShell substitutes to Chinese aviation lubricants users should contact their local Shell company.

TYPICAL PROPERTIES

Typical properties as reported in this publication are determined by averaging actual batch data provided by the manufacturing facilities over a period of time. This data is therefore typical but obviously cannot be guaranteed to be identical to the batches of products provided at any specific time. In some instances, this averaging involves more than one manufacturing facility when products are supplied from a number of facilities. It must be emphasised that the data provided in this publication is presented only as a guide for the assistance of AeroShell product users.

TECHNICAL SERVICE

Shell provides a full technical service in support of its products and their performance. Two elements of this service are firstly highly qualified technical staff and secondly laboratories and product research/development facilities. The technical staff maintain contact with customer, engine and airframe manufacturers, and accessory equipment manufacturers. The laboratories and product research/development facilities of Shell Global Solutions provide laboratory services to assist in problem analysis and product development.

PAGES FOR NOTES

At various points, blank pages have been included for notes.

FURTHER INFORMATION AND PUBLICATIONS

Additional information, changes in approval status, changes in specifications, user experience and other useful data is available from local Shell companies.

In addition, brochures and leaflets on particular topics are published from time to time. Copies of any brochure/leaflet are available from local Shell companies.
## CLASSIFICATION OF AEROSHELL PRODUCTS AND PRODUCT REFERENCE

### AVIATION TURBINE FUELS (Jet Fuels)
- Shell Jet A-1 30
- Shell Jet A 30
- Shell Jet B 30
- Shell TS-1 31
- Shell No.3 31
- Shell JP-4 33
- Shell JP-5 33
- Shell JP-8 33
- Shell JP-8 +100 33
- Shell AeroJet 40
- AeroShell Oil W100 62
- AeroShell Oil W120 62
- AeroShell Oil W 15W-50 66
- AeroShell Oil W100 Plus 70

### TURBINE OILS
- MINERAL
  - AeroShell Turbine Oil 2 86
  - AeroShell Turbine Oil 3 88
  - AeroShell Turbine Oil 3SP 90
- SYNTHETIC
  - AeroShell Turbine Oil 308 94
  - AeroShell Turbine Oil 390 98
  - AeroShell Turbine Oil 500 102
  - AeroShell Turbine Oil 529 106
  - AeroShell Turbine Oil 531 110
  - AeroShell Turbine Oil 555 114
  - AeroShell Turbine Oil 560 120
  - AeroShell Turbine Oil 750 126

### AVIATION GASOLINES (Avgas)
- Shell Avgas 82UL 34
- Shell Avgas 100 34
- Shell Avgas 100LL 34

### POWER BOOST FLUIDS
- Shell Methanol Mixture 45/55/0 42
- Shell Demineralised Water 42

### ADDITIVES
- AeroShell Performance Additive 101 44

### SHELL WATER DETECTOR
- 50

### PISTON ENGINE OILS
- STRAIGHT
  - AeroShell Oil 65 60
  - AeroShell Oil 80 60
  - AeroShell Oil 100 60
  - AeroShell Oil 120 60
- ASHLESS DISPERSANT
  - AeroShell Oil W65 62
  - AeroShell Oil W80 62

### HYDRAULIC FLUIDS
- AeroShell Fluid 4 188
- AeroShell Fluid 31 190
- AeroShell Fluid 41 194
- AeroShell Fluid 51 198
- AeroShell Fluid 61 202
- AeroShell Fluid 71 206
- AeroShell Fluid 71S 207
- AeroShell Fluid 71SSF and LGF 210

### PRESERVATIVES
- INTERNAL
  - AeroShell Fluid 2F 216
  - AeroShell Fluid 2T 218
- EXTERNAL
  - AeroShell Compound 02 222
  - AeroShell Compound 05 224

### OTHER FLUIDS
- LUBRICATING OILS
  - AeroShell Fluid 1 228
  - AeroShell Fluid 3 230
  - AeroShell Fluid 12 236
  - AeroShell Fluid 18 238
- GEARBOX OILS
  - AeroShell Fluid 5L-A 232
  - AeroShell Fluid 5M-A 234
  - AeroShell Fluid S.8350 248
- CALIBRATING FLUIDS
  - AeroShell Calibrating Fluid 2 250
- DE-ICING FLUIDS
  - AeroShell Compound 06A 252
  - AeroShell Compound 07 254
- AVIONIC COOLING FLUIDS
  - AeroShell Fluid 602 240
- FLUIDS FOR CLEANING, PRESERVING AND LUBRICATING
  - AeroShell Fluid 634 244
**DISCONTINUED AEROSHELL GRADERS**

This table lists AeroShell grades which have been discontinued since 1975. Also included are the U.S. and British specifications that the grades were approved to, a description of the grade, plus details about a suitable alternative AeroShell Grade.

<table>
<thead>
<tr>
<th>AeroShell Grade</th>
<th>U.S.</th>
<th>Specification British</th>
<th>Description/Superseded by</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Turbine Oil 9</td>
<td>–</td>
<td>DEF STAN 91-97</td>
<td>A 9 mm²/s mineral turbine oil. There is no suitable alternative AeroShell Grade.</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 9B</td>
<td>–</td>
<td>DEF STAN 91-97</td>
<td>A 9 mm²/s mineral turbine oil with an EP agent. There is no suitable alternative AeroShell Grade.</td>
</tr>
<tr>
<td>Shell Aviation Grease 7</td>
<td>MILG-23827B</td>
<td>DEF STAN 91-53</td>
<td>A general purpose synthetic grease. Acceptable alternative is AeroShell Grease 7, but the two grades should not be mixed.</td>
</tr>
<tr>
<td>AeroShell Grease 8</td>
<td>–</td>
<td>DEF STAN 91-54</td>
<td>A grease containing graphite. No direct replacement, although AeroShell Grease 17 may be suitable for some applications.</td>
</tr>
<tr>
<td>AeroShell Grease 22A</td>
<td>MILG-81322</td>
<td>–</td>
<td>Advanced general purpose grease. Replaced by AeroShell Grease 22C, which in turn has been replaced by AeroShell Grease 22CF.</td>
</tr>
<tr>
<td>AeroShell Grease 22C</td>
<td>MILG-81322</td>
<td>–</td>
<td>Advanced general purpose grease. Replaced by AeroShell Grease 22CF.</td>
</tr>
<tr>
<td>AeroShell Grease 23</td>
<td>MILG-81827A</td>
<td>–</td>
<td>High load capacity grease. Alternative grade is AeroShell Grease 23C.</td>
</tr>
<tr>
<td>AeroShell Fluid 1AC</td>
<td>AAF.3580D</td>
<td>–</td>
<td>A special hydraulic fluid. No direct alternative, although some equipment manufacturers have approved alternative grades.</td>
</tr>
<tr>
<td>AeroShell Fluid 7</td>
<td>MILH-6083</td>
<td>DTD.5540</td>
<td>A preservative mineral hydraulic fluid. Replaced by AeroShell Fluid 71.</td>
</tr>
<tr>
<td>AeroShell Fluid 10</td>
<td>–</td>
<td>DTD.791C</td>
<td>A wax thickened piston engine storage oil. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Fluid 14</td>
<td>–</td>
<td>DTD.445A</td>
<td>A cleaning fluid. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Fluid 61 Type II</td>
<td>MILH-46170B</td>
<td>–</td>
<td>Preservative synthetic hydrocarbon hydraulic fluid dyed red. Alternative is AeroShell Fluid 61 Type I which is undyed.</td>
</tr>
<tr>
<td>AeroShell Compound 01</td>
<td>–</td>
<td>–</td>
<td>A quick drying preservative fluid. In many cases, two coats of AeroShell Compound 02 can be used in place of Compound 01.</td>
</tr>
<tr>
<td>AeroShell Compound 06</td>
<td>–</td>
<td>–</td>
<td>Denatured ethyl alcohol. No direct alternative, although AeroShell Compound 06A or AeroShell Compound 07 may be suitable for some applications.</td>
</tr>
<tr>
<td>AeroShell Compound 09</td>
<td>MILM-7866C</td>
<td>–</td>
<td>Molybdenum disulphide powder. There is no suitable AeroShell alternative.</td>
</tr>
<tr>
<td>Shell Compound S.7632</td>
<td>MILA-8243D</td>
<td>–</td>
<td>De-icing fluid.</td>
</tr>
<tr>
<td>Shell Aviation Fluid 5.7229</td>
<td>–</td>
<td>–</td>
<td>A compressor wash fluid. No AeroShell alternative.</td>
</tr>
</tbody>
</table>
In many countries there has been increasing interest in health, safety and environmental issues arising from the handling and use of oil products. Of late, legislation in many countries has changed, or is changing, with the result that information quickly becomes either out of date or is insufficient for a particular area.

The environmental impact of aviation lubricants is small when compared with total lubricants or with the whole of aviation. Nevertheless, all AeroShell grades comply with international norms. Environmental actions taken by Shell and which are constantly under review include:-

- All AeroShell components registered in U.S. and Europe and increasingly in other countries such as Japan, China, Australia, Korea
- Safety Data Sheets are available for all grades
- Storage and handling information available to operators
- Labelling standards

Many countries now require Material Safety Data Sheets (MSDS) to be prepared for individual products and for these documents to be readily available to the users of the product.

Safety Data Sheets are available for all AeroShell grades and copies of these can be made available by local Shell companies. Where necessary, local Shell companies will ensure that any document they supply will comply with local legislation. If no local legislation exists then the data will be in accordance with the requirements of the European Community. These Safety Data Sheets contain information on:-

- Composition/information on ingredients
- Hazard identification
- First Aid measures
- Fire Fighting measures
- Accidental release measures
- Exposure control/personal protection
- Toxicological information
- Ecological information
- Disposal considerations
- Regulatory information

These Safety Data Sheets are revised and re-issued whenever there is a change in the legal requirements and thus operators should always ensure that they are in possession of the latest edition. They can be accessed via the Internet at www.shell.com/aviation/aeroshell.

Safety Data Sheets are intended to act as a guide to users of Shell Aviation products and whilst the information is given in good faith, any remedial action must be the responsibility of the persons concerned and "Shell" cannot be responsible for any loss or damage resulting from any action taken.
QUALITY CONTROL, STORAGE, HANDLING AND RETESTING OF AEROShell PRODUCTS

Generally AeroShell products are very stable and do not normally deteriorate if stored and handled correctly.

Owing to the nature of aviation there is a need to adopt procedures which enhance safety requirements and ensure product quality. Thus these recommendations must be considered as minimum requirements and any local requirements (e.g. ISO 9000, governmental and/or aviation authority requirements) which are more stringent take precedence.

QUALITY CONTROL

All AeroShell products are blended in batches with each batch composed of the identical formulation to all previous batches. A range of tests are performed on each batch to evaluate the physical, chemical and performance characteristics of the product. Historically, the batch-to-batch variations are minor and within the limits of test repeatability.

As each batch is prepared, a small quantity of product is set aside in sealed containers. These are then kept for a period of time in order to provide a reference base.

Equally as important as good quality control during the blending and filling operation is correct storage and handling of the product prior to use. Customers can enhance the product storage by using first-in, first-out inventory procedures and maintaining the oil under normal storage conditions (i.e. indoors, protected from excessive heat, moisture, dust, etc.) and full details of the recommended storage, handling and retesting procedures are given in this section.

PRODUCT QUALITY

In making any product which conforms to a military specification, a manufacturer can choose either to just barely meet the specification or to exceed the specification performance requirements. When a product exceeds the specification minimum requirements, the customer is provided with extra protection. The majority of AeroShell branded products exceed the specifications against which they are approved and have become acknowledged as industry standards. The products which Shell companies supply for military use are the same products supplied to commercial customers. The fact that the AeroShell products perform well in commercial operations further attests to the quality cushion which is provided to the military organisation using them.

IMPORTANCE OF CORRECT STORAGE AND HANDLING

The importance of correct storage and handling cannot be over emphasised.

Shell manufacturing plants pay particular attention to quality control throughout the entire manufacturing, blending and filling process of all aviation products. Rigorous checks take place during these operations and thorough testing before release of a product ensures that it meets the requirements of the specification and is fit to do the job for which it is intended.

It is therefore very important that operators and users of these products take equal care when handling and storing these products so that they remain in first class condition.

THE MOST COMMON PROBLEMS

Deterioration of product quality arises mainly from contamination by water and/or dirt, and by temperature extremes during storage. In addition, deterioration can occur through the container being badly dented or damaged. Invariably, the sharp corners of dented or damaged containers are places of weakness where pinholes easily occur and rust readily forms.

WATER CONTAMINATION

Contamination by water can occur in two ways:

By ‘breathing’ of the container. In principal this happens when a container is stored in the open air. It may then be subjected to wide temperature changes (this includes, for example, the variation between daytime and night time temperature). At elevated temperatures the contents of the package will expand, and the layer of air above the oil will try to find a way out. With drums this is even possible through well sealed bungs.

When cooling takes place, humid air often has the opportunity to penetrate into the drum, where the moisture then condenses out and the product becomes contaminated. Initially no more than a few droplets may be introduced, but with time the amount progressively increases and the contamination becomes significant and can lead to internal rusting of the container.

By penetration of water present on top of the container. Containers are carefully and thoroughly sealed after filling. However, if either breathing or if rusting (leading to pinholes in the container) has occurred, it is possible for water present on top of the container to penetrate the container and contaminate the product.

Preventing water contamination is simple: Store the product in a warehouse immediately after receipt. The warehouse should be dry, clean and not subject to wide temperature changes.
STORAGE TEMPERATURES
Aviation lubricants should not be stored in the open air. Even inside warehouses, strong sunlight entering through windows and open doors can cause prolonged high temperatures on the surfaces of containers, which may affect product quality. Accordingly, containers should be kept in a shaded location.

Certain aviation products (in most cases for ground application) are affected by extremes of cold. Such low temperatures can inhibit the performance of these products and make them either difficult to pour, or difficult to use. Currently the only AeroShell product that is susceptible to extreme cold is AeroShell Compound 02 (an external corrosion protective).

VOLATILE COMPONENT PRODUCTS
In general, aviation lubricating oils do not present an inherent fire risk. The main exceptions are those products containing volatile components, e.g. certain AeroShell Compounds. If a product is suspected of being volatile, it should be stored in a separate special flameproof store room, away from other products. It is not advisable to store more than will be needed for direct use.

AeroShell products with volatile components are:
- AeroShell Compounds 02, 06A and 07

SHELF LIFE, PERIODIC INSPECTION AND RE-TESTING
It is very important that no misunderstanding should ever arise over the contents of a container. Issue of an incorrect product from the warehouse should be prevented at all costs – especially for aviation applications. Great care must therefore be taken to ensure that the right product is received in the first instance. Furthermore, after products have been received, markings on containers and cartons should be kept legible; if necessary, they should be re-stencilled.

If a product is in store for a prolonged period of time, it is important to determine that it is still suitable for use. At regular intervals (exact time is for the user’s decision, but it could be every quarter or every six months) a visual inspection of the outside of the cartons (for small pack) or containers (if drums or pails) should be undertaken checking for signs of leaks or damage. Those which are leaking or badly damaged should be downgraded for non-aviation use or destroyed in accordance with local environmental regulations.

- Drums must be placed horizontally with the bungs at the ‘quarter to three’ position.
- Pails and cartons must be stored in such a way that they cannot be damaged.

CONTAMINATION BY DIRT
Dirt cannot normally penetrate to the contents of a container until it has been opened. The dirt present in a dusty atmosphere will settle upon the surfaces of containers. Do not remove product from such containers without first having taken the proper precautions.

- Prevention
AeroShell products should be stored in a dry, dust-free warehouse. Before a container is opened the top should be thoroughly cleaned. In the case of drums it is recommended that the whole top, and particularly the area around the bungs, should be thoroughly cleaned.

- Greases
Greases require special precautions. Grease containers should never be opened in a dusty atmosphere. Before removing the contents, make sure that the equipment to be used for this is clean and free from dust and dirt. A wooden scraper is generally not recommended because it leaves small particles of wood mixed in with the grease which could affect the performance of the product.

In order to prevent oil separation into the hole from which grease has been removed, the surface of the product should be flattened out. Therefore: Always leave a smooth surface, and close the container after use!

Oil separation to a greater or lesser extent occurs with all greases. Unless the separation is excessive the grease can be used providing it is stirred well before use.

- Superclean Hydraulic Fluids
Superclean hydraulic fluids, as the name implies, are hydraulic fluids which are exceptionally clean. This is achieved by extensive filtering of the fluid, thorough cleaning of containers and packing in a clean room.

In view of this, particular care should be taken when opening the containers since it is too easy for the fluid to lose its superclean properties. It is recommended that for superclean fluids a dispensing device, which includes fine filtration, is used.
If a product is still in stock after a number of years, then it is necessary to take samples and test key properties to verify that the product continues to be fit for purpose. For the majority of AeroShell grades, representative samples from each batch should be re-tested after the specified time from date of manufacture or, if not known, date of order or date of receipt can be used instead.

Different products are subject to different re-test periods; similarly, the tests which need to be carried out on a product to verify its continued suitability for use depend on the type of product and field experience developed over the years. The re-test periods and the tests required for AeroShell products are based primarily on those specified in the NATO Standardization Agreement STANAG 3149 (Edition 8) entitled "Minimum Quality Surveillance of Petroleum Products". They are listed in the table below:

<table>
<thead>
<tr>
<th>Product</th>
<th>Initial Retest Period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All piston engine oils</td>
<td>4</td>
</tr>
<tr>
<td>All turbine engine oils</td>
<td>4</td>
</tr>
<tr>
<td>All greases</td>
<td>3</td>
</tr>
<tr>
<td>All hydraulic fluids</td>
<td>3</td>
</tr>
<tr>
<td>AeroShell Fluids 1, 2F, 2T, 2XN, 3, 5L-A, 5M-A, 12, 18</td>
<td>4</td>
</tr>
<tr>
<td>AeroShell Fluids 602, 634, 5.8350</td>
<td>3</td>
</tr>
<tr>
<td>AeroShell Compounds 02, 05, 06A</td>
<td>4</td>
</tr>
<tr>
<td>AeroShell Compound 07</td>
<td>2</td>
</tr>
<tr>
<td>AeroShell Calibrating Fluid 2</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: in some countries, the local military authorities may adhere to re-test limits more stringent than those listed above and these would need to be applied when supplying product to them.

The first re-test date shall be at the original frequency stated above. Subsequent re-tests shall follow at half that frequency. For example, the original re-test period for AeroShell Oil W100 is 4 years; thus the first re-test is due 4 years after date of manufacture with the next re-test 2 years later, with subsequent re-tests following every 2 years thereafter.

Normally there is no requirement to do a full specification test since in many specifications there are tests which are difficult/complex to do or which involve specialised hardware. Generally these can only be done by an oil products laboratory which specialises in aviation oils and greases. Instead, a reduced set of tests is specified for each product which focuses on those properties which would reveal any deterioration that has occurred in the product over the period in storage.

In some cases, the cost of re-testing can be higher than the value of the product in stock and in such situations it is doubtful that it makes economic sense to re-test the product. Where re-testing is undertaken, then samples from each and every batch involved must be taken according to the cube root rule to determine how many containers need to be sampled.

All re-test results should be compared with the relevant specification requirements and, more importantly, with the original certificate of quality to assess if deterioration has occurred. Based on this comparison, a decision can then be made as to the suitability of the product for continued use or whether further testing is required, or if the product should be downgraded or discarded.

**TO SUM UP**

In general, AeroShell products are inherently stable. If stored properly, their quality, properties and performance should not be affected by prolonged storage.

For greatest economic efficiency, it is recommended that products should be issued from the warehouse in the order in which they were received.

In other words: FIRST IN – FIRST OUT

If, for some reason, a product has to be stored for longer than is economically desirable, and some doubt arises about its quality, it is recommended that Shell technical staff should be contacted for information about the product’s continued suitability for aviation applications.
A constant temperature should be maintained throughout the year if necessary by means of heating or air conditioning.

Good ventilation highly desirable.

Fire extinguishers of the foam, dry powder or carbon dioxide type should be located at accessible spots.

The room must be spacious enough to permit the handling of drums and other containers, and such tasks as tapping oil and opening tins. It should be big enough to allow easy access to the stored containers.

A constant temperature should be maintained throughout the year if necessary by means of heating or air conditioning.

Good ventilation highly desirable.

A lock should be provided to secure the warehouse.

A pump and other useful tools should be present.

Good lighting should be provided also an electricity connection and a water supply.
SAFETY IN FUELLING OPERATIONS

Delivering the Correct Grade of Fuel

Before delivering any fuel into the aircraft, the fuelling crew need to confirm with certainty the correct grade and quantity of fuel required. This is particularly important when fuelling general aviation aircraft overwing.

The procedure below is followed to ensure the delivery of the correct fuel grade:

1. All aircraft fuelled overwing should display clearly (close to the fuelling point) the grade of fuel required.
2. If the grade marking is not displayed, a Fuel Order Form must be completed and signed by an authorised member of the aircraft crew.
3. If the grade marking or Fuel Order Form is not available, no fuel will be delivered. There is a particular problem present when refuelling types of aircraft which may exist in both turbine engine ... look similar and the piston engine type may be turbo-charged, with large lettering on the cowlings saying “TURBO” etc.

Operators should therefore make certain that all fuelling points on their aircraft are clearly marked with the correct grade of fuel.

Indentification of Aviation Fuels

The various grades of aviation gasoline are coloured to aid recognition. These colours have been established by international agreement. Turbine fuels, however, are not dyed and are generally colourless.

In addition to fuel identification by colour, a marking and coding system has been adopted to identify the various airport fuel handling facilities and pieces of equipment according to the fuel they contain. Aviation gasolines are identified by name, using white letters on a red background; in contrast, turbine fuels are identified by white letters on a black background.

All portions of the fuelling facility and equipment where an error might occur, no matter how remote the possibility, are identified and keyed in the same marking and colour code. In addition, wherever possible, selective couplings are used to prevent the transfer of one grade into another.

Quality Assurance

The Shell Aviation Service is designed to ensure that aviation fuels are at all times delivered into aircraft on specification and in a clean and dry condition. Shell operates throughout the world according to the standards set out in the Shell Aviation Quality Assurance Manual and the Shell Airport Operations Manual.

Regular audits by Shell Aviation personnel are made to ensure Shell’s standards are maintained at all of Shell’s locations worldwide.

Types of Aviation Fuel

There are two categories of aviation fuel in common use today: aviation gasoline (known as Avgas) and turbine fuel or jet fuel. Details of these are given in the relevant fuels section in this handbook.

Facilities

Shell sets high standards for the facilities used to handle aviation fuels. Storage depots are designed to store optimum quantities of fuel at the high standard required by the Shell quality assurance system. Mobile equipment used to deliver fuels to customers’ aircraft is designed to ensure speedy, safe and efficient service. For both fixed and mobile equipment the emphasis is on achieving the correct balance between simplicity and sophistication. To help achieve this, Shell maintains contacts with equipment suppliers around the world and is active in international organisations responsible for equipment standards.

Good initial design and high standards of construction are complemented by regular testing and maintenance of all critical pieces of equipment.
Experience and Training

Shell has been in the aviation fuel business for more than 90 years and during that time has built up a wealth of experience. This is communicated to all Shell Companies by means of manuals, training courses and periodic publications and which is furthermore backed up by the extensive research facilities of Shell Global Solutions.

Shell staff are, therefore, fully aware of all aspects of safety required for the storage, handling and dispensing of aviation fuels.

Static Electricity

Matches, cigarette lighters, smoking, open flames and even backfires from vehicles or aircraft are obvious sources of ignition. Another source, not so visible or obvious, is the spark created by static electricity. Static electricity charges are generated in various degrees whenever one body passes through or against another. An aircraft in flight through the air, a fueller driving on a roadway, the rapid flow of fuel through a pipe or filter, and even the splashing of fuel into a fueller or aircraft during loading and fuelling operations, generates static electricity. A greater generation of static electricity may be expected when handling turbine fuels than when handling aviation gasoline; a basic reason for this is the higher viscosity of the fuel. Large turbine-powered aircraft demand large quantities of clean, dry fuel. The high-speed fuelling rates and the flow through ultra fine filter/separators required to meet this demand for cleanliness can create extremely high static electrical charges.

The hazard from the charging of the fuel itself is reduced by the use of a static dissipator additive. However, a static charge may still accumulate on the aircraft during flight or on the ground and it is the duty of the fueller to bleed off any charge before performing any act which may draw a spark.

The bleeding-off of an electrical charge from a body of fuel or an aircraft is not always an instantaneous act as is commonly believed. It may take several seconds to bleed off all the charge from some fuels.

When handling all aviation fuels, the following procedures are adopted:

1. Connect the bonding wire from the fueller or cabinet to the aircraft.
2. In the case of overwing fuelling, connect the fuel nozzle bonding wire to the aircraft before the tank cover is opened (underwing connectors do not need to be bonded to the aircraft).
3. When disconnecting, reverse the order.

It cannot be emphasised too strongly the hazard present from static electricity when moving any hydrocarbon product. Many accidents outside airfield operations, in the home and at work, are caused by the mishandling of fuels.

Remember: If it’s metal, bond it. If it’s plastic, don’t use it!!!
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.
ACCESS TO AVIATION FUEL SPECIFICATIONS

Because it is important to refer only to the most recent issues of fuel specifications, their detailed requirements have not been tabulated in this AeroShell Book since they could quickly become out-of-date. Copies of the specifications cited above can be obtained from the following authorities:

DEF STAN Specifications
Ministry of Defence
Directorate of Standardisation
Kentigern House
65 Brown Street
Glasgow G2 8EX
UK

phone +44 141 224 2496
fax +44 141 224 2503

NOTE: DEF STAN specifications are freely available from their web site at http://www.dstan.mod.uk

ASTM Specifications
ASTM specifications are published annually in the ASTM Book of Standards, Section 5 (on paper and CD). Copies are available from:

ASTM
100 Barr Harbor Drive
West Conshohocken
PA 19428-2959
USA

phone +1 610 832 9585
fax +1 610 832 9555

ASTM website is http://www.astm.org

NOTE: Specifications are available for a charge.

US Military Specifications
Department of Defense
DODSSP
Building 4/ Section D
700 Robins Avenue
PA 19111-5094
USA

phone +1 215 697 2667
fax +1 215 697 1462

NOTE: US Military specifications are freely available from their web site at http://assist.daps.dla.mil/quicksearch

IATA Guidance Material for Aviation Turbine Fuels Specifications
IATA issue an excellent guide covering commercial aviation fuels and additives. The latest edition can be obtained from:

Fuel Services
IATA
800 Place Victoria
PO Box 113
Montreal
Quebec
Canada H6Z 1M1

phone +1 514 874 0202
fax +1 514 874 2661
IATA website is http://www.iataonline.com

AFQRJOS Check List for Jet A-1
AVIATION FUEL ADDITIVES

Aviation fuel additives are compounds added to the fuel in very small quantities, usually measurable only in parts per million, to provide special or improved qualities. The quantity to be added and approval for its use in various grades of fuel is strictly controlled by the appropriate specifications.

A few additives in common use are as follows:-

1. **Anti-knock additives** reduce the tendency of gasoline to detonate. Tetra-ethyl lead (TEL) is the only approved anti-knock additive for aviation use and has been used in motor and aviation gasolines since the early 1930s.

2. **Anti-oxidants** prevent the formation of gum deposits on fuel system components caused by oxidation of the fuel in storage and also inhibit the formation of peroxide compounds in certain jet fuels.

3. **Static dissipator additives** reduce the hazardous effects of static electricity generated by movement of fuel through modern high flow-rate fuel transfer systems. Static dissipator additives do not reduce the need for ‘bonding’ to ensure electrical continuity between metal components (e.g. aircraft and fuelling equipment) nor do they influence hazards from lightning strikes.

4. **Corrosion inhibitors** protect ferrous metals in fuel handling systems, such as pipelines and fuel storage tanks, from corrosion. Some corrosion inhibitors also improve the lubricating properties (lubricity) of certain jet fuels.

5. **Fuel System Icing Inhibitors (Anti-icing additives)** reduce the freezing point of water precipitated from jet fuels due to cooling at high altitudes and prevent the formation of ice crystals which restrict the flow of fuel to the engine. This type of additive does not affect the freezing point of the fuel itself. Anti-icing additives can also provide some protection against microbiological growth in jet fuel.

6. **Metal de-activators** suppress the catalytic effect which some metals, particularly copper, have on fuel oxidation.

7. **Biocide additives** are sometimes used to combat microbiological growths in jet fuel, often by direct addition to aircraft tanks; as indicated above, some anti-icing additives appear to possess biocidal properties.

8. **Thermal Stability Improver** additives are sometimes used in military JP-8 fuel, to produce a grade referred to as JP-8+100, to inhibit deposit formation in the high temperature areas of the aircraft fuel system.

FUEL PROPERTIES NOT IN SPECIFICATIONS

Fuel specifications do not list all the properties of aviation fuels; it would be impractical for them to do so because by no means all of these properties could be tested for at the creation of each new fuel batch. However, many of these properties not listed in official fuel specifications may nevertheless be important to the designers of aircraft engines and airframes because they describe certain aspects of the fuel’s behaviour when in aircraft tanks and fuel systems.

Examples of these properties are:

- Surface tension
- Specific heat
- Thermal conductivity
- Enthalpy
- Heat of vapourisation
- Lubricity
- Permittivity
- Flammability limits
- Autoignition temperature
- Spark ignition energy
- Bulk Modulus
- Solubility of gases in fuel
- Solubility of water in fuel
- Enthalpy
- Heat of vapourisation
- Lubricity
- Permittivity

Information and typical values for these properties can be obtained from a variety of publications. The most useful one for designers of aircraft and engine fuel systems is probably the Coordinating Research Council Inc. Report No. 530, titled “Handbook of Aviation Fuel Properties” (CRC Doc. No. 530). This was published in 1983 and is available from the Society of Automotive Engineers, Inc., General Publications Department, 400 Commonwealth Drive, Warrendale, Pennsylvania PA 15096 U.S.A.
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.
SHELL POWER BOOST FLUIDS

It used to be commonplace for large piston engines to require special fluids to increase their take-off power. Similar injection systems are also incorporated in some turbo-jet and turbo-prop engines. The power increase is achieved by cooling the air consumed, to raise its density and thereby increase the weight of air available for combustion. This effect can be obtained by using water alone but it is usual to inject a mixture of methanol and water to produce a greater degree of evaporative cooling and also to provide additional fuel energy.

For piston engines, methanol/water mixtures are used and these may have 1 percent of a corrosion inhibiting oil added. The injection system may be used to compensate for the power lost when operating under high temperature and/or high altitude conditions (i.e. with low air densities) or to obtain increased take-off power under normal atmospheric conditions, by permitting higher boost pressure for a short period.

Both water alone and methanol/water mixtures are used in some gas turbine engines, principally to restore the take-off power (or thrust) lost when operating under low air density conditions. Use of a corrosion inhibitor in power boost fluids supplied for these engines is not permitted.

The methanol and water used must be of very high quality to avoid formation of engine deposits. The water must be either demineralised or distilled and the only adulterant permitted in the methanol is up to 0.5 percent of pyridine if required by local regulations as a de-naturant. In the past there were several different grades of water/methanol mixtures, e.g. 45/55/0 for turbine engines, 50/50/0 for piston engines (this was also available with 1% corrosion inhibiting oil and designated 50/50/1) and 60/40/0, however, with decreasing demand Shell now only supplies 45/55/0. The table shows the principal characteristics of Shell demineralised water and of the commonly used methanol/water blend.

---

**Shell Grade Designation**

Joint Service Designation

**Specifications:**

British (Military)
Rolls-Royce
Pratt & Whitney

**Composition:**

Methanol (BS.506)
Pure Water
Corrosion inhibiting oil

**Properties:**

Appearance
Density @ 15°C (kg/l)
Residue on evaporation (ppm)
Principal application

---

**Shell Methanol/Water Mixture 45/55/0 (note 1)**

Joint Service Designation

DEF STAN 68-253
MSRR 9359
CPW 328

**Composition:**

Methanol (BS.506)
Pure Water
Corrosion inhibiting oil

**Properties:**

Appearance
Density @ 15°C (kg/l)
Residue on evaporation (ppm)
Principal application

---

**Shell Demineralised Water**

DEF STAN 68-253
AEP W Issue 2

---

**Notes:**

1. Sometimes also referred to in specifications as Methanol/Water 44/56 grade
2. Up to 0.5% pyridine permitted as a de-naturant in BS.506
AEROSHELL PERFORMANCE ADDITIVE 101

AeroShell Performance Additive 101, developed for the USAF JP-8 +100 programme by BetzDearborn (now GE Betz) for high temperature, high performance jet fuel, helps improve engine reliability while reducing overall operating and maintenance costs.

AeroShell Performance Additive 101 is a unique, patented jet fuel additive designed to improve the thermal stability of military jet fuels. An extensive testing programme has demonstrated engine performance improvements and substantial cost savings.

AeroShell Performance Additive 101 is the only product to meet the goals of the U.S. Air Force JP-8 +100 Project. It has over three million flight hours in operation at USAF and ANG locations and is now available to non-U.S. military customers.

AeroShell Performance Additive 101 is approved for use in all military and civil engines manufactured by Pratt & Whitney and General Electric. Approval in Rolls-Royce and other manufacturers’ engines is pending.

AeroShell Performance Additive 101 is designed to:
• provide greater fuel heat-dispersing capacity by allowing fuel temperatures to increase by as much as 56°C (100°F) without degradation.
• reduce deposits in turbine engines using all grades of jet fuel.
• prevent and clean up carbon in fuel system and combustion sections of turbine engines.
• reduce smoke signature.

Improves Jet Fuel Thermal Stability

In today’s military aircraft, standard jet fuel can break down and form deposits on metal surfaces, when thermally stressed to temperatures above 150°C (300°F). This severe environment requires substantially improved fuel stability. In a variety of static and dynamic laboratory tests, along with advanced simulator rigs, Shell Aviation’s additive programme, in conjunction with BetzDearborn (now GE Betz), has already demonstrated a minimum of 56°C (100°F) improvement over today’s jet fuel in both the bulk and wetted wall areas of aircraft fuel systems.

Reduces Fuel Manifold & Nozzle Coking

Carbon build-up (coking) can create back pressure in fuel manifolds, as well as distort fuel nozzle spray patterns. Altered flame patterns can contribute to metal fatigue in both the combustion and turbine sections of the engine. High engine cycle fatigue often occurs. In severe cases, turbine damage leading to catastrophic engine failure is possible.

Coke build up along the walls of the fuel manifold system can cause changes in hydraulic pressure and contribute to erratic fuel controller performance. In "real world" field testing and subsequent routine usage in JP-8 +100, AeroShell Performance Additive 101 has minimised equipment replacement costs by reducing coking, allowing optimum performance levels to be achieved.

Reduces Unscheduled Engine Removals

Reports of after-burner and other fuel related malfunctions usually trigger a mandatory inspection to duplicate and correct the malfunction before the engine can be put back into active service. These engine inspections are costly but necessary to ensure pilot safety and aircraft integrity. In military field testing, continuous use of AeroShell Performance Additive 101 dramatically reduced the frequency of these fuel related incidents and consequently lowered the cost of engine removals by as much as 50%.*
Afterburner (reheat) malfunctions are dangerous and can place pilots and their equipment in jeopardy. Failures to ignite afterburner spray fuel rings can cause mechanical damage, place pilots at risk, and in combat, potentially mean the split-second difference between life and death.

AeroShell Performance Additive 101 has been field tested in a wide range of high performance jet engines as part of the USAF JP-8 +100 Programme and has shown that it significantly reduces these malfunctions - by as much as 80%*.

**Improves Engine Cleanliness**

Following the introduction of JP-8 +100, hot engine sections, from the combustion zone through to the afterburner tail exhaust, previously covered with light carbon deposits, have actually cleaned up and remained clean. Visual inspection of aircraft tail sections, combined with field boroscope inspections of fuel manifolds and nozzles have confirmed this benefit.

**Improving Flight Safety**

**Reduces Operational & Maintenance Costs**

Keeping the fuel system and jet engine clean from carbon deposits caused by the thermal stressing of jet fuel can reduce overall engine maintenance costs by as much as 70% per flight hour*.

Additive Injection

AeroShell Performance Additive 101 should be applied at the truck or vehicle refuelling operation using an injector system to meter the additive flow. Care should be taken if moving the injection point further up the refuelling process (such as into bulk storage tanks) in order to avoid deactivation of water coalescer systems by the detergent/dispersant action of the additive.

The recommended dose rate for AeroShell Performance Additive 101 in JP-8 is 256 ppm (mg/litre) or 1:4000. The product is oil soluble with good low temperature handling characteristics and can be injected undiluted in its delivered form.

**Performance Evaluation**

AeroShell Performance Additive 101 should be used in conjunction with a monitoring program designed to focus on fuel-related malfunctions. It is usual to measure the actual number of malfunctions, average time between occurrences, and the reduction in maintenance and labour costs. An additional measure is the effect on fleet readiness rate after treatment.

Caution: before using AeroShell Performance Additive 101, check with the aircraft/engine manufacturer to determine if the additive is approved for use in their equipment or, if not, under what terms and conditions the additive might be evaluated.
To learn more about how your operation can benefit today from the advanced technology of AeroShell jet fuel additives, contact email: APA101Project@aviation.shell.com

**Summary of Benefits**

- Improved Jet Fuel Thermal Stability
- Cleaner Engines and Components
- Reduced Operational Costs
- Fewer Engine Removals
- Lower Abort Rates
- Lower Maintenance Costs
- Improved Air Readiness
- Improved Flight Safety

*Based on data collected on the following engine types: F100-PW-100, F100-PW-200 Series, J85-GE-5, J69-T-25
Additional field tested engine types include: F110-GE-100, TF34-GE-100, T56-A-15

**Non-Military Usage of AeroShell Performance Additive 101**

Although the development of AeroShell Performance Additive 101 was the result of a requirement in military aircraft, benefits could also be achievable in commercial aviation. However, engine overhaul lives in civil aviation are an order of magnitude greater than those of military aircraft; consequently it is unrealistic to expect the same dramatic reductions in maintenance costs. What other benefits might be achievable?

By keeping fuel and combustion systems clean, optimum combustion conditions should be maintained for longer and this should have a beneficial effect on the normal performance deterioration rate seen during service. This could be translated into an improvement in specific fuel consumption, but any improvement is likely to be small and difficult to measure. Even so, an improvement of only 0.2%, say, in specific fuel consumption can still have a significant effect on an airline’s fuel bill. Such benefits can only be quantified by prolonged flight trials and Shell Aviation is currently working with several airlines to generate these data.

Another benefit of AeroShell Performance Additive 101 has already been demonstrated in a number of combustor rig trials, where it was seen to actively reduce particulates and heavy unburned hydrocarbons in the exhaust emissions. Further rig and engine testing is planned to quantify the emissions reduction capability of AeroShell Performance Additive 101.
SHELL WATER DETECTOR

The Shell Water Detector is a device for determining the presence in jet fuels of finely dispersed undissolved water in concentrations lower than those normally detectable by visual examination. Water dispersions of this type can result from the emulsification of a water/fuel mixture during pumping, or from the precipitation of dissolved water due to a fall in fuel temperature.

CONSTRUCTION

The detector consists of two parts:

a) A standard polythene or nylon hypodermic syringe of 5 ml capacity with a Record type nozzle fitting.

b) A plastic detector capsule in which is fitted a disc of filter paper treated with water sensitive chemicals.

USE

Before use the detector capsule should be examined in order to confirm that the paper is of a uniform yellow colour. The detector capsule is fitted to the syringe, then the capsule and approximately half of the syringe is immersed in the sample under test and the plunger withdrawn until the fuel reaches the 5ml mark. The capsule should be examined for any difference in colour between the inner wetted portion and the outer portion which is protected by the plastic moulding.

It is important to note that:

a) The screw cap should be replaced on the capsule container immediately the required capsule has been removed to prevent discolouration of the remaining capsules by atmospheric humidity. Unused capsules should not be left lying about or kept loose in the pocket.

b) A capsule should be used once only and then discarded because the sensitivity of the device is a function of the quantity of fuel passing through the paper.

INTERPRETATION OF RESULTS

The presence of undissolved water is indicated by a change in colour of the centre portion of the detector paper. The Shell Water Detector begins to react at very low levels of water contamination even below 10 ppm and the resulting colour change becomes progressively more noticeable with increasing water content until at approximately 30 ppm a distinct green colour is obtained giving a positive indication of water contamination. At lower water contamination levels a yellow/green colour is obtained which increases to blue/green and finally blue/black at very high levels of water contamination.

APPLICATION

The Shell Water Detector should be used as follows to check samples of jet fuels immediately after they are drawn:

a) Road vehicle and RTW drain samples – before discharge into airport storage.

b) Bottom samples from airport tanks – immediately before release.

c) Fueller and trailer compartment drain samples – after each replenishment.

d) Hydrant dispenser filter drain samples – after each aircraft fuelling.

e) Fueller filter drain samples – after the first aircraft fuelling, after filling or topping up either fueller or trailer.

f) Drain samples from filtration equipment on hydrant delivery and fueller loading racks – daily.

STORAGE LIFE AND SUPPLY ARRANGEMENTS

The recommended life for Shell Water Detector capsules is nine months from time of manufacture. The life expiry date (month/year) is marked on the bottom of each tube of capsules and is also printed on one end of each box of ten tubes.
For many years the performance of aircraft piston engines was such that they could be lubricated satisfactorily by means of straight mineral oils, blended from specially selected petroleum base stocks. However, demand for oils with higher degrees of thermal and oxidation stability necessitated ‘fortifying’ them with the addition of small quantities of non-petroleum materials. The first additives incorporated in straight mineral piston engine oils were based on the metallic salts of barium and calcium. In highly-rated engines the performance of these oils with respect to oxidation and thermal stability was excellent, but the combustion chambers of the majority of engines could not tolerate the presence of the ash deposits derived from these metal containing additives.

To overcome the disadvantages of harmful combustion chamber deposits, a non-metallic, i.e. non-ash forming, polymeric additive was developed which was incorporated in blends of selected mineral oil base stocks, to give the range of AeroShell W Oils.

Following extensive operational success in a wide range of civil engines, military specifications based on the general characteristics of AeroShell W Oils were prepared and issued.

AeroShell W Oils were in service with the world’s airlines and aircraft operators for many years when they operated big transport piston engine aircraft, during which time these oils became virtually the standard for all aircraft piston engines. Nevertheless, supplies of straight AeroShell Oils remained available primarily for running-in the aircraft piston engine and for the few operators who required them. Today these oils (both AeroShell W Oils and AeroShell Oils) are still required for the smaller piston engine aircraft flying in air taxi operations or flying clubs or flown by private pilots.

More recently, a semi-synthetic multigrade W oil for piston engines (AeroShell Oil W 15W-50) has been added to the range. This grade has become very popular amongst engine manufacturers and operators alike. In order to cater for those Lycoming engines which need improved load carrying (i.e. those engine models which require the addition of Lycoming Additive LW 16702) AeroShell Oil W 15W-50 was upgraded in 1986 to include an anti-wear additive.

In recent years, utilisation of piston engine aircraft has decreased resulting in the aircraft spending more time on the ground. This led to an increase in corrosion being seen inside the engine and in order to combat this AeroShell Oil W 15W-50 was further upgraded in 1993 to include a very effective anti-corrosion additive package.

For those operators who prefer a straight grade but still want anti-wear and anti-corrosion benefits of the multigrade oil, AeroShell Oil W100 Plus has recently been added to the range.

**SPECIFICATIONS**

Since the 1940s, piston engine operators have relied on two U.S. Military Specifications for defining piston engine lubrication requirements. Beginning with the old standby non-dispersant MIL-L-6082 oils and continuing through the MIL-L-22851 Ashless Dispersant products, the U.S. Military Specifications were the standards for oil performance worldwide. In military circles Grades 1065 and 1100 as well as Type II and III were familiar grade identifications, whilst in civil use Grades 65, 80, 100 and 120 were common. However, that has all changed.

The SAE Fuels and Lubricants Technical Committee 8 – Aviation Piston Engine Fuels and Lubricant Committee has been working very closely with the U.S. Navy to convert these Military Specifications into SAE Standards. Also involved were oil manufacturers, engine builders, test laboratories and the American FAA. In due course agreement was reached on a new set of performance standards for piston engine oils. These new SAE Standards are J-1966 Lubricating Oil, Aircraft Piston Engine (Non-Dispersant) and J-1899 Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant), both of which have now been adopted for use. The adoption of these new SAE Standards means that the two Military Specifications (MIL-L-6082 and MIL-L-22851) are now obsolete.

These new specifications include upgraded and improved tests and have been designed to meet current technology, and include the latest test methods and precision limits.

The most obvious change for users is the move from the old Grade or Type Number system to the more common SAE viscosity classification. Thus products in both SAE specifications are defined as SAE 30, 40, 50 or 60. In addition for the first time, multigrade aviation oils are included in the new specifications.

The U.K. has now cancelled DERD 2450 and DERD 2472 and adopted the SAE specifications.
**FUNCTION OF PISTON ENGINE OIL**

A piston engine oil’s function inside a piston engine is to:-

- reduce friction between moving parts
- provide necessary cooling to internal areas
- cushion moving parts against shock and help seal piston rings to cylinder walls
- protect highly finished internal parts of the engine from rust and corrosion
- keep interior of engine clean and free of dirt, sludge, varnish and other harmful contaminants

**APPLICATION**

AeroShell Oils and AeroShell W Oils are intended for use in four-stroke cycle aircraft reciprocating piston engines. They are not recommended for use in automotive engines converted for use in aircraft, and in these cases the conversion shop should be consulted for proper oil recommendations.

The term “ashless dispersant” was given to aviation oils to distinguish them from straight mineral aircraft piston engine oils. Automotive and heavy duty truck engine oils contain ashless dispersants and ash-containing detergents. They were traditionally called detergent oils (some aircraft operators incorrectly refer to ashless dispersant oils as “detergent oils”).

Because of the negative effect of ash on aircraft engine performance, it is very important that ash-containing oils are NOT used in an aircraft piston engine.

The reverse is also true. Never use an aircraft piston engine oil in a modern automobile or heavy duty truck engine.

Due to differences in metallurgy, operating conditions and fuel specifications, an aircraft oil will not meet all of the automobile/heavy-duty engine’s requirements. In addition, the aviation oils are not qualified for this application and their use could result in voiding the warranty and/or reduction in engine life.

Thus automobile oils MUST NOT be used in aircraft engines which use or specify SAE J-1899 or J-1966 oils. Similarly aviation oils MUST NOT be used in automobile engines.

**SELECTION OF RIGHT GRADE OF OIL**

For the majority of aircraft piston engines the selection of the right grade is important to maximise engine performance and engine life.

<table>
<thead>
<tr>
<th>Running-in use</th>
<th>Normal operation use</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Oils</td>
<td>AeroShell W Oils</td>
</tr>
</tbody>
</table>

**SELECTION OF CORRECT VISCOSITY GRADE**

AeroShell Oils and AeroShell W Oils are each available in four grades. The grades differ only by viscosity and thus cover the needs of all reciprocating engines now in airline and general aviation operation. There is no general rule by which the correct grade for every engine type can be chosen, but the following table provides approximate guidance for selecting the most suitable grade, based on the average ambient outside air temperature at engine start-up.

<table>
<thead>
<tr>
<th>AeroShell Oil</th>
<th>65 and W65</th>
<th>80 and W80</th>
<th>100, W100 and W100 Plus</th>
<th>120 and W120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air temperature °C</td>
<td>Below -12</td>
<td>-17 to 21</td>
<td>15.6 to 32</td>
<td>Above 26</td>
</tr>
<tr>
<td>Corresponding SAE No.</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
</tr>
</tbody>
</table>

Note: This table does not apply to AeroShell Oil W 15W-50.

N.B. For large engines the choice depends greatly upon the operator’s preference and past experience. Traditionally the choice seems to be associated with climatic zones: AeroShell Oil W100 or W100 Plus is preferred for temperate regions and AeroShell Oil W120 for warmer climates.

**ENGINE CONVERSION**

Elaborate precautions are not needed when changing from straight mineral oil to AeroShell W Oils, since both types of oil are compatible with each other.

Experience has shown that AeroShell W Oils do not loosen or affect the hard carbonaceous material already deposited in high-time engines, and may therefore be introduced at any time during the operational life of an engine.
The easiest and possibly the best way of converting a fleet of engines to an AeroShell W Oil is to ‘top-up’ with the oil commencing from a given date, and the majority of operators use this method following procedures recommended by the engine manufacturers concerned.

However, other operators have drained engines and refilled them with AeroShell W Oil. If this procedure is adopted, the oil filters should be checked after a ground run and at short intervals during initial operation, because the fresh charge of AeroShell W Oil may disperse ‘pockets’ of partly oxidised straight mineral oil which may have bound together and retained flaky carbonaceous material during previous operation.

**OIL CHANGE INTERVAL**

Almost all oil change recommendations specify not only an engine hour time limit, but also a calendar time limit. On low usage aircraft the calendar time limit is usually more critical than the engine hour limit. The need for frequent oil changes in aircraft is not caused by the oil wearing out, but rather by the oil becoming contaminated with by-products of combustion, dirt, water (both atmospheric as well as from condensation inside an engine) and unburnt fuel. This contamination can cause corrosion in the oil wetted areas of an engine and thus changing the oil removes these contaminants and helps to minimise corrosion. In order to minimise this corrosion inside low usage engines, calendar time changes are important.

**OIL CHANGE EXTENSION**

Many operators are interested in extending oil change intervals. As a general rule extensions are not recommended for the following reasons:-

- many engine manufacturers do not approve extended intervals
- possibility of losing engine manufacturers’ warranty on engine
- possibility that extended intervals will shorten engine life

The initial enthusiasm in the U.S. for extended intervals has declined due to problems associated with lead sludge found in engines. Many operators have now reverted back to the engine manufacturers’ oil change recommendations and found that these problems disappear.

Operators are urged to follow the engine manufacturers’ or rebuilders’ recommendation for oil change interval.

**BREAK-IN PROCEDURE**

Some aircraft engine manufacturers and rebuilders/overhaul agencies suggest in their service bulletins the use of straight mineral oil in new or newly overhauled engines for break-in. These straight mineral oils are usually recommended for the first 25 to 50 or even 100 hours of operation, or until the oil consumption stabilises. Other rebuilders or manufacturers, especially for such engines as the Lycoming O-320H, recommend an ashless dispersant oil for break-in. Operators should check with engine manufacturers or rebuilders for the correct recommendation for the specific engine and application.

**STABILITY IN STORAGE**

AeroShell W Oils are inherently stable and providing they have been stored and handled correctly prolonged storage does not have any effect on their quality, properties or performance.

**RADIAL ENGINES**

Radial engines utilise special parts and, depending upon the type of aircraft, application and climate are often subject to specific problems not seen in other types of piston engines.

In a radial engine each bank of cylinders has all of the cylinders in the same plane and transmits power through a single master rod bearing to the crankshaft. This master rod bearing is subjected to high loading and absorbs the shock and vibration from the cylinders and thus requires very good protection from the lubricant. Generally radial engines have greater piston and bearing clearances and thus require a high viscosity oil.

As a result of all this heavy duty stress, it is recommended that for radial engines used in normal operation (all operations except agricultural spraying), an oil such as AeroShell Oil W120 is used in moderate to temperate climates and AeroShell Oil W100 in cooler climates (if breaking-in then AeroShell Oil 120 and 100 respectively). Alternatively AeroShell Oil W 15W-50 could be used in those radial engines for which it is approved. None of these oils contain zinc additives which if used would quickly destroy the master rod bearing.

Agricultural operations represent a special problem for an oil used in radial engines. This is because of problems with high dirt and overspray ingestion into the oil. The best way to combat this is proper maintenance, good flying procedures and frequent oil changes.
NON-AVIATION USE OF AEROSHELL PISTON ENGINE OILS

In selecting an AeroShell piston engine oil for a non-aviation application the properties of the oil 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.

VINTAGE AIRCRAFT

Vintage aircraft piston engines, including vintage radial engines, were approved on oils available when the engine was originally manufactured, such oils being no longer available. If the engine was approved on an aviation oil other than a MIL-L-6082 or a MIL-L-22851 oil then operators should consult with either the engine rebuildor or oil supplier. On no account assume that present oils are direct replacements for old vintage aircraft applications.

OIL ANALYSIS

Routine oil analysis is now seen as a valuable part of a good maintenance programme. Increasingly, operators are adopting oil analysis programmes in order to help discover problems before they turn into major failures. Typically these programmes consist of spectrometric wear metal check, together with a few simple oil tests such as viscosity and acidity. Shell Companies can offer this service to operators.

It is important to note that the information gained is only as good as the sampling procedure. A single test is not enough to reveal trends and significant changes, it can only tell an operator if there is already a serious problem. Operators should therefore:-

• Take samples properly
  For best results, take the sample about midway through the draining of hot oil from the sump. A sample pulled off the bottom may be dirtier than normal. The sample should be taken the same way every time. An improperly taken sample can lead to mistaken conclusions about engine problems.

• Rely on a series of consistent tests over time
  Operators should look for significant changes or trends over time, not just absolute values.

• Take samples properly
  Always take the sample the same way at the same time interval. Always properly label the sample so that its identity is known.

It is likely that higher wear metal levels will occur during break-in or following some maintenance procedures.
AEROSHELL OILS 65, 80, 100 and 120

AeroShell straight mineral oils are blended from selected high viscosity index base stocks. These oils do not contain additives except for a small quantity of pourpoint depressant (which is added when improved fluidity at very low temperature is required) and an anti-oxidant.

APPLICATIONS
AeroShell Oils are available in four different viscosity grades:

- AeroShell Oil 65
- AeroShell Oil 80
- AeroShell Oil 100
- AeroShell Oil 120

The suffix for each grade corresponds to the viscosity of the oil at 210°F in Saybolt Universal Seconds.

The appropriate grades of these AeroShell Oils are approved for use in four-stroke cycle certified aircraft reciprocating piston engines (except Porsche) and other aircraft radial engines which use oil to specification SAE J-1966 (MIL-L-6082E) and which do not require use of an oil containing a dispersant additive. AeroShell Oils are used primarily during break-in of most new or recently overhauled four-stroke cycle aviation piston engines. The duration and lubrication recommendations for break-in vary, so operators should refer to the original engine manufacturer and/or overhaul facility for specific recommendations.

SPECIFICATIONS
The U.S. Specification SAE J-1966 replaces MIL-L-6082E.

Although it was planned to replace the British Specification DERD 2472 with a DEF STAN specification this has now been put into abeyance and instead the SAE specification has been adopted.

<table>
<thead>
<tr>
<th>AEROSHELL OIL</th>
<th>65</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>Approved J-1966 SAE Grade 30</td>
<td>Approved J-1966 SAE Grade 40</td>
</tr>
<tr>
<td>British</td>
<td>—</td>
<td>Approved J-1966 SAE Grade 40</td>
</tr>
<tr>
<td>French</td>
<td>(AIR 3560/D Grade SAE 30)</td>
<td>(AIR 3560/D Grade SAE 40)</td>
</tr>
<tr>
<td>Russian</td>
<td>—</td>
<td>MS-14</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-113 Obsolete</td>
<td>—</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OM-107 Obsolete</td>
<td>OM-170</td>
</tr>
</tbody>
</table>

( ) indicates the product is equivalent to specification.

<table>
<thead>
<tr>
<th>Typical Properties</th>
<th>65</th>
<th>80</th>
<th>100</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE viscosity grade</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>4.5</td>
<td>5.0</td>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>0.887</td>
<td>0.892</td>
<td>0.896</td>
<td>0.898</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 100°C</td>
<td>11.8</td>
<td>14.6</td>
<td>19.7</td>
<td>24.8</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>—</td>
<td>150</td>
<td>230</td>
<td>—</td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>94</td>
<td>Above 94</td>
<td>Above 94</td>
<td>94</td>
</tr>
<tr>
<td>Flashpoint Cleveland Open Cup °C</td>
<td>230</td>
<td>Above 240</td>
<td>Above 250</td>
<td>250</td>
</tr>
<tr>
<td>Carbon residue % m</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Total acidity mgKOH/g</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Sulphur % m</td>
<td>0.1</td>
<td>0.13</td>
<td>0.13</td>
<td>0.15</td>
</tr>
<tr>
<td>Copper corrosion @ 100°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ash content % m</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
</tr>
</tbody>
</table>

These products are made in more than one location and the approval status and typical properties may vary between locations.
AEROSHELL OILS W65, W80, W100 and W120

AeroShell W Oils were the first non-ash dispersant oils to be used in aircraft piston engines. They combine non-metallic additives with selected high viscosity index base stocks to give exceptional stability, dispersancy and anti-foaming performance. These additives leave no metallic ash residues that can lead to deposit formation in combustion chambers and on spark plugs, which can cause pre-ignition and possible engine failure.

APPLICATIONS

AeroShell W Oils are available in four different viscosity grades:

- AeroShell Oil W65  –  AeroShell Oil W80
- AeroShell Oil W100  –  AeroShell Oil W120

The suffix for each grade corresponds to the viscosity of the oil at 210°F in Saybolt Universal Seconds.

AeroShell W Oils are intended for use in four-stroke cycle certified reciprocating piston engines, including fuel-injected and turbocharged engines. AeroShell W Oils are not recommended for use in automotive engines. For automotive engines converted for use in aircraft, the specific engine manufacturer or the conversion agency should be consulted for proper oil recommendation.

Most radial engine operators use AeroShell Oil W120 in warm weather operations with AeroShell Oil W100 or AeroShell Oil W 15W-50 being used in cooler ambient temperatures.

AeroShell Oil W100 or AeroShell Oil W 15W-50 are the common choices for most operators of Lycoming and Continental flat engines but, during colder parts of the year, use of AeroShell Oil W80 in place of AeroShell Oil W100 would be an excellent choice.

Although some engine manufacturers and overhaulers suggest in their service bulletins the use of a straight mineral oil in new or recently overhauled engines for break-in, other rebuilders and manufacturers especially for engines such as the Lycoming O-320H recommend use of an AeroShell W Oil for break-in. Operators should therefore check with engine rebuilders or manufacturers for the correct recommendations for the specific engine.

AEROSHELL W OILS

- Promote engine cleanliness
- Help keep engines sludge free
- Help reduce oil consumption
- Help engines reach TBO (Time Between Overhaul)
- Protect highly stressed engine parts against scuffing and wear

SPECIFICATIONS

The U.S. specification SAE J-1899 replaces MIL-L-22851D

Although it was planned to replace the British Specification DERD 2450 with a DEF STAN specification this has now been put into abeyance and instead the SAE specification has been adopted.

<table>
<thead>
<tr>
<th>AEROSHELL OIL</th>
<th>W65</th>
<th>W80</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>Approved J-1899 SAE Grade 30</td>
<td>Approved J-1899 SAE Grade 40</td>
</tr>
<tr>
<td>British</td>
<td>—</td>
<td>Approved J-1899 SAE Grade 40</td>
</tr>
<tr>
<td>French</td>
<td>—</td>
<td>(AIR 3570 Grade SAE 40)</td>
</tr>
<tr>
<td>Russian</td>
<td>—</td>
<td>MS-14</td>
</tr>
<tr>
<td>NATO Code</td>
<td>—</td>
<td>O-123 Obsolete</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>—</td>
<td>OMD-160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AEROSHELL OIL</th>
<th>W100</th>
<th>W120</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>Approved J-1899 SAE Grade 50</td>
<td>Approved J-1899 SAE Grade 60</td>
</tr>
<tr>
<td>British</td>
<td>Approved J-1899 SAE Grade 50</td>
<td>Approved J-1899 SAE Grade 60</td>
</tr>
<tr>
<td>French</td>
<td>(AIR 3570 Grade SAE 50)</td>
<td>(AIR 3570 Grade SAE 60)</td>
</tr>
<tr>
<td>Russian</td>
<td>MS-20</td>
<td>—</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-125 Obsolete</td>
<td>O-128 Obsolete</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OMD-250</td>
<td>OMD-370</td>
</tr>
</tbody>
</table>

( ) indicates the product is equivalent to specification.
EQUIPMENT MANUFACTURERS APPROVALS

AeroShell W Oils are approved for use by the following engine manufacturers:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Approval Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textron Lycoming</td>
<td>301F</td>
</tr>
<tr>
<td>Teledyne Continental</td>
<td>MHS 24B</td>
</tr>
<tr>
<td>Pratt &amp; Whitney</td>
<td>Service Bulletin 1183-S</td>
</tr>
<tr>
<td>Curtiss Wright</td>
<td>Various Service Bulletins – refer to relevant Bulletin</td>
</tr>
<tr>
<td>Franklin Engines</td>
<td>Various Service Bulletins – refer to relevant Bulletin</td>
</tr>
</tbody>
</table>

AEROSHELL OIL

Typical Properties

<table>
<thead>
<tr>
<th></th>
<th>W65</th>
<th>W80</th>
<th>W100</th>
<th>W120</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE viscosity grade</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>2.0</td>
<td>4.0</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>0.886</td>
<td>0.887</td>
<td>0.889</td>
<td>0.894</td>
</tr>
<tr>
<td>Kinematic viscosity</td>
<td>@ 100°C</td>
<td>11.0</td>
<td>14.5</td>
<td>20.2</td>
</tr>
<tr>
<td></td>
<td>@ 40°C</td>
<td>84</td>
<td>126</td>
<td>213</td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>115</td>
<td>115</td>
<td>110</td>
<td>120</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>−25</td>
<td>Below −22</td>
<td>Below −18</td>
<td>Below −18</td>
</tr>
<tr>
<td>Flashpoint Cleveland</td>
<td>Above 240</td>
<td>Above 260</td>
<td>Above 240</td>
<td></td>
</tr>
<tr>
<td>Open Cup °C</td>
<td>227</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Carbon residue % m</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>0.25</td>
</tr>
<tr>
<td>Total acidity mgKOH/g</td>
<td>0.01</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Sulphur % m</td>
<td>0.1</td>
<td>0.13</td>
<td>0.14</td>
<td>0.18</td>
</tr>
<tr>
<td>Copper corrosion @ 100°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ash content % m</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
<td>0.006</td>
</tr>
</tbody>
</table>

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

These products are made in more than one location and the approval status and typical properties may vary between locations.
AEROSHELL OIL W 15W-50

AeroShell Oil W 15W-50 is a unique blend of high quality mineral oil and over 50% synthetic hydrocarbon base stocks, plus the AeroShell Oil W ashless dispersant additive system. This semi-synthetic blend offers high performance in a wide variety of applications and conditions. The synthetic base stock performance provides for better cold temperature pumping and protection than single grade oils. In addition, the blend of synthetic and high quality mineral base stocks provide high temperature performance superior to that of other fully approved aircraft piston engine oils. The mineral base stocks help disperse lead by-products of combustion, thereby keeping engines free of “grey paint” or lead sludge that can be a problem with some fully synthetic oils.

The anti-wear additive system in AeroShell Oil W 15W-50 provides outstanding wear protection for critical camshafts, lifters and other high wear components.

The anti-corrosion additive package in AeroShell Oil W 15W-50 helps protect low usage engines and engines in high humidity climates against rust and corrosion of critical engine parts such as camshafts and lifters.

AeroShell Oil W 15W-50 provides superior anti-corrosion protection for all types of certified aircraft piston engines. When used with proper maintenance procedures, the product provides maximum protection and improves the likelihood that aircraft engines will reach TBO. In addition, this product provides outstanding high temperature oxidation protection for hot running engines. It is designed to keep engines cleaner with less sludge and varnish build-up in critical ring belt and other areas.

APPLICATIONS

AeroShell Oil W 15W-50 is intended for use in certified four-stroke cycle aircraft piston engines. AeroShell Oil W 15W-50 is superior to single grade oils in almost every application. It offers easier starting, better lubrication after start-up, reduced wear, reduced corrosion and rusting, and improved cleanliness, with oil pressures and temperatures equal to that of single grade SAE 50 oils at fully warmed up conditions.

The anti-corrosion additive system is designed to prevent rust or corrosion in all types of aircraft piston engines. In comparative testing of camshaft rusting under high humidity conditions, AeroShell Oil W 15W-50 was almost entirely rust free while other camshafts conditioned on other oils showed sometimes heavy rusting on cam lobes and bearing surfaces.

These results indicate that AeroShell Oil W 15W-50 can provide maximum anti-corrosion protection for aircraft piston engines, when combined with proper maintenance practices and proper operating conditions.

Because of the improved flow characteristics of AeroShell Oil W 15W-50, operators may observe slightly lower oil temperatures in some aircraft. On larger aircraft, the oil cooler flap will normally compensate for this change. However, in small aircraft, oil temperature could be reduced slightly. Operators should always check the oil temperature to ensure that they are in the range specified by the manufacturer. Most manufacturers recommend cruising oil temperatures between 82 to 93°C (180 to 200°F). Oil temperatures significantly below this range can result in excessive water and fuel contamination in the crankcase.

AEROSHELL OIL W 15W-50

- Provides unsurpassed rust and corrosion protection for aircraft engines
- Promotes engine cleanliness, fights wear, offers excellent anti-foam properties
- Helps reduce oil consumption by up to 50% and provides superior oil flow at low temperatures
- Compatible with other approved aircraft piston engine oils
- Functions as an all season oil, no seasonal changes needed
- Reduces fuel consumption by up to 5% over straight grades
- Provides unequalled high temperature oxidation stability

Refer to General Notes at the front of this section for information on oil change recommendations and engine break-in.

AeroShell Oil W 15W-50 is not recommended for use in automotive engines. For automotive engines converted for use in aircraft, the specific engine manufacturer or the conversion agency should be consulted for proper oil recommendation.

SPECIFICATIONS

AeroShell Oil W 15W-50 was developed in co-operation with Textron Lycoming and Teledyne Continental Motors and conforms to their specifications 301F and MHS-24A respectively. This oil is also approved under Military Specification MIL-L-22851 which is now obsolete and has been replaced by the SAE J-1899 specification. AeroShell Oil W 15W-50 is also approved for use in all Pratt & Whitney radial aircraft engines. In addition AeroShell Oil W 15W-50 meets the provisions of Lycoming Service Bulletin 446C and 471, plus Service Instruction 1409A and meets the American FAA Airworthiness Directive 80-04-03 which specifies special anti-wear requirements for certain engine models.
AeroShell Oil W 15W-50 already contains, in the correct proportions, an anti-wear additive equivalent to the Lycoming additive LW 16702; operators who use AeroShell Oil W 15W-50 do not need to add this Lycoming additive to the oil.

AeroShell Oil W 15W-50 is qualified for use in all Teledyne Continental Motors’ liquid cooled and air cooled aircraft piston engines.

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved SAE J-1899 Grade Multigrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved SAE J-1899 Grade Multigrade</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>0-162 Obsolete</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OMD-162</td>
</tr>
</tbody>
</table>

**EQUIPMENT MANUFACTURERS APPROVALS**

AeroShell Oil W 15W-50 is approved for use by the following engine manufacturers:

- **Textron Lycoming**
  - 301F
  - Service Bulletins 446C and 471
  - Service Instruction 14909A

- **Teledyne Continental**
  - MHS 24A
  - SIL 99-2

- **Pratt & Whitney**
  - Service Bulletin 1183-S

- **FAA**
  - Airworthiness Directive 80-04-03

**Properties**

<table>
<thead>
<tr>
<th>Properties</th>
<th>SAE J-1899 Multigrade</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>–</td>
<td>Mixed synthetic hydrocarbon and mineral</td>
</tr>
<tr>
<td>SAE Viscosity Grade</td>
<td>Multigrade</td>
<td>Multigrade</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>–</td>
<td>4.0</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>Report 0.86</td>
<td></td>
</tr>
<tr>
<td>Kinematic Viscosity mm²/s @ 100°C</td>
<td>–</td>
<td>19.6</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>122</td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>100 min</td>
<td>160</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>Report –36</td>
<td></td>
</tr>
<tr>
<td>Flashpoint Cleveland Open Cup °C</td>
<td>220 min</td>
<td>238</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>1.0 max</td>
<td>0.01</td>
</tr>
<tr>
<td>Carbon Residue Ramsbottom % m</td>
<td>–</td>
<td>0.14</td>
</tr>
<tr>
<td>Sulphur % m</td>
<td>0.6 max</td>
<td>0.1</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>1 max</td>
<td>1</td>
</tr>
<tr>
<td>3 hrs @ 205°C</td>
<td>3 max</td>
<td>2</td>
</tr>
<tr>
<td>Ash content % m</td>
<td>0.011 max</td>
<td>0.006</td>
</tr>
<tr>
<td>Trace sediment</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Foaming tendency</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Elastomer compatibility AMS 3217/1 72 hrs @ 70°C swell %</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>AMS 3217/4 72 hrs @ 150°C swell %</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Trace metal content</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

A viscosity/temperature chart is shown at the end of this section. This product is made in more than one location and the approval status and typical properties may vary between locations.
AEROSHELL OIL W100 PLUS

AeroShell Oil W100 Plus is a new single grade oil that combines the single grade, ashless dispersant performance found in AeroShell Oil W100 and the anti-wear/anti-corrosion additives of AeroShell Oil W15W-50 Multigrade. It’s the oil for pilots who prefer a single grade but who also want the extra protection and performance.

APPLICATIONS

The advanced additives in AeroShell Oil W100 Plus provide better rust and wear protection than conventional single grades. The additives work as a protective barrier to prevent critical parts from being slowly degraded by rust or wear, especially when an aircraft sits idle. This protection helps keep the camshaft and lifters coated, reducing the likelihood of premature damage and helping operators reach TBO.

AeroShell Oil W100 Plus

- Blended from selected high viscosity mineral base oils
- Contains AeroShell’s proven W Oils additive package
- Additional anti-wear additives (containing Lycoming additive LW 16702)
- Additional anti-corrosion additives
- Fully compatible with other approved aircraft piston engine oils

SPECIFICATIONS

Approved SAE J-1899 SAE Grade 50

AeroShell Oil W100 Plus already contains, in the correct proportions, an anti-wear additive equivalent to the Lycoming additive LW 16702; thus it already complies with FAA Airworthiness Directive 80-04-03. Operators who use AeroShell Oil W100 Plus DO NOT need to add this Lycoming additive to the oil.

AeroShell Oil W100 Plus is qualified for use in all Teledyne Continental Motors liquid cooled and air cooled aircraft piston engines.

EQUIPMENT MANUFACTURERS’ APPROVALS

AeroShell Oil W100 Plus is approved for use by the following engine manufacturers:

<table>
<thead>
<tr>
<th>Textron Lycoming</th>
<th>Service Bulletin 446C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teledyne Continental</td>
<td>SIL 99-2</td>
</tr>
<tr>
<td>FAA</td>
<td>Airworthiness Directive 80-04-03R2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
<th>SAE J-1988 SAE 50</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour ASTM</td>
<td>-</td>
<td>3.0</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>Report</td>
<td>0.893</td>
</tr>
<tr>
<td>Kinematic Viscosity @ 100°C mm²/s</td>
<td>16.3-21.9 Report</td>
<td>19.96</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>95 min</td>
<td>116</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–18 max</td>
<td>–21</td>
</tr>
<tr>
<td>Flashpoint Cleveland Open Cup °C</td>
<td>243 min</td>
<td>288</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>1.0 max</td>
<td>0.02</td>
</tr>
<tr>
<td>Sulphur % m</td>
<td>1.0 max</td>
<td>0.26</td>
</tr>
<tr>
<td>Copper corrosion</td>
<td>1 max</td>
<td>18</td>
</tr>
<tr>
<td>Ash content % m</td>
<td>0.011 max</td>
<td>0.002</td>
</tr>
</tbody>
</table>

A viscosity/temperature chart is shown at the end of this section.
TYPICAL TEMPERATURE/VISCOSITY CURVES OF AEROSHELL W OILS
The earliest gas turbine engines were developed using straight mineral oils but the operational requirements for low temperature starting, either on the ground or at high altitude (re-lights) led to the development of a range of straight mineral oils with viscosities far lower than those of conventional aircraft engine oil of that time. For example, oils with viscosities between 2 mm\(^2/s\) and 9 mm\(^2/s\) at 100°C became standard for gas turbine engines, compared with viscosities of 20 mm\(^2/s\) to 25 mm\(^2/s\) at 100°C for piston engine oils.

Although demand for the low viscosity straight mineral turbine oils is diminishing, the following list tabulates the range of specifications covered.

- MIL-PRF-6081D Grade 1010 - AeroShell Turbine Oil 2
- DEF STAN 91-99 (DERD 2490) - AeroShell Turbine Oil 3
- DEF STAN 91-97 (DERD 2479/0) - AeroShell Turbine Oil 9 (grade now withdrawn)
- DEF STAN 91-97 (DERD 2479/1) - AeroShell Turbine Oil 9B (grade now withdrawn)

The higher viscosity 9 mm\(^2/s\) oils in the foregoing range were required for the highly loaded propeller reduction gears of turboprop engines. In some of these engines the natural load carrying characteristics derived from the viscosity of the oil alone was not enough and required improvement by an EP (Extreme Pressure) additive. The resultant blend, AeroShell Turbine Oil 9B (grade now withdrawn), was used by aircraft and helicopter operators.

With the progressive development of the gas turbine engine to provide a higher thrust and compression ratio, etc., the mineral oils were found to lack stability and to suffer from excessive volatility and thermal degradation at the higher temperatures to which they were subjected.

At this stage, a revolutionary rather than evolutionary oil development took place concurrently with engine development and lubricating oils derived by synthesis from naturally occurring organic products found an application in gas turbine engines. The first generation of synthetic oils were all based on the esters of sebacic acid, principally dioctyl sebacate. As a class, these materials exhibited outstanding properties which made them very suitable as the basis for gas turbine lubricants.

However, these materials yielded a product with a viscosity of about 3 mm\(^2/s\) at 100°C and alone had insufficient load carrying ability to support and transmit high gear loads. Therefore, to these materials were added thickeners (complex esters), which gave the required degree of load carrying ability and raised the final viscosity to about 7.5 mm\(^2/s\) at 100°C.

Unlike straight mineral oils, the synthetic oils had to rely on additives, and in later formulations on multi-component additive packages, to raise their performance. This was particularly necessary to improve resistance to oxidation and thermal degradation; important properties which govern long term engine cleanliness.

The two different basic grades of synthetic oil found favour on opposite sides of the Atlantic; in the U.S.A. 3 mm\(^2/s\) oils became standard while, in the U.K., 7.5 mm\(^2/s\) oils were used. AeroShell Turbine Oil 300 and AeroShell Turbine Oil 750 respectively were developed to meet these two separate requirements.

The situation persisted for some years until 3 mm\(^2/s\) oils were required for use in British pure jet engines. For many years AeroShell Turbine Oil 300 was the standard Shell 3 mm\(^2/s\) oil and rendered satisfactory airline service in many different types of British and American engines. However, to provide a more than adequate margin of performance and to allow for further increase of operational life, principally in Rolls-Royce engines, AeroShell Turbine Oil 390 was developed.

Although the use of 3 mm\(^2/s\) oils in aero-engines has declined, the use in auxiliary power units is increasing where, because of the low temperature viscometric properties, use of 3 mm\(^2/s\) oils gives improved cold starting reliability after prolonged cold soak.

Soon after the introduction of AeroShell Turbine Oil 390 American practice changed. With the almost continuous increases in engine size and power output a demand developed in the U.S.A. for oils possessing improved thermal stability and high load carrying ability, with some sacrifice in low temperature performance, and the idea of introducing a "Type II" 5 mm\(^2/s\) oil was formed.

These 5 mm\(^2/s\) ‘second generation’, oils were usually based on ‘hindered’ esters and have since found wide application in American engines and subsequently in British, Canadian and French engines. AeroShell Turbine Oil 500 was developed to meet these requirements.

To meet the requirements to lubricate the engines of supersonic aircraft AeroShell Turbine Oil 555 was developed as an advanced 5 mm\(^2/s\) synthetic oil with high temperature and load carrying performance.
Changes which have taken place over the last two decades in engine performance (in terms of improved fuel consumption, higher operating temperatures and pressures) and in maintenance practices have resulted in increased severity in lubricant operating conditions. These types of changes stress the engine oil and thus the original Type II oils are becoming less suitable for use in modern aircraft engines. This has resulted in the need for engine oils with very good (and improved) thermal stability such as AeroShell Turbine Oil 560. This type of oil with better thermal stability is now generally known as "third generation" or "HTS".

In military aviation, the British Military initially standardised on the 7.5 mm²/s oils as defined by DERD 2487 (now renumbered as DEF STAN 91-98), but then, in the mid 1980s switched and decided that future requirements will be met by the specification DERD 2497 (now renumbered as DEF STAN 91-100) covering high temperature performance oils.

In the U.S.A., the U.S. Air Force continues to prefer 3 mm²/s oils, and, more recently, 4 mm²/s oils and maintains their performance requirements by revisions to specification MIL-PRF-7808 (formerly MIL-7808). The U.S. Navy, with interest in turbo-prop engines and helicopter gearboxes, etc., have tended to use 5 mm²/s oils and after a series of specifications have finalised their requirements in the MIL-PRF-23699 specification (formerly MIL-23699). This latest issue of this specification, MIL-PRF-23699F, now caters for three classes of 5 mm²/s oils; these are Standard Class (STD), the Corrosion Inhibited class (C/I) and the High Thermal Stability Class (HTS). Various AeroShell Turbine Oils are approved for each Class and the Summary Table at the end of these notes should be consulted for further information.

More recently with the need to transmit more power and higher loads through helicopter gearboxes it has become apparent that MIL-PRF-23699 oils may not be completely satisfactory. With this in mind, many helicopter manufacturers (as well as the U.S. Navy) have now turned to the advanced high load carrying 5 mm²/s oil AeroShell Turbine Oil 555. This in turn has led to the development of a U.S. military specification DOD-L-85734 which covers a helicopter transmission oil against which AeroShell Turbine Oil 555 is fully approved.

VINTAGE AIRCRAFT

Vintage aircraft turbine engines were approved on oils available when the engine was originally manufactured and in many cases these oils were specific blends of mineral oils, such oils being no longer available. If the engine was approved on a mineral turbine oil other than MIL-6081 or DEF STAN 91-99 (formerly DERD 2490) oils then operators should consult with either the engine manufacturer/rebuilder or oil supplier. In some cases it is possible to switch to a synthetic turbine oil but such a move can only be considered on a case by case basis. On no account assume that present turbine oils (both mineral and synthetic) are direct replacements for old vintage aircraft applications.

OIL ANALYSIS

Routine oil analysis is now seen as a valuable part of a good maintenance programme. Increasingly operators are adopting oil analysis programmes in order to help discover problems before they turn into major failures. Typically these programmes consist of spectrometric wear metal check, together with a few simple oil tests such as viscosity and acidity. Shell Companies can offer this service to operators.

It is important to note that the information gained is only as good as the sampling procedure. A single test is not enough to reveal trends and significant changes, it can only tell an operator if there is already a serious problem. Operators should therefore:

• Take samples properly

For best results, take the sample immediately after engine shutdown. The sample should be taken the same way every time. An improperly taken sample can lead to mistaken conclusions about engine problems.

• Rely on a series of consistent tests over time

Operators should look for significant changes or trends over time, not just absolute values.

• Be consistent

Always take the sample the same way at the same time interval. Always properly label the sample so that it’s identity is known.

APPLICATIONS

Whenever an aircraft is certified, all of the engine oils 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 engine oils which are qualified to be used. The U.S. Federal Aviation Administration (FAA) regulations state that only engine oils 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 engine oil should be used.
OIL APPROVALS

The oil approvals listed in this section are believed to be current at time of printing, however, the respective engine manufacturer’s manuals and service bulletins should be consulted to ensure that the oil conforms with the engine manufacturer’s latest lubricant approval listing.

TYPICAL PROPERTIES

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

COMPRESSOR WASHING

Some turbine engine manufacturers permit or even recommend regular compressor washing. In this, water and/or special wash fluid is sprayed into the compressor during either ground idle running or during the final stages of engine shut down. The purpose of this washing is to restore the performance of the compressor by washing off any salt/sand/dirt/dust which may have collected on the compressor blade thereby causing deterioration in the performance of the compressor.

Operators should strictly follow the engine manufacturers’ requirements for performing the compressor wash and in particular any requirement for a drying run since incorrect application of the wash/drying cycle could lead to contamination of the oil system by water and/or special wash fluid.

OIL CHANGE INTERVAL

For many gas turbine engines there is no set oil change interval, this is because the oil in the system changes over through normal consumption in a reasonable number of hours. For some engines, particularly smaller engines, the engine manufacturer recommends regular oil changes. Operators should therefore adhere to the recommendations for the specific model of engine they operate. Depending upon the condition of the oil and the oil wetted areas of the engine, the engine manufacturer may be prepared to authorise oil change extensions.

For gas turbines used in coastal operations (e.g. off-shore helicopter operations) where there is salt in the atmosphere, in high temperature/high humidity areas or in sandy/dusty areas regular oil changes can be beneficial because it allows removal of any salt/sand/dust/dirt/water contamination from the oil.

OIL CHANGEOVER

Generally synthetic turbine oils in one viscosity group are compatible and miscible with all other synthetic oils in the same viscosity group (and in many cases other viscosity groups as well). However, in changing from one synthetic turbine oil to another, an operator must follow the engine manufacturers’ recommendations.

Change by top-off (mixing) allows the change over to take place slowly and there is increasing evidence that this is less of a shock to the engine and engine oil system. Whilst most engine manufacturers e.g. Rolls Royce, GE, P&W, CFM, etc., allow change by top-off (mixing), other engine manufacturers e.g. Honeywell, do not and only allow changeover by either drain and refill or drain, flush and refill.

It is Shell’s policy to always recommend that the engine manufacturer’s recommendations are followed. In addition it is recommended that for the initial period during and after change over the oil filters are inspected more frequently.

COMPATIBILITY WITH MATERIALS

The advent of synthetic oil for gas turbine engine lubrication permitted greater extremes of temperature to be safely encountered (far in excess of those possible with mineral oils), and brought with it the problem of compatibility, not only of elastomers, but of metals, paints, varnishes, insulation materials and plastics. In fact all materials associated with lubricants in aircraft have had to be reviewed and new materials evolved, in some cases, to enable maximum benefit to be obtained from the use of synthetic turbine oils.

Much of this evaluation has been undertaken by the manufacturers in the industries concerned, and may be summarised under the general heading of the materials groups.

ELASTOMER COMPATIBILITY

When using a synthetic ester turbine 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 here can only be considered as a guideline.

<table>
<thead>
<tr>
<th>Elastomer/Plastic</th>
<th>Mineral Turbine Oils</th>
<th>Synthetic Ester Turbine Oils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorocarbon (Viton)</td>
<td>Very good</td>
<td>Very good</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Good</td>
<td>Poor to Good (high nitrile content is better)</td>
</tr>
<tr>
<td>Polyester</td>
<td>Good</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Silicone</td>
<td>Poor to Good</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Teflon</td>
<td>Very Good</td>
<td>Very good</td>
</tr>
<tr>
<td>Nylon</td>
<td>Poor to Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Buna -S</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Perbunan</td>
<td>Good</td>
<td>Fair to Good</td>
</tr>
<tr>
<td>Methacrylate</td>
<td>Good</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Neoprene</td>
<td>Fair to Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>Poor to Fair</td>
<td>Poor</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Butyl Rubber</td>
<td>Very Poor to Poor</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Poly Vinyl Chloride</td>
<td>Poor to Good</td>
<td>Poor</td>
</tr>
</tbody>
</table>

**Compatibility Rating:**

Very Good – Good – Fair – Poor – Very Poor

**PAINTS**

Epoxy resin paints have been found to be practically the only paints entirely compatible giving no breakdown or softening or staining in use, except for the very light colour shades, which are susceptible to staining due to the actual colour of the anti-oxidant inhibitor contained in practically all ester based lubricants.

**PLASTICS**

Only the more common plastics can be considered for evaluation of compatibility.

The best from chemical and physical aspects is polytetrafluoroethylene, as might be expected from its generally inert properties. This is closely followed by higher molecular weight nylon. Polyvinyl chloride is rapidly softened by the hot oil and is not recommended. Currently, polythene and terylene are also suspect in this respect, but have not been extensively evaluated.

**VARNISHES**

Many commonly used phenolic impregnated varnishes are softened by contact with the hot oil, but a few of the harder grades show moderate to good resistance. Silicone varnishes and TS 188 are considerably softened. Modified alkyd type varnishes, when baked, possess good resistance to oil but have poor resistance to water. When good resistance to water is also required, it is recommended that the varnish be coated with a water resistant finish.

**MINERAL AND VEGETABLE OILS**

Ester based synthetic oils are incompatible with mineral and vegetable oils. In no circumstances should these products be used together and, if changing from one type to another, then particular care is needed to ensure that all traces of the previous product are removed prior to ester lubricant application.

**METALS**

Copper and alloys containing copper

As in mineral oil applications, pure copper has a marked catalytic effect at sustained high oil temperatures on the breakdown of the esters to acid derivatives, and its use in engines or other equipment is thus most undesirable. Copper alloys such as brass and bronze do not possess this property to any great degree and can be used with safety.
Aluminium and steel and their alloys
These materials are not affected.

Cadmium
Cadmium, in the form of plating as a protective treatment for storage of parts destined to be in contact with oil in service, experiences a tendency at the higher temperatures to be taken into solution by synthetic oils. This solvent action does not harm the lubricant, but the slow removal of cadmium plating after many hours of service will detract from its efficiency as a subsequent protective.

Lead and alloys containing lead
Lead and all alloys containing lead are attacked by synthetic lubricants. The way the lubricant reacts with the lead differs according to the type of lubricant, but in general, all lead compounds should be avoided. The most common forms of lead are lead abradable seals and lead solder used particularly in filters and mesh screens. In these cases the mesh screen should be brazed.

OTHER METALS
Magnesium is not affected except where hydrolysis occurs. Thus magnesium should not be used if there is any likelihood of hydrolysis occurring or alternatively the magnesium could be coated with epoxy to protect it.

Monel and Inconel are not affected.

Tungsten accumulates a very thin soft black film after prolonged immersion in synthetic oils under static conditions. It is readily removed by wiping, leaving no sign of corrosion. Under the scrubbing conditions normally associated with circulatory oil systems this film does not materialise and its effect may be ignored.

Zinc, as galvanised protective, is attacked by synthetic lubricants leading to the formation of zinc soaps and thus should not be used. Storage of synthetic oils is best achieved in tinned mild steel cans or failing this, bright mild steel.

Titanium is not affected.

Silver and silver plating is generally not affected. However, in some synthetic ester oils, the additive pack, especially high load additives, react with the silver and blacken or even de-plate the silver.

Nickel and alloys are generally satisfactory.

Tin plating is generally satisfactory.
For aircraft oil tanks the recommended material is light alloy or stainless steel.

NON-AVIATION USE OF AEROSHELL TURBINE ENGINE OILS
In selecting an AeroShell turbine engine oil for a non-aviation application, the properties of the oil 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.

The main use of AeroShell turbine engine oils in non-aviation applications is in aero-derived industrial and marine gas turbine applications. Such engines have found application in:
- electrical power generation
- large pumps and compressors, especially in pipeline applications and in petrochemical process industry
- marine propulsion

In an aero-engine, essential design features are it’s size and weight, which results in compact units. Such designs place heavy demands on the engine components and lubricants to ensure total reliability in the high temperatures within the engine.

The land and sea based derivatives of the aero-engines retain the essential design elements of their aviation versions and thus have similar lubrication requirements. Engine manufacturers therefore approve the use of aircraft synthetic turbine oils in these engines. Only these lubricants have the characteristics required to provide the unit lubrication and cooling within the severe operating environment.

There is a full range of AeroShell turbine oils approved by the major engine manufacturers for use in their industrial and marine derivatives of aero-engines and a quick reference table is included at the end of this section.
<table>
<thead>
<tr>
<th>Specification</th>
<th>Number</th>
<th>308</th>
<th>390</th>
<th>500</th>
<th>529</th>
<th>531</th>
<th>555</th>
<th>560</th>
<th>750</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-P-7808L</td>
<td>Grade 3</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>U.S. Air Force 3 mm²/s oil specification</td>
</tr>
<tr>
<td></td>
<td>Grade 4</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>4 mm²/s oil specification</td>
</tr>
<tr>
<td>MIL-P-23699F</td>
<td>STD</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>U.S. Navy 5 mm²/s oil specification</td>
</tr>
<tr>
<td></td>
<td>C/I</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HTS</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>DOD-L-85734</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td>U.S. helicopter transmission specification</td>
</tr>
<tr>
<td></td>
<td>DEF STAN 91-93</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>U.K. 5 mm²/s Marine Gas Turbine oil specification</td>
</tr>
<tr>
<td></td>
<td>(DERD 2458)</td>
<td>DEF STAN 91-94</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>U.K. 3 mm²/s oil specification</td>
</tr>
<tr>
<td></td>
<td>(DERD 2468)</td>
<td>DEF STAN 91-98</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>U.K. 7.5 mm²/s oil specification</td>
</tr>
<tr>
<td></td>
<td>(DERD 2487)</td>
<td>DEF STAN 91-100</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>U.K. Advanced 5 mm²/s oil specification</td>
</tr>
<tr>
<td></td>
<td>(DERD 2497)</td>
<td>DEF STAN 91-101</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>U.K. 5 mm²/s oil specification</td>
</tr>
<tr>
<td></td>
<td>(DERD 2499)</td>
<td>Grade OX.27</td>
<td>—</td>
<td>—</td>
<td>Approved</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grade OX.28</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>
AEROSHELL TURBINE OIL 2

AeroShell Turbine Oil 2 is a 2 mm²/s mineral turbine oil blended from mineral base stocks to which a pour-point depressant and an anti-oxidant have been added.

APPLICATIONS
AeroShell Turbine Oil 2 is widely used for inhibiting fuel systems and fuel system components during storage. AeroShell Turbine Oil 2 is an analogue to the Russian Grade MK-8 and can therefore be used in engines which require the use of MK-8.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-6081D Grade 1010</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td></td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 3516/A</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to MK-8</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-133</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OM-10 (Obsolete)</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>Properties</th>
<th>MIL-PRF-6081D Grade 1010</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td>Mineral</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>-</td>
<td>0.875</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 37.8°C</td>
<td>10.0 min</td>
<td>10.5</td>
</tr>
<tr>
<td>@ −40°C</td>
<td>3000 max</td>
<td>2700</td>
</tr>
<tr>
<td>Viscosity stability 3hrs @ −40°C</td>
<td>2 max</td>
<td>0.2</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>−57 max</td>
<td>Below −57</td>
</tr>
<tr>
<td>Flashpoint Cleveland Open Cup °C</td>
<td>132 min</td>
<td>154</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>0.10 max</td>
<td>0.02</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>5.5 max</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 121°C</td>
<td>1 max</td>
<td>Passes</td>
</tr>
<tr>
<td>Trace sediment ml/200ml</td>
<td>0.005 max</td>
<td>0.001</td>
</tr>
<tr>
<td>Corrosion &amp; oxidation stability 168 hrs @ 121°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– metal weight change</td>
<td>-5 to +20</td>
<td>Passes</td>
</tr>
<tr>
<td>– change in viscosity @ 37.8°C %</td>
<td>0.2 max</td>
<td>Less than 0.2</td>
</tr>
<tr>
<td>– acid number change mgKOH/g</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
AEROSHELL TURBINE OIL 3

AeroShell Turbine Oil 3 is a 3 mm²/s mineral turbine oil blended from mineral base stocks to which an anti-corrosion additive has been added.

APPLICATIONS
AeroShell Turbine Oil 3 was developed for early pure jet engines and is still approved for some versions of these engines plus the Turbomeca Astazou, Artouste, Turmo, Bastan and Marbore engines. AeroShell Turbine Oil 3 is widely used for inhibiting fuel systems and fuel system components during storage.
AeroShell Turbine Oil 3 is an analogue to the Russian Grade MK-8 and can therefore be used in engines which require the use of MK-8. It is also used as the mineral turbine oil component in the mixture of mineral turbine oil and piston engine oil used in Russian turbo-prop engines.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-99</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 3515/B</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to MK-8</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-135</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OM-11</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>DEF STAN 91-99</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td>Mineral</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>–</td>
<td>0.875</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 40°C</td>
<td>12.0 min</td>
<td>12.28</td>
</tr>
<tr>
<td></td>
<td>1250 max</td>
<td>1112</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–45 max</td>
<td>Below –45</td>
</tr>
<tr>
<td>Flashpoint Pensky Martin Closed Cup °C</td>
<td>144 min</td>
<td>146</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>0.30 max</td>
<td>0.15</td>
</tr>
<tr>
<td>Strong acid number mgKOH/g</td>
<td>NIL</td>
<td>NIL</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>1 max</td>
<td>Passes</td>
</tr>
<tr>
<td>Saponification matter mgKOH/g</td>
<td>1 max</td>
<td>0.25</td>
</tr>
<tr>
<td>Ash % m/m</td>
<td>0.01 max</td>
<td>0.001</td>
</tr>
<tr>
<td>Aromatic content %</td>
<td>10 max</td>
<td>6.0</td>
</tr>
<tr>
<td>Oxidation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– total acid number increase mgKOH/g</td>
<td>0.7 max</td>
<td>0.24</td>
</tr>
<tr>
<td>– asphaltenes % m/m</td>
<td>0.35 max</td>
<td>0.09</td>
</tr>
</tbody>
</table>
AEROSHELL TURBINE OIL 3SP

AeroShell Turbine Oil 3SP is a 3 mm²/s mineral turbine oil incorporating additives to improve anti-wear and anti-oxidant properties as well as low temperature properties.

APPLICATIONS

AeroShell Turbine Oil 3SP has excellent low temperature properties and is approved for use in Russian engines which use the Russian grades MS-8P, MK-8P and MS-BRK. Typical civil applications include various models of the Il-62, Il-76, Il-86, Il-114, Tu-134, Tu-154, YAK-40, AN-12, AN-26, AN-30, and M-15 aircraft as well as the Mi-6 and Mi-10 helicopters. Typical military applications include the MiG-9, MiG-11, MiG-15, MiG-17, MiG-21, Su-7, Su-9, Su-11 and Su-15 aircraft.

AeroShell Turbine Oil 3SP is approved for use in the preservation of oil and fuel systems where Russian grades MK-8, MS-8P and MS-BRK are used.

AeroShell Turbine Oil 3SP can also be used in oil mixtures where this oil is mixed with piston engine oil. Typical mixtures are:

SM-4.5 = 75% MS-8P + 25% MS-20 = 75% AeroShell Turbine Oil 3SP + 25% AeroShell Oil 100
SM-8.0 = 50% MS-8P + 50% MS-20 = 50% AeroShell Turbine Oil 3SP + 50% AeroShell Oil 100
SM-11.5 = 25% MS-8P + 75% MS-20 = 25% AeroShell Turbine Oil 3SP + 75% AeroShell Oil 100

Typical applications for these mixtures include the Il-8, AN-12, AN-24, AN-26, AN-28 and AN-30 aircraft as well as various military aircraft and some helicopter transmissions.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>(See table below)</td>
</tr>
<tr>
<td>NATO Code</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

AeroShell Turbine Oil 3SP has been tested and approved by the Central Institute of Aviation Motors (CIAM) in Moscow as follows:

<table>
<thead>
<tr>
<th>Engine oils</th>
<th>MS-8P (OST 38.01163-78)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MS-8R (TU 38-1011181-88)</td>
</tr>
<tr>
<td>Preservative oil</td>
<td>MK-8 (GOST 6457-66)</td>
</tr>
<tr>
<td></td>
<td>MS-8P</td>
</tr>
<tr>
<td></td>
<td>MS-8R</td>
</tr>
</tbody>
</table>

AeroShell Turbine Oil 3SP is also approved and ratified in Decision No DB - 6.8 - 21 by:

GUAP Goscomoboronprom (Chief Department of Aviation Industry of Defence Industry State Committee of Russian Federation)

DVT MT (Aviation Transport Department of Ministry of Transport of Russian Federation).
In their qualification approval testing programme, CIAM tested AeroShell Turbine Oil 3SP against the requirements of the OST 38.01163-78 Specification and in comparison with a sample of Russian-produced MS-8P. When comparing results, it is important to realise that the OST 38.01163-78 specification was written specifically to cover MS-8P which was made from a particular mineral base oil; a direct analogue of this base oil is not available outside of Russia and so it is to be expected that not all the properties of AeroShell Turbine Oil 3SP would necessarily be identical to those of MS-8P, nor even fully conform to the OST 38.01163-78 specification. This was, indeed, found to be the case by CIAM. Nevertheless, CIAM still approved AeroShell Turbine Oil 3SP as being a suitable alternative to MS-8P.

In terms of volatility - flash point and evaporation loss - AeroShell Turbine Oil 3SP does not conform to the requirements of OST 38.01163-78. However, CIAM proceeded to approve AeroShell Turbine Oil 3SP on the basis that aircraft which use it would formerly have used MK-8P, which was more volatile than the MS-8P which replaced it. CIAM confirmed its acceptance of a lower flash point in their letter dated 24th February, 1994.

With regard to load carrying/anti-wear properties, when assessed by the 4-ball machine, AeroShell Turbine Oil 3SP was found to give marginally inferior results to MS-8P. However, when subjected to CIAM to more realistic, high temperature, SH-3 gearbox bench testing, the results were good and CIAM concluded in their report that all aspects of pinion teeth wear did not exceed the accepted norms and that operation of the gearbox was “normal”. Furthermore, deterioration of the oil after test was minimal. Although each batch of AeroShell Turbine Oil 3SP manufactured by Shell is tested on a 4-ball machine, the test methods used are ASTM D2596 and/or D4172 which would not necessarily produce identical results to the Russian GOST 9490-75 method.

* CIAM ACCEPTS LIMIT OF 140°C. REFER TO LETTER OF APPROVAL FOR DETAILS OF WAIVER.
AEROSHELL TURBINE OIL 308

AeroShell Turbine Oil 308 is a 3 mm²/s synthetic ester oil incorporating additives to improve resistance to oxidation and corrosion and to minimize wear.

APPLICATIONS
AeroShell Turbine Oil 308 was developed specifically for use in particular models of aircraft turbo-prop and turbo-jet engines for which a MIL-PRF-7808 (formerly MIL-L-7808) oil is required.
AeroShell Turbine Oil 308 contains a synthetic ester oil and should not be used in contact with incompatible seal materials and it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-7808L Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O - 148</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX - 9</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MIL-PRF-7808L Grade 3</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Synthetic ester</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Density @ 15°C</td>
<td>kg/l</td>
<td>0.956</td>
</tr>
<tr>
<td>Kinematic viscosity</td>
<td>mm²/s</td>
<td>3.0 min</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>11.5 min</td>
<td>12.0</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>–</td>
<td>2400</td>
</tr>
<tr>
<td>@ –51°C</td>
<td>17000 max</td>
<td>12000</td>
</tr>
<tr>
<td>Viscosity stability</td>
<td></td>
<td>Must pass</td>
</tr>
<tr>
<td>Pourpoint</td>
<td>°C</td>
<td>–</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup</td>
<td>°C</td>
<td>210 min</td>
</tr>
<tr>
<td>Total Acidity</td>
<td>mgKOH/g</td>
<td>0.3 max</td>
</tr>
<tr>
<td>Trace metal content</td>
<td></td>
<td>Must pass</td>
</tr>
<tr>
<td>Evaporation 6.5 hrs @ 205°C % m</td>
<td></td>
<td>30 max</td>
</tr>
<tr>
<td>Silver – bronze corrosion @ 232°C</td>
<td>gm/m²</td>
<td>± 4.5 max</td>
</tr>
<tr>
<td>– silver</td>
<td>gm/m²</td>
<td>± 4.5 max</td>
</tr>
<tr>
<td>– bronze</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deposit Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– deposit rating</td>
<td>%</td>
<td>1.5 max</td>
</tr>
<tr>
<td>– neutralization number change %</td>
<td></td>
<td>20 max</td>
</tr>
<tr>
<td>– viscosity change @ 40°C %</td>
<td></td>
<td>100 max</td>
</tr>
<tr>
<td>Storage stability</td>
<td></td>
<td>Must pass</td>
</tr>
<tr>
<td>Compatibility</td>
<td></td>
<td>Must pass</td>
</tr>
</tbody>
</table>

Table continued
### Table continued

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-7808L Grade 3</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastomer compatibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAE-AMS 3217/1, 168 hrs @ 70°C</td>
<td>– % swell</td>
<td>12 to 35</td>
</tr>
<tr>
<td>SAE-AMS 3217/4, 72 hrs @ 175°C</td>
<td>– % swell</td>
<td>2 to 25</td>
</tr>
<tr>
<td>– tensile strength change %</td>
<td>50 max</td>
<td>50</td>
</tr>
<tr>
<td>– elongation change %</td>
<td>50 max</td>
<td>3.5</td>
</tr>
<tr>
<td>– hardness change %</td>
<td>20 max</td>
<td>9.0</td>
</tr>
<tr>
<td>SAE-AMS 3217/5, 72 hrs @ 150°C</td>
<td>– % swell</td>
<td>2 to 25</td>
</tr>
<tr>
<td>– tensile strength change %</td>
<td>50 max</td>
<td>Less than 50</td>
</tr>
<tr>
<td>– elongation change %</td>
<td>50 max</td>
<td>Less than 50</td>
</tr>
<tr>
<td>– hardness change %</td>
<td>20 max</td>
<td>Less than 20</td>
</tr>
<tr>
<td>Static foam test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– foam volume ml</td>
<td>100 max</td>
<td>30</td>
</tr>
<tr>
<td>– foam collapse time secs</td>
<td>60 max</td>
<td>15</td>
</tr>
<tr>
<td>Dynamic foam test</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Corrosion and oxidation stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Bearing deposition stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– deposit rating</td>
<td>60 max</td>
<td>&lt;60</td>
</tr>
<tr>
<td>– filter deposit weight g</td>
<td>2.0 max</td>
<td>&lt;2</td>
</tr>
<tr>
<td>– viscosity change @ 40°C</td>
<td>–5 to +25</td>
<td>Passes</td>
</tr>
<tr>
<td>– acid number change mgKOH/g</td>
<td>1.0 max</td>
<td>&lt;1</td>
</tr>
<tr>
<td>– metal weight change mg/cm²</td>
<td>±0.2 max</td>
<td>Passes</td>
</tr>
<tr>
<td>Gear load carrying capacity</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

A viscosity/temperature chart is shown at the end of this section.
AEROSHELL TURBINE OIL 390

AeroShell Turbine Oil 390 is a 3 mm²/s synthetic diester oil incorporating a carefully selected and balanced combination of additives to improve thermal and oxidation stability and to increase the load carrying ability of the base oil.

APPLICATIONS
AeroShell Turbine Oil 390 was developed primarily as an improved 3 mm²/s oil for British turbo-jet engines. AeroShell Turbine Oil 390 is fully approved for a wide range of turbine engines.

More recently, because of the low temperature characteristics of AeroShell Turbine Oil 390, there is interest in using this oil in auxiliary power units (APU) in order to overcome the effects of cold soak. Normal practice is to shut down the APU during cruise, the APU then experiences cold soak, often prolonged, and when the unit is started there is considerable difficulty resulting in the unit not coming up to speed in the given time, thus causing a hung start.

In such cases where the APU is subject to a long cold soak the viscosity of standard 5 mm²/s oils used in the APU will increase from 5 mm²/s at 100°C to typically 10,000 mm²/s at -40°C. At this much higher viscosity the oil cannot flow easily leading to a large viscous drag within the APU, thereby contributing to the difficulty in starting. AeroShell Turbine Oil 390 on the other hand experiences a much smaller viscosity increase (typically 2000 mm²/s at -40°C) with a reduction in viscous drag which is often sufficient to overcome hung start problems.

All experience to date shows a considerable improvement in cold reliability of the APU when AeroShell Turbine Oil 390 is used.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-94</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to IPM-10, VNII NP 50-1-4f and 4u, and 36Ku-A</td>
</tr>
<tr>
<td>NATO Code</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-7</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURER’S APPROVALS
AeroShell Turbine Oil 390 is approved for use in all models of the following engines:

<table>
<thead>
<tr>
<th>Engine</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honeywell</td>
<td>GTCP 30, 36, 70, 85, 331 and 660 APUs</td>
</tr>
<tr>
<td></td>
<td>Starters, Turbo compressors</td>
</tr>
<tr>
<td>Pratt &amp; Whitney</td>
<td>PW901A APU</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
</tr>
<tr>
<td>Rolls Royce</td>
<td>Conway, Spey, Tay, M45H</td>
</tr>
<tr>
<td>Turbomeca</td>
<td>Astazou, Artouste, Bastan, Marbore, Makila, Turmo</td>
</tr>
<tr>
<td>PROPERTIES</td>
<td>DEF STAN 91-94</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Oil type</td>
<td>–</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>–</td>
</tr>
<tr>
<td>Kinematic viscosity mm²</td>
<td></td>
</tr>
<tr>
<td>@ 40°C</td>
<td>16.0 max</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>4.0 min</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>13000 max</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–60 max</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>225 min</td>
</tr>
<tr>
<td>Foam characteristics</td>
<td>Must pass</td>
</tr>
<tr>
<td>Trace element content</td>
<td>Must pass</td>
</tr>
<tr>
<td>Elastomer compatibility, swell tests %</td>
<td></td>
</tr>
<tr>
<td>– nitrile</td>
<td>14 to 26</td>
</tr>
<tr>
<td>– viton</td>
<td>15 to 25</td>
</tr>
<tr>
<td>– silicone</td>
<td>16 to 24</td>
</tr>
<tr>
<td>Solid particle contamination</td>
<td></td>
</tr>
<tr>
<td>– sediment mg/l</td>
<td>10 max</td>
</tr>
<tr>
<td>– total ash of sediment mg/l</td>
<td>1 max</td>
</tr>
<tr>
<td>Corrosivity</td>
<td>Must pass</td>
</tr>
<tr>
<td>High temperature oxidative stability</td>
<td></td>
</tr>
<tr>
<td>Load carrying ability</td>
<td>Report</td>
</tr>
</tbody>
</table>

A viscosity/temperature chart is shown at the end of this section.
AEROSHELL TURBINE OIL 500

AeroShell Turbine Oil 500 is a 5 mm²/s synthetic hindered ester oil incorporating a carefully selected and balanced combination of additives to improve thermal and oxidation stability and metal passivation.

APPLICATIONS
AeroShell Turbine Oil 500 was developed essentially to meet the requirements of Pratt & Whitney 521 Type II and MIL-L-23699 specifications and is entirely suitable for most civil and military engines requiring this class of lubricant. AeroShell Turbine Oil 500 is approved for use in a wide range of turbine engines as well as the majority of accessories.
AeroShell Turbine Oil 500 contains a synthetic ester oil and should not be used in contact with incompatible seal materials and it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-23699F Grade STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-101 Grade OX-27</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 299/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-156</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-27</td>
</tr>
<tr>
<td>Pratt &amp; Whitney</td>
<td>Approved 521C Type II</td>
</tr>
<tr>
<td>General Electric</td>
<td>Approved D-50 TF 1</td>
</tr>
<tr>
<td>Allison</td>
<td>Approved EMS-53 (Obsolete)</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURER’S APPROVALS

AeroShell Turbine Oil 500 is approved for use in all models of the following engines:

**Honeywell**
- TFE 731, TPE 331, GTCP 30, 36, 85, 331, 660 and 700 series APUs.
- ALF 502, LF507, LTS101, LTP101, T53, T55, AL5512

**Allison (Rolls-Royce)**
- 250 Series, 501 D13, T56, GMA 2100, GMA 3007

**BMW-Rolls Royce**
- BR710, BR715

**CFM International**
- CFM 56 cleared for flight evaluation

**GE**
- GE 90, CF6, CT58, CF700, CJ610, CJ805, CF34, CT7, CT64

**IAE**
- V2500 Series, all marques

**Motorlet**
- M601D, E and Z

**Pratt & Whitney**
- JT3, JT4, JT8, JT9, JT12, PW4000, PW6000

**Pratt & Whitney Canada**
- JT15, PT6A, PT6T, ST6, PW100, PW200, PW300, PW500

**Rolls-Royce**
- RB211-22B, -524, -535, Trent, Tay, Gnome, Spey, RB183, Adour, M45H, Viper (Series MK 301, 521, 522, 526, 535, 540, 601, 623 and 632)

Full details of the approval status of AeroShell Turbine Oil 500 in APUs and other engines/accessories is available.
### PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23699F Grade STD</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>Synthetic ester</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Kinematic Viscosity (mm²/s) @ 100°C</td>
<td>4.90 to 5.40</td>
<td>5.17</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>23.0 min</td>
<td>25.26</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>13000 max</td>
<td>8996</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup (°C)</td>
<td>246 min</td>
<td>256</td>
</tr>
<tr>
<td>Pourpoint (°C)</td>
<td>–54 max</td>
<td>&lt;–54</td>
</tr>
<tr>
<td>Total Acidity (mgKOH/g)</td>
<td>1 max</td>
<td>0.01</td>
</tr>
<tr>
<td>Evaporation Loss 6.5 hrs @ 204°C % m</td>
<td>10.0 max</td>
<td>2.52</td>
</tr>
<tr>
<td>Foaming</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Swelling of Standard Synthetic Rubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAE-AMS 3217/1, 72 hrs @ 70°C swell %</td>
<td>5 to 25</td>
<td>Within Limits</td>
</tr>
<tr>
<td>SAE-AMS 3217/4, 72 hrs @ 204°C swell %</td>
<td>5 to 25</td>
<td>Within Limits</td>
</tr>
<tr>
<td>standard silicone rubber 96 hrs @ 121°C</td>
<td>5 to 25</td>
<td>Within Limits</td>
</tr>
<tr>
<td>Thermal Stability/Corrosivity 96 hrs @ 274°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change (mg/cm²)</td>
<td>4 max</td>
<td>0.5</td>
</tr>
<tr>
<td>– viscosity change (%)</td>
<td>5 max</td>
<td>2.69</td>
</tr>
<tr>
<td>– Total Acid Number Change (mgKOH/g)</td>
<td>6 max</td>
<td>2.03</td>
</tr>
<tr>
<td>Corrosion &amp; Oxidation Stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72 hrs @ 175°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 204°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 218°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Ryder Gear Test, Relative Rating Hercolube A</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Bearing Test Rig</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1½ conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Overall deposit demerit rating</td>
<td>80.0 max</td>
<td>47</td>
</tr>
<tr>
<td>– viscosity change @ 40°C %</td>
<td>–5 to +30</td>
<td>19</td>
</tr>
<tr>
<td>– Total Acid Number change (mgKOH/g)</td>
<td>2 max</td>
<td>1.1</td>
</tr>
<tr>
<td>– filter deposits (g) @ 204°C</td>
<td>3 max</td>
<td>0.4</td>
</tr>
<tr>
<td>Sonic shear stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– viscosity change @ 40°C %</td>
<td>4 max</td>
<td>NIL</td>
</tr>
<tr>
<td>Trace metal content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment (mg/l)</td>
<td>10 max</td>
<td>2.6</td>
</tr>
<tr>
<td>Ash (mg/l)</td>
<td>1 max</td>
<td>0.05</td>
</tr>
</tbody>
</table>


A viscosity/temperature chart is shown at the end of this section.
AEROSHELL TURBINE OIL 529

AeroShell Turbine Oil 529 is a 5 mm²/s synthetic ester oil incorporating additives to improve thermal and oxidation stability.

APPLICATIONS
AeroShell Turbine Oil 529 was developed specifically for use in those applications for which a MIL-PRF-23699 (previously MIL-L-23699) oil is required but where engine/equipment manufacturers brand name approval is not required. Typical use would be in military operated aircraft.

Where a MIL-PRF-23699 oil with engine/equipment manufacturers brand name approval is required then AeroShell Turbine Oils 500 and 560 are recommended.

AeroShell Turbine Oil 529 contains a synthetic ester oil and should not be used in contact with incompatible seal materials, it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-23699F Grade STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-101</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 299/A</td>
</tr>
<tr>
<td>Russian</td>
<td>-</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-156</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>Equivalent OX-27</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURERS’ APPROVALS
AeroShell Turbine Oil 529 is not approved by brand name by engine/equipment manufacturers.

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23699F Grade STD</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>Synthetic ester</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Kinematic Viscosity mm²/s @ 100°C</td>
<td>4.90 to 5.40</td>
<td>5.2</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>23.0 min</td>
<td>27.4</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>13000 max</td>
<td>11950</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>246 min</td>
<td>252</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–54 max</td>
<td>–60</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>1 max</td>
<td>0.075</td>
</tr>
<tr>
<td>Evaporation Loss 6.5 hrs @ 204°C % m</td>
<td>10.0 max</td>
<td>2.7</td>
</tr>
<tr>
<td>Swelling of Standard Synthetic Rubber SAE-AMS 3217/1, 72 hrs @ 70°C swell %</td>
<td>5 to 25</td>
<td>14.1</td>
</tr>
<tr>
<td>SAE-AMS 3217/4, 72 hrs @ 204°C swell %</td>
<td>5 to 25</td>
<td>8.6</td>
</tr>
<tr>
<td>standard silicone rubber 96 hrs @ 121°C</td>
<td>5 to 25</td>
<td>Within limits</td>
</tr>
<tr>
<td>Thermal Stability/Corrosivity 96 hrs @ 274°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change mg/cm²</td>
<td>4 max</td>
<td>–0.5</td>
</tr>
<tr>
<td>– viscosity change %</td>
<td>5 max</td>
<td>–1.2</td>
</tr>
<tr>
<td>– Total Acid Number Change mgKOH/g</td>
<td>6 max</td>
<td>3.86</td>
</tr>
</tbody>
</table>

Table continued
### PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MIL-PRF-23699F Grade STD</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion &amp; Oxidation Stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72 hrs @ 175°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 204°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 218°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Ryder Gear Test, Relative Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hercolube A</td>
<td>%</td>
<td>102</td>
</tr>
<tr>
<td>Bearing Test Rig Type 1½ conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Overall deposit demerit rating</td>
<td>80.0 max</td>
<td>32.2</td>
</tr>
<tr>
<td>– Viscosity change @ 40°C %</td>
<td>–5 to +30</td>
<td>+13.3</td>
</tr>
<tr>
<td>– Total Acid Number change mgKOH/g</td>
<td>2 max</td>
<td>1.04</td>
</tr>
<tr>
<td>– Filter deposits g</td>
<td>3 max</td>
<td>0.235</td>
</tr>
<tr>
<td>Sonic shear stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Viscosity change @ 40°C %</td>
<td>4 max</td>
<td>0.6</td>
</tr>
<tr>
<td>Trace metal content</td>
<td>Must pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Sediment mg/l</td>
<td>10 max</td>
<td>0</td>
</tr>
<tr>
<td>Ash mg/l</td>
<td>1 max</td>
<td>0</td>
</tr>
</tbody>
</table>
AEROSHELL TURBINE OIL 531

AeroShell Turbine Oil 531 is a 5 mm²/s synthetic ester oil incorporating additives to improve thermal and oxidation stability. A corrosion inhibitor has also been added.

APPLICATIONS
AeroShell Turbine Oil 531 was developed specifically for use in those applications for which a corrosion inhibited MIL-PRF-23699 (previously MIL-L-23699) oil is required but where engine/equipment manufacturers brand name approval is not required. Typical use would be in military operated aircraft and in engines in storage.

Where MIL-PRF-23699 oil with engine/equipment manufacturers brand name approvals is required then AeroShell Turbine Oil 500 and 560 are recommended.

AeroShell Turbine Oil 531 contains a synthetic ester oil and should not be used in contact with incompatible seal materials, it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-23699F Grade C/I</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-152</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURER’S APPROVALS
AeroShell Turbine Oil 531 is not approved by brand name by engine/equipment manufacturers.

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23699F Grade C/I</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>Synthetic ester</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Kinematic Viscosity mm²/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 100°C</td>
<td>4.90 to 5.40</td>
<td>5.0</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>23.0 min</td>
<td>24.3</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>13000 max</td>
<td>11000</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>246 min</td>
<td>252</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–54 max</td>
<td>–57</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>1 max</td>
<td>0.48</td>
</tr>
<tr>
<td>Evaporation Loss 6.5 hrs @ 204°C % m</td>
<td>10.0 max</td>
<td>4.7</td>
</tr>
<tr>
<td>Foaming</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Swelling of Standard Synthetic Rubber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAE-AMS 3217/1, 72 hrs @ 70°C swell %</td>
<td>5 to 25</td>
<td>18.7</td>
</tr>
<tr>
<td>SAE-AMS 3217/4, 72 hrs @ 204°C swell %</td>
<td>5 to 25</td>
<td>16.8</td>
</tr>
<tr>
<td>standard silicone rubber 96 hrs @ 121°C</td>
<td>5 to 25</td>
<td>Within Limits</td>
</tr>
<tr>
<td>Thermal Stability/Corrosivity 96 hrs @ 274°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change mg/cm²</td>
<td>4 max</td>
<td>–0.8</td>
</tr>
<tr>
<td>– viscosity change %</td>
<td>5 max</td>
<td>–1.4</td>
</tr>
<tr>
<td>– Total Acid Number Change mgKOH/g</td>
<td>6 max</td>
<td>3.75</td>
</tr>
</tbody>
</table>

Table continued
<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23699F Grade C/I</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion &amp; Oxidation Stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 175°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 204°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 218°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Ryder Gear Test, Relative Rating Hercolube A</td>
<td>102 min</td>
<td>113</td>
</tr>
<tr>
<td>Bearing corrosion</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Bearing Test Rig Type 1½ conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall deposit demerit rating</td>
<td>80.0 max</td>
<td>35</td>
</tr>
<tr>
<td>Viscosity change @ 40°C</td>
<td>–5 to +30</td>
<td>+17.3</td>
</tr>
<tr>
<td>Total Acid Number change mgKOH/g</td>
<td>2 max</td>
<td>0.57</td>
</tr>
<tr>
<td>Filter deposits g</td>
<td>3 max</td>
<td>0.3</td>
</tr>
<tr>
<td>Sonic shear stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity change @ 40°C</td>
<td>4 max</td>
<td>0.1</td>
</tr>
<tr>
<td>Trace metal content</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Sediment (mg/l)</td>
<td>10 max</td>
<td>0</td>
</tr>
<tr>
<td>Ash (mg/l)</td>
<td>1 max</td>
<td>0</td>
</tr>
</tbody>
</table>
AEROSHELL TURBINE OIL 555

AeroShell Turbine Oil 555 is an advanced 5 mm²/s synthetic hindered ester oil incorporating a finely balanced blend of additives to improve thermal and oxidation stability and to increase the load carrying ability of the base oil.

APPLICATIONS
AeroShell Turbine Oil 555 was specifically developed to meet the high temperatures and load carrying requirements of SST engines and the DEF STAN 91-100 (formerly DERD 2497) and XAS-2354 specifications. AeroShell Turbine Oil 555 was also designed to give enhanced performance in current engines.

More recently with the need to transmit more power and higher loads through helicopter transmission and gearbox systems (many helicopters use a synthetic turbine engine oil in the transmission/gearbox system) it has become apparent that the use of a very good load carrying oil, such as AeroShell Turbine Oil 555 is necessary. This in turn has led to the development of a U.S. Military Specification, DOD-L-85734, which covers a helicopter transmission oil against which AeroShell Turbine Oil 555 is fully approved.

AeroShell Turbine Oil 555 contains a synthetic ester oil and should not be used in contact with incompatible seal materials and it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved DOD-L-85734</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-100</td>
</tr>
<tr>
<td></td>
<td>Note: both UK and US production are manufactured to the same formulation.</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-160</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-26</td>
</tr>
<tr>
<td>Pratt &amp; Whitney</td>
<td>Approved 521C Type II</td>
</tr>
<tr>
<td>General Electric</td>
<td>Approved D-50 TF 1</td>
</tr>
<tr>
<td>Allison</td>
<td>Approved EMS-53 (Obsolete)</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURER’S APPROVALS
AeroShell Turbine Oil 555 is approved for use in all models of the following engines:

<table>
<thead>
<tr>
<th>Honeywell</th>
<th>Auxiliary Power Units GTCP 30, 36, 85, 331, 660 and 700 series</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Electric</td>
<td>CT58, CT64, CF700, CJ610</td>
</tr>
<tr>
<td>Motorlet</td>
<td>MD601D, E and Z</td>
</tr>
<tr>
<td>Pratt &amp; Whitney</td>
<td>JT3, JT4, JT8, JT9, JT12, PW4000</td>
</tr>
<tr>
<td>Pratt &amp; Whitney Canada</td>
<td>ST6, PW200</td>
</tr>
<tr>
<td>Rolls-Royce</td>
<td>Trent, Adour, Gem, Gnome, M45H, Olympus 593, RB199</td>
</tr>
<tr>
<td>Turbomeca</td>
<td>Makila</td>
</tr>
<tr>
<td>IAE</td>
<td>V2500 Series, all marques</td>
</tr>
</tbody>
</table>
EQUIPMENT MANUFACTURER’S APPROVALS – HELICOPTER TRANSMISSIONS

AeroShell Turbine Oil 555 is approved for an increasing number of helicopter transmissions, whilst details are listed below, it is important that operators check latest status with the helicopter manufacturer. In all cases it is important to check compatibility with seals used in the transmission/gearbox.

<table>
<thead>
<tr>
<th>US Military</th>
<th>Approved for helicopter transmission specification DOD-L-85734</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eurocopter</td>
<td>Approved for Super Puma, for other helicopters check with Eurocopter</td>
</tr>
<tr>
<td>Agusta</td>
<td>Approved for A109 and A129 models, for other models check with Agusta</td>
</tr>
<tr>
<td>Bell Helicopter Textron</td>
<td>Approved for all Bell turbine engine powered helicopters</td>
</tr>
<tr>
<td>Boeing Vertol</td>
<td>Approved for Chinook</td>
</tr>
<tr>
<td>McDonnell Douglas</td>
<td>Approved</td>
</tr>
<tr>
<td>MBB</td>
<td>Approved</td>
</tr>
<tr>
<td>Sikorsky</td>
<td>Approved for S-61N (note other types such as the S-70 and S-76 do not use synthetic turbine oils in the transmission)</td>
</tr>
<tr>
<td>Westland Helicopters</td>
<td>Approved for some models</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>DOD-L-85734</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Kinematic Viscosity</td>
<td>mm²/s</td>
</tr>
<tr>
<td>@ 98.9°C</td>
<td>25.0 min</td>
</tr>
<tr>
<td>@ 37.8°C</td>
<td>13000 max</td>
</tr>
<tr>
<td>@ –40°C</td>
<td></td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup</td>
<td>°C</td>
</tr>
<tr>
<td>Pourpoint</td>
<td>°C</td>
</tr>
<tr>
<td>Total Acidity</td>
<td>mgKOH/g</td>
</tr>
<tr>
<td>Evaporation Loss 6.5 hrs</td>
<td>% m</td>
</tr>
<tr>
<td>Foaming</td>
<td>Must pass</td>
</tr>
<tr>
<td>Swelling of Standard Synthetic Rubber</td>
<td>SAE-AMS 3217/1, 72 hrs @ 70°C swell</td>
</tr>
<tr>
<td>SAE-AMS 3217/4, 72 hrs @ 204°C swell</td>
<td>%</td>
</tr>
<tr>
<td>Thermal Stability/Corrosivity</td>
<td>96 hrs @ 274°C</td>
</tr>
<tr>
<td>– metal weight change</td>
<td>mg/cm²</td>
</tr>
<tr>
<td>– viscosity change @ 37.8°C</td>
<td>%</td>
</tr>
<tr>
<td>– Total Acid Number Change</td>
<td>mgKOH/g</td>
</tr>
</tbody>
</table>

Table continued
### Table continued

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>DOD-L-85734</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion &amp; Oxidation Stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72 hrs @ 175°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 204°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 218°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Ryder Gear Test, Relative Rating Hercolube A %</td>
<td>145</td>
<td>&gt;145</td>
</tr>
<tr>
<td>Bearing Test Rig Type 1½ conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Overall deposit demerit rating</td>
<td>80.0 max</td>
<td>22</td>
</tr>
<tr>
<td>- Viscosity change @ 37.8°C %</td>
<td>-5 to +30</td>
<td>21</td>
</tr>
<tr>
<td>- Total Acid Number change mgKOH/g</td>
<td>2 max</td>
<td>0.83</td>
</tr>
<tr>
<td>- Filter deposits g</td>
<td>3 max</td>
<td>0.5</td>
</tr>
<tr>
<td>Sonic shear stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Viscosity change @ 40°C %</td>
<td>4 max</td>
<td>NIL</td>
</tr>
<tr>
<td>Trace metal content</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Sediment mg/l</td>
<td>10 max</td>
<td>Passes</td>
</tr>
<tr>
<td>Ash mg/l</td>
<td>1 max</td>
<td>Passes</td>
</tr>
</tbody>
</table>

AeroShell Turbine Oil 555 is also approved for use in the industrial and marine versions of the Rolls-Royce RB211-22 and Olympus engines, General Electric LM 100, 250, 350, 1500 and 2500 engines.

A viscosity/temperature chart is shown at the end of this section.
AEROSHELL TURBINE OIL 560

AeroShell Turbine Oil 560 is a third generation, high performance, low coking 5 mm²/s synthetic hindered ester oil incorporating a carefully selected and finely balanced combination of additives to improve thermal and oxidation stability.

APPLICATIONS
Changes which have taken place over the last twenty years in engine performance (in terms of improved fuel consumption, higher operating temperatures and pressures) and maintenance practices have resulted in increased severity in lubricant operating conditions.

AeroShell Turbine Oil 560 was developed to withstand the hostile environments of today’s high powered, high compression engines in which the older generation of oils can be stressed up to and beyond their thermal limits, as evidenced by oil coking in the high temperature bearing areas.

By overcoming the problems associated with using old technology oils in new technology engines, AeroShell Turbine Oil 560:
* maintains a cleaner engine
* provides improved load carrying capacity
* reduces maintenance costs
* prolongs bearing life
in both new and existing engines.

In order for military authorities to take advantage of this better performance in military engines the specification MIL-PRF-23699 was re-written to include a “High Thermal Stability” (HTS) grade as well as the Standard (STD) and Corrosion Inhibited (C/I) grades. AeroShell Turbine Oil 560 is fully approved as an HTS oil.

With effect from January 1st 2002, AeroShell Turbine Oil 560 has been manufactured with an improved formulation to further enhance its anti-coking performance.

AeroShell Turbine Oil 560 contains a synthetic ester oil and should not be used in contact with incompatible seal materials and it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-23699F Grade HTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-101</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 299/A</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to VNII NP 50-1-4F, B3V, LZ-240, VNII NP 50-1-4U and 36/Ku-A</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-154</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>Equivalent OX-27</td>
</tr>
<tr>
<td>Pratt &amp; Whitney</td>
<td>Approved 521C Type II</td>
</tr>
<tr>
<td>General Electric</td>
<td>Approved D-50 TF1</td>
</tr>
<tr>
<td>Allison</td>
<td>Approved EMS-53 (Obsolete)</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURER’S APPROVALS
AeroShell Turbine Oil 560 is approved for use in all models of the following engines:

<table>
<thead>
<tr>
<th>Honeywell</th>
<th>TFE 731, TPE 331, APU (majority of models), LTS 101, LTP 101, ALF 502, LF 507, AS907, AS977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allison (Rolls-Royce)</td>
<td>250 Series</td>
</tr>
<tr>
<td>BMW/Rolls-Royce</td>
<td>BR710, BR715</td>
</tr>
<tr>
<td>CFM International</td>
<td>CFM-56 (all models)</td>
</tr>
<tr>
<td>GE</td>
<td>GE 90, CF6 (all models), CJ610, CF700, CT58, CF34</td>
</tr>
</tbody>
</table>

Table continued
<table>
<thead>
<tr>
<th>EQUIPMENT MANUFACTURER’S APPROVALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IAE</strong></td>
</tr>
<tr>
<td>V2500 Series</td>
</tr>
<tr>
<td><strong>IHI</strong></td>
</tr>
<tr>
<td>FJR 710</td>
</tr>
<tr>
<td><strong>Pratt &amp; Whitney</strong></td>
</tr>
<tr>
<td>JT3D, JT8D, JT9D, PW4000 Series [cleared for flight evaluation in PW2000 engines]</td>
</tr>
<tr>
<td><strong>Pratt &amp; Whitney Canada</strong></td>
</tr>
<tr>
<td>PT6T, PT6A (some models only), PW100 Series, JT15D, PW200 Series, PW300 Series, PW500 Series, PW901A APU</td>
</tr>
<tr>
<td><strong>Rolls-Royce</strong></td>
</tr>
<tr>
<td>RB211-22B, -524, -535, Spey, Tay, RB183, Adour</td>
</tr>
<tr>
<td><strong>Turbomeca</strong></td>
</tr>
<tr>
<td>Arriel, Makila, RTM 322, TM 319, TM 333, TP 319, various models of Astazou and Artouste engines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23699F</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>Synthetic ester</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Kinematic Viscosity</td>
<td>mm²/s</td>
<td>4.90 to 5.40</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>23.0 min</td>
<td>13000 max</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>26.71</td>
<td></td>
</tr>
<tr>
<td>@ –40°C</td>
<td>13000 max</td>
<td>11000</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>246 min</td>
<td>268</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–54 max</td>
<td>–60</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>1 max</td>
<td>0.14</td>
</tr>
<tr>
<td>Evaporation Loss 6.5 hrs @ 204°C % m</td>
<td>10.0 max</td>
<td>2.0</td>
</tr>
<tr>
<td>Swelling of Standard Synthetic Rubber SAE-AMS 3217/1, 72 hrs @ 70°C swell %</td>
<td>5 to 25</td>
<td>12.9</td>
</tr>
<tr>
<td>SAE-AMS 3217/4, 72 hrs @ 204°C swell %</td>
<td>5 to 25</td>
<td>12.9</td>
</tr>
<tr>
<td>standard silicone rubber 90 hrs @ 121°C</td>
<td>5 to 25</td>
<td>8.9</td>
</tr>
<tr>
<td>Thermal Stability/Corrosivity 96 hrs @ 274°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change mg/cm²</td>
<td>4 max</td>
<td>0.23</td>
</tr>
<tr>
<td>– viscosity change @ 37.8°C %</td>
<td>5 max</td>
<td>0.3</td>
</tr>
<tr>
<td>– Total Acid Number Change mgKOH/g</td>
<td>6 max</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table continued
<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23699F Grade HTS</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion &amp; Oxidation Stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 175°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 204°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ 218°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Ryder Gear Test, Relative Rating</td>
<td>Hercolube A % 102</td>
<td>126</td>
</tr>
<tr>
<td>Bearing Test Rig (200 hrs)</td>
<td>Type 1½ conditions</td>
<td></td>
</tr>
<tr>
<td>- Overall deposit demerit rating</td>
<td>35 max</td>
<td>26</td>
</tr>
<tr>
<td>- viscosity change @ 40°C %</td>
<td>0 to +35</td>
<td>30.8</td>
</tr>
<tr>
<td>- Total Acid Number change mgKOH/g</td>
<td>1.5 max</td>
<td>0.98</td>
</tr>
<tr>
<td>- filter deposits g</td>
<td>3 max</td>
<td>0.55</td>
</tr>
<tr>
<td>Sonic shear stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- viscosity change @ 40°C %</td>
<td>4 max</td>
<td>NIL</td>
</tr>
<tr>
<td>Trace metal content</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

AeroShell Turbine Oil 560 is also approved for use in the industrial and marine versions of the Rolls-Royce RB211-22, Avon, Spey, Olympus and Tyne engines, Pratt & Whitney GG3/FT3, GG4/FT4, GG12/FT12, GGB/FT8 engines, all General Electric LM Series of units, some Honeywell and Turbomeca industrial engines and certain Solar gas turbine engines.

A viscosity/temperature chart is shown at the end of this section.
AEROSHELL TURBINE OIL 750

AeroShell Turbine Oil 750 is a 7½ mm²/s synthetic mixed ester oil containing a thickener and additives which provide excellent load carrying, thermal and oxidation stability.

APPLICATIONS

AeroShell Turbine Oil 750 was developed to meet the requirements of DERD 2487 (now DEF STAN 91-98) and to provide a high standard of lubrication in British civil gas turbines, particularly turbo-prop engines where a good load carrying oil was required for the propeller reduction gearbox.

AeroShell Turbine Oil 750 is also approved by the Russian authorities as an analogue to MN-7.5u and for those Russian turbo-prop applications which require the use of mixtures of mineral turbine oil and aircraft piston engine oil.

AeroShell Turbine Oil 750 contains a synthetic ester oil and should not be used in contact with incompatible seal materials and it also affects some paints and plastics. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-98 (replaces DERD 2487)</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent AIR 3517</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to TU 38.1011722-85 Grade MN-7.5u</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-149 (equivalent O-159)</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-38</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURER’S APPROVALS

AeroShell Turbine Oil 750 is approved for use in all models of the following engines:

- **Honeywell**: Auxiliary Power Units (some models)
- **Pratt & Whitney Canada**: PT6 (some models)
- **Rolls-Royce**: Dart, Tyne, Avon (some early models only), Gnome, Pegasus, Palouste, Nimbus, Proteus, Orpheus, Olympus 200 and 300
- **Sikorsky**: S-61N transmissions
- **Soloviev**: D30 engine
- **Turbomeca**: Astazou, Bastan, Turmo, Artouste, Arriel, Malika

PROPERTIES

<table>
<thead>
<tr>
<th>DEF STAN 91-98</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Density @ 15°C (kg/l)</td>
<td>Report 0.947</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s</td>
<td>36.0 max</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>7.35 min</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>13000 max</td>
</tr>
<tr>
<td>@ −40°C</td>
<td>10140</td>
</tr>
<tr>
<td>@ −40°C after storage @ −54°C for 12 hr</td>
<td>10800</td>
</tr>
</tbody>
</table>

Table continued
<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>DEF STAN 91-98</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashpoint Cleveland Open Cup</td>
<td>216 min</td>
<td>242</td>
</tr>
<tr>
<td>Pourpoint</td>
<td>–54 max</td>
<td>Below –54</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>Report</td>
<td>0.03</td>
</tr>
<tr>
<td>Foaming characteristics</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Sediment mg/l</td>
<td>10 max</td>
<td>Less than 10</td>
</tr>
<tr>
<td>Total ash of sediment mg/l</td>
<td>1 max</td>
<td>Less than 1</td>
</tr>
<tr>
<td>Trace element content</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Elastomer swell tests</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Corrosivity, metal weight change</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Gear Machine Rating</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Shear Stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– viscosity change @ 40°C %</td>
<td>2 max</td>
<td>Less than 2</td>
</tr>
<tr>
<td>– condition of oil</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Compatibility and miscibility</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Homogeneity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 210°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

A viscosity/temperature chart is shown at the end of this section.
### AERO DERIVED IGTs: APPROVED STATUS

<table>
<thead>
<tr>
<th>Engine Manufacturer</th>
<th>Engine</th>
<th>AEROSHELL TURBINE OIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>390</td>
</tr>
<tr>
<td>Allison</td>
<td>501K, 570K and 571K Series</td>
<td>Approved</td>
</tr>
<tr>
<td>General Electric</td>
<td>LM 100, 290, 350 and 150</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>LM 2500</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>LM 3000</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>LM 6000</td>
<td>Approved</td>
</tr>
<tr>
<td>Pratt &amp; Whitney Canada (PWAC)</td>
<td>ST6-75, -76</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>ST6-73</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>ST6A, ST6B, ST6J, ST6K, ST6L</td>
<td>Approved (1)</td>
</tr>
<tr>
<td>Rolls-Royce</td>
<td>Trent</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Avon</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Gnome</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Olympus</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Protones</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>RB211-22</td>
<td>Approved (2)</td>
</tr>
<tr>
<td></td>
<td>RB211-24</td>
<td>Approved (3)</td>
</tr>
<tr>
<td></td>
<td>Spey Industrial</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Spey Marine</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Tyne</td>
<td>Approved</td>
</tr>
<tr>
<td>Solar</td>
<td>Centaur</td>
<td>Approved (4)</td>
</tr>
<tr>
<td></td>
<td>Mars</td>
<td>Approved (4)</td>
</tr>
<tr>
<td></td>
<td>Saturn</td>
<td>Approved (4)</td>
</tr>
<tr>
<td>Honeywell</td>
<td>TF25, -35, -40</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>?</td>
</tr>
</tbody>
</table>

Table continued

<table>
<thead>
<tr>
<th>Engine Manufacturer</th>
<th>Engine</th>
<th>AEROSHELL TURBINE OIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbomeca</td>
<td>Astagaz XII &amp; XIV</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Astazou IV</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Bastangaz IV, VI &amp; VII</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Oredon IV</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>Turmagaz III</td>
<td>Approved</td>
</tr>
<tr>
<td>Turbo Power &amp; Marine</td>
<td>GG3/FT3</td>
<td>Approved</td>
</tr>
<tr>
<td>(Pratt &amp; Whitney)</td>
<td>GG4/FT4</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>GG12/FT12</td>
<td>Approved</td>
</tr>
<tr>
<td></td>
<td>GG8/FT8</td>
<td>Approved</td>
</tr>
</tbody>
</table>

**Notes:**

- Consult the engine manufacturer for details on latest approvals
- AeroShell Turbine Oil 555 can be used if SB 49-59 has been incorporated
- .22/Mk1 lube system combination only
- 10,000 hours max. on Viton “O” seals
- Oils approved on a unit by unit basis, not all units can use synthetic oils thus the manual for specific unit must be consulted or the unit manufacturer contacted.
Typical temperature/viscosity curves of Aeroshell turbine oils.
THE DEFINITION OF A GREASE IS:

"A solid or semi-solid lubricant comprising a dispersion of a thickening
agent in a liquid lubricant to which various additives have been added to
improve particular properties".

Within the aviation industry there are very many grease lubricated
applications covering a very wide range of performance requirements
which are being increasingly extended through new technology
developments.

Over the years, many different formulation greases have been developed to
meet specific requirements, and one of Shell’s recent objectives, as a major
supplier of aviation greases, has been the development of wide
performance range products.

Greases, depending on the thickening agent, are broadly classified as
either soap-based or non-soap. The soap based greases include, for
example, aluminum, calcium, sodium or lithium soaps; the non-soaps silica
gel, clay and substituted urea.

The low melting points of some soap greases limit their usefulness. As a
result alternative thickening agents have been developed – soap-complex
thickened greases, and non-soap greases with a much higher or no melting
point. Non-soap thickening agents were developed for greases needing
superior high temperature performance characteristics. Shell’s search for
thickeners without the limitations of the soap-type, resulted in their
‘Microgel®’ technology.

Shell Companies have developed and patented an inorganic grease
thickening agent, based on hectorite clay, which has been registered under
the Shell trade name of ‘Microgel®’. The Microgel® thickener, which does
not have any of the limitations of soap type thickeners, provides the
AeroShell greases in which it is used with the following excellent physical
properties, making them particularly suitable for multi-purpose as well as
specialised applications:

1. No melting point, within any conceivable temperature range to which
   aircraft greases are likely to be subjected.
2. Very little change in consistency with variation in temperature.
3. Extremely good load carrying ability without the need for extreme
   pressure additive.
4. Excellent water resistance due to the use of exclusive tenacious
   waterproofing agents developed by Shell.
5. Low oil separation or ‘bleeding’, because of the high gelling efficiency
   of Microgel®.

During recent years the number of greases required for aircraft
lubrication/maintenance has been reduced by more extensive use of multi-
purpose greases. However, because of commercial and technological
limitations, special greases are still required. Most aircraft grease
requirements are covered by the products in the AeroShell grease range.

To minimise the number of greases required per aircraft it should be
remembered that by far the most widely used specification in the aviation
industry today is the general purpose grease to MIL-PRF-23827.

More recently Boeing has introduced a multi-purpose grease specification
(BMS 3-33) which is intended to replace many of the different greases now
required in support of Boeing aircraft.

Detailed information of each AeroShell grease is given in this section, but
for ease of reference AeroShell greases can be split into the following
application categories.

ADVANCED MULTI-PURPOSE GREASES

(Wide temperature range with good load carrying properties)

- AeroShell Grease 7
- AeroShell Grease 16
- AeroShell Grease 17
- AeroShell Grease 22 (& 22CF)
- AeroShell Grease 23C
- AeroShell Grease 33

AeroShell Grease 7 and AeroShell Grease 17 have a useful operating
temperature range of –73°C to +149°C. This coupled with their good load
carrying ability make them entirely suitable for multi-purpose applications in
aircraft fleets. Grease containing molybdenum disulphide (AeroShell
Grease 17) is particularly effective for lubricating heavily loaded sliding
steel surfaces.

AeroShell Grease 16 has excellent temperature performance. This, coupled
with its good load carrying properties, makes it suitable for multi-purpose
applications in civil aircraft operating for long periods at high speeds. The
useful operating temperature range is –54°C to +204°C.

AeroShell Grease 22 is recommended for most aviation anti-friction
bearing applications. It is especially recommended for use wherever severe
operating conditions are encountered as in high bearing loads, high
speed, wide operating temperature range, and particularly where long
grease retention and high resistance to water washout are required.
AeroShell Grease 22CF has similar properties and is available as an alternative to AeroShell Grease 22 when necessary.

AeroShell Grease 33 has a useful temperature range of −73°C to +121°C and is suitable for the majority of airframe grease applications.

LOAD CARRYING GREASES

<table>
<thead>
<tr>
<th>Grease</th>
<th>Typical mean Hertz load (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Grease 7</td>
<td>60</td>
</tr>
<tr>
<td>AeroShell Grease 11 MS</td>
<td>57</td>
</tr>
<tr>
<td>AeroShell Grease 16</td>
<td>57</td>
</tr>
<tr>
<td>AeroShell Grease 17</td>
<td>60</td>
</tr>
<tr>
<td>AeroShell Grease 22 (22CF)</td>
<td>39 (35)</td>
</tr>
<tr>
<td>AeroShell Grease 33</td>
<td>60</td>
</tr>
</tbody>
</table>

AeroShell Greases 7, 16, 17, 22 and 33 are suitable for operating under heavy load, e.g. gearboxes, retracting screws, worms, chains, and undercarriage pivot bearings, etc.

EXTREME TEMPERATURE GREASES

<table>
<thead>
<tr>
<th>Grease</th>
<th>Useful operating temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Grease 7</td>
<td>−73 to +149°C</td>
</tr>
<tr>
<td>AeroShell Grease 15</td>
<td>−73 to +232°C</td>
</tr>
<tr>
<td>AeroShell Grease 16</td>
<td>−54 to +204°C</td>
</tr>
<tr>
<td>AeroShell Grease 17</td>
<td>−73 to +149°C</td>
</tr>
<tr>
<td>AeroShell Grease 22</td>
<td>−65 to +204°C</td>
</tr>
<tr>
<td>AeroShell Grease 22CF</td>
<td>−54 to +177°C</td>
</tr>
<tr>
<td>AeroShell Grease 23C</td>
<td>−62 to +177°C</td>
</tr>
<tr>
<td>AeroShell Grease 33</td>
<td>−73 to +121°C</td>
</tr>
</tbody>
</table>

AeroShell Grease 15 is suitable for use in lightly loaded ball and roller bearings throughout the temperature range quoted.

HIGH TEMPERATURE GREASES WHICH HAVE GOOD LOAD CARRYING ABILITY

<table>
<thead>
<tr>
<th>Grease</th>
<th>Useful maximum temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Grease 5</td>
<td>+177°C</td>
</tr>
<tr>
<td>AeroShell Grease 7</td>
<td>+149°C</td>
</tr>
<tr>
<td>AeroShell Grease 16</td>
<td>+204°C</td>
</tr>
<tr>
<td>AeroShell Grease 17</td>
<td>+149°C</td>
</tr>
<tr>
<td>AeroShell Grease 22</td>
<td>+204°C</td>
</tr>
<tr>
<td>AeroShell Grease 22CF</td>
<td>+177°C</td>
</tr>
<tr>
<td>AeroShell Grease 23C</td>
<td>+177°C</td>
</tr>
</tbody>
</table>

AeroShell Grease 5 is recommended for normal high temperature applications when low temperature properties are not required; it has proved to be an excellent wheel bearing grease.

GREASE WITH ENHANCED CORROSION INHIBITION

AeroShell Grease 33

AeroShell Grease 33 has enhanced corrosion resistance, and resistance to washout from water, de-icing fluids and other maintenance fluids.

GENERAL PURPOSE GREASES WHICH HAVE A LIMITED OPERATING TEMPERATURE RANGE

<table>
<thead>
<tr>
<th>Grease</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>AeroShell Grease 14</td>
</tr>
</tbody>
</table>

AeroShell Grease 6 has a useful temperature range of −40°C to +121°C, good load carrying ability and is inexpensive, which makes it suitable for use as a general grease for piston engined aircraft.

AeroShell Grease 14 is now the universally accepted helicopter grease with a useful operating temperature range of −54°C to +94°C. Owing to its excellent anti-fret properties it is especially recommended for the lubrication of helicopter main and tail rotor bearings.
GENERAL COMMENTS

TYPE OF BASE OILS

Mineral
AeroShell Grease 5
AeroShell Grease 6
AeroShell Grease 14
AeroShell Grease S.4768
AeroShell Grease 11MS

Synthetic Hydrocarbon
AeroShell Grease 22
AeroShell Grease 22CF
AeroShell Grease 23C

Synthetic Ester
AeroShell Grease 7
AeroShell Grease 17

Silicone Oil
AeroShell Grease 15

Mixed Synthetic Hydrocarbon and Ester
AeroShell Grease 33

SPECIAL GREASES

Microgel
AeroShell Grease 5
AeroShell Grease 6
AeroShell Grease 14
AeroShell Grease S.4768
AeroShell Grease 11MS

Clay Thickener Lithium Complex
AeroShell Grease 22CF
AeroShell Grease 33

Calcium Soap
AeroShell Grease 14

Hydrocarbon and Ester
AeroShell Grease 33

Mixed Mineral and Synthetic
AeroShell Grease 16

APPLICATIONS

Whenever an aircraft is certified, all of the greases 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 greases which are qualified to be used. The U.S. Federal Aviation Administration (FAA) regulations state that only greases 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 greases should be used.
COMPATIBILITY WITH MATERIALS

When using greases containing a synthetic oil, particularly an ester oil, the compatibility with sealing materials, plastics or paints has to be examined.

Greases with a silicone oil base should not be used when silicone elastomers are present.

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.

<table>
<thead>
<tr>
<th>Elastomer/Plastic</th>
<th>Mineral Oil Based Greases</th>
<th>Synthetic Hydrocarbon Based Greases</th>
<th>Synthetic Ester Based Greases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flurocarbon (Viton)</td>
<td>Very Good</td>
<td>Very Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Good</td>
<td>Good</td>
<td>Poor to Good (high nitrile content is better)</td>
</tr>
<tr>
<td>Polyester</td>
<td>Good</td>
<td>Good</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Silicone</td>
<td>Poor to Good</td>
<td>Poor to Good</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Teflon</td>
<td>Very Good</td>
<td>Very Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Nylon</td>
<td>Poor to Good</td>
<td>Poor to Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Buna-S</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Perbunan</td>
<td>Good</td>
<td>Good</td>
<td>Fair to Good</td>
</tr>
<tr>
<td>Methacrylate</td>
<td>Good</td>
<td>Good</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Neoprene</td>
<td>Fair to Good</td>
<td>Fair to Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>Poor to Fair</td>
<td>Poor to Fair</td>
<td>Poor</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Butyl Rubber</td>
<td>Very Poor to Poor</td>
<td>Very Poor to Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Poly Vinyl Chloride</td>
<td>Poor to Good</td>
<td>Poor to Good</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Compatibility Rating:
- Very Good - Good - Fair - Poor - Very Poor

MAIN REQUIREMENTS

The majority of aviation grease specifications call for greases to be evaluated in the following tests:
- Drop point
- Penetration at 25°C, unworked/worked
- Evaporation loss in 22 hours (temperature varies according to specification)
- Corrosion, copper strip at 100°C
- Water resistance at 40°C
- Anti-friction bearing performance (temperature varies according to specification)
- Mean Hertz load
- Oil separation in 30 hours (temperature varies according to specification)
- Bomb oxidation pressure drop (conditions vary according to specification).

In addition most aviation grease specifications call up other tests which are either specific to the type of grease or to the intended application.

TYPICAL PROPERTIES

In the following section typical properties are quoted for each grease; there may be deviations from the typical figures given but test figures will fall within the specification requirements. Due to poor repeatability of the low temperature torque test, typical test figures for this have not been included.

BASE OIL VISCOSITY

Although not normally part of the specification requirements, typical base oil viscosities have been quoted for the majority of AeroShell Greases.

USEFUL OPERATING TEMPERATURE RANGE

The useful operating temperature ranges are quoted for guidance only. Continuous operation of equipment, with bearing temperatures at or in excess of these maximum and minimum limits for the grade in use, is not recommended.

OIL SEPARATION

Oil separation to a greater or lesser extent occurs with all greases. Unless the separation is excessive the grease can be used providing it is stirred well before use.
COMPATIBILITY AND INTERMIXING OF GREASES

What is grease incompatibility? The National Lubricating Grease Institute (NLGI) definition states that two greases show incompatibility when a mixture of the products shows physical properties or service performance which are markedly inferior to those of either of the greases before mixing. Performance or properties inferior to one of the products and superior to the other may be due to simple mixing and would not be considered as evidence of incompatibility; this is sometimes referred to as “performance dilution”.

In general, mixing of greases made with different thickener types should be avoided; thus Microgel® or clay thickened greases should not be mixed with soap thickened (e.g. lithium complex) greases as this can lead to breakdown of the thickener structure. Incompatibility between greases can also arise from additive interactions. In some cases, different greases approved to the same specification may be incompatible with each other; to account for this, the MIL-PRF-23827C specification has recently been amended to divide approved greases into Type I (soap-based) and Type II (clay-based).

GREASE SUBSTITUTION

Airframe and grease manufacturers do not recommend intermixing different types or brand names of grease, even if they are considered optional to each other, because of possible incompatibility. When changing over from one type or brand name grease to another, the recommended practice is to remove all of the old grease from the bearing surfaces and internal cavities of the lubricated mechanism prior to application of the new grease. If this is not possible or practicable, then the “purging” technique should be employed.

Generally, “purging” is defined as “the process of injecting grease into the grease fitting until the old grease has been visibly exhausted from the mechanism and only the new grease is coming out.” It is advisable to seek information from the aircraft manufacturers and their maintenance manuals for their recommendations regarding purging procedures.

Note: The definition of purging is not specific to the substitution of greases and applies equally to routine re-greasing with the same grease where the object in this case is to expel contaminants such as wear debris, dust, dirt and water which may have accumulated in the grease during service. That is, purging should always be done where the design of the lubricated component is amenable to this purging process.

Always consult the Aircraft Maintenance Manual, Maintenance Planning Document or Component Overhaul Manual, and any associated Service Bulletins for advice on the correct grade of grease to be used in a particular mechanism and on the method of application and/or replacement of that grease. In particular, the latest issues of the following publications should be consulted for the most up-to-date advice:

- Airbus Service Information Letter SIL 12-008 “General Purpose Aviation Greases Functional Interchangeability”
- FAA Flight Standards Information Bulletin for Airworthiness FSAW 02-02C “The Potential Adverse Effects of Grease Substitution”

After changing from one type or brand of grease to another, operators may choose to shorten the re-greasing interval by 50% for the following period and then revert to the normal re-greasing interval specified in the Aircraft Maintenance Manual. This will help to ensure that the new type or brand of grease has fully replaced the old. It is not good practice to randomly or intermittently alternate between grease types or brands, even though they may be approved to the same grease specification. Grease manufacturers carefully balance the components in their greases for optimum performance. Therefore even if two different greases are not incompatible, it is unlikely that all mixtures of the two greases will maintain the same optimal performance as the individual greases (“performance dilution”). Once an action has been taken to change grease types or brands, then the chosen grease should always be used for subsequent re-greasing.

Wherever possible, use of a grease gun or grease in cartridges is recommended. If grease is used directly from tins or pails, it is important that wooden scrapers are not employed and that the tin lid is replaced firmly immediately the grease has been removed in order to prevent contamination by airborne dust, dirt and atmospheric moisture.
GREASE SELECTION

In selecting a grease for a particular application the following should be considered:

- **Lubrication Requirements**
  - friction requirements
  - wear control
  - penetration
  - cooling (heat dissipation)
  - sealing
  - corrosion resistance

- **Engineering Component**
  - type of component
  - nature of contact (rolling, sliding, etc.)
  - load, speed and size
  - metallurgy/chemistry of component
  - geometrics/space constraints

- **Environment Factor**
  - temperature
  - atmosphere conditions (humidity, dirt/dust contamination)
  - ingress of water or other fluids
  - seal materials
  - health and safety

- **Endurance and Application**
  - method of application
  - re-lubrication interval
  - life expectancy of lubricant
  - life expectancy under exceptional conditions
  - life expectancy of component
  - need for protection against unexpected event
  - performance versus cost

AEROSHELL GREASES IN NON-AVIATION APPLICATIONS

In selecting an AeroShell Grease for a non-aviation application the properties of the greases 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 GREASE 5

AeroShell Grease 5 is a high temperature grease composed of a mineral oil thickened with Microgel®, possessing good load-carrying ability. It is inhibited against oxidation and corrosion and has excellent resistance to water. The useful operating temperature range is –23°C to +177°C.

APPLICATIONS
AeroShell Grease 5 is particularly effective for use as a wheel bearing grease, especially when landing speeds are high, and is suitable for the lubrication of aircraft and engine accessories operating at high speeds and at relatively high temperatures, e.g. magneto gens, generators and starters. For the lubrication of rolling bearings which are required to start at temperatures as low as –23°C an adequate period should be allowed for the grease to channel.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Meets MIL-G-3545C (Obsolete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Meets DTD.878A (Obsolete)</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 359/A</td>
</tr>
<tr>
<td>Russian</td>
<td>--</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-359 (Obsolete)</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-277 (Obsolete)</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-G-3545C</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td></td>
</tr>
<tr>
<td>Thickener type</td>
<td>Microgel</td>
<td></td>
</tr>
<tr>
<td>Base oil viscosity mm²/² @ 40°C</td>
<td>–</td>
<td>500 to 525</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>32</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>–23 to +177</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>177 min</td>
<td>260+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>250 to 300</td>
<td>284</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>–</td>
<td>281</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C 100 hrs lb/in²</td>
<td>10 max</td>
<td>6</td>
</tr>
<tr>
<td>500 hrs lb/in²</td>
<td>25 max</td>
<td>15</td>
</tr>
<tr>
<td>Oil separation @ 100°C, in 30 hrs % m</td>
<td>5 max</td>
<td>0.5</td>
</tr>
<tr>
<td>Water resistance test loss @ 41°C % m</td>
<td>20 max</td>
<td>0.5</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 149°C % m</td>
<td>–</td>
<td>1.0</td>
</tr>
<tr>
<td>Mean Hertz Load kg</td>
<td>–</td>
<td>37</td>
</tr>
<tr>
<td>Copper corrosion 24 hrs @ 100°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Bearing protection 2 days @ 51°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Anti-friction bearing performance @ 149°C hrs</td>
<td>–</td>
<td>600+</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Amber</td>
</tr>
</tbody>
</table>

COMPATIBILITY

Aeropropellants, Gaffney, HMX, and nitrous oxide are very likely to react with the grease, particularly when hot. For compatibility charts see the Shell Greases Data Book.
**AEROSHELL GREASE 6**

AeroShell Grease 6 is a general purpose grease composed of a mineral oil thickened with Microgel®, possessing good all-round properties within a limited range. It is inhibited against oxidation and corrosion and has good water resistance and low noise capability.

The useful operating temperature range is −40°C to +121°C.

**APPLICATIONS**

AeroShell Grease 6 is a general purpose airframe grease for use in anti-friction bearings, gearboxes and plain bearings within the temperature range of −40°C to +121°C.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-24139A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meets MIL-G-7711A (Obsolete)</td>
</tr>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-12</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 382/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-382</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-271</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th>MIL-PRF-24139A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
</tr>
<tr>
<td>Thickener type</td>
<td>Microgel</td>
</tr>
<tr>
<td>Base oil viscosity mm²/s</td>
<td></td>
</tr>
<tr>
<td>@ 40°C</td>
<td>35</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>5.5</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th>MIL-PRF-24139A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>149 min</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>265 to 320</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>–</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C</td>
<td></td>
</tr>
<tr>
<td>100 hrs lb/in²</td>
<td>10 max 9</td>
</tr>
<tr>
<td>500 hrs lb/in²</td>
<td>25 max 15</td>
</tr>
<tr>
<td>Oil separation @ 100°C, in 30 hrs % m</td>
<td>–</td>
</tr>
<tr>
<td>Water resistance test loss @ 38°C % m</td>
<td>5 max 2.0</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 121°C % m</td>
<td>–</td>
</tr>
<tr>
<td>Mean Hertz Load kg</td>
<td>30</td>
</tr>
<tr>
<td>Antifriction bearing performance @ 121°C hrs</td>
<td>–</td>
</tr>
<tr>
<td>Copper corrosion 24 hrs @ 100°C Must pass Passes</td>
<td></td>
</tr>
<tr>
<td>Bearing protection 2 days @ 51°C Must pass Passes</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
</tr>
</tbody>
</table>
AEROSHELL GREASE 7

AeroShell Grease 7 is an advanced multi-purpose grease, composed of a synthetic oil thickened with Microgel®, possessing good load carrying ability over a wide temperature range. It is inhibited against corrosion and has excellent resistance to water. The useful operating temperature range is –73°C to +149°C.

APPLICATIONS

AeroShell Grease 7 satisfies nearly all the airframe grease requirements of turbine engined aircraft and also those of piston engined aircraft provided that seal incompatibility does not occur. Most civil aircraft manufacturers approve AeroShell Grease 7 as a general purpose grease either by brand name or by specification. It is recommended for lubricating highly loaded gears, actuator screw mechanisms, etc., also for instrument and general airframe lubrication within the temperature range of –73°C to +149°C. AeroShell Grease 7 contains a synthetic ester oil and should not be used in contact with incompatible seal materials. Refer to the General Notes at the front of this section.

AeroShell Grease 7 is a clay-based grease approved to MIL-PRF-23827C Type II; it should not be mixed with soap-based greases approved to MIL-PRF-23827C Type I.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-23827C (Type II)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 354/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-354</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23827C Type II</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Synthetic</td>
<td>Synthetic ester (Diester)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-23827C Type II</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickener type</td>
<td>Clay</td>
<td>Microgel</td>
</tr>
<tr>
<td>Base oil viscosity @ –40°C mm²/s</td>
<td>–</td>
<td>1150</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>10.3</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>3.1</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>–73 to +149</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>165 min</td>
<td>260+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>270 to 310</td>
<td>296</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>200 min</td>
<td>283</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C 100 hrs kPa</td>
<td>70 max</td>
<td>62</td>
</tr>
<tr>
<td>500 hrs kPa</td>
<td>105 max</td>
<td>96.5</td>
</tr>
<tr>
<td>Oil separation @ 100°C, in 30 hrs % m</td>
<td>5 max</td>
<td>3.0</td>
</tr>
<tr>
<td>Water resistance test loss @ 38°C % m</td>
<td>20 max</td>
<td>0.80</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 100°C % m</td>
<td>2.0 max</td>
<td>0.5</td>
</tr>
<tr>
<td>Mean Hertz Load kg</td>
<td>30 min</td>
<td>60</td>
</tr>
<tr>
<td>Antifriction bearing performance @ 121°C hrs</td>
<td>–</td>
<td>2460</td>
</tr>
<tr>
<td>Copper corrosion 24 hrs @ 100°C Bearing protection 2 days @ 52°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Buff</td>
</tr>
</tbody>
</table>

www.shell.com/aviation
AEROSHELL GREASE 11MS

AeroShell Grease 11MS is a smooth homogenous airframe grease which additionally contains 5% molybdenum disulphide. AeroShell Grease 11MS consists of a high quality petroleum oil, a non-soap thickener plus corrosion and oxidation inhibitors.

APPLICATIONS
AeroShell Grease 11MS is mainly intended for use in highly loaded, slow moving, sliding surface applications. Typical use is in bogie pivot pins and other landing gear assemblies operating in the temperature range of –40°C to +121°C.

AeroShell Grease 11MS should not be used in any type of bearing application without prior performance evaluation.

SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

AeroShell Grease 11MS is not covered by any military specification.

AeroShell Grease 11MS is approved by Boeing for use on specific landing gear components on various aircraft including the Boeing 767 and Boeing 777.

PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
</tr>
<tr>
<td>Thickener type</td>
<td>Inorganic gel</td>
</tr>
<tr>
<td>Base oil viscosity @ 40°C</td>
<td>38 mm²/S</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>6.0 mm²/S</td>
</tr>
<tr>
<td>Useful operating temperature range</td>
<td>–</td>
</tr>
<tr>
<td>@ 4°C</td>
<td>–40 to +121°C</td>
</tr>
<tr>
<td>Drop point</td>
<td>274 °C</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>310</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>300</td>
</tr>
<tr>
<td>Oil separation @ 100°C, 30 hrs</td>
<td>1.8 % loss</td>
</tr>
<tr>
<td>Water resistance test loss 1 hr @ 37.8°C</td>
<td>1.7 % loss</td>
</tr>
<tr>
<td>Evaporation loss 22 hrs @ 121°C</td>
<td>1.5 m %</td>
</tr>
<tr>
<td>Load Wear Index</td>
<td>57</td>
</tr>
<tr>
<td>Colour</td>
<td>Black</td>
</tr>
</tbody>
</table>
**AEROSHELL GREASE 14**

AeroShell Grease 14 is a helicopter multi-purpose grease composed of a mineral oil thickened with a calcium soap, possessing outstanding anti-fret and anti-moisture corrosion properties. It is oxidation and corrosion inhibited.

*The useful operating temperature range is ~54°C to +93°C.*

**APPLICATIONS**

AeroShell Grease 14 is the leading helicopter multi-purpose grease and is approved by all helicopter manufacturers. Owing to its anti-fret properties, AeroShell Grease 14 is particularly suitable for the lubrication of helicopter main and tail rotor bearings, splines, etc.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-G-25537C</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-51</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-366</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-284</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th>MIL-G-25537C</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
</tr>
<tr>
<td>Base oil viscosity mm²/s</td>
<td>–</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>12.5</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>3.1</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
</tr>
<tr>
<td>–54 to +93</td>
<td></td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th>MIL-G-25537C</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop point °C</td>
<td>140 min</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>265 to 305</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>200 min</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C 100 hrs MPa</td>
<td>0.0345 max</td>
</tr>
<tr>
<td>400 hrs MPa</td>
<td>0.1378 max</td>
</tr>
<tr>
<td>Oil separation @ 100°C, 30 hrs % m</td>
<td>5.0 max</td>
</tr>
<tr>
<td>Water resistance test loss % m</td>
<td>–</td>
</tr>
<tr>
<td>Evaporation loss 22 hrs @ 100°C % m</td>
<td>7.0 max</td>
</tr>
<tr>
<td>Antifriction bearing performance @ 93°C hrs</td>
<td>–</td>
</tr>
<tr>
<td>Copper corrosion 24 hrs @ 100°C</td>
<td>Must pass</td>
</tr>
<tr>
<td>Bearing protection 2 days @ 52°C</td>
<td>Must pass</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
</tr>
</tbody>
</table>
AEROSHELL GREASE 15

AeroShell Grease 15 is an extreme temperature range grease, composed of silicone oil with an organic thickener. AeroShell Grease 15 is inhibited against corrosion and oxidation, and possesses excellent high temperature and mechanical stability properties and low evaporation rate. It is water resistant.

The useful temperature range is –73°C to +232°C.

AeroShell Grease 15 has a tendency to bleed and should be stirred before use.

AeroShell Grease 15 has replaced AeroShell Grease 15A.

APPLICATIONS
AeroShell Grease 15 is a special grease suitable for use in lightly loaded ball and roller bearings through a temperature range of –73°C to +232°C. AeroShell Grease 15 is recommended for continuous high temperature service, e.g. for turbine engine control bearings, or where low torque properties are required at temperatures down to –73°C.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-G-25013E</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-55 (Obsolete)</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue of VNII NP 235</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-372</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-300</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MIL-G-25013E</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Silicone</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Teflon</td>
</tr>
<tr>
<td>Base oil viscosity @ 40°C</td>
<td>–</td>
<td>55</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>14.0</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>–73 to +232</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>230 min</td>
<td>260+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>260 to 320</td>
<td>280</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 100 hrs kPa</td>
<td>35.0</td>
<td>2</td>
</tr>
<tr>
<td>Low temperature torque @ –73°C Starting - Nm</td>
<td>0.35 max</td>
<td>0.32</td>
</tr>
<tr>
<td>Running - Nm</td>
<td>0.05 max</td>
<td>0.035</td>
</tr>
<tr>
<td>Oil separation @ 232°C, 30 hrs % m</td>
<td>7.5 max</td>
<td>3.0</td>
</tr>
<tr>
<td>Water resistance test loss @ 40°C % m</td>
<td>20 max</td>
<td>3.1</td>
</tr>
<tr>
<td>Evaporation loss 22 hrs @ 205°C % m</td>
<td>4.0 max</td>
<td>2.7</td>
</tr>
<tr>
<td>High temperature bearing performance @ 232°C hrs</td>
<td>500 min</td>
<td>518+</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Off white</td>
</tr>
</tbody>
</table>
**AEROSHELL GREASE 16**

AeroShell Grease 16 is an advanced multi-purpose grease for aircraft, composed of a synthetic and mineral oil thickened with Microgel®. AeroShell Grease 16 has excellent load carrying ability and water resistance. It is inhibited against corrosion and heavily fortified against oxidation.

The useful operating temperature range is –54°C to +204°C.

**APPLICATIONS**

AeroShell Grease 16 is suitable for the lubrication of anti-friction bearings operating under load at high speeds and high or low temperature conditions within the range –54°C to +204°C. AeroShell Grease 16 is recommended for Boeing Aircraft where Boeing has approved the grease under their BMS 3-24A specification. AeroShell Grease 16 has excellent load carrying ability and is particularly suitable for applications where both thrust load and high temperatures are encountered. As a result of its good retention and water resistant properties AeroShell Grease 16 is suitable as a wheel bearing grease for aircraft with very high landing speeds.

AeroShell Grease 16 contains 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.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Meets MIL-G-25760A (Obsolete)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Meets DTD.5579 (Obsolete)</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent AIR 4207/A</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to ST (NK-50)</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-361</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-292 (Obsolete)</td>
</tr>
<tr>
<td>Boeing</td>
<td>Approved BMS 3-24A</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MIL-G-25760A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Polyester synthetic plus Mineral</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Microgel</td>
</tr>
<tr>
<td>Base oil viscosity</td>
<td>mm²/s</td>
<td></td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>26.2</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>5.2</td>
</tr>
<tr>
<td>Useful operating temperature range</td>
<td>–</td>
<td>–54 to +204</td>
</tr>
<tr>
<td>Drop point</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>@ 25°C</td>
<td>260 min</td>
<td>260+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>–</td>
<td>308</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>–</td>
<td>290</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 100 hrs</td>
<td>lb/in²</td>
<td>5 max</td>
</tr>
<tr>
<td>@ 500 hrs</td>
<td>lb/in²</td>
<td>–</td>
</tr>
<tr>
<td>Oil separation @ 177°C in 30 hrs</td>
<td>% m</td>
<td>5.0 max</td>
</tr>
<tr>
<td>Water resistance test loss @ 37.8°C</td>
<td>% m</td>
<td>50 max</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 177°C</td>
<td>% m</td>
<td>7.0 max</td>
</tr>
<tr>
<td>Anti-friction bearing performance @ 177°C</td>
<td>hrs</td>
<td>400 min</td>
</tr>
<tr>
<td>Copper corrosion 24 hr @ 100°C</td>
<td>–</td>
<td>Must pass</td>
</tr>
<tr>
<td>Bearing protection 2 days @ 52°C</td>
<td>–</td>
<td>Must pass</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Light Brown</td>
</tr>
</tbody>
</table>
AEROSHELL GREASE 17

AeroShell Grease 17 is an advanced multi-purpose grease containing 5% molybdenum disulphide and composed of a synthetic ester oil thickened with Microgel® (AeroShell Grease 7 with 5% molybdenum disulphide). AeroShell Grease 17 has outstanding properties over a wide temperature range. AeroShell Grease 17 is corrosion inhibited and heavily fortified against oxidation and has excellent resistance to water.

The useful operating temperature range is –73°C to +149°C.

APPLICATIONS

AeroShell Grease 17 is particularly suitable for lubricating heavily loaded sliding steel surfaces, e.g. bogie pivot pins on aircraft landing gear assemblies. It is also recommended as an anti-friction bearing lubricant. AeroShell Grease 17 contains a synthetic ester oil and should not be used in contact with incompatible seal materials. Refer to the General Notes at the front of this section.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-G-21164D</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 353/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-353</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MIL-G-21164D</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Synthetic Diester</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Microgel</td>
</tr>
<tr>
<td>Base oil viscosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ –40°C</td>
<td>–</td>
<td>1150</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>10.3</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>3.1</td>
</tr>
<tr>
<td>Useful operating temp range °C</td>
<td>–</td>
<td>–73 to +149</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>165 min 260+</td>
<td></td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>260 to 310</td>
<td>295</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>200 min 287</td>
<td></td>
</tr>
<tr>
<td>Bomb oxidation pressure drop 100 hrs kPa (psi)</td>
<td>68.9 (10) max 55.1 (8)</td>
<td></td>
</tr>
<tr>
<td>500 hrs kPa (psi)</td>
<td>103.4 (15) max 103.4 (15)</td>
<td></td>
</tr>
<tr>
<td>Oil separation @ 100°C in 30 hrs % m</td>
<td>5 max 2.5</td>
<td></td>
</tr>
<tr>
<td>Water resistance test loss @ 40°C % m</td>
<td>20 max 1.0</td>
<td></td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 100°C % m</td>
<td>2.0 max 0.6</td>
<td></td>
</tr>
<tr>
<td>Anti-friction bearing performance @ 121°C hrs</td>
<td>1000 min 2850</td>
<td></td>
</tr>
<tr>
<td>Extreme pressure properties – load wear index</td>
<td>50 min 60</td>
<td></td>
</tr>
<tr>
<td>Copper corrosion 24 hr @ 100°C</td>
<td>Must pass Passes</td>
<td></td>
</tr>
<tr>
<td>Bearing protection 2 days @ 52°C</td>
<td>Must pass Passes</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Dark Grey</td>
</tr>
</tbody>
</table>
AEROSHELL GREASE 22

AeroShell Grease 22 is a versatile advanced general purpose grease composed of a synthetic hydrocarbon oil thickened with Microgel®, with outstanding performance characteristics. Appropriate additives are included to achieve the necessary oxidation and corrosion resistance, anti-wear properties and load carrying properties. The useful operating temperature range is –65°C to +204°C.

APPLICATIONS

AeroShell Grease 22 is especially recommended for use wherever severe operating conditions are encountered as in high bearing loads, high speeds, wide operating temperature range, and particularly where long grease retention and high resistance to water washout are required. The wide range of applications include aircraft wheel bearings, engine accessories, control systems, actuators, screw-jacks, servo mechanisms and electric motors, helicopter rotor bearings, instruments, airframe lubrication, hinge pins, static joints, landing gears.

AeroShell Grease 22 contains 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.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-81322F NLGI Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Approved DOD-G-24508A</td>
</tr>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-52</td>
</tr>
<tr>
<td>French</td>
<td>Approved DCSEA 395/A</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue of CIATIM 201 and 203, VNII NP 207, ERA (VNII NP 286M) and ST (NK-50)</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-395</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-293</td>
</tr>
</tbody>
</table>

PROPERTIES | MIL-PRF-81322F NLGI Grade 2 | TYPICAL |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Synthetic Hydrocarbon</td>
<td></td>
</tr>
<tr>
<td>Thickener type</td>
<td>Microgel</td>
<td></td>
</tr>
<tr>
<td>Base oil viscosity @ –40°C</td>
<td>–</td>
<td>7500</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>30.5</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>3.7</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>–65 to +204</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>232 min</td>
<td>260+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>269 to 295</td>
<td>275</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>–</td>
<td>271</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C 100 hrs MPa (psi)</td>
<td>0.083 (12) max</td>
<td>0.027 (4)</td>
</tr>
<tr>
<td>500 hrs MPa (psi)</td>
<td>0.172 (25) max</td>
<td>0.069 (10)</td>
</tr>
<tr>
<td>Oil separation @ 177°C in 30 hrs % m</td>
<td>2.0 to 8.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Water resistance test loss @ 41°C % m</td>
<td>20 max</td>
<td>0.5</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 177°C % m</td>
<td>10 max</td>
<td>4.3</td>
</tr>
<tr>
<td>Anti-friction bearing performance @ 177°C hrs</td>
<td>400 min</td>
<td>400+</td>
</tr>
<tr>
<td>Load carrying capacity/ Mean Hertz Load kg</td>
<td>30 min</td>
<td>45</td>
</tr>
<tr>
<td>Copper corrosion 24 hr @ 100°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Bearing protection 2 days @ 52°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Amber</td>
</tr>
</tbody>
</table>

www.shell.com/aviation
AEROSHELL GREASE 22CF

AeroShell Grease 22CF is an advanced general purpose grease composed of a clay thickened synthetic hydrocarbon oil. Appropriate additives are included to achieve the necessary oxidation and corrosion resistance, and anti-wear properties and load carrying properties.

The useful operating temperature range is −54°C to +177°C.

AeroShell Grease 22CF has replaced AeroShell Grease 22C.

APPLICATIONS

AeroShell Grease 22CF is especially recommended for use wherever severe operating conditions are encountered as in high bearing loads, high speeds, wide operating temperature range, and particularly where long grease retention and high resistance to water washout are required.

The wide range of applications include aircraft wheel bearings, engine accessories, control systems, actuators, screw-jacks, servo mechanisms and electric motors, helicopter rotor bearings, instruments, airframe lubrication, hinge pins, static joints, landing gears.

AeroShell Grease 22CF contains 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.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-81322F NLGI Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-52</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 395/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-395</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>Equivalent XG-293</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-81322F NLGI Grade 2</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Clay</td>
</tr>
<tr>
<td>Base oil viscosity mm/s @ 40°C</td>
<td>–</td>
<td>30</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>6.0</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>−54 to +177</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>232 min</td>
<td>232+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>269 to 295</td>
<td>280</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C</td>
<td>0.083 max</td>
<td>0.045</td>
</tr>
<tr>
<td>100 hrs MPa</td>
<td>0.172 max</td>
<td>0.124</td>
</tr>
<tr>
<td>500 hrs MPa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil separation @ 177°C % m in 30 hrs</td>
<td>2.0 to 8.0</td>
<td>3.75</td>
</tr>
<tr>
<td>Water resistance test loss @ 41°C % m</td>
<td>20 max</td>
<td>11.0</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 177°C % m</td>
<td>10 max</td>
<td>6.25</td>
</tr>
<tr>
<td>High temperature performance @ 177°C hrs</td>
<td>400 min</td>
<td>500+</td>
</tr>
<tr>
<td>Load Wear Index/Mean Hertz Load kg</td>
<td>30 min</td>
<td>35</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Brown</td>
</tr>
</tbody>
</table>

www.shell.com/aviation
AEROSHELL GREASE 23C

AeroShell Grease 23C is an advanced load carrying grease composed of a clay thickened synthetic hydrocarbon oil and containing molybdenum disulphide. Appropriate additives are included to achieve the necessary oxidation and corrosion resistance, and anti-wear properties and load carrying properties.

The useful operating temperature range is –54°C to +177°C.

APPLICATIONS

AeroShell Grease 23C is designed for use as a lubricant for heavily loaded splines, sliding surfaces and in anti-friction bearings.

AeroShell Grease 23C should not be used for other than steel surfaces without prior performance evaluation.

AeroShell Grease 23C contains 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.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-G-81827A</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>MIL-G-81827A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Clay</td>
</tr>
<tr>
<td>Base oil viscosity mm²/s @ 40°C</td>
<td>–</td>
<td>30</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
<td>6.0</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>–54 to +177</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>232 min</td>
<td>232+</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>265 to 320</td>
<td>285</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C</td>
<td>–</td>
<td>0.172 (55) max</td>
</tr>
<tr>
<td>100 hrs MPa (psi)</td>
<td>–</td>
<td>Less than 0.172 (25)</td>
</tr>
<tr>
<td>500 hrs MPa (psi)</td>
<td>0.172 (55) max</td>
<td>–</td>
</tr>
<tr>
<td>Oil separation @ 177°C in 30 hrs % m</td>
<td>10 max</td>
<td>1.5</td>
</tr>
<tr>
<td>Water resistance test loss @ 38°C % m</td>
<td>20 max</td>
<td>3.85</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 177°C % m</td>
<td>12 max</td>
<td>4.0</td>
</tr>
<tr>
<td>High temperature performance @ 177°C hrs</td>
<td>400 min</td>
<td>500+</td>
</tr>
<tr>
<td>Extreme pressure properties (load wear index) kg</td>
<td>50 min</td>
<td>55</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Black</td>
</tr>
</tbody>
</table>
AEROSHELL GREASE 33

AeroShell Grease 33 is a synthetic universal airframe grease composed of a lithium complex thickened synthetic base oil with corrosion and oxidation inhibitors and load carrying additives. The useful operating temperature range is –73°C to +121°C.

APPLICATIONS

For many years aircraft operators have been seeking to rationalise the greases used on aircraft and to reduce the number of different greases in their inventories. Recently Boeing began research on a new, general purpose, corrosion-inhibiting grease. The aim was for a non-clay based grease that would provide longer life for components and mechanisms and possess improved wear and corrosion resistance. This led to the introduction of the new Boeing Specification BMS 3-33.

Owing to the wide range of operating temperatures, loads and other environmental conditions required for various aircraft components, several different types of grease with different desirable properties are used during routine lubrication of aircraft components. Boeing, in developing their BMS 3-33 specification, took account of the properties of the different grease types used on aircraft and wrote a specification for a grease which would provide improved performance and which could be used in the widest possible range of grease applications.

AeroShell Grease 33 is approved to BMS 3-33A and offers the improved performance properties required by this specification.

AeroShell Grease 33 can be used for routine lubrication on Boeing aircraft where MIL-PRF-23827C or BMS 3-24 is specified. AeroShell Grease 33 can also be used in some applications on Boeing aircraft which require use of MIL-G-21164. Other applications on Boeing aircraft which require use of MIL-G-21164 and other greases are being reviewed and in due course Boeing will issue details of the full range of applications. For the current status, refer to the latest issue of Boeing Service Letter “BMS 3-33 General Purpose Aircraft Grease”.

AeroShell Grease 33 can be used for routine lubrication in applications where MIL-PRF-23827C is specified on aircraft manufactured by McDonnell Douglas, Airbus, BAe Regional Aircraft, Canadair, Lockheed, Embraer, Fokker and Gulfstream (except for wheel bearings, applications above 121°C and sliding applications requiring molybdenum disulphide).

Other aircraft manufacturers are evaluating AeroShell Grease 33 with the aim of approving it for use on their aircraft. Operators should regularly check with these manufacturers for the latest status.

Use of AeroShell Grease 33 can provide operators with the following benefits:

- Reduced inventories
- Easier maintainability (one major grease for most applications)
- Reduced maintenance labour costs
- Less chance of product mis-application

AeroShell Grease 33 contains a synthetic oil and must not be used with incompatible seal materials. Refer to the General Notes at the front of this section for further information.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-23827C (Type I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-354</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
<tr>
<td>Boeing</td>
<td>Approved BMS 3-33A</td>
</tr>
<tr>
<td>PROPERTIES</td>
<td>BMS 3-33A</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Oil type</td>
<td>Synthetic hydrocarbon/Ester</td>
</tr>
<tr>
<td>Thickener type</td>
<td>Lithium Complex</td>
</tr>
<tr>
<td>Base oil viscosity mm²/s</td>
<td></td>
</tr>
<tr>
<td>@ −40°C</td>
<td>–</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>–</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>−73 to +121</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>–</td>
</tr>
<tr>
<td>Worked penetration @ 25°C</td>
<td>265 to 315</td>
</tr>
<tr>
<td>Unworked penetration @ 25°C</td>
<td>–</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop from 758 kPa (110 psi) @ 99°C @ 100 hr kPa [psi] max</td>
<td>70 (10) max</td>
</tr>
<tr>
<td>@ 500 hr kPa [psi] max</td>
<td>105 (15) max</td>
</tr>
<tr>
<td>Oil separation @ 100°C, 30 hr %m</td>
<td>–</td>
</tr>
<tr>
<td>Water resistance test loss (79°C) %m</td>
<td>7.5 max</td>
</tr>
<tr>
<td>Evaporation loss, 500 hr @ 121°C %m</td>
<td>10 max</td>
</tr>
<tr>
<td>Mean Hertz Load kg</td>
<td>–</td>
</tr>
<tr>
<td>Antifriction bearing performance @ 121°C hrs</td>
<td>–</td>
</tr>
<tr>
<td>Copper corrosion 24 hrs @ 100°C Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Bearing protection 2 days @ 52°C Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour</td>
<td>Blue-green</td>
</tr>
</tbody>
</table>
AEROSHELL GREASE 43C

AeroShell Grease 43C is a synthetic lithium base grease with the addition of additives to achieve the necessary lubricity, oxidation resistance and moisture corrosion protection properties.

The useful operating temperature range is -54°C to +93°C.

APPLICATIONS

AeroShell Grease 43C is primarily intended for use in pneumatic systems as a lubricant between rubber seals and metal parts (under dynamic conditions). AeroShell Grease 43C is also suitable for use in pressurised cabin bulkhead grommets and other mechanisms requiring rubber to metal lubrication and is also an excellent lubricant for metal on metal surfaces.

AeroShell Grease 43C should not be used with certain types of rubber without determining the compatibility between the rubber and this grease.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved SAE-AMS-G-4343</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>SAE-AMS-G-4343</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 392/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-392</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>XG-269</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>SAE-AMS-G-4343</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Synthetic</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Lithium Soap</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>-54 to +93</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>163 min</td>
<td>196</td>
</tr>
<tr>
<td>Worked penetration</td>
<td>260 to 300</td>
<td>285</td>
</tr>
<tr>
<td>Bomb oxidation pressure drop @ 99°C 100 hrs lb/in²</td>
<td>5.0 max</td>
<td>0.8</td>
</tr>
<tr>
<td>Oil separation @ 100°C in 30 hrs % m</td>
<td>5.0 max</td>
<td>2.0</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs @ 99°C % m</td>
<td>2.5 max</td>
<td>0.6</td>
</tr>
<tr>
<td>Rust preventive properties</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Copper corrosion</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Tan</td>
</tr>
</tbody>
</table>
**AEROSHELL GREASE S.4768**

AeroShell Grease S.4768 is an anti-seize product composed of 50% by weight molybdenum disulphide conforming to DEF STAN 68-62 in a lithium-based grease.

AeroShell Grease S.4768 is suitable for use at temperatures up to +350°C.

**APPLICATIONS**
AeroShell Grease S.4768 is an anti-seize grease for use on metal parts, e.g. threaded connections, splines, etc.

**SPECIFICATIONS**

| U.S. | – |
| British | Approved DEF STAN 80-81 |
| French | – |
| Russian | Analogue to GOST 14068-79, VNII NP 232 |
| NATO Code | S-722 |
| Joint Service Designation | ZX-38 |

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>DEF STAN 80-81</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td>Mineral</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Lithium</td>
</tr>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>Up to +350</td>
</tr>
<tr>
<td>Drop point °C</td>
<td>100 min</td>
<td>Over 150</td>
</tr>
<tr>
<td>Worked penetration at 25°C</td>
<td>200 to 300</td>
<td>250</td>
</tr>
<tr>
<td>Molybdenum disulphide content %m</td>
<td>50 min</td>
<td>50</td>
</tr>
<tr>
<td>Corrosive substances</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Black</td>
</tr>
</tbody>
</table>

www.shell.com/aviation
AEROSH ELL GREASE S.7108

AeroShell Grease S.7108 is a gasoline and oil resistant grease, composed of a clay thickened synthetic resin fortified with corrosion inhibitors and metal deactivator.

APPLICATIONS
AeroShell Grease S.7108 is used for the lubrication of carburettor controls and taper plug valves and as a valve sealant, etc., in fuel and oil systems. AeroShell Grease S.7108 is also suitable for the lubrication of metal surfaces in contact with rubber.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>SAE-AMS-G-6032</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-6</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent DCSEA 363/A</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to GOST 7171-78</td>
</tr>
<tr>
<td></td>
<td>Grade BU</td>
</tr>
<tr>
<td>NATO Code</td>
<td>G-363</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>Equivalent XG-235</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>SAE-AMS-G-6032</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Synthetic</td>
</tr>
<tr>
<td>Thickener type</td>
<td>–</td>
<td>Clay</td>
</tr>
<tr>
<td>Penetration at 10°C (¼ scale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unworked</td>
<td>20 to 72</td>
<td>28</td>
</tr>
<tr>
<td>Worked</td>
<td>–</td>
<td>60</td>
</tr>
<tr>
<td>Solubility in fuel</td>
<td>% m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 max</td>
<td>Less than 5</td>
</tr>
<tr>
<td>Resistance to aqueous solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distilled water</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>50% solution alcohol and distilled water</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Copper corrosion</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Film stability and corrosion on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>steel 1 week @ 100°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Tan</td>
</tr>
</tbody>
</table>
AEROSHELL COMPOUND 08

AeroShell Compound 08 is a heavy duty anti-seize compound, composed of equal parts by weight of fine graphite (SS-G-659 or DEF STAN 96-1) and mineral jelly (VV-P-236 or DEF STAN 91-38).

AeroShell Compound 08 is suitable for use at temperatures up to 500°C.

APPLICATIONS

AeroShell Compound 08 is recommended for use as an anti-seize compound on propeller shafts, threaded connections, splines, spark plug threads and similar threaded aircraft engine accessory equipment. When used on spark plug threads all traces of this material must be removed from the insulator as it is electrically conductive.

AeroShell Compound 08 is not intended as a general purpose lubricant and should not be used in ball and roller bearings.

AeroShell Compound 08 may be used in contact with corrosion resistant metals such as austenitic stainless steels, titanium, nickel, and cobalt alloys. Due to the graphite compound in AeroShell Compound 08, this material should NOT be used in contact with aluminium, magnesium, cadmium or zinc alloys and platings without prior evaluation. Because AeroShell Compound 08 conducts electricity readily, the mating of dissimilar alloys which may create an electrical potential should be avoided.

SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>SAE-AMS-2518A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>Up to 500</td>
</tr>
<tr>
<td>Worked penetration</td>
<td>170 to 260</td>
<td>Above 170</td>
</tr>
<tr>
<td>Melting point °C</td>
<td>–</td>
<td>55</td>
</tr>
<tr>
<td>Flash point °C</td>
<td>200 min</td>
<td>250</td>
</tr>
<tr>
<td>Evaporation loss in 60 mins @ 110°C % m</td>
<td>2.0 max</td>
<td>0.1</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Black</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>SAE-AMS-2518A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful operating temperature range °C</td>
<td>–</td>
<td>Up to 500</td>
</tr>
<tr>
<td>Worked penetration</td>
<td>170 to 260</td>
<td>Above 170</td>
</tr>
<tr>
<td>Melting point °C</td>
<td>–</td>
<td>55</td>
</tr>
<tr>
<td>Flash point °C</td>
<td>200 min</td>
<td>250</td>
</tr>
<tr>
<td>Evaporation loss in 60 mins @ 110°C % m</td>
<td>2.0 max</td>
<td>0.1</td>
</tr>
<tr>
<td>Colour</td>
<td>–</td>
<td>Black</td>
</tr>
</tbody>
</table>
AEROSHELL HYDRAULIC FLUIDS

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

- AeroShell Fluid 4
- AeroShell Fluid 41
- AeroShell Fluid 71
- AeroShell Fluid 31
- AeroShell Fluid 51
- AeroShell Fluid 61
- AeroShell Shock Strut Fluid (SSF)
- 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 71 is a preservative mineral hydraulic fluid for use in hydraulic systems and components that are in storage as well as hydraulic system test rigs.

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

AeroShell Fluid 51 is a low temperature synthetic hydrocarbon fire resistant hydraulic fluid.

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

AeroShell SSF and LGF are hydraulic fluids specifically for landing gear shock struts of some aircraft.

For some types of aircraft, proprietary non-inflammable fluids of non-petroleum origin (phosphate ester type) are required. Shell Companies can supply Skydrol 5008-4 and LD-4 phosphate ester fluids against a known demand.

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 10^7 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.
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.

CHANGE OVER

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.

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.
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 been reduced in size and operating pressures have increased with the result that particulates in the hydraulic fluid can cause system failures through blocking nozzles and pipes or through erosion (for example particulates hitting metal surface and eroding it away) and/or wear. Thus these specifications include very tight limits on particulates and typically for MIL-PRF-5606H, MIL-PRF-83282D and MIL-PRF-87257A the requirement is of the order:

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Microscopic Count</th>
<th>Automatic Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 15 µm</td>
<td>2,500</td>
<td>10,000</td>
</tr>
<tr>
<td>16 to 25 µm</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>26 to 50 µm</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>51 to 100 µm</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>over 100 µm</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

MIL-PRF-5606H allows automatic method only
MIL-PRF-83282D allows both methods
MIL-PRF-87257A allows automatic method only

Shell manufacturing plants when manufacturing these fluids go to considerable effort to meet these stringent limits, this includes multistage filtration, pre-cleaning of containers immediately before filling and packaging the fluid in 'clean room' conditions.

However, it is pointless for Shell manufacturing plants to go to these extreme lengths if operators themselves do not handle the fluid correctly in order to ensure 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.

<table>
<thead>
<tr>
<th>Elastomer/Plastic</th>
<th>Mineral Oil Based Hydraulic Fluids</th>
<th>Synthetic Hydrocarbon Based Hydraulic Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flurocarbon (Viton)</td>
<td>Very Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Polyether</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Silicone</td>
<td>Poor to Good</td>
<td>Poor to Good</td>
</tr>
<tr>
<td>Teflon</td>
<td>Very Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Nylon</td>
<td>Poor to Good</td>
<td>Poor to Good</td>
</tr>
<tr>
<td>Buna-S</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Perbunan</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Methacrylate</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Neoprene</td>
<td>Fair to Good</td>
<td>Fair to Good</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>Poor to Fair</td>
<td>Poor to Fair</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Butyl Rubber</td>
<td>Very Poor to Poor</td>
<td>Very Poor to Poor</td>
</tr>
<tr>
<td>Poly Vinyl Chloride</td>
<td>Poor to Good</td>
<td>Poor to Good</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>TYPES OF HYDRAULIC FLUIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral</td>
</tr>
<tr>
<td>AeroShell Fluid 4</td>
</tr>
<tr>
<td>AeroShell Fluid 41</td>
</tr>
<tr>
<td>AeroShell Fluid 71</td>
</tr>
<tr>
<td>AeroShell Fluid SSF</td>
</tr>
<tr>
<td>AeroShell Fluid LGF</td>
</tr>
<tr>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>AeroShell Fluid 31</td>
</tr>
<tr>
<td>AeroShell Fluid 51</td>
</tr>
<tr>
<td>AeroShell Fluid 61</td>
</tr>
<tr>
<td>Phosphate Ester</td>
</tr>
<tr>
<td>Skydrol 500B4</td>
</tr>
<tr>
<td>Skydrol LD4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HYDRAULIC FLUID CLEANLINESS - SUPERCLEAN PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
The latest issues of specifications MIL-PRF-5606, MIL-PRF-6083, MIL-PRF-46170, MIL-PRF-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.

---

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>AEROSHELL FLUID</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Meets Equivalent</td>
</tr>
<tr>
<td>31</td>
<td>Approved</td>
</tr>
<tr>
<td>61</td>
<td>Approved</td>
</tr>
<tr>
<td>61</td>
<td>Approved</td>
</tr>
<tr>
<td>71</td>
<td>Approved</td>
</tr>
<tr>
<td>SS/LGF</td>
<td>Approved</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>AEROSHELL FLUID</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-PRF-5606A</td>
<td>Approved</td>
</tr>
<tr>
<td>MIL-PRF-5606H</td>
<td>Approved</td>
</tr>
<tr>
<td>MIL-PRF-46170C</td>
<td>Approved</td>
</tr>
<tr>
<td>MIL-PRF-83282D</td>
<td>Approved</td>
</tr>
<tr>
<td>MIL-PRF-87257A</td>
<td>Approved</td>
</tr>
<tr>
<td>DEF STAN 91-48</td>
<td>Equivalent</td>
</tr>
<tr>
<td>DEF STAN 91-48</td>
<td>Approved</td>
</tr>
<tr>
<td>DEF STAN 80142</td>
<td>Approved</td>
</tr>
<tr>
<td>H-515</td>
<td>Approved</td>
</tr>
<tr>
<td>H-520</td>
<td>Approved</td>
</tr>
<tr>
<td>H-537</td>
<td>Approved</td>
</tr>
<tr>
<td>H-538</td>
<td>Approved</td>
</tr>
<tr>
<td>H-544</td>
<td>Approved</td>
</tr>
<tr>
<td>C-635</td>
<td>Approved</td>
</tr>
<tr>
<td>BMS 332</td>
<td>Approved</td>
</tr>
</tbody>
</table>

---

www.shell.com/aviation
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 excellent low temperature flow and anti-wear properties, exceptional antifoam characteristics, and excellent oxidation stability.

AeroShell Fluid 4 is dyed red.

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. AeroShell Fluid 4 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, 51, 61 and 71, 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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Meets MILH-5606A (Obsolete – see AeroShell Fluid 41)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>British</th>
<th>Meets DTD.585 (Obsolete – see AeroShell Fluid 41) Approved DEF STAN 91-48 Grade Normal (European production only)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>French</th>
<th>Approved DCSEA 415/A</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Russian</th>
<th>Analogue to AMG-10</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NATO Code</th>
<th>H-520 (European production only)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Joint Service Designation</th>
<th>OM-18 (European production only)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>DEF STAN 91-48 Grade Normal</th>
<th>TYPICAL (European Production)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Oil type</th>
<th>Mineral</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Kinematic viscosity mm²/s @ 100°C</th>
<th>4.0 min</th>
<th>5.30</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 40°C</td>
<td>13 min</td>
<td>14.1</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>500 max</td>
<td>491</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>3000 max</td>
<td>2300</td>
</tr>
</tbody>
</table>

| Flashpoint Pensky Martin Closed Cup °C | 81 min | 105 |

<table>
<thead>
<tr>
<th>Pourpoint °C</th>
<th>–60 max</th>
<th>&lt; –60</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total acid number mgKOH/g</th>
<th>0.2 max</th>
<th>0.01</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Relative Density @ 15.6/15.6°C</th>
<th>–</th>
<th>0.87</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Evaporation @ 100°C %m</th>
<th>20 max</th>
<th>10</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Colour</th>
<th>Red</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Copper corrosion</th>
<th>2 max</th>
<th>Passes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Low temperature stability</th>
<th>Must pass</th>
<th>Passes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Shear stability</th>
<th>Must pass</th>
<th>Passes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Foaming characteristics</th>
<th>Must pass</th>
<th>Passes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Phosphorus content % m/m</th>
<th>0.035 to 0.050</th>
<th>Passes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Oxidation &amp; corrosion stability 168 hrs @ 135°C</th>
<th>Must pass</th>
<th>Passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>– metal weight change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– change in viscosity @ 40°C %</td>
<td>–5 to +20</td>
<td>+2.0</td>
</tr>
<tr>
<td>– change in acid number mgKOH/g</td>
<td>0.2 max</td>
<td>+0.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anti-wear properties, scar diam mm</th>
<th>1.5 max</th>
<th>0.95</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Rubber swell 168 hrs @ 70°C vol change %</th>
<th>19 to 30</th>
<th>25</th>
</tr>
</thead>
</table>

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, antiwear, 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 to +205°C.

APPLICATIONS

AeroShell Fluid 31 is recommended for use in aircraft, ordnance, and missile systems operating from –40°C to +205°C. 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 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, 51, 61 and 71 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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-83282D</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>(MIL-PRF-83282D)</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to DCSEA 437/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>H-537</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-19</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>MIL-PRF-83282D</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s</td>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>@ 205°C</td>
<td>1.0 min</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>3.45 min</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>14.0 min</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>2200 max</td>
</tr>
<tr>
<td>Flashpoint</td>
<td></td>
</tr>
<tr>
<td>Cleveland Open Cup °C</td>
<td>205 min</td>
</tr>
<tr>
<td>Fire Point</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>245 min</td>
</tr>
<tr>
<td>Total Acidity</td>
<td>mgKOH/g</td>
</tr>
<tr>
<td></td>
<td>0.10 max</td>
</tr>
<tr>
<td>Evaporation loss 6.5 hrs % m</td>
<td>20 max</td>
</tr>
<tr>
<td>Relative density @ 15.6/15.6°C</td>
<td>Report</td>
</tr>
<tr>
<td>Pourpoint</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>–55 max</td>
</tr>
</tbody>
</table>

Table continued
## Hydraulic Fluids

### Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>MIL-PRF-83282D</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low temperature stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>72 hrs @ −40°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High temperature stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>100 hrs @ 205°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravimetric Filtration, mg/100ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filtration time, minutes</td>
<td>0.3 max</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>15 max</td>
<td>Less than 15</td>
</tr>
<tr>
<td>Particle Count, Automatic, per Lt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 15 µm</td>
<td>10000 max</td>
<td>1331</td>
</tr>
<tr>
<td>16 to 25 µm</td>
<td>1000 max</td>
<td>190</td>
</tr>
<tr>
<td>26 to 50 µm</td>
<td>150 max</td>
<td>55</td>
</tr>
<tr>
<td>51 to 100 µm</td>
<td>20 max</td>
<td>4</td>
</tr>
<tr>
<td>&gt;100 µm</td>
<td>5 max</td>
<td>0</td>
</tr>
<tr>
<td>Water content, ppm</td>
<td>100 max</td>
<td>82</td>
</tr>
<tr>
<td>Foam resistance, ASTM Seq 1</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Flame propagation, cm/s</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Rubber swell, NBR-L, %</td>
<td>18 to 30</td>
<td>Passes</td>
</tr>
<tr>
<td>4-Ball Wear, 1 hr @ 75°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scar dia, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 kg load/1200 rpm</td>
<td>0.21 max</td>
<td>0.18</td>
</tr>
<tr>
<td>10 kg load/1200 rpm</td>
<td>0.30 max</td>
<td>0.24</td>
</tr>
<tr>
<td>40 kg load/1200 rpm</td>
<td>0.65 max</td>
<td>0.50</td>
</tr>
<tr>
<td>Oxidation &amp; corrosion stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>168 hrs @ 121°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– viscosity change @ 40°C, %</td>
<td>10 max</td>
<td>Less than 10</td>
</tr>
<tr>
<td>– change in acidity, mgKOH/g</td>
<td>0.2 max</td>
<td>Less than 0.02</td>
</tr>
<tr>
<td>Flammability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

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 excellent low temperature fluidity as well as exceptional 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 and pressurised between –54°C to 135°C.

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, 51, 61 and 71 and SSF/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.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-5606H* (both U.S. and European production)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-48 Grade Superclean* (European production only)</td>
</tr>
<tr>
<td>French</td>
<td>Approved DCSEA 415/A</td>
</tr>
<tr>
<td>Russian</td>
<td>Analogue to AMG-10</td>
</tr>
<tr>
<td>NATO Code</td>
<td>H-515* (equivalent H-520)</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OM-15* (equivalent OM-18)</td>
</tr>
</tbody>
</table>

*Superclean grades

The British specification DEF STAN 91-48 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.
<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-5606H</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Production</td>
<td>European Production</td>
<td></td>
</tr>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity $\text{mm}^2/\text{s}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 100°C</td>
<td>4.90 min</td>
<td>6.13</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>13.2 min</td>
<td>15.68</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>600 max</td>
<td>384</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>2500 max</td>
<td>1450</td>
</tr>
<tr>
<td>Viscosity index</td>
<td>–</td>
<td>214</td>
</tr>
<tr>
<td>Flashpoint, Pensky Martin closed cup $^\circ\text{C}$</td>
<td>82 min</td>
<td>104</td>
</tr>
<tr>
<td>Autoignition temperature $^\circ\text{C}$</td>
<td>–</td>
<td>230</td>
</tr>
<tr>
<td>Pourpoint $^\circ\text{C}$</td>
<td>–60 max</td>
<td>&lt;-60</td>
</tr>
<tr>
<td>Total acid number $\text{mgKOH/g}$</td>
<td>0.20 max</td>
<td>0</td>
</tr>
<tr>
<td>Evaporation loss 6 hrs $@ 71^\circ\text{C}$ %m</td>
<td>20 max</td>
<td>16.5</td>
</tr>
<tr>
<td>Water content ppm</td>
<td>100 max</td>
<td>55</td>
</tr>
<tr>
<td>Relative density $@ 15.6/15.6^\circ\text{C}$</td>
<td>Report</td>
<td>0.874</td>
</tr>
<tr>
<td>Colour</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Particulate contamination, number of particles per 100 ml in size range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 15 µm</td>
<td>10000 max</td>
<td>1200</td>
</tr>
<tr>
<td>15 to 25 µm</td>
<td>1000 max</td>
<td>550</td>
</tr>
<tr>
<td>25 to 50 µm</td>
<td>150 max</td>
<td>70</td>
</tr>
<tr>
<td>50 to 100 µm</td>
<td>20 max</td>
<td>5</td>
</tr>
<tr>
<td>over 100 µm</td>
<td>5 max</td>
<td>0</td>
</tr>
<tr>
<td>Copper corrosion</td>
<td>2e max</td>
<td>lb</td>
</tr>
<tr>
<td>Steel on steel wear, scar diam, $\text{mm}$</td>
<td>1.0 max</td>
<td>0.65</td>
</tr>
<tr>
<td>Rubber swell, L rubber %</td>
<td>19 to 30</td>
<td>22</td>
</tr>
<tr>
<td>Corrosiveness &amp; oxidation, 168 hrs $@ 135^\circ\text{C}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– viscosity change $@ 40^\circ\text{C}$ %</td>
<td>–5 to +20</td>
<td>8.08</td>
</tr>
<tr>
<td>– acid number change $\text{mgKOH/g}$</td>
<td>0.20 max</td>
<td>0.02</td>
</tr>
<tr>
<td>Low temperature stability 72 hrs $@ –54^\circ\text{C}$</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Shear stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– viscosity change $@ 40^\circ\text{C}$</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– acid number change</td>
<td>0.2 max</td>
<td>Less than 0.2</td>
</tr>
<tr>
<td>Gravimetric filtration mg/100ml</td>
<td>0.3 max</td>
<td>0.1</td>
</tr>
<tr>
<td>filtration time min</td>
<td>15 max</td>
<td>10</td>
</tr>
<tr>
<td>Foaming tendency</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Barium content ppm</td>
<td>10 max</td>
<td>Nil</td>
</tr>
</tbody>
</table>

A viscosity/temperature curve is shown at the end of this section.
AEROSHELL FLUID 51

AeroShell Fluid 51 is a synthetic hydrocarbon and ester based fluid for use in hydraulic systems which require reliable operation in extreme low and high temperatures as well as performance outside the capability of traditional MIL-PRF-5606 mineral based fluids.

AeroShell Fluid 51 is formulated with high technology additives to provide oxidation and corrosion resistance, anti-wear, and anti-foaming protection. AeroShell Fluid 51 is superclean filtered to ensure optimum performance in particulate monitored systems.

AeroShell Fluid 51 is dyed red. The useful operating temperature range is –54°C to +135°C.

APPLICATIONS

AeroShell Fluid 51 is recommended for use in aircraft, ordnance and missile systems operating from –54°C to +135°C. This fluid should be considered for use in auto pilots, shock absorbers, brakes, flight control systems, hydraulic servo-control systems and other systems using synthetic elastomer seals. This fluid is especially recommended for use in high altitude aircraft that normally operate with extended loiter times and high endurance levels such as UAVs and ELINT systems.

AeroShell Fluid 51 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 51 is compatible with AeroShell Fluids 4, 31, 41, 61 and 71 and can be used in systems designed to operate with MIL-PRF-5606, MIL-PRF-6083, MIL-PRF-83282 and MIL-PRF-46170 fluids.

Chlorinated solvents should not be used for cleaning hydraulic components which use AeroShell Fluid 51. The residual solvent contaminates the hydraulic fluid and may lead to corrosion.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-87257A</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>(MIL-PRF-87257A)</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>H-538</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-538</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-87257A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>–</td>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 100°C</td>
<td>2.0 min</td>
<td>2.12</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>6.7 min</td>
<td>6.80</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>550 max</td>
<td>440</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>2500 max</td>
<td>1945</td>
</tr>
<tr>
<td>Flashpoint °C</td>
<td>160 min</td>
<td>175</td>
</tr>
<tr>
<td>Fire Point °C</td>
<td>170 min</td>
<td>185</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>0.20 max</td>
<td>0.00</td>
</tr>
<tr>
<td>Evaporation loss 6.5 hrs @150°C % m</td>
<td>20 max</td>
<td>13.5</td>
</tr>
<tr>
<td>Relative density @ 15.6/15.6°C</td>
<td>Report</td>
<td>0.838</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–60 max</td>
<td>–65</td>
</tr>
<tr>
<td>Low temperature stability 72 hrs @ –54°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>High temperature stability – change in viscosity @ 40°C %</td>
<td>5 max</td>
<td>Less than 5</td>
</tr>
<tr>
<td>– change in acidity</td>
<td>0.1 max</td>
<td>Less than 0.1</td>
</tr>
<tr>
<td>Gravimetric Filtration, mg/100ml</td>
<td>0.3 max</td>
<td>0.12</td>
</tr>
<tr>
<td>Filtration time minutes</td>
<td>15 max</td>
<td>12</td>
</tr>
<tr>
<td>Particle Count, Automatic, per Lt</td>
<td>10000 max</td>
<td>2400</td>
</tr>
<tr>
<td>5 to 15 µm</td>
<td>1000 max</td>
<td>250</td>
</tr>
<tr>
<td>16 to 25 µm</td>
<td>150 max</td>
<td>90</td>
</tr>
<tr>
<td>26 to 50 µm</td>
<td>20 max</td>
<td>5</td>
</tr>
<tr>
<td>51 to 100 µm</td>
<td>5 max</td>
<td>0</td>
</tr>
<tr>
<td>Over 100 µm</td>
<td>5 max</td>
<td>0</td>
</tr>
</tbody>
</table>

Table continued
<table>
<thead>
<tr>
<th><strong>PROPERTIES</strong></th>
<th><strong>MIL-PRF-87257A</strong></th>
<th><strong>TYPICAL</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content</td>
<td>ppm 100 max</td>
<td>65</td>
</tr>
<tr>
<td>Foam resistance</td>
<td>ASTM Seq 1 65 ml max</td>
<td>20</td>
</tr>
<tr>
<td>Flame propagation</td>
<td>cm/s 0.40 max</td>
<td>Conforms</td>
</tr>
<tr>
<td>Rubber swell, NBR-L</td>
<td>% 19 to 30</td>
<td>23</td>
</tr>
<tr>
<td>4-Ball Wear, 75°C - scar dia, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 kg load</td>
<td>0.21 max</td>
<td>0.17</td>
</tr>
<tr>
<td>10 kg load</td>
<td>0.30 max</td>
<td>0.22</td>
</tr>
<tr>
<td>40 kg load</td>
<td>0.65 max</td>
<td>0.52</td>
</tr>
<tr>
<td>Chlorine content</td>
<td>ppm 50 max</td>
<td>Less than 50</td>
</tr>
<tr>
<td>Flammability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Oxidation &amp; corrosion stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– metal weight change</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– viscosity change</td>
<td>% 10 max</td>
<td>Less than 10</td>
</tr>
<tr>
<td>– change in acidity</td>
<td>mgKOH/g 0.2 max</td>
<td>Less than 0.02</td>
</tr>
</tbody>
</table>
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.

APPLICATIONS
Aeroshell Fluid 61 is designed for use where a fire resistant preservative grade hydraulic fluid is required and is suitable for operational use as well as preservation of components during storage and shipment.
Aeroshell Fluid 61 has an operating temperature range of –40°C to +204°C.
Aeroshell Fluid 61 is compatible with Aeroshell Fluids 4, 31, 41, 51 and 71.
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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-46170C Type I*</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>H-544</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>MIL-PRF-46170C Type I</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>Synthetic Hydrocarbon</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 100°C</td>
<td>3.4 min</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>19.5 max</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>2600 max</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>Report 2488</td>
</tr>
<tr>
<td>Flashpoint Cleveland Open cup °C</td>
<td>218 min</td>
</tr>
<tr>
<td>Fire Point Cleveland Open Cup °C</td>
<td>246 min</td>
</tr>
<tr>
<td>Acid or Base number mgKOH/g</td>
<td>0.2 max</td>
</tr>
<tr>
<td>Evaporation loss 22 hrs @149°C % m</td>
<td>5.0 max</td>
</tr>
<tr>
<td>Relative density @ 15.6/15.6°C</td>
<td>–</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–54 max</td>
</tr>
<tr>
<td>Water Content ppm</td>
<td>500 max</td>
</tr>
<tr>
<td>Auto-ignition temperature °C</td>
<td>343 min</td>
</tr>
<tr>
<td>Colour</td>
<td>Undyed</td>
</tr>
<tr>
<td>Particle Count, Automatic, per Lt</td>
<td>10000 max</td>
</tr>
<tr>
<td>5 to 25 µm</td>
<td>1414</td>
</tr>
<tr>
<td>26 to 50 µm</td>
<td>250 max</td>
</tr>
<tr>
<td>51 to 100 µm</td>
<td>4</td>
</tr>
<tr>
<td>Over100 µm</td>
<td>10 max</td>
</tr>
</tbody>
</table>

Table continued
### Table continued

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-46170C Type I</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace sediment mg/l</td>
<td>0.005 max</td>
<td>0.001</td>
</tr>
<tr>
<td>Rubber swell, 168 hrs @ 70°C % swell</td>
<td>15 to 25</td>
<td>21.5</td>
</tr>
<tr>
<td>4-Ball Wear, 75°C scar dia, mm</td>
<td>0.3 max</td>
<td>0.23</td>
</tr>
<tr>
<td>10 kg load/1200 rpm</td>
<td>0.65 max</td>
<td>0.38</td>
</tr>
<tr>
<td>Galvanic corrosion</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Oxidation &amp; corrosion stability 168 hrs @ 121°C % metal weight change</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>viscosity change @ 40°C %</td>
<td>10 max</td>
<td>Less than 10</td>
</tr>
<tr>
<td>change in acidity mgKOH/g</td>
<td>0.3 max</td>
<td>Less than 0.3</td>
</tr>
<tr>
<td>Low temperature stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Rust prevention</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Flammability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

A viscosity/temperature curve is shown at the end of this section.
AEROSHELL FLUID 71

AeroShell Fluid 71 is a preservative mineral hydraulic fluid of improved cleanliness. AeroShell Fluid 71 is composed of a mineral base oil with an additive package which results in a product with excellent corrosion preventative properties as well as excellent oxidation stability, and good anti-wear characteristics.

AeroShell Fluid 71 is dyed red.

The useful operating temperature range is –54°C to +121°C.

APPLICATIONS

AeroShell Fluid 71 is intended for preserving hydraulic equipment in storage and also for use in rig testing of hydraulic components. AeroShell Fluid 71 should only be used in hydraulic systems employing synthetic rubber seals suitable for MIL-PRF-5606/DEF STAN 91-48 (AeroShell Fluids 4 or 41) type of fluids. Refer to General Notes at the front of this section for further information.

AeroShell Fluid 71 is compatible with AeroShell Fluids 4, 31, 41, 51 and 61.

Chlorinated solvents should not be used for cleaning hydraulic components which use AeroShell Fluid 71. The residual solvent contaminates the hydraulic fluid and may lead to corrosion.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>British</th>
<th>French</th>
<th>Russian</th>
<th>NATO Code</th>
<th>Joint Service Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved MIL-PRF-6083F</td>
<td>Equivalent DEF STAN 80-142</td>
<td>Equivalent to DCSEA 535/A</td>
<td>–</td>
<td>C-635</td>
<td>Equivalent PX-26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-6083F</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ –40°C</td>
<td>800 max</td>
<td>525</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>3500 max</td>
<td>2400</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>13 min</td>
<td>14.3</td>
</tr>
<tr>
<td>Flashpoint Pensky Martin Closed Cup °C</td>
<td>82 min</td>
<td>88</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>0.2 max</td>
<td>0.12</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–59 max</td>
<td>Below –59</td>
</tr>
<tr>
<td>Relative density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.879</td>
</tr>
<tr>
<td>Water content ppm</td>
<td>500</td>
<td>200</td>
</tr>
<tr>
<td>Colour</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Trace sediment mg/l</td>
<td>0.005 max</td>
<td>0.002</td>
</tr>
<tr>
<td>Oxidation &amp; corrosion stability 168 hrs @ 121°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– metal weight change</td>
<td></td>
<td>Passes</td>
</tr>
<tr>
<td>– viscosity change @ 40°C</td>
<td>–5 to +20</td>
<td>Passes</td>
</tr>
<tr>
<td>– acid number change mgKOH/g</td>
<td>0.2 max</td>
<td>Less than 0.2</td>
</tr>
<tr>
<td>Copper corrosion</td>
<td>3a max</td>
<td>Passes</td>
</tr>
<tr>
<td>Corrosion inhibition</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

Table continued
### Table continued

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-6083F</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size per 100 ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 25 µm</td>
<td>10000 max</td>
<td>1170</td>
</tr>
<tr>
<td>26 to 50 µm</td>
<td>250 max</td>
<td>90</td>
</tr>
<tr>
<td>51 to 100 µm</td>
<td>50 max</td>
<td>10</td>
</tr>
<tr>
<td>Over 100 µm</td>
<td>10 max</td>
<td>1</td>
</tr>
<tr>
<td>Low temperature stability 72 hrs @ –54°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Shear stability change in viscosity @ 40°C</td>
<td>2.0 max</td>
<td>0.06</td>
</tr>
<tr>
<td>Rubber swell L rubber %</td>
<td>19 to 28</td>
<td>23</td>
</tr>
<tr>
<td>Evaporation loss 22 hrs @ 100°C %</td>
<td>75 max</td>
<td>62</td>
</tr>
<tr>
<td>Foaming tendency</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Steel on steel wear, wear scar diam, mm</td>
<td>1.0 max</td>
<td>Passes</td>
</tr>
<tr>
<td>Gravimetric filtration mg/100ml filtration time mins</td>
<td>0.5 max</td>
<td>Less than 0.5</td>
</tr>
<tr>
<td></td>
<td>15 max</td>
<td>12</td>
</tr>
</tbody>
</table>

A viscosity/temperature curve is shown at the end of this section.
AEROSHELL SSF AND LGF

AeroShell Shock Strut Fluid (SSF) and AeroShell Landing Gear Fluid (LGF) are mineral hydraulic fluids (MIL-PRF-6083 and MIL-PRF-5606 respectively) 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 SSF is AeroShell Fluid 71 plus additives.
AeroShell LGF is AeroShell Fluid 41 plus additives.

APPLICATIONS
AeroShell SSF is recommended for all normal applications whilst the better low temperature properties of AeroShell LGF make it particularly suitable in areas of low temperature operations.
AeroShell SSF and AeroShell LGF are compatible with each other as well as with AeroShell Fluids 4, 41 and 71.
AeroShell SSF and LGF are straw yellow in colour.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
<tr>
<td>Boeing</td>
<td>Approved BMS 3-32A [AeroShell SSF is approved to Type I and AeroShell LGF is approved to Type II]</td>
</tr>
<tr>
<td>McDonnell Douglas</td>
<td>Approved DPM-6177</td>
</tr>
</tbody>
</table>

EQUIPMENT MANUFACTURERS APPROVALS
AeroShell SSF and LGF are approved for use in the shock struts of the following aircraft:

<table>
<thead>
<tr>
<th>Boeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>707/720, 727, 737, 747 (except those using BMS 3-11 fluids), 757, 767 and 777</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lockheed</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1011 Tristar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>McDonnell Douglas</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-8, DC-9, DC-10, MD-80, MD-11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CML Code 02-004A (SSF)</td>
</tr>
</tbody>
</table>

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

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>SSF</th>
<th>LGF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base hydraulic fluid specification</td>
<td>MIL-PRF-6083F</td>
<td>MIL-PRF-5606H</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 40°C</td>
<td>14.5</td>
<td>14.5</td>
</tr>
<tr>
<td>@ –40°C</td>
<td>560</td>
<td>423</td>
</tr>
<tr>
<td>@ –54°C</td>
<td>2640</td>
<td>1780</td>
</tr>
<tr>
<td>Flashpoint °C</td>
<td>108</td>
<td>110</td>
</tr>
<tr>
<td>Neutralisation Number mgKOH/g</td>
<td>2.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaporation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSF 22 hrs @ 99°C</td>
</tr>
<tr>
<td>LGF 6 hrs @ 71°C</td>
</tr>
</tbody>
</table>
**Table continued**

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>SSF TYPICAL</th>
<th>LGF TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative density @ 15.6/15.6°C</td>
<td>0.882</td>
<td>0.874</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–62</td>
<td>Below –68</td>
</tr>
<tr>
<td>Foaming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seq I Foam/Collapse time sec</td>
<td>30/30</td>
<td>45</td>
</tr>
<tr>
<td>Seq II Foam/Collapse time sec</td>
<td>20/10</td>
<td>–</td>
</tr>
<tr>
<td>Seq III Foam/Collapse time sec</td>
<td>30/30</td>
<td>–</td>
</tr>
<tr>
<td>Corrosion – Oxidation Stability (121°C/168 hrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Weight Change mg/cm²</td>
<td>+0.002</td>
<td>–0.06</td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>0</td>
<td>–0.005</td>
</tr>
<tr>
<td>Steel</td>
<td>0</td>
<td>–0.02</td>
</tr>
<tr>
<td>Magnesium</td>
<td>+0.002</td>
<td>+0.01</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0</td>
<td>+0.01</td>
</tr>
<tr>
<td>Fluid Properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in viscosity %</td>
<td>+15</td>
<td>+10.5</td>
</tr>
<tr>
<td>Change in Acid Number mgKOH/g</td>
<td>+0.5</td>
<td>+0.05</td>
</tr>
<tr>
<td>Insolubles</td>
<td>1.0mg/100ml</td>
<td>Clear</td>
</tr>
<tr>
<td>4-ball wear, scar diam. mm</td>
<td>0.43</td>
<td>0.43</td>
</tr>
<tr>
<td>Colour</td>
<td>Yellow</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
AEROSHELL PRESERVATIVES

AeroShell Preservatives are used for the preservation and protection of aircraft, aircraft engines and aircraft components.

Two classes of corrosion preservatives are used on aircraft, those for protecting engine interiors and those for exterior application.

Corrosion protectives (internal-engines)

Corrosion protection fluids are used for preventing cold corrosion which would occur during the storage or shipment of engines, principally because of the action of fuel combustion products trapped in piston engine cylinders after shut-down. In addition 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:

<table>
<thead>
<tr>
<th>Piston engine practice:</th>
<th>American</th>
<th>British</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIL-E-6058B</td>
<td>D.Eng.R.D. 2027</td>
</tr>
<tr>
<td></td>
<td>(Obsolete)</td>
<td>(Obsolete)</td>
</tr>
<tr>
<td></td>
<td>(Obsolete)</td>
<td>(Obsolete)</td>
</tr>
</tbody>
</table>

For inhibited engine oils in piston engines the British procedure was to motor the engines cold using a ‘storage’ oil [DEF STAN 91-40] in the engine oil system, followed by spraying of various parts internally with a wax thickened oil/petrol mixture (DTD.791C).

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 (AeroShell Fluid 2F, MIL-C-6529C Type II), 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. AeroShell Fluid 2XN is the concentrate for AeroShell Fluid 2F.

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-23699F has been revised to include a corrosion inhibited (C/I) grade alongside the standard (STD) grade and high temperature grade (HTS). AeroShell Turbine Oil 531 is approved to the C/I grade and full details are given in the engine oils section of this publication.

Corrosion Protectives - external

AeroShell Compound 02
AeroShell Compound 05

A variety of exterior corrosion preventative are in current use to provide the many kinds of protection needed. The choice of protective depends upon the degree of protection necessary and ease of removal required. AeroShell Compound 02 is a temporary protective, whilst AeroShell Compound 05, which is a petroleum jelly/beeswax mixture, affords medium protection.

Corrosion protection is a big subject and whilst it is not within the scope of this handbook (there being many other publications available) the following key elements may be helpful in deciding what corrosion preventative to specify or use in any particular application. The key elements are:-

- period of protection required, i.e. short, medium or long term
- whether component or assembly is stored indoor, outdoors or undercover
- climatic conditions at point of storage if outside
- whether preservative is to be applied hot or cold
- method of application, i.e. spray, brush, dipping
- whether preservative includes a solvent as a carrier which then volatilises off
- film thickness of the preservative
- film strength i.e. hard, soft
- whether preservative is to be removed or is permanent
- whether component is to be handled (fingerprints are corrosive and some protective films cannot withstand handling)
- what other methods are used to aid or enhance preservation, for example, wrapping in grease proof paper, silica gel moisture absorbing crystals, cacooning assemblies etc.

Protectives for a wide range of applications are provided by Shell Ensis products, and Shell Vapour Phase Inhibitors, but these products are outside the scope of this publication.
AEROSHELL FLUID 2F

AeroShell Fluid 2F is an inhibited "flyaway" lubricating oil for the internal protection of piston engines during storage.

AeroShell Fluid 2F consists of three parts AeroShell Oil 100 (SAE J-1966 Grade SAE 50) with one part AeroShell Fluid 2XN (MIL-C-6529C Type I) – a corrosion preventative.

APPLICATIONS

AeroShell Fluid 2F is used as a piston engine preservative oil, also as a "flyaway" oil, in place of the normal engine oil. A period of 15 minutes engine running under idling conditions is required to ensure adequate distribution throughout the engine. It can also be applied to other parts of the engine and its accessories by spraying. The ashless anti-corrosion 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. Detailed instructions for inhibiting piston engines are given in specifications MIL-E-6058B and MIL-E-6059A and in relevant engine manufacturer’s publications.

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

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-C-6529C Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 1503/B Type B</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>C-609</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-270 (obsolete)</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>MIL-C-6529C Type II</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>–</td>
</tr>
<tr>
<td>Kinematic viscosity (\text{mm}^2/\text{s}) @ 98.9°C</td>
<td>22.5 max</td>
</tr>
<tr>
<td>– @ 37.8°C</td>
<td>–</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup (\text{°C})</td>
<td>204 min</td>
</tr>
<tr>
<td>Pourpoint (\text{°C})</td>
<td>–12 max</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
</tr>
<tr>
<td>Carbon residue (%)</td>
<td>2 max</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>0.015 max</td>
</tr>
<tr>
<td>Lead corrosion, 4 hrs @ 149°C, (\text{mg/in}^2)</td>
<td>70 max</td>
</tr>
<tr>
<td>Copper corrosion, 3 hrs @ 100°C</td>
<td>–</td>
</tr>
<tr>
<td>Rust protection (humidity cabinet)</td>
<td>–</td>
</tr>
</tbody>
</table>
**AEROSHELL FLUID 2T**

AeroShell Fluid 2T is a preservative mineral oil used for protecting certain types of turbine engine.

AeroShell Fluid 2T consists of three parts AeroShell Turbine Oil 2 (MIL-PRF-6081D Grade 1010 - a mineral turbine engine oil) with one part AeroShell Fluid 2XN (MIL-C-6529C Type I) – a corrosion preventative concentrate).

**APPLICATIONS**

AeroShell Fluid 2T is intended for preserving aircraft gas turbines which use engine oils to specification MIL-PRF-6081D, and in some engines using engine oils meeting specification DEF STAN 91-99 (DERD 2490). The ashless anti-corrosion additive package together with the highly refined mineral base oils protects the engine by minimising the effects of humidity and neutralising the acidic components of engine oil oxidation.

AeroShell Fluid 2T can either be purchased ready-mixed or can be blended using three parts AeroShell Turbine Oil 2 and one part AeroShell Fluid 2XN.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MILC-6529C Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 1504/B</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>C-610</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MIL-C-6529C Type III</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>–</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity @ 40°C mm²/s</td>
<td>–</td>
<td>22.15</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>–</td>
<td>174</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.88</td>
</tr>
<tr>
<td>Carbon residue %m</td>
<td>–</td>
<td>0.45</td>
</tr>
<tr>
<td>Ash %m</td>
<td>–</td>
<td>0.01</td>
</tr>
<tr>
<td>Lead corrosion, 4 hrs @ 149°C, mg/in²</td>
<td>–</td>
<td>14.3</td>
</tr>
<tr>
<td>Copper corrosion, 3 hrs @ 100°C</td>
<td>–</td>
<td>Passes</td>
</tr>
<tr>
<td>Rust protection (humidity cabinet)</td>
<td>–</td>
<td>Passes</td>
</tr>
</tbody>
</table>
AEROSHELL FLUID 2XN

AeroShell Fluid 2XN is a corrosion preventative concentrate from which AeroShell Fluid 2F and AeroShell Fluid 2T are blended; the blending proportions are one part AeroShell Fluid 2XN to three parts Aeroshell Oil 100 for AeroShell Fluid 2F and one part AeroShell Fluid 2XN to three parts AeroShell Turbine Oil 2 for Aeroshell Fluid 2T.

In general, operators should obtain supplies blended ready for use in engines, unless the use of the concentrate is specified.

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.

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.

The ashless anti-corrosion additive package together with the highly refined mineral base oil protects the engine by minimising the effects of humidity and neutralising the acidic components of engine oil oxidation and, in piston engines, the combustion byproducts as well.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-C-6529C Type I</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>(Has adopted MIL-C-6529C Type I) Approved DTD900/4913A (Obsolete)</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 1503/B Type B Concentrate</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>C-608</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>ZX-21</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-C-6529C Type I</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Type</td>
<td>–</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity @ 37.8°C</td>
<td>–</td>
<td>254</td>
</tr>
<tr>
<td>@ 98.9°C</td>
<td>–</td>
<td>20.0</td>
</tr>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>–</td>
<td>254</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–</td>
<td>–17</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.9</td>
</tr>
<tr>
<td>Carbon residue %m</td>
<td>–</td>
<td>0.5</td>
</tr>
<tr>
<td>Ash %m</td>
<td>–</td>
<td>0.01</td>
</tr>
<tr>
<td>Lead corrosion, 4 hrs @ 149°C, mg/in²</td>
<td>–</td>
<td>35</td>
</tr>
<tr>
<td>Copper corrosion, 3 hrs @ 100°C</td>
<td>–</td>
<td>Passes</td>
</tr>
<tr>
<td>Rust protection (humidity cabinet)</td>
<td>–</td>
<td>Passes</td>
</tr>
</tbody>
</table>
AEROSHELL COMPOUND 02

AeroShell Compound 02 is a quick drying lanolised fluid that provides temporary protection against corrosion.

The specification DEF.2331A (now obsolete) covered two grades of product namely PX-1 (Dyed) and PX-1 (Undyed) and originally AeroShell Compound 02 was dyed green and thus approved to PX-1 (Dyed). Current and future supplies of AeroShell Compound 02 to DEF STAN 80-217 will be undyed.

APPLICATIONS

AeroShell Compound 02 is intended for general use on aircraft components and metal surfaces which are liable to corrode during storage. AeroShell Compound 02 should be well shaken before use and may be applied by spraying, brushing or dipping. It can be removed with kerosene, gasoline, white spirit, hydrocarbon solvents or suitable alkaline cleaner.

After application, the solvent evaporates to leave a thin soft film, which hardens slightly with age. The film is not hard enough to withstand handling, and the articles should be wrapped in grease-resistant wrapping if necessary. Articles should preferably be cleaned before use to remove any grit or dirt, the film itself will normally dissolve in lubricating oil.

In many cases two coats of AeroShell Compound 02 can be used in place of the obsolete grade AeroShell Compound 01 which met specifications MIL-C-16173D and DTD.663A.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>DEF STAN 80-217</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corresponding MIL-PRF-16173E Grade 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>British</td>
<td>Approved DEF STAN 80-217</td>
<td></td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 1501</td>
<td></td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>NATO Code</td>
<td>C-614</td>
<td></td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>PX-1</td>
<td></td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>DEF STAN 80-217</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashpoint, SFCC °C</td>
<td>–</td>
<td>40</td>
</tr>
<tr>
<td>Total Solid Content @ 150°C %m</td>
<td>28 to 32</td>
<td>30</td>
</tr>
<tr>
<td>Water Content % vol</td>
<td>0.1 max</td>
<td>0.05</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.830</td>
</tr>
<tr>
<td>Film forming properties</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Drying time @ 20°C hr</td>
<td>–</td>
<td>1.0</td>
</tr>
<tr>
<td>Film thickness (dip application), microns</td>
<td>–</td>
<td>7.0</td>
</tr>
</tbody>
</table>
AEROSHELL COMPOUND 05

AeroShell Compound 05 is a petroleum jelly/beeswax mixture for protecting metal parts against corrosion under temperate and tropical conditions. Specification DEF STAN 80-85 requires the product to have the following approximate composition:

- High melting point mineral jelly (DEF STAN 91-38) 90% mass
- Beeswax (CS.2177) 10% mass.

APPLICATIONS

AeroShell Compound 05 is used for protecting piston assemblies, anti-friction bearings, chains and other small parts under temperate and tropical conditions. AeroShell Compound 05 is applied by hot dipping in melted material to give a film about 0.5 mm thick, the thickness can be controlled by the temperature and period of immersion. This gives a fairly firm, greasy film, with a slightly higher melting point, better texture and better protective qualities than plain mineral jelly. Grease resistant wrapping is necessary to protect the film from damage, but parts should be wrapped only after the film has set. The coating should be cleaned off before use, particularly to ensure freedom from grit and dirt, but meticulous cleaning is not necessary as any residual material will normally disperse harmlessly in the lubricant.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Corresponding MIL-C-11796C</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 80-85</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to AIR 8136</td>
</tr>
<tr>
<td>Russian</td>
<td>-</td>
</tr>
<tr>
<td>NATO Code</td>
<td>C-628</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>PX-11</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>DEF STAN 80-85</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting point °C</td>
<td>65 min</td>
<td>70</td>
</tr>
<tr>
<td>Saponification value mgKOH/g</td>
<td>8.5 min</td>
<td>9.4</td>
</tr>
<tr>
<td>Ash % m</td>
<td>0.05 max</td>
<td>0.02</td>
</tr>
<tr>
<td>Inorganic Acidity</td>
<td>NIL</td>
<td>NIL</td>
</tr>
<tr>
<td>Total Acidity mgKOH/g</td>
<td>1.7 to 2.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>
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
- Fluids for cleaning, preserving and lubricating

### Lubricating Oils
- AeroShell Fluid 1
- AeroShell Fluid 3
- AeroShell Fluid 12
- AeroShell Fluid 18

AeroShell Fluid 1 is an aircraft instrument and light mineral lubricating oil. 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.

AeroShell Fluid 18 is a low temperature, water displacing general purpose oil.

### Gearbox Oils
- AeroShell Fluid 5L-A
- AeroShell Fluid 5M-A
- AeroShell Fluid S.8350

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

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 06A
- 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 Compounds 06A and 07. A mixture of equal volumes of AeroShell Compounds 07 and 06A, is suitable as a defrosting spray for aircraft parked in the open. 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.

### Cleaner, Lubricant and Preservative
- AeroShell Fluid 634

AeroShell Fluid 634 combines the three essential functions of cleaning, lubrication and preservation in a single product and although developed for aircraft weapon systems it is now used in an increasing number of other applications.
**AEROSHELL FLUID 1**

AeroShell Fluid 1 is a light lubricating mineral oil containing, by specification, less than 0.10% mass stearic acid.

**APPLICATIONS**

For use as a lubricant where a light anti-freezing oil is required, e.g. on aircraft instruments, gun mounting buffers, hydraulic couplings, controls, door hinges, etc. Also used as a preservative oil for Stromberg carburettors and some fuel systems.

AeroShell Turbine Oil 3 can be used as an alternative to AeroShell Fluid 1, but AeroShell Fluid 1 must never be used as an alternative to AeroShell Turbine Oil 3.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th><strong>U.S.</strong></th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>British</strong></td>
<td>Approved DEF STAN 91-44</td>
</tr>
<tr>
<td><strong>French</strong></td>
<td>Equivalent to AIR 3515/B</td>
</tr>
<tr>
<td><strong>Russian</strong></td>
<td>–</td>
</tr>
<tr>
<td><strong>NATO Code</strong></td>
<td>O-134</td>
</tr>
<tr>
<td><strong>Joint Service Designation</strong></td>
<td>OM-13</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th>DEF STAN 91-44</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ −25°C</td>
<td>1250 max</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>12 min</td>
</tr>
<tr>
<td>Flashpoint Pensky Martin Closed Cup °C</td>
<td>144 min</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>−45 min</td>
</tr>
<tr>
<td>Aniline point °C</td>
<td>85 min</td>
</tr>
<tr>
<td>Aniline point change after extraction with sulphuric acid °C</td>
<td>5.5 max</td>
</tr>
<tr>
<td>Total acidity mgKOH/g</td>
<td>0.3 max</td>
</tr>
<tr>
<td>Ash %m</td>
<td>0.01 max</td>
</tr>
<tr>
<td>Density @15°C kg/l</td>
<td>–</td>
</tr>
<tr>
<td>Trace element content</td>
<td>Must pass</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>Must pass</td>
</tr>
</tbody>
</table>

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

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-7870C

**British**

Approved DEF STAN 91-47

**French**

-

**Russian**

-

**NATO Code**

O-142

**Joint Service Designation**

OM-12

**PROPERTIES**

**MIL-PRF-7870C**

**TYPICAL**

<table>
<thead>
<tr>
<th>Property</th>
<th>MIL-PRF-7870C</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 38°C</td>
<td>10 min</td>
<td>10.0</td>
</tr>
<tr>
<td>@ -40°C</td>
<td>4000 max</td>
<td>Less than 4000</td>
</tr>
<tr>
<td>Flashpoint Cleveland Open Cup °C</td>
<td>130 min</td>
<td>155</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>-57 max</td>
<td>Below -57</td>
</tr>
<tr>
<td>Evaporation at 99°C, 22hrs %m</td>
<td>25 max</td>
<td>13</td>
</tr>
<tr>
<td>Total acid number mgKOH/g</td>
<td>–</td>
<td>0.3</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.89</td>
</tr>
<tr>
<td>Low temperature stability 72 hrs @ -54°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Oxidation &amp; corrosion stability 168 hrs @ 121°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– metal weight change %</td>
<td>–5 to +20</td>
<td>10</td>
</tr>
<tr>
<td>– viscosity change %</td>
<td>0.2 max</td>
<td>0.02</td>
</tr>
<tr>
<td>– acid number change mgKOH/g</td>
<td>–</td>
<td>0.02</td>
</tr>
<tr>
<td>Corrosivity</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>ASTM colour</td>
<td>–</td>
<td>&lt; 0.5</td>
</tr>
</tbody>
</table>

A viscosity/temperature curve is shown at the end of this section.
AEROSHELL FLUID 5L-A

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

AeroShell Fluid 5L-A has good low temperature characteristics.

APPLICATIONS
AeroShell Fluid 5L-A is used for the lubrication of gears where high tooth loadings exist, particularly when operating at low temperature. AeroShell Fluid 5L-A is particularly suitable for the lubrication of radar gearboxes, constant speed alternator drives. AeroShell Fluid 5L-A is also used in those helicopter transmissions (gearboxes) which require use of this type of MIL-PRF-6086 oil.

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

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-6086E Light Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-112 Grade L</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-153</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>Equivalent OEP-30</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MIL-PRF-6086E Light Grade</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s  @ 37.8°C</td>
<td>23 to 34</td>
<td>27.8</td>
</tr>
<tr>
<td></td>
<td>@ 98.9°C</td>
<td>–</td>
</tr>
<tr>
<td>Flashpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleveland Open Cup °C</td>
<td>137.8 min</td>
<td>190</td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>80 min</td>
<td>100</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–40 max</td>
<td>Below –40</td>
</tr>
<tr>
<td>Total Acid Number mgKOH/g</td>
<td>1.0 max</td>
<td>0.1</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.89</td>
</tr>
<tr>
<td>Load Wear Index kg</td>
<td>40 min</td>
<td>45.5</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>8 max</td>
<td>1.0</td>
</tr>
<tr>
<td>Foaming, sequence I, II, III</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-6086E Medium Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DEF STAN 91-112 Grade M</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent to DCSEA 255/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-155</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OEP-70</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>MIL-PRF-6086E Medium Grade</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s</td>
<td>60 to 82</td>
</tr>
<tr>
<td>@ 37.8°C</td>
<td>–</td>
</tr>
<tr>
<td>@ 98.9°C</td>
<td></td>
</tr>
<tr>
<td>Flashpoint</td>
<td></td>
</tr>
<tr>
<td>Cleveland Open Cup °C</td>
<td>154.5 min</td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>80 min</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–29 max</td>
</tr>
<tr>
<td>Total Acid Number mgKOH/g</td>
<td>1.0 max</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
</tr>
<tr>
<td>Load Wear Index kg</td>
<td>40 min</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>8 max</td>
</tr>
<tr>
<td>Foaming, sequence I, II, III</td>
<td>Must pass</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>Must pass</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-6085D</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-49</td>
</tr>
<tr>
<td>French</td>
<td>Equivalent AIR 3511/A</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-147</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>Equivalent OX-14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-6085D</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Synthetic ester</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 54.4°C</td>
<td>–</td>
<td>8 min</td>
</tr>
<tr>
<td>@ –53.9°C</td>
<td>–</td>
<td>12000 max</td>
</tr>
<tr>
<td>Flashpoint Cleveland Open Cup °C</td>
<td>–</td>
<td>185 min</td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>–</td>
<td>–57 max</td>
</tr>
<tr>
<td>Total Acid Number mgKOH/g</td>
<td>–</td>
<td>0.20</td>
</tr>
<tr>
<td>Relative Density at 15.6/15.6°C</td>
<td>–</td>
<td>0.925</td>
</tr>
<tr>
<td>Evaporation loss in 22 hrs at 120°C % m</td>
<td>–</td>
<td>1.80 max</td>
</tr>
<tr>
<td>Colour ASTM</td>
<td>–</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Oxidation and corrosion stability 168 hrs @ 135°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– metal weight change</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>– viscosity change @ 54.5°C</td>
<td>± 5</td>
<td>0.5</td>
</tr>
<tr>
<td>– total acid number change</td>
<td>–</td>
<td>0.1</td>
</tr>
<tr>
<td>– insolubles mg/100ml</td>
<td>–</td>
<td>1.0</td>
</tr>
<tr>
<td>Low temperature stability</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Corrosivity</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

A viscosity/temperature curve is shown at the end of this section.
AEROSHELL FLUID 18

AeroShell Fluid 18 is a highly refined petroleum lubricating oil and contains additives to inhibit corrosion and rusting and improve water displacing characteristics.

APPLICATIONS
AeroShell Fluid 18 is for use in the lubrication and corrosion protection of small arms and automatic weapons and as a general purpose lubricant for all applications where water displacing, corrosion protection, and low temperature lubrication is required.

AeroShell Fluid 18 is also intended for locks, hinges, electric motors, fans, small bearings, control rods and cables and can be used in numerous non-aviation applications.

AeroShell Fluid 18 is not recommended as a lubricant at temperatures below -57°C.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-32033</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Equivalent DEF STAN 91-79 (obs)</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>O-190 (obs)</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>OX-18 (obs)</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MIL-PRF-32033</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>Mineral</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 40°C</td>
<td>11 min</td>
<td>11.3</td>
</tr>
<tr>
<td>@ -40°C</td>
<td>7000 max</td>
<td>4500</td>
</tr>
<tr>
<td>@ -54°C</td>
<td>60000 max</td>
<td>55700</td>
</tr>
<tr>
<td>Flashpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleveland Open Cup</td>
<td>135 min</td>
<td>150</td>
</tr>
<tr>
<td>Pourpoint</td>
<td>°C</td>
<td>–57 max</td>
</tr>
<tr>
<td>Total Acid Number</td>
<td>–</td>
<td>0.44</td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
<td>0.890</td>
</tr>
<tr>
<td>Evaporation 22 hrs at 100°C %</td>
<td>25 max</td>
<td>23</td>
</tr>
<tr>
<td>Precipitation number</td>
<td>ml</td>
<td>0.005 max</td>
</tr>
<tr>
<td>Oxidation and corrosion stability 168 hrs @ 121°C</td>
<td>–</td>
<td>–5 to +20</td>
</tr>
<tr>
<td>– viscosity change %</td>
<td>– change in acidity mgKOH/g</td>
<td>–</td>
</tr>
<tr>
<td>– metal weight change</td>
<td>Must pass</td>
<td>Must pass</td>
</tr>
<tr>
<td>Water displacing properties</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Galvanic corrosion</td>
<td>None</td>
<td>Passes</td>
</tr>
<tr>
<td>Rust protection 168 hrs @ 43°C</td>
<td>No rust</td>
<td>Passes</td>
</tr>
</tbody>
</table>

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 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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-87252C</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>S-1748</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

PROPERTIES | MIL-PRF-87252C | TYPICAL
---|---------------|----------------|
Relative Density at 15.6/15.6°C | – | 0.799 |
Viscosity mm²/s |
@ 100°C | 1.65 min | 1.77 |
@ 40°C  | 5.0 min  | 5.29 |
@ −40°C | 300 max  | 280 |
@ −54°C | 1300 max  | 1094 |
Viscosity Index | – | 145 |
Pourpoint °C | – | −73 |
Flash point °C | 150 min | 160 |
Fire point °C | 160 min | 171 |
Evaporation Loss at 204°C, 6.5 hr %m | – | 17 |
Total Acid Number mgKOH/g | 0.2 max | < 0.01 |
Water content, Karl Fischer ppm | 50 max | 35 |
Density g/cc Dilatometer |
@ 0°C  | – | 0.8058 |
@ 100°C | – | 0.7392 |
@ 190°C | – | 0.6768 |
Specific Heat cal/g°C |
@ −17.8°C | – | 0.49 |
@ 37.8°C | – | 0.54 |
@ 149°C  | – | 0.63 |
@ 260°C  | – | 0.72 |

Table continued
<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>MIL-PRF-87252C</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Conductivity, heat probe method, cal/hr cm² (°C/cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ −17.8°C</td>
<td>–</td>
<td>1.26</td>
</tr>
<tr>
<td>@ 37.8°C</td>
<td>–</td>
<td>1.21</td>
</tr>
<tr>
<td>@ 149°C</td>
<td>–</td>
<td>1.12</td>
</tr>
<tr>
<td>@ 260°C</td>
<td>–</td>
<td>1.02</td>
</tr>
<tr>
<td>Coefficient of Thermal Expansion Dilatometer 1/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 50°C</td>
<td>–</td>
<td>0.00083</td>
</tr>
<tr>
<td>50 to 100°C</td>
<td>–</td>
<td>0.00092</td>
</tr>
<tr>
<td>100 to 150°C</td>
<td>–</td>
<td>0.00103</td>
</tr>
<tr>
<td>150 to 190°C</td>
<td>–</td>
<td>0.00117</td>
</tr>
<tr>
<td>Dielectric Constant 400 Hz</td>
<td>–</td>
<td>2.10</td>
</tr>
<tr>
<td>Power Factor 400 Hz</td>
<td>–</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Dielectric breakdown Voltage, Kv 35 min</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Volume Resistivity @ 25°C ohm-cm</td>
<td>1.0 x 10¹⁰ min</td>
<td>2.9 x 10¹⁵</td>
</tr>
<tr>
<td>Particle Count, Automatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 15µm</td>
<td>10000 max</td>
<td>2664</td>
</tr>
<tr>
<td>16 to 25µm</td>
<td>1000 max</td>
<td>345</td>
</tr>
<tr>
<td>26 to 50µm</td>
<td>150 max</td>
<td>86</td>
</tr>
<tr>
<td>51 to 100µm</td>
<td>20 max</td>
<td>10</td>
</tr>
<tr>
<td>&lt; 100µm</td>
<td>5 max</td>
<td>0</td>
</tr>
<tr>
<td>Elastomer Compatibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended (Swell &lt;5%)</td>
<td>–</td>
<td>Nitrile (N674-70)</td>
</tr>
<tr>
<td>Fluorosilicone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorocarbon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyacrylate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal (Swell &lt;15%)</td>
<td>–</td>
<td>Nitrile (N497-70)</td>
</tr>
<tr>
<td>Not recommended (Swell &gt;15%)</td>
<td>–</td>
<td>Ethylene</td>
</tr>
<tr>
<td>Propylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buna N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
AEROSHELL FLUID 634

AeroShell Fluid 634 is a highly penetrating, mobile liquid lubricant which combines three essential functions in a single product: cleaning, lubrication and preservation of hand held weapons and weapons systems of both large and small calibre.

APPLICATIONS

AeroShell Fluid 634 is formulated to meet the complete requirements of cleaning, lubricating, and preserving both small and large calibre weapons in virtually all climatic conditions from -54°F to +65°C. In addition AeroShell Fluid 634 contains no ozone depleting compounds. AeroShell Fluid 634 can be used in place of the following specifications: MIL-C-372, VVL-800C, MIL-PRF-3150, MIL-PRF-14107 and MIL-L-46000.

Cleaning

AeroShell Fluid 634 provides additives which in addition to their ability to penetrate between metal surfaces, aid in the effective removal of built up dirt, corrosion particles and firing residues which can be abrasive to both recoil and gas operated mechanisms.

Preservation

After cleaning, a thin-film layer of preservative forms immediately on the surfaces which not only displaces water but provides a corrosion resistant barrier against rust and dirt.

Lubrication

AeroShell Fluid 634 incorporates advanced technology additives to enhance film strength and anti-wear properties, thereby reducing friction between moving parts and minimising wear and the build-up of wear related debris.

AeroShell Fluid 634 is not limited only to ordnance use, in fact, it has been proven effective in a wide variety of applications including automotive, aviation, marine, and general plant maintenance of industrial equipment.

Equipment manufacturers will have their own policy regarding cleaning and preservation which will take account of equipment design, climatic conditions, length of storage, etc. It is therefore important to follow their recommendations.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-63460D</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>$-758</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
<tr>
<td>PROPERTIES</td>
<td>MIL-PRF-63460D</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Oil type</td>
<td>–</td>
</tr>
<tr>
<td>Viscosity mm$^2$/s @ 40°C</td>
<td>9.0 min</td>
</tr>
<tr>
<td></td>
<td>3700 max</td>
</tr>
<tr>
<td>Viscosity mm$^2$/s @ -54°C</td>
<td></td>
</tr>
<tr>
<td>Pourpoint °C</td>
<td>-59 max</td>
</tr>
<tr>
<td>Flash point COC °C</td>
<td>65.5 min</td>
</tr>
<tr>
<td>Shell 4 ball wear</td>
<td>0.8 max</td>
</tr>
<tr>
<td>@ 40 kg 1200 rpm 75°C, 1 hr, scar diameter mm</td>
<td></td>
</tr>
<tr>
<td>Relative Density @ 15.6/15.6°C</td>
<td>–</td>
</tr>
<tr>
<td>Firing residue removal %</td>
<td>80 min</td>
</tr>
<tr>
<td>Salt spray corrosion resistance</td>
<td>Must pass</td>
</tr>
<tr>
<td>Humidity cabinet rust resistance 49°C, 100% rel. Humidity, 900 hrs</td>
<td>Must pass</td>
</tr>
<tr>
<td>Water displacement and stability</td>
<td>Must pass</td>
</tr>
<tr>
<td>Metal corrosion tests, wt change mg/cm$^2$, 168 hrs @ 55°C</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>1.5 max</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.2 max</td>
</tr>
<tr>
<td>Brass</td>
<td>1.0 max</td>
</tr>
<tr>
<td>Steel</td>
<td>0.2 max</td>
</tr>
<tr>
<td>Copper</td>
<td>1.5 max</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.5 max</td>
</tr>
<tr>
<td>Cadmium</td>
<td>1.5 max</td>
</tr>
<tr>
<td>Low temperature residue and fluidity</td>
<td>Must pass</td>
</tr>
<tr>
<td>Falex load carrying capacity, 750 lb jaw load</td>
<td>750 lbs min</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>DTD.900/4981A</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Mineral</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s @ 40°C</td>
<td>–</td>
<td>182</td>
</tr>
<tr>
<td>@ 100°C</td>
<td>16.26 to 17.42</td>
<td>17.0</td>
</tr>
<tr>
<td>Viscosity Index</td>
<td>85 min</td>
<td>97</td>
</tr>
<tr>
<td>Flashpoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleveland Open Cup °C</td>
<td>177 min</td>
<td>228</td>
</tr>
<tr>
<td>Pourpoint</td>
<td>°C</td>
<td>–18 max</td>
</tr>
<tr>
<td>Total Acid Number mgKOH/g</td>
<td>0.2</td>
<td>0.15</td>
</tr>
<tr>
<td>Density at 15°C kg/l</td>
<td>–</td>
<td>0.895</td>
</tr>
<tr>
<td>Evaporation loss @ 150°C</td>
<td>5 max</td>
<td>3.0</td>
</tr>
<tr>
<td>Precipitation number ml</td>
<td>0.05 max</td>
<td>0.01</td>
</tr>
<tr>
<td>Copper corrosion</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Foaming, sequence I, II, III</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>

www.shell.com/aviation
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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Approved MIL-PRF-7024E Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>–</td>
</tr>
<tr>
<td>French</td>
<td>–</td>
</tr>
<tr>
<td>Russian</td>
<td>–</td>
</tr>
<tr>
<td>NATO Code</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>–</td>
</tr>
</tbody>
</table>

**PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MIL-PRF-7024E Type II</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil type</td>
<td>–</td>
<td>Mineral</td>
</tr>
<tr>
<td>Relative density @ 15.6/15.6 °C</td>
<td>0.77 ± 0.005</td>
<td>0.77</td>
</tr>
<tr>
<td>Temperature – density variation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 15°C</td>
<td>–</td>
<td>0.7705</td>
</tr>
<tr>
<td>@ 20°C</td>
<td>–</td>
<td>0.759</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>0.752</td>
</tr>
<tr>
<td>@ 80°C</td>
<td>–</td>
<td>0.7225</td>
</tr>
<tr>
<td>Kinematic viscosity mm²/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 10°C</td>
<td>–</td>
<td>1.46</td>
</tr>
<tr>
<td>@ 25°C</td>
<td>1.17 ± 0.05</td>
<td>1.15</td>
</tr>
<tr>
<td>@ 40°C</td>
<td>–</td>
<td>0.95</td>
</tr>
<tr>
<td>Flashpoint by TAG method °C</td>
<td>38 min</td>
<td>43</td>
</tr>
<tr>
<td>Distillation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBP °C</td>
<td>149 min</td>
<td>158</td>
</tr>
<tr>
<td>End point °C</td>
<td>210 max</td>
<td>196</td>
</tr>
<tr>
<td>Recovery %</td>
<td>98.5 min</td>
<td>98.5</td>
</tr>
<tr>
<td>Total Acid Number mgKOH/g</td>
<td>0.015 max</td>
<td>0.007</td>
</tr>
<tr>
<td>Colour, Saybolt</td>
<td>–</td>
<td>30</td>
</tr>
<tr>
<td>Copper corrosion 3 hrs @ 100°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Aromatics % vol</td>
<td>20 max</td>
<td>&lt; 1.0</td>
</tr>
</tbody>
</table>
AEROSHELL COMPOUND 06A

AeroShell Compound 06A is used as a de-icing fluid for windscreens, carburettors and propellers.

APPLICATIONS
AeroShell Compound 06A and ethyl alcohol (obsolete grade AeroShell Compound 06) are equally effective for de-icing and are miscible in all proportions. However, operators should follow the aircraft manufacturer’s recommendations regarding the type of fluid to be used, because of possible side effects.

SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>British</th>
<th>French</th>
<th>Russian</th>
<th>NATO Code</th>
<th>Joint Service Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equivalent TT-I-735a Grade B</td>
<td>Approved BS.1595</td>
<td>Equivalent AIR 3660/B</td>
<td>–</td>
<td>S-737</td>
<td>AL-11</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>BS.1595</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashpoint (Abell) °C</td>
<td>–</td>
<td>10.0</td>
</tr>
<tr>
<td>Distillation Range: IBP °C</td>
<td>81.5</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Dry °C</td>
<td>83.0</td>
</tr>
<tr>
<td>Water content %m</td>
<td>0.5 max</td>
<td>0.085</td>
</tr>
<tr>
<td>Density @ 20°C kg/l</td>
<td>0.785 to 0.787</td>
<td>0.786</td>
</tr>
<tr>
<td>Miscibility with water</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
<tr>
<td>Colour Hazen units</td>
<td>15 max</td>
<td>5</td>
</tr>
<tr>
<td>Residue on evaporation %</td>
<td>0.002 max</td>
<td>0.0002</td>
</tr>
<tr>
<td>Aldehydes &amp; Ketones % mass as acetone</td>
<td>0.01 max</td>
<td>0.007</td>
</tr>
<tr>
<td>Alkalinity or acidity, % mass as acetic acid</td>
<td>0.002 max</td>
<td>0.0002</td>
</tr>
</tbody>
</table>
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:

- Ethane glycol (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

<table>
<thead>
<tr>
<th>U.S.</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td>Approved DTD.406B</td>
</tr>
<tr>
<td>French</td>
<td>-</td>
</tr>
<tr>
<td>Russian</td>
<td>-</td>
</tr>
<tr>
<td>NATO Code</td>
<td>S-745</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>AL-5</td>
</tr>
</tbody>
</table>

PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>DTD.406B</th>
<th>TYPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashpoint, Cleveland Open Cup °C</td>
<td>-</td>
<td>54.4</td>
</tr>
<tr>
<td>Kinematic viscosity @ 20°C mm²/s</td>
<td>11.0-13.0</td>
<td>11.4</td>
</tr>
<tr>
<td>Cold Test @ −40°C</td>
<td>No Deposition</td>
<td>Complies</td>
</tr>
<tr>
<td>pH value</td>
<td>6.0-7.5</td>
<td>6.9</td>
</tr>
<tr>
<td>Conductivity, micromho/cm</td>
<td>5.0 max</td>
<td>0.5</td>
</tr>
<tr>
<td>Density @ 15°C kg/l</td>
<td>1.092-1.097</td>
<td>1.094</td>
</tr>
<tr>
<td>Miscibility with water @ 15°C</td>
<td>Must pass</td>
<td>Passes</td>
</tr>
</tbody>
</table>
TYPICAL TEMPERATURE/VISCOSITY CURVE OF OTHER AEROSHELL FLUIDS

Temperature: °C

Kinematic viscosity: mm²/s
## TEMPERATURE CONVERSION CHART

The central figure in each column is the temperature in degrees Celsius or Fahrenheit which require conversion. If this is in terms of degrees Celsius, the corresponding Fahrenheit temperature will be found to the right of it; if the given temperature is in terms of Fahrenheit, the corresponding Celsius temperature is to the left.

<table>
<thead>
<tr>
<th>°C</th>
<th>°F</th>
<th>°C</th>
<th>°F</th>
<th>°C</th>
<th>°F</th>
<th>°C</th>
<th>°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>-73.3</td>
<td>-100</td>
<td>-1.1</td>
<td>30</td>
<td>86.0</td>
<td>21.2</td>
<td>70</td>
<td>158.0</td>
</tr>
<tr>
<td>-68.7</td>
<td>-90</td>
<td>-0.6</td>
<td>31</td>
<td>87.8</td>
<td>21.7</td>
<td>71</td>
<td>159.8</td>
</tr>
<tr>
<td>-62.2</td>
<td>-80</td>
<td>0.0</td>
<td>32</td>
<td>89.6</td>
<td>22.2</td>
<td>72</td>
<td>161.6</td>
</tr>
<tr>
<td>-56.7</td>
<td>-70</td>
<td>0.6</td>
<td>33</td>
<td>91.4</td>
<td>22.8</td>
<td>73</td>
<td>163.4</td>
</tr>
<tr>
<td>-51.0</td>
<td>-60</td>
<td>1.1</td>
<td>34</td>
<td>93.2</td>
<td>23.3</td>
<td>74</td>
<td>165.2</td>
</tr>
<tr>
<td>-45.6</td>
<td>-50</td>
<td>1.7</td>
<td>35</td>
<td>95.0</td>
<td>23.9</td>
<td>75</td>
<td>167.0</td>
</tr>
<tr>
<td>-40.0</td>
<td>-40</td>
<td>2.2</td>
<td>36</td>
<td>96.8</td>
<td>24.4</td>
<td>76</td>
<td>168.8</td>
</tr>
<tr>
<td>-34.4</td>
<td>-30</td>
<td>2.8</td>
<td>37</td>
<td>98.6</td>
<td>25.0</td>
<td>77</td>
<td>170.6</td>
</tr>
<tr>
<td>-28.9</td>
<td>-20</td>
<td>3.3</td>
<td>38</td>
<td>100.4</td>
<td>25.6</td>
<td>78</td>
<td>172.4</td>
</tr>
<tr>
<td>-23.3</td>
<td>-10</td>
<td>3.9</td>
<td>39</td>
<td>102.2</td>
<td>26.1</td>
<td>79</td>
<td>174.2</td>
</tr>
<tr>
<td>-17.8</td>
<td>0</td>
<td>4.4</td>
<td>40</td>
<td>104.0</td>
<td>26.7</td>
<td>80</td>
<td>176.0</td>
</tr>
<tr>
<td>-12.2</td>
<td>1</td>
<td>5.0</td>
<td>41</td>
<td>105.8</td>
<td>27.2</td>
<td>81</td>
<td>177.8</td>
</tr>
<tr>
<td>-6.7</td>
<td>2</td>
<td>5.6</td>
<td>42</td>
<td>107.6</td>
<td>27.8</td>
<td>82</td>
<td>179.6</td>
</tr>
<tr>
<td>-1.2</td>
<td>3</td>
<td>6.1</td>
<td>43</td>
<td>109.4</td>
<td>28.3</td>
<td>83</td>
<td>181.4</td>
</tr>
<tr>
<td>-0.4</td>
<td>4</td>
<td>6.7</td>
<td>44</td>
<td>111.2</td>
<td>28.9</td>
<td>84</td>
<td>183.2</td>
</tr>
<tr>
<td>-0.1</td>
<td>5</td>
<td>7.2</td>
<td>45</td>
<td>113.0</td>
<td>29.4</td>
<td>85</td>
<td>185.0</td>
</tr>
<tr>
<td>-0.1</td>
<td>6</td>
<td>7.8</td>
<td>46</td>
<td>114.8</td>
<td>30.0</td>
<td>86</td>
<td>186.8</td>
</tr>
<tr>
<td>-0.1</td>
<td>7</td>
<td>8.4</td>
<td>47</td>
<td>116.6</td>
<td>30.6</td>
<td>87</td>
<td>188.6</td>
</tr>
<tr>
<td>-0.1</td>
<td>8</td>
<td>8.9</td>
<td>48</td>
<td>118.4</td>
<td>31.1</td>
<td>88</td>
<td>190.4</td>
</tr>
<tr>
<td>-0.1</td>
<td>9</td>
<td>9.4</td>
<td>49</td>
<td>120.2</td>
<td>31.7</td>
<td>89</td>
<td>192.2</td>
</tr>
<tr>
<td>-0.1</td>
<td>10</td>
<td>10.0</td>
<td>50</td>
<td>122.0</td>
<td>32.2</td>
<td>90</td>
<td>194.0</td>
</tr>
<tr>
<td>-0.1</td>
<td>11</td>
<td>10.6</td>
<td>51</td>
<td>123.8</td>
<td>32.8</td>
<td>91</td>
<td>195.8</td>
</tr>
<tr>
<td>-0.1</td>
<td>12</td>
<td>11.2</td>
<td>52</td>
<td>125.6</td>
<td>33.3</td>
<td>92</td>
<td>197.6</td>
</tr>
<tr>
<td>-0.1</td>
<td>13</td>
<td>11.8</td>
<td>53</td>
<td>127.4</td>
<td>33.9</td>
<td>93</td>
<td>199.4</td>
</tr>
<tr>
<td>-0.1</td>
<td>14</td>
<td>12.4</td>
<td>54</td>
<td>129.2</td>
<td>34.4</td>
<td>94</td>
<td>201.2</td>
</tr>
<tr>
<td>-0.1</td>
<td>15</td>
<td>13.0</td>
<td>55</td>
<td>131.0</td>
<td>35.0</td>
<td>95</td>
<td>203.0</td>
</tr>
<tr>
<td>-0.1</td>
<td>16</td>
<td>13.6</td>
<td>56</td>
<td>132.8</td>
<td>35.6</td>
<td>96</td>
<td>204.8</td>
</tr>
<tr>
<td>-0.1</td>
<td>17</td>
<td>14.2</td>
<td>57</td>
<td>134.6</td>
<td>36.1</td>
<td>97</td>
<td>206.6</td>
</tr>
<tr>
<td>-0.1</td>
<td>18</td>
<td>14.8</td>
<td>58</td>
<td>136.4</td>
<td>36.7</td>
<td>98</td>
<td>208.4</td>
</tr>
<tr>
<td>-0.1</td>
<td>19</td>
<td>15.4</td>
<td>59</td>
<td>138.2</td>
<td>37.2</td>
<td>99</td>
<td>210.2</td>
</tr>
<tr>
<td>-0.6</td>
<td>20</td>
<td>16.0</td>
<td>60</td>
<td>140.0</td>
<td>37.8</td>
<td>100</td>
<td>212.0</td>
</tr>
<tr>
<td>-0.6</td>
<td>21</td>
<td>16.6</td>
<td>61</td>
<td>141.8</td>
<td>38.3</td>
<td>101</td>
<td>213.8</td>
</tr>
<tr>
<td>-0.6</td>
<td>22</td>
<td>17.2</td>
<td>62</td>
<td>143.6</td>
<td>38.8</td>
<td>102</td>
<td>215.6</td>
</tr>
<tr>
<td>-0.6</td>
<td>23</td>
<td>17.8</td>
<td>63</td>
<td>145.4</td>
<td>39.4</td>
<td>103</td>
<td>217.4</td>
</tr>
<tr>
<td>-0.6</td>
<td>24</td>
<td>18.4</td>
<td>64</td>
<td>147.2</td>
<td>40.0</td>
<td>104</td>
<td>219.2</td>
</tr>
<tr>
<td>-0.6</td>
<td>25</td>
<td>19.0</td>
<td>65</td>
<td>149.0</td>
<td>40.6</td>
<td>105</td>
<td>221.0</td>
</tr>
<tr>
<td>-0.6</td>
<td>26</td>
<td>19.6</td>
<td>66</td>
<td>150.8</td>
<td>41.2</td>
<td>106</td>
<td>222.8</td>
</tr>
<tr>
<td>-0.6</td>
<td>27</td>
<td>20.2</td>
<td>67</td>
<td>152.6</td>
<td>41.7</td>
<td>107</td>
<td>224.6</td>
</tr>
<tr>
<td>-0.6</td>
<td>28</td>
<td>20.8</td>
<td>68</td>
<td>154.4</td>
<td>42.3</td>
<td>108</td>
<td>226.4</td>
</tr>
<tr>
<td>-0.6</td>
<td>29</td>
<td>21.4</td>
<td>69</td>
<td>156.2</td>
<td>42.9</td>
<td>109</td>
<td>228.2</td>
</tr>
</tbody>
</table>

### Conversion Formulas

- °C = \( \frac{5}{9} \times (°F - 32) \)
- °F = \( \frac{9}{5} \times °C + 32 \)
### MISCELLANEOUS CONVERSION CHART

Some useful conversion factors are listed below. For a full range, consult [www.onlineconversion.com](http://www.onlineconversion.com)

<table>
<thead>
<tr>
<th>To convert from:</th>
<th>to:</th>
<th>multiply by:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To convert from:</strong></td>
<td><strong>to:</strong></td>
<td><strong>multiply by:</strong></td>
</tr>
<tr>
<td><strong>Calorific Value.</strong> SI units - mass basis-Joule/kilogramme (J/kg); volume basis-Joule/cubic metre (J/m³)</td>
<td>MJ/kg</td>
<td>Btu/lb</td>
</tr>
<tr>
<td></td>
<td>Btu/lb</td>
<td>kWh/kg</td>
</tr>
<tr>
<td></td>
<td>cal/(kcal/kg)</td>
<td>Btu/lb</td>
</tr>
<tr>
<td><strong>Concentration</strong> (mass/volume) and <strong>Density.</strong> SI unit - kilogramme/cubic metre (kg/m³)</td>
<td>kg/m³(g/litre)</td>
<td>kg/litre</td>
</tr>
<tr>
<td></td>
<td>lb/1000 UK gal</td>
<td>mg/litre</td>
</tr>
<tr>
<td></td>
<td>lb/1000 US gal</td>
<td>mg/litre</td>
</tr>
<tr>
<td></td>
<td>g/US gal</td>
<td>g/litre</td>
</tr>
<tr>
<td></td>
<td>kg/litre</td>
<td>lb/UK gal</td>
</tr>
<tr>
<td></td>
<td>kg/litre</td>
<td>lb/ft³</td>
</tr>
<tr>
<td><strong>Concentration</strong> (volume/volume). SI unit - cubic metre/cubic metre (m³/m³)</td>
<td>ml/UK gal</td>
<td>ml/litre or litre/m³</td>
</tr>
<tr>
<td></td>
<td>ml/US gal</td>
<td>ml/litre or litre/m³</td>
</tr>
<tr>
<td></td>
<td>ppm</td>
<td>%vol</td>
</tr>
<tr>
<td><strong>Energy/Heat/Work.</strong> SI unit - Joule (J)</td>
<td>Btu</td>
<td>kJ</td>
</tr>
<tr>
<td></td>
<td>Btu</td>
<td>kWh</td>
</tr>
<tr>
<td></td>
<td>therm</td>
<td>MJ</td>
</tr>
<tr>
<td></td>
<td>cal</td>
<td>J</td>
</tr>
<tr>
<td></td>
<td>kWh</td>
<td>MJ</td>
</tr>
<tr>
<td><strong>Force.</strong> SI unit - Newton (N)</td>
<td>lbf</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>pdl</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>dyne</td>
<td>mN</td>
</tr>
<tr>
<td><strong>Length.</strong> SI unit - metre (m)</td>
<td>in</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>ft</td>
<td>m</td>
</tr>
<tr>
<td><strong>Mass.</strong> SI unit - kilogram (kg)</td>
<td>kg</td>
<td>lb</td>
</tr>
<tr>
<td></td>
<td>lb</td>
<td>g</td>
</tr>
<tr>
<td></td>
<td>UK ton (2240 lb) long</td>
<td>tonne(t)</td>
</tr>
<tr>
<td></td>
<td>UK ton (2000 lb) short</td>
<td>tonne(t)</td>
</tr>
<tr>
<td><strong>Power/Heat Flow.</strong> SI unit - Watt (W)</td>
<td>h.p.</td>
<td>kW</td>
</tr>
<tr>
<td></td>
<td>ft.lbf/s</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>Btu/hr</td>
<td>W</td>
</tr>
<tr>
<td><strong>Pressure.</strong> SI unit - Newton/square metre (N/m²)</td>
<td>N/m²(Pascal)</td>
<td>bar</td>
</tr>
<tr>
<td></td>
<td>lbf/in²(psi)</td>
<td>N/m²(Pa)</td>
</tr>
<tr>
<td></td>
<td>lbf/in²</td>
<td>mbar</td>
</tr>
<tr>
<td></td>
<td>kgf/cm²</td>
<td>N/m²</td>
</tr>
<tr>
<td></td>
<td>kgf/cm²</td>
<td>lbf/in²</td>
</tr>
<tr>
<td></td>
<td>in Hg</td>
<td>mbar</td>
</tr>
<tr>
<td></td>
<td>atmosphere</td>
<td>mbar</td>
</tr>
<tr>
<td></td>
<td>lbf/in²(psi)</td>
<td>Pa</td>
</tr>
<tr>
<td></td>
<td>lbf/in²(psi)</td>
<td>Bar</td>
</tr>
<tr>
<td></td>
<td>Bar</td>
<td>Pa (N/m²)</td>
</tr>
<tr>
<td><strong>Volume.</strong> SI units - cubic metre (m³)</td>
<td>m³</td>
<td>ft³</td>
</tr>
<tr>
<td></td>
<td>in³</td>
<td>cm³</td>
</tr>
<tr>
<td></td>
<td>UK gal</td>
<td>m³</td>
</tr>
<tr>
<td></td>
<td>US gal</td>
<td>m³</td>
</tr>
<tr>
<td></td>
<td>UK gal</td>
<td>litre</td>
</tr>
<tr>
<td></td>
<td>US gal</td>
<td>litre</td>
</tr>
</tbody>
</table>

### (Relative Density) Specific Gravity/API conversion

\[
\text{Specific Gravity } 15.6/15.6°C = \frac{141.5}{\text{API} + 131.5}
\]

### Kinematic viscosity

\[
\text{mm}^2/\text{s} = 1\text{cSt}
\]
British, U.S., French and Russian Military Specifications for aviation fuels, engine oils, hydraulic fluids, greases and other aviation products used on aircraft.

This part of the AeroShell Book contains five lists relating to British and U.S. Military Aviation specifications, NATO Code Numbers, Joint Service Designations and Shell Aviation Products. The lists are interrelated in that they contain the same data arranged in different forms for easy reference. In each list or table, the title data is given in the first column in numerical order.

A sixth list gives details of French Military Aviation Specifications and Shell Aviation Products. A seventh list gives similar information for Russian Specifications. Specifications of other countries have not been included for reasons of space and their more limited application.

Details of the precise relationship between the various items on each line are given in the introductions preceding each list.

The significance of the letters incorporated in the various specification numbers and reference symbols are given in the key in the following page.

In the column headed “Product and Application” only the most important and representative known uses have been named, and these are intended to serve as an indication of the type of application for which each grade is suitable.

A range of substitutes to Russian grades have been developed for use in aircraft manufactured in Russia, some of which have been approved by the Russian Authorities and full details of these approvals are given in the list of Russian Specifications.

Some AeroShell products are manufactured at more than one location. It is possible that the approval status will vary according to the source of material.

The specification information provided is believed correct at time of going to press. However, commercial and military specifications for aviation products are subject to frequent changes, and where applications require compliance of AeroShell grades to new or revised specifications, consultation with the local Shell company is advised.

In many cases where an AeroShell grade is not listed an unbranded, specification grade may be available; for further details please consult your local AeroShell supplier.
## CONTENTS

<table>
<thead>
<tr>
<th>KEY</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Aviation Specifications</td>
<td>270</td>
</tr>
<tr>
<td>U.S. Aviation Specifications</td>
<td>290</td>
</tr>
<tr>
<td>NATO Code Numbers</td>
<td>310</td>
</tr>
<tr>
<td>British Joint Service Designations</td>
<td>324</td>
</tr>
<tr>
<td>French Aviation Specifications</td>
<td>338</td>
</tr>
<tr>
<td>Russian Specifications</td>
<td>346</td>
</tr>
<tr>
<td>AeroShell Grades</td>
<td>362</td>
</tr>
</tbody>
</table>

### BRITISH SPECIFICATIONS

- **DTD** | Procurement Executive Ministry of Defence (Director of Materials Research)
- **DEF** | Procurement Executive Ministry of Defence (Director General Engine Development)
- **D.Eng.R.D.** | Procurement Executive Ministry of Defence (Director of General Engineering Research and Development)
- **DERD** | Director of Standardisation, Ministry of Defence
- **CS** | Procurement Executive Ministry of Defence (Materials Quality Assurance Directorate)
- **BS** | British Standards Institution
- **TS** | Technical Specification

### U.S. SPECIFICATIONS

- **AAF** | U.S. Army Air Force
- **AN** | U.S. Air Force Navy Aeronautical
- **JAN** | Joint Army/Navy
- **MIL** | U.S. Military Specification
- **DOD** | Department of Defense
- **PRF** | Performance Standard
- **DTL** | Detail Standard
- **VV** | U.S. Federal Specification
- **JJJ** | U.S. Federal Specification
- **TT** | U.S. Federal Specification
- **SS** | U.S. Federal Specification
- **O**  | U.S. Federal Specification
- **P**  | U.S. Federal Specification

www.shell.com/aviation
BRITISH JOINT SERVICE DESIGNATIONS

Oils
OM Oil mineral
OEP Oil extreme pressure
OMD Oil mineral detergent
OF Oil fatty
OC Oil compound
OX Oil miscellaneous
The number following represents the approximate viscosity at 40°C

Greases
LG Lime base grease
XG Miscellaneous greases
This covers greases made from less common soaps, e.g. aluminium, lithium, etc., unspecified soaps or mixture of soaps. The group also includes greases containing fatty oils, synthetic oils, graphite or other non-soap additives.
The number following represents the approximate worked penetration.

Miscellaneous Products
PX Protective, miscellaneous. Materials for temporary protection against corrosion of metal equipment in storage.
ZX Speciality, miscellaneous
AL Coolants, anti-freezing and de-icing agents
The number following is merely an arbitrary serial number.

NATO Symbols
F All fuels
O All oils except those developed for some primary function other than lubrication
H All oils where the hydraulic properties are the main consideration
G All greases except those developed for a special function
C All products possessing anti-corrosion properties
S All products which were developed for special functions, i.e. speciality products
P All products for use as propellants
BRITISH AVIATION SPECIFICATIONS

SCOPE OF LIST

This list is comprised of British Specifications in the DTD, DTD.900, DED, DEF, DEF STAN, D.Eng.R.D., D.Eng.D., DERD, BS, CS and TS series which cover aviation fuels, lubricants and allied products.

It should be noted that the original title "Director General Engine Research and Development" was modified to exclude "Research" and this resulted in a general change from D.Eng.R.D. to D.Eng.D. More recently both D.Eng.R.D. and D.Eng.D. were changed to DERD as the specifications were amended, or new specifications were issued by the department concerned.

In the 1980s many British Ministry of Defence DTD specifications were rewritten as DEF STAN specifications.

Recently it was decided to standardise British Specifications as Defence Standards (commonly referred to as DEF STAN), and many of the DERD specifications have been changed over. The changeover is virtually complete and all current DERD, DTD, CS and TS specifications have now been converted to DEF STAN specifications; in doing so the numeric part has also been changed. Obsolete or Cancelled British Specifications will not be changed.

The British Ministry of Defence has also adopted certain U.S. Military Specifications, these include MIL-L-5020, MIL-PRF-46010, MIL-S-81087, MIL-L-46000, MIL-PRF-83282, DOD-L-25681 and SAE J-1899 and J-1966; details of these specifications are included in the section on U.S. Aviation Specifications.

British Defence Standards can be downloaded as Acrobat documents from the UK MoD website http://dstan.mod.uk.

INTERPRETATION OF LIST

In the column headed "Alternative U.S. Specification", only those specifications which are equivalent, or acceptable alternatives, to the British Specification are shown.

Where an asterisk * appears in the last column of the list, the AeroShell grade recommended does not necessarily meet all the clauses of the British Specification, but is the nearest product marketed by Shell.

For easy reference, obsolete specifications are shown in both the current and superseded specification columns. In the former case, a suitable comment is made, namely, "OBsolete – superseded by …"
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DTD.72A</td>
<td>DTD.72</td>
<td>–</td>
<td>OF-300 (Obsolete)</td>
<td>Treated castor oil, specification now OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.279C</td>
<td></td>
<td>–</td>
<td>–</td>
<td>CANCELLED – superseded by DEF STAN 80-83</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.392B</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 80-80</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.406B</td>
<td>DTD.406A</td>
<td>S-745</td>
<td>AL-5</td>
<td>De-icing fluid – ethylene glycol/alcohol/water mixture</td>
<td>–</td>
<td>AeroShell Compound 07</td>
</tr>
<tr>
<td>DTD.417B</td>
<td>DTD.417A, DTD.201</td>
<td>O-140</td>
<td>OM-150</td>
<td>Low temperature oil for aircraft controls, specification now OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.445A</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.581C</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-112</td>
<td>MIL-H-5606A Obsolete</td>
<td>AeroShell Fluid 4*</td>
</tr>
<tr>
<td>DTD.585 Obsolete</td>
<td></td>
<td>–</td>
<td>–</td>
<td>Hydraulic oil – petroleum base</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.585B Obsolete</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-48 Grade Superclean</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.791C</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 81-205</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.804</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 80-34</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.8068</td>
<td></td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-54</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>--------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>DTD.822B</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.878A</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DTD.5601</td>
<td></td>
<td>AeroShell Grease 5</td>
</tr>
<tr>
<td>DTD.8978</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.900AA Series</td>
<td>DTD.900Z</td>
<td></td>
<td></td>
<td>Approval procedure for proprietary materials and processes. See later in this section for details of selected individual approvals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5527A</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5530</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DTD.5617</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5540B</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 80-142</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5578</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5579</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DTD.5601</td>
<td>AeroShell Grease 16 still available for civil market meeting DTD.5579</td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td>DTD.5581</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5585A</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5586</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 68-61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5598</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5601A</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5609</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 91-51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5610</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by MIL-G-4343C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.5617</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DEF STAN 80-81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.900/4042A</td>
<td>S-718</td>
<td>ZK-24</td>
<td></td>
<td>Anti-seize compound, aircraft oxygen system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.900/4081C</td>
<td></td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by DTD.900/6103A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.900/4386A</td>
<td>DTD.900/4386</td>
<td>OX-16</td>
<td></td>
<td>Dowty liquid fluid for aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.900/4630A</td>
<td></td>
<td></td>
<td></td>
<td>Molybdenum disulphide grease for certain precision ball bearings and actuator gearboxes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTD.900/4639</td>
<td></td>
<td>ZK-30</td>
<td></td>
<td>Lubricant, solid film, unbounded, graphite dispersion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>--------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>DTD.900/4802B</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Lubrication of gearbox drive, shaft universal joints</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4872A</td>
<td>DTD.900/4309</td>
<td>–</td>
<td>XG-344</td>
<td>Lubricant for certain turbine, engine starters</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4877A</td>
<td>–</td>
<td>–</td>
<td>ZX-36</td>
<td>Lubricant for fitting electrical cables in aircraft</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4881D</td>
<td>DTD.900/4881C</td>
<td>–</td>
<td>OX-20</td>
<td>Phosphate ester hydraulic fluid</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4907</td>
<td>–</td>
<td>S-1746</td>
<td>AL-34</td>
<td>Anti-icing protection fluid for parked aircraft. Not suitable for use in aircraft de-icing systems.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4910A</td>
<td>DTD.900/4910</td>
<td>–</td>
<td>–</td>
<td>Grease for actuator screw jack and flap transmission system of certain aircraft</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4913A</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by MIL-C-6529C Type I</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4914A</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-85</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4939A</td>
<td>DTD.900/4939</td>
<td>AL-36</td>
<td>(Obsolete)</td>
<td>Windscreen washing fluid for certain aircraft</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/4981A</td>
<td>–</td>
<td>OEP-215</td>
<td>–</td>
<td>Helicopter gearbox oil</td>
<td>–</td>
<td>AeroShell Fluid S.8350</td>
</tr>
<tr>
<td>DTD.900/4990</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Molybdenum disulphide grease for special applications</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DTD.900/6103A</td>
<td>DTD.900/4081</td>
<td>OX-87</td>
<td>–</td>
<td>Hydraulic fluid for certain aircraft</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2001A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-44</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2004A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-42</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2007A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-39</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2181A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-40</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2261A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-12</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2304</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 68-62</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2331A (Obsolete)</td>
<td>DEF.2331 DTD.121D</td>
<td>C-614</td>
<td>PX-1 dyed PX-1 undyed</td>
<td>Temporary rust preventive – dyed Temporary rust preventive – undyed OBSELETE – superseded by DEF STAN 80-217 MILC-16173E Grade 2</td>
<td>–</td>
<td>AeroShell Compound 02</td>
</tr>
<tr>
<td>DEF.2332A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 80-34</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2333</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 91-38</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF.2334</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSELETE – superseded by DEF STAN 80-85 [formerly DEF STAN 91-50]</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 01-5</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Fuels, lubricants and associated products</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 05-50</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Series of test methods for testing fuels, lubricants and associated products</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td>-------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>DEF STAN 59-10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Silicone compound for insulating and sealing electrical equipment. Specification now superseded by DEF STAN 68-69</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-7</td>
<td>-</td>
<td>-</td>
<td>ZX-33 (Obsolete)</td>
<td>CANCELLED</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-10</td>
<td>DTD.900/4916 CS.3122</td>
<td>C-634</td>
<td>PX-24</td>
<td>Water displacing and protective fluid</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-11</td>
<td>-</td>
<td>-</td>
<td>PX-10 (Obsolete)</td>
<td>CANCELLED – superseded by DEF STAN 68-10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-61</td>
<td>DTD.5586</td>
<td>-</td>
<td>AL-26</td>
<td>Inhibited coolant fluid</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-62</td>
<td>DEF.2304</td>
<td>S-740</td>
<td>ZX-35</td>
<td>Molybdenum disulphide powder</td>
<td>SAE-AMS-M-7866</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-69</td>
<td>DEF STAN 59-10</td>
<td>S-736</td>
<td>XG-250</td>
<td>Electrical insulating silicone compound</td>
<td>SAE AS8660</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-108</td>
<td>-</td>
<td>-</td>
<td>AL-20</td>
<td>Technical ethanediol</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-118</td>
<td>DEF STAN 68-217</td>
<td>-</td>
<td>-</td>
<td>De-icing/anti-icing fluid for runways</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-127</td>
<td>TS10177</td>
<td>S-757</td>
<td>AL-39</td>
<td>Inhibited ethanediol antifreeze</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-128</td>
<td>TS10067E</td>
<td>-</td>
<td>OBSOLETE – superseded by DEF STAN 68-150</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-129</td>
<td>TS10188</td>
<td>-</td>
<td>AL-40</td>
<td>Methanol/water mixture for hydrogen generation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-150</td>
<td>DEF STAN 68-128</td>
<td>-</td>
<td>AL-48</td>
<td>Mixture of AL-41 and AL-61</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-217</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>CANCELLED – see DEF STAN 68-118</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-251</td>
<td>DERD 2461</td>
<td>S-1747</td>
<td>AL-61</td>
<td>Fuel soluble pipeline corrosion inhibitor/lubricity improving additive for aviation turbine fuels</td>
<td>MIL-PRF-25017F</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-252</td>
<td>DERD 2451</td>
<td>S-1745</td>
<td>AL-41</td>
<td>Fuel system icing inhibitor, high flash type</td>
<td>MIL-DTL-85470B</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-253</td>
<td>DERD 2491</td>
<td>-</td>
<td>AL-24 (Obsolete)</td>
<td>Methanol/water mixtures</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 68-253</td>
<td>DERD 2491</td>
<td>S-1744</td>
<td>AL-28</td>
<td>Methanol/water mixtures</td>
<td>Shell Methmix 45/55/0</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 79-15</td>
<td>-</td>
<td>S-1739</td>
<td>WTA</td>
<td>Demineralised water</td>
<td>-</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>DEF STAN 80-34</td>
<td>DEF.2332A DTD.804</td>
<td>-</td>
<td>PX-4</td>
<td>Corrosion preventive compound</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 80-80</td>
<td>DTD.392B</td>
<td>S-720</td>
<td>ZX-13</td>
<td>Anti-seize compound for aircraft, graphite and petroleum mixture</td>
<td>SAE-AMS-2518A AeroShell Compound 08</td>
<td></td>
</tr>
<tr>
<td>DEF STAN 80-81</td>
<td>DTD.5617</td>
<td>S-722</td>
<td>ZX-38</td>
<td>Anti-seize compound, molybdenum disulphide</td>
<td>-</td>
<td>AeroShell Grease S.4768</td>
</tr>
<tr>
<td>DEF STAN 80-83</td>
<td>DTD.279A</td>
<td>-</td>
<td>PX-32</td>
<td>Corrosion preventive compound for aircraft structures</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DEF STAN 80-85</td>
<td>DEF.2334 DEF STAN 91-50</td>
<td>C-628</td>
<td>PX-11</td>
<td>Corrosion preventive compound</td>
<td>-</td>
<td>AeroShell Compound 05</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>----------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>DEF STAN 80-142</td>
<td>DTD.5540B</td>
<td>C-635</td>
<td>PX-26</td>
<td>Preservative mineral hydraulic fluid of improved cleanliness</td>
<td>MIL-PRF-6083F</td>
<td>AeroShell Fluid 71*</td>
</tr>
<tr>
<td>DEF STAN 80-143</td>
<td>TS.10131</td>
<td>–</td>
<td>PX-28</td>
<td>Preservative for internal airframe surfaces</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 80-145</td>
<td>–</td>
<td>–</td>
<td>PX-15</td>
<td>Corrosion preventive</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 80-186</td>
<td>TS.10164</td>
<td>–</td>
<td>PX-31</td>
<td>Corrosion preventive</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 81-205</td>
<td>DTD.791C</td>
<td>C-613</td>
<td>PX-13</td>
<td>Aircraft piston engine corrosion preventive oil</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 80-217</td>
<td>DEF.2331A</td>
<td>C-614</td>
<td>PX-1</td>
<td>Corrosion preventive, Soft film, Cold application</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-4</td>
<td>–</td>
<td>F-76</td>
<td>DIESO F-76</td>
<td>Alternative turbine/diesel engine fuel for use in certain Naval helicopters. This specification is primarily for F-76 (DIESO F-76, Fuel, Naval Distillate)</td>
<td>MIL-F-16884J</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-6</td>
<td>–</td>
<td>G-363</td>
<td>XG-235</td>
<td>Gasoline and oil resistant grease</td>
<td>SAE-AMS-G-6032</td>
<td>AeroShell Grease S.7108</td>
</tr>
<tr>
<td>DEF STAN 91-12</td>
<td>DEF.2261A</td>
<td>G-382</td>
<td>XG-271</td>
<td>General purpose aircraft grease. Specification now obsolete</td>
<td>MILG-7711A</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>DEF STAN 91-19</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>CANCELLED — superseded by U.S. Specification MIL-L-8937D which in turn has been superseded by MIL-PRF-46010F (NATO S-1738, Joint Service ZX-34)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-27</td>
<td>–</td>
<td>G-403</td>
<td>XG-279</td>
<td>Grease</td>
<td>MIL-PRF-10924G</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-28</td>
<td>DEF.2001A</td>
<td>H-576</td>
<td>OM-33</td>
<td>Hydraulic oil for certain radar equipment</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-30</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>CANCELLED</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-35</td>
<td>–</td>
<td>–</td>
<td>OX-30</td>
<td>Emulsifying petroleum hydraulic fluid for use in certain types of radar equipment</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-38</td>
<td>DEF.2333</td>
<td>–</td>
<td>PX-6</td>
<td>Technical petrolatum Stiff, tacky petrolatum Soft petrolatum</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-39</td>
<td>DEF.2007A</td>
<td>H-576</td>
<td>OM-33</td>
<td>Hydraulic oil for certain radar equipment</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-40</td>
<td>DEF.2181A</td>
<td>C-615</td>
<td>PX-27</td>
<td>Corrosion preventive oil for aircraft piston engines</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-44</td>
<td>DEF.2001A DTD.44D</td>
<td>O-134</td>
<td>OM-13</td>
<td>General purpose lubricating oil</td>
<td>–</td>
<td>AeroShell Fluid 1 (AeroShell Turbine Oil 3)</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>-------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>DEF STAN 91-46</td>
<td>DTD.5581</td>
<td>–</td>
<td>–</td>
<td>Damping fluid, dimethyl silicone, various grades</td>
<td>YVO-1078B</td>
<td>–</td>
</tr>
<tr>
<td>Grade 3</td>
<td></td>
<td>–</td>
<td>S-1712</td>
<td>ZK-41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 10</td>
<td></td>
<td>–</td>
<td>S-1714</td>
<td>ZK-42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 20</td>
<td></td>
<td>–</td>
<td>S-1716</td>
<td>ZK-43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 50</td>
<td></td>
<td>–</td>
<td>S-1718</td>
<td>ZK-44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 100</td>
<td></td>
<td>–</td>
<td>S-1720</td>
<td>ZK-45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 500</td>
<td></td>
<td>–</td>
<td>–</td>
<td>ZK-46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1000</td>
<td></td>
<td>–</td>
<td>–</td>
<td>ZK-47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 7500</td>
<td></td>
<td>–</td>
<td>S-1724</td>
<td>ZK-48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 12500</td>
<td></td>
<td>–</td>
<td>–</td>
<td>ZK-49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 20000</td>
<td></td>
<td>–</td>
<td>S-1726</td>
<td>ZK-50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 60000</td>
<td></td>
<td>–</td>
<td>–</td>
<td>ZK-51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 100000</td>
<td></td>
<td>–</td>
<td>S-1728</td>
<td>ZK-52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 200000</td>
<td></td>
<td>–</td>
<td>S-1732</td>
<td>ZK-53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-47</td>
<td>DTD.5578</td>
<td>O-142</td>
<td>OM-12</td>
<td>General purpose lubricating oil of low freezing point</td>
<td>MIL-PRF-7870C</td>
<td>AeroShell Fluid 3</td>
</tr>
<tr>
<td>Grade Super clean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade Normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(European production approved, U.S. production is equivalent)</td>
</tr>
<tr>
<td>DEF STAN 91-48</td>
<td>TS.10165</td>
<td>H-520</td>
<td>OM-18</td>
<td>Hydraulic fluid of improved performance</td>
<td>–</td>
<td>AeroShell Fluid 4</td>
</tr>
<tr>
<td>Grade Normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(European production only is approved)</td>
</tr>
<tr>
<td>DEF STAN 91-49</td>
<td>DTD.8228</td>
<td>O-147</td>
<td>OX-14</td>
<td>Low temperature synthetic lubricating oil</td>
<td>MIL-PRF-6085D</td>
<td>AeroShell Fluid 12</td>
</tr>
<tr>
<td>DEF STAN 91-50</td>
<td></td>
<td>–</td>
<td>–</td>
<td>Replaced by DEF STAN 80-85</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-51</td>
<td>DTD.5609</td>
<td>G-366</td>
<td>XG-284</td>
<td>Helicopter general purpose and anti-fretting grease</td>
<td>MIL-G-25537C</td>
<td>AeroShell Grease 14</td>
</tr>
<tr>
<td>DEF STAN 91-52</td>
<td>DTD.5601A</td>
<td>G-395</td>
<td>XG-293</td>
<td>Multi-purpose aircraft grease</td>
<td>MIL-PRF-81322F, NLGI Grade 2</td>
<td>AeroShell Grease 22, AeroShell Grease 22CF*</td>
</tr>
<tr>
<td>DEF STAN 91-53</td>
<td>DTD.5598</td>
<td>G-354</td>
<td>XG-287</td>
<td>Grease, multi-purpose, low temperature</td>
<td>MIL-PRF-23827C</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-54</td>
<td>DTD.806B</td>
<td>G-355</td>
<td>XG-285</td>
<td>Graphited grease</td>
<td>MIL-G-7187, (Obsolete)</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-55</td>
<td>DTD.5585A</td>
<td>G-372</td>
<td>XG-300</td>
<td>Extreme high temperature ball and roller bearing grease. UK MoD has adopted MIL-G-25013E</td>
<td>MIL-G-25013E</td>
<td>AeroShell Grease 15</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-56</td>
<td>DTD.897A</td>
<td>G-394</td>
<td>XG-315</td>
<td>Silicone grease for pneumatic systems</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-57</td>
<td>DTD.5527A</td>
<td>G-353</td>
<td>XG-276</td>
<td>Molybdenum disulphide grease for use in heavily loaded applications at high and low temperatures</td>
<td>MIL-G-21164D</td>
<td>–</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-64</td>
<td></td>
<td>–</td>
<td>XG-305</td>
<td>Molybdenum disulphide grease</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-66</td>
<td></td>
<td>–</td>
<td>–</td>
<td>The segregation, handling and quality assurance of petroleum fuels, lubricants and associated products</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>-------------------------</td>
<td>--------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>DEF STAN 91-69</td>
<td></td>
<td>OX-125</td>
<td>Helicopter transmission fluid 9 mm²/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-71</td>
<td>TS.10134</td>
<td>OX-165</td>
<td>Synthetic lubricating fluid for gears and transmissions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-78</td>
<td></td>
<td>PX-19</td>
<td>Soft film corrosion preventive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-79</td>
<td>O-190 (Obsolete)</td>
<td>OX-18</td>
<td>CANCELLED. Preservative general purpose lubricating oil. Requirements now contained in DEF STAN 91-102</td>
<td>MIL-PRF-32033</td>
<td>AeroShell Fluid 18*</td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-85</td>
<td>DTD.900/4914A</td>
<td>G-357</td>
<td>Synthetic grease with graphite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-86</td>
<td>DERD 2452</td>
<td>F-44</td>
<td>AVCAT/FSI</td>
<td>Aviation turbine fuel, high flash type with FSII</td>
<td>MIL-DTL-5624T Grade JP-5</td>
<td>Shell JP-5 Special arrangements necessary</td>
</tr>
<tr>
<td>DEF STAN 91-87</td>
<td>DERD 2453</td>
<td>F-34</td>
<td>AVTUR/FSI</td>
<td>Aviation turbine fuel, kerosine type with FSII</td>
<td>MIL-DTL-83133E Grade JP-8</td>
<td>Shell JP-8 Special arrangements necessary</td>
</tr>
<tr>
<td>DEF STAN 91-88</td>
<td>DERD 2454</td>
<td>F-40</td>
<td>AVTAG/FSI</td>
<td>Aviation turbine fuel, wide cut type with FSII</td>
<td>MIL-DTL-5624T Grade JP-4</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-89</td>
<td>DERD 2492</td>
<td>S-746</td>
<td>AVPIN</td>
<td>Isopropyl nitrate for certain engine starters</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-90</td>
<td>DERD 2485</td>
<td>F-12</td>
<td>AVGAS 80</td>
<td>Aviation gasoline Grade 80/87</td>
<td>ASTM D910</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-90</td>
<td>DERD 2485</td>
<td>–</td>
<td>AVGAS 100</td>
<td>Aviation gasoline Grade 100/130</td>
<td>ASTM D910</td>
<td>Shell Avgas 100</td>
</tr>
<tr>
<td>DEF STAN 91-90</td>
<td>DERD 2485</td>
<td>F-18</td>
<td>AVGAS 100LL</td>
<td>Aviation gasoline 100/130 Low Lead</td>
<td>ASTM D910</td>
<td>Shell Avgas 100LL</td>
</tr>
<tr>
<td>DEF STAN 91-91</td>
<td>DERD 2494</td>
<td>F-35</td>
<td>AVTUR</td>
<td>Aviation turbine fuel, kerosine type</td>
<td>MIL-DTL-83133E ASTM D1655</td>
<td>Shell Jet A-1 Shell AeroJet*</td>
</tr>
<tr>
<td>DEF STAN 91-92</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Intended to replace DERD 2450 but will not now be issued</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-93</td>
<td>DERD 2458</td>
<td>OX-22</td>
<td>Synthetic lubricating oil for marine gas turbines</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-94</td>
<td>DERD 2468</td>
<td>OX-7</td>
<td>Synthetic lubricating oil for aircraft turbine engines 3 mm²/s viscosity</td>
<td>–</td>
<td>AeroShell Turbine Oil 390</td>
<td></td>
</tr>
<tr>
<td>DEF STAN 91-96</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Intended to replace DERD 2472 but will not now be issued</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-97</td>
<td>DERD 2479/0</td>
<td>O-138</td>
<td>OMM-71</td>
<td>Mineral lubricating oil 9 mm²/s viscosity</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-97</td>
<td>DERD 2479/1</td>
<td>O-136</td>
<td>OEP-71</td>
<td>Mineral lubricating oil with EP additive 9 mm²/s viscosity</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-98</td>
<td>DERD 2487</td>
<td>O-149</td>
<td>OX-38</td>
<td>Synthetic lubricating oil for aircraft gas turbine engines 7.5 mm²/s viscosity</td>
<td>–</td>
<td>AeroShell Turbine Oil 750</td>
</tr>
<tr>
<td>DEF STAN 91-99</td>
<td>DERD 2490</td>
<td>O-135</td>
<td>OM-11</td>
<td>Mineral aviation turbine oil, 3 mm²/s viscosity</td>
<td>–</td>
<td>AeroShell Turbine Oil 3</td>
</tr>
<tr>
<td>DEF STAN 91-100</td>
<td>DERD 2497</td>
<td>O-160</td>
<td>OX-26</td>
<td>Synthetic lubricating oil for aircraft gas turbine 5 mm²/s viscosity</td>
<td>–</td>
<td>AeroShell Turbine Oil 555</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>DEF STAN 91-101 Grade OX-27</td>
<td>DERD 2499 Grade OX-27</td>
<td>O-156</td>
<td>OX-27</td>
<td>Synthetic lubricating oil for aircraft gas turbines 5 mm²/s viscosity</td>
<td>MIL-PRF-23699F Grade STD</td>
<td>AeroShell Turbine Oil 500</td>
</tr>
<tr>
<td>DEF STAN 91-101 Grade OX-28</td>
<td>DERD 2499 Grade OX-28</td>
<td>–</td>
<td>OX-28</td>
<td>Synthetic lubricating oil for certain gas turbines 5 mm²/s viscosity (marine use)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-102</td>
<td>DEF STAN 91-79</td>
<td>O-157</td>
<td>OX-24</td>
<td>Low temperature lubricating oil for weapons</td>
<td>MIL-PRF-14107D</td>
<td>AeroShell Fluid 18*</td>
</tr>
<tr>
<td>DEF STAN 91-103</td>
<td>–</td>
<td>–</td>
<td>PX-36</td>
<td>Corrosion preventive, cleaner and lubricant for weapons</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-105</td>
<td>DEF STAN 91-28</td>
<td>G-421</td>
<td>XG-291</td>
<td>Grease, multi-purpose, heavy duty</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-106</td>
<td>–</td>
<td>–</td>
<td>XG-294</td>
<td>Grease, multi-purpose, elevated temperature range</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 91-112</td>
<td>DTD.581C</td>
<td>O-153</td>
<td>OEP-30</td>
<td>Extreme pressure gear oil Grade Light</td>
<td>MIL-PRF-6086D Grade Light</td>
<td>AeroShell Fluid SLA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-155</td>
<td>OEP-70</td>
<td>Grade Medium</td>
<td>MIL-PRF-6086D Grade Medium</td>
<td>AeroShell Fluid SMA</td>
</tr>
<tr>
<td>DEF STAN 91-114 (in preparation)</td>
<td>DTD.417B</td>
<td>–</td>
<td>OM-150</td>
<td>Low temperature oil for aircraft controls</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DEF STAN 96-1 (Obsolete)</td>
<td>DTD.77</td>
<td>S-732</td>
<td>ZK-20 (Obsolete)</td>
<td>Graphite powder – lubricating grade. Specification now obsolete</td>
<td>SS-G-659a</td>
<td>–</td>
</tr>
<tr>
<td>DED.2472</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by D.Eng.R.D.2472</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DED.2480</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERR 2450 Grade D-65 (Obsolete)</td>
<td>–</td>
<td>O-123</td>
<td>OMD-160</td>
<td>Lubricating oil for aircraft piston engines – ashless dispersant type, SAE 40 Grade</td>
<td>SAE J-1899 Grade SAE 40</td>
<td>AeroShell Oil W80</td>
</tr>
<tr>
<td>DERR 2450 Grade D-80 (Obsolete)</td>
<td>–</td>
<td>O-125</td>
<td>OMD-250</td>
<td>Lubricating oil for aircraft piston engines – ashless dispersant type, SAE 50 Grade</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>AeroShell Oil W100</td>
</tr>
<tr>
<td>DERR 2450 Grade D-100 (Obsolete)</td>
<td>–</td>
<td>O-128</td>
<td>OMD-370</td>
<td>Lubricating oil for aircraft piston engines – ashless dispersant type, SAE 60 Grade</td>
<td>SAE J-1899 Grade SAE 60</td>
<td>AeroShell Oil W120</td>
</tr>
<tr>
<td>DERD 2451</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-252</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2452</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-86</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2453</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-87</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2454</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-88</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2458</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-93</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2461</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-251</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>DERD 2468</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-94</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2469</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>D.Eng.R.D. 2470</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2472 A/O (Obsolete)</td>
<td>DED 2472</td>
<td>O-115</td>
<td>OM-170</td>
<td>Lubricating oil for aircraft piston engines, SAE 40 Grade</td>
<td>SAE J-1966 Grade 40</td>
<td>AeroShell Oil 80</td>
</tr>
<tr>
<td>DERD 2472 B/O (Obsolete)</td>
<td>DED 2472</td>
<td>O-117</td>
<td>OM-270</td>
<td>Lubricating oil for aircraft piston engines, SAE 50 Grade</td>
<td>SAE J-1966 Grade 50</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td>DERD 2472 A/2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2472 B/2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2475</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DERD 2485</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2479/0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-97</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2479/1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-97</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>D.Eng.R.D. 2481</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DERD 2491</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>D.Eng.R.D. 2482</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DERD 2494</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2485</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-90</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2486</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2487</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-98</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>D.Eng.R.D. 2488</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DERD 2498</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2490</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-99</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2491</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-253</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2492</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-89</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2493</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2494</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-91</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>D.Eng.R.D. 2495</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2497</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-100</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2498</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-86</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>DERD 2499</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-101</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>BS.D.34</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by B.S. 2537</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>BS.148.84</td>
<td>–</td>
<td>S-756</td>
<td>OM-16 OM-22</td>
<td>Transformer oil Transformer oil – low temperature</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>--------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>BS.245:76 Type 1</td>
<td>–</td>
<td>–</td>
<td>S-752</td>
<td>White Spirit</td>
<td>White spirit</td>
<td>MIL-PRF-680 Type 1</td>
</tr>
<tr>
<td>BS.290</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Turpentine (included in BS.244)</td>
<td>–</td>
</tr>
<tr>
<td>BS.506:87</td>
<td>–</td>
<td>–</td>
<td>S-747</td>
<td>AL-14</td>
<td>Methanol</td>
<td>O-M-232K Grade A</td>
</tr>
<tr>
<td>BS.1595:86</td>
<td>–</td>
<td>–</td>
<td>S-737</td>
<td>AL-11</td>
<td>Isopropyl alcohol (anti-icing fluid)</td>
<td>TTI-735A Grade A</td>
</tr>
<tr>
<td>BS.3150:59</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>BS.3591 OP</td>
<td>DEF.58 CS.606F</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Denatured ethyl alcohol, for windscreens and carburettor de-icing</td>
<td>MIL-A-6091C</td>
</tr>
<tr>
<td>BS.4475:75</td>
<td>DEF.2002</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>This specification covers a range of products for various industrial applications</td>
<td>–</td>
</tr>
<tr>
<td>BS.3118</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-79</td>
<td></td>
</tr>
<tr>
<td>BS.3120</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-78</td>
<td></td>
</tr>
<tr>
<td>TS.10035A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td></td>
</tr>
<tr>
<td>TS.10067E</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-128</td>
<td></td>
</tr>
<tr>
<td>TS.10131</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 80-143</td>
<td></td>
</tr>
<tr>
<td>TS.10134A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-71</td>
<td></td>
</tr>
<tr>
<td>TS.10164</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 80-186</td>
<td></td>
</tr>
<tr>
<td>TS.10165</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 91-48</td>
<td></td>
</tr>
<tr>
<td>TS.10177</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-127</td>
<td></td>
</tr>
<tr>
<td>TS.10180</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td></td>
</tr>
<tr>
<td>TS.10188</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-129</td>
<td></td>
</tr>
<tr>
<td>TS.10228</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Ice control agent for aircraft runways</td>
<td></td>
</tr>
<tr>
<td>TS.10266A TS.10266</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Cleaning fluid for compressors of gas turbine engines</td>
<td></td>
</tr>
<tr>
<td>TS.10281</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Cleaning compound for aircraft surfaces</td>
<td></td>
</tr>
<tr>
<td>TS.10151</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by DEF STAN 68-10</td>
<td></td>
</tr>
</tbody>
</table>
U.S. AVIATION SPECIFICATIONS

SCOPE OF LIST

This list is comprised of U.S. Military Specifications which cover aviation fuels, engine oils, hydraulic fluids, greases and allied products.

Currently major changes are taking place to U.S. Specifications. The U.S. authorities have decided to eliminate MIL specifications as they are currently known and replace them by Performance specifications. These will be labelled MIL-PRF- followed by a number. Many MIL-PRF- specifications have now been issued and others will follow until all current MIL specifications have been converted. The numeric part of the MIL-PRF-designation is the same as the numeric part of the MIL specification it replaces; however, the letter which denotes the Revision level has also changed. Some other MIL specifications have been converted to Detail specifications denoted by MIL-DTL- followed by a number. MIL specifications which are cancelled or obsolete will not be changed.

For certain products, the US authorities have decided to no longer maintain military specifications; in these cases, they have been converted to civil specifications by the SAE (Society of Automotive Engineers).

Recent examples of this change include:
- MIL-L-7808K has become MIL-PRF-7808L
- MIL-L-23699E has become MIL-PRF-23699F
- MIL-T-83188D has become MIL-DTL-83188E
- MIL-G-4343C has become SAE-AMS-G-4343

U.S. Military specifications and Qualified Products Lists (QPLs) can be downloaded as Acrobat documents from U.S. Department of Defense site http://assist.daps.dla.mil/quicksearch.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-P-116J</td>
<td>MIL-P-116H</td>
<td>–</td>
<td>Refer to MIL-STD-2073/1D Standard Practice for Military Packaging</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-372D</td>
<td>MIL-C-372D</td>
<td>–</td>
<td>Solvent cleaning compound for automatic weapons</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-680</td>
<td>P-D-680B</td>
<td>–</td>
<td>Degreasing solvent</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-907E</td>
<td>MILA-907D</td>
<td>–</td>
<td>High temperature anti-seize thread compound</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-S-3136B</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by TS-735</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-3150D</td>
<td>MIL-L-3150C</td>
<td>O-192</td>
<td>Preservative Lubricating Oil – Medium</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-G-3278A</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by MIL-23827A</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-G-3572B</td>
<td>MIL-L-3572A</td>
<td>–</td>
<td>Lubricant, colloidal graphite in oil</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-L-3918A</td>
<td>MIL-L-3918</td>
<td>–</td>
<td>Jewel bearing instrument oil – INACTIVE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-C-4339D</td>
<td>MIL-C-4339C</td>
<td>C-630</td>
<td>Soluble corrosion preventive oil – INACTIVE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-L-5020C</td>
<td>ANC-116 MIL-L-5020B</td>
<td>S712</td>
<td>Aircraft compass liquid</td>
<td>–</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>MIL-T-5542E</td>
<td>–</td>
<td>–</td>
<td>Specification cancelled. Use MIL-G-27617.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>MIL-C-5545C</td>
<td>AN-C-178 MIL-C-5545B</td>
<td>C-612</td>
<td>Corrosion preventive compound for aircraft engines, heavy oil type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-G-5572F</td>
<td></td>
<td></td>
<td>Specification cancelled. Use ASTM D910</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-H-5606A (Obsolete)</td>
<td>MIL-O-5606</td>
<td></td>
<td>Hydraulic aircraft oil, petroleum base. Remains available for civil use.</td>
<td>DTD 585 (Obsolete)</td>
<td>AeroShell Fluid 4*</td>
</tr>
<tr>
<td>MIL-PRF-5606H</td>
<td>MIL-H-5606G H-515</td>
<td></td>
<td>Hydraulic aircraft oil, petroleum base, of improved cleanliness and performance</td>
<td>DEF STAN 91-48 Grade Superclean</td>
<td>AeroShell Fluid 41</td>
</tr>
<tr>
<td>MIL-E-5607F (Obsolete)</td>
<td>MIL-E-5607E</td>
<td></td>
<td>Process for preparation for storage and shipment of gas turbine engines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-DTL-5624T</td>
<td>MIL-PRF-5624S MIL-T-5624P</td>
<td>F-40</td>
<td>Aircraft turbine engine fuel</td>
<td>DEF STAN 91-88</td>
<td></td>
</tr>
<tr>
<td>Grade JP-4 Grade JP-5</td>
<td>MIL-PRF-5624P</td>
<td>F-44</td>
<td>Wide cut, gasoline type with FSII High flash point, kerosine type with FSII</td>
<td>DEF STAN 91-86</td>
<td></td>
</tr>
<tr>
<td>Grade JP-5</td>
<td></td>
<td></td>
<td></td>
<td>Shell JP-5</td>
<td></td>
</tr>
<tr>
<td>MIL-E-6532D (Obsolete)</td>
<td>ANG-14a MIL-E-6032C G-363</td>
<td></td>
<td>Gasoline and oil resistant grease – superseded by SAE-AMS-G-6032</td>
<td>DEF STAN 91-6</td>
<td>AeroShell Grease 5.7108</td>
</tr>
<tr>
<td>MIL-E-6059A (Inactive)</td>
<td>ANE-50</td>
<td></td>
<td>Processes for corrosion protection, pre-oiling and ground operation of aircraft</td>
<td>D.Eng.R.D. 2027</td>
<td></td>
</tr>
<tr>
<td>Grade 1005</td>
<td>MIL-L-6081C O-132 (Obsolete) O-133</td>
<td></td>
<td>Aircraft mineral turbine oil Grade 1005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 2</td>
</tr>
<tr>
<td>MIL-PRF-6083F</td>
<td>MIL-H-6083E C-635</td>
<td></td>
<td>Preservative oil of improved cleanliness for hydraulic equipment</td>
<td>DEF STAN 80-142</td>
<td>AeroShell Fluid 71</td>
</tr>
<tr>
<td>MIL-PRF-6085D</td>
<td>MIL-L-6085C AN-O-11 O-147</td>
<td></td>
<td>Low volatility aircraft instrument lubricating oil</td>
<td>DEF STAN 91-49</td>
<td>AeroShell Fluid 12</td>
</tr>
<tr>
<td>MIL-PRF-6086E Grade L – Light Grade M – Medium</td>
<td>MIL-L-6086D O-153 O-155</td>
<td></td>
<td>Lubricating gear oil, petroleum base. Low viscosity Medium viscosity</td>
<td>DEF STAN 91-112 Grade OEP-30 Grade OEP-70</td>
<td>AeroShell Fluid 5L-A AeroShell Fluid 5MA</td>
</tr>
<tr>
<td>MIL-C-6529C</td>
<td>MIL-C-7853 MIL-C-6529B</td>
<td>C-608</td>
<td>Non metallic aircraft engine corrosion preventive compounds Type I – concentrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C-609</td>
<td>Type II – ready mixed material for aircraft piston engines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C-610</td>
<td>Type III – ready mixed material for jet aircraft engines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-S-6625A (Obsolete)</td>
<td>MILS-6625</td>
<td></td>
<td>Anticing spray equipment for aircraft windshield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-C-6708</td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by MIL-C-16173E, Grade 1 and MIL-C-11796C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-G-6711</td>
<td></td>
<td></td>
<td>OBSOLETE – superseded by SS-G-659a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-7024E</td>
<td>MIL-C-7024D</td>
<td></td>
<td>Calibrating fluid for aircraft fuel systems and components Type I – normal heptane</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type II – special run Stoddard solvent Type III – high flashpoint fluid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See later in this section.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-G-7118A</td>
<td>-</td>
<td>-</td>
<td>OBSELETE – superseded by MIL-PRF-23827C</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-7187</td>
<td>-</td>
<td>-</td>
<td>OBSELETE – superseded by MIL-G-21164D</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-7421B</td>
<td>-</td>
<td>-</td>
<td>OBSELETE – superseded by MIL-PRF-23827C</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-7711A</td>
<td>-</td>
<td>-</td>
<td>OBSELETE – superseded by MIL-G-81322 AeroShell Grease 6 still available for civil market meeting MIL-G-7711A and NATO Code G-382</td>
<td>-</td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td>MIL-PRF-7808BL</td>
<td>MIL-L7808K</td>
<td>O-148</td>
<td>Synthetic lubricating oil for military gas turbines</td>
<td>(MIL-PRF-7808BL Grade 3)</td>
<td>-</td>
</tr>
<tr>
<td>Grade 3</td>
<td></td>
<td></td>
<td>Normal grade</td>
<td></td>
<td>AeroShell Turbine Oil 308</td>
</tr>
<tr>
<td>Grade 4</td>
<td></td>
<td>O-163</td>
<td>Higher viscosity/greater thermal stability grade</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>MIL-M-7866C</td>
<td>MILM-7866B</td>
<td>S-740</td>
<td>Molybdenum disulphide powder – superseded by SAE-AMS-M-7866</td>
<td>DEF STAN 68-62</td>
<td>-</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-787OC</td>
<td>ANO-6a MIL-L7870C</td>
<td>O-142</td>
<td>General purpose low temperature lubricating oil</td>
<td>DEF STAN 91-47</td>
<td>AeroShell Fluid 3</td>
</tr>
<tr>
<td>MIL-PRF-8188D</td>
<td>MIL-C-8188C</td>
<td>C-638</td>
<td>Synthetic corrosion protective oil for aircraft gas turbines</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-A-8243D</td>
<td>MIL-A-8243C</td>
<td>-</td>
<td>De-icing and defrosting fluid</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Grade 3</td>
<td></td>
<td></td>
<td>Type I – propylene glycol base with inhibitor</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Grade 4</td>
<td></td>
<td></td>
<td>Type II – ethylene glycol base with inhibitor</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-H-8446B</td>
<td>MIL-H-8446A</td>
<td>-</td>
<td>Aircraft non-petroleum hydraulic fluid</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-S-8660C</td>
<td>MIL-I-8660B</td>
<td>S-736</td>
<td>Silicone compound – superseded by SAE AS8660</td>
<td>DEF STAN 68-69</td>
<td>-</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-8937D</td>
<td>MIL-S-1738</td>
<td>S-1738</td>
<td>OBSELETE – superseded by MIL-L-46010B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-T-9188C</td>
<td>MIL-T-9188B</td>
<td>-</td>
<td>Tricresyl phosphate for use as an aviation gasoline additive</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-9236B</td>
<td>-</td>
<td>-</td>
<td>OBSELETE – superseded by MIL-L-27502</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-10924G</td>
<td>MIL-G-10924F</td>
<td>G-403</td>
<td>Multi-purpose grease</td>
<td>DEF STAN 91-27</td>
<td>-</td>
</tr>
<tr>
<td>MIL-L-11734C</td>
<td>MIL-L-11734B</td>
<td>-</td>
<td>Synthetic lubricating oil (mechanical time fuses)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-C-11796C</td>
<td>MIL-C-11796B MIL-C-15167 MIL-C-6708 in part</td>
<td>C-633 - C-627 (Obsolete)</td>
<td>Corrosion preventive, petrolatum, hot application</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-A-13881C</td>
<td>MIL-A-13881B</td>
<td>-</td>
<td>Mica based anti-seize compound</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Obsolete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-H-13919B</td>
<td>-</td>
<td>-</td>
<td>OBSELETE – superseded by MIL-H-46170</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-14107D</td>
<td>MIL-PRF-14107D</td>
<td>O-157</td>
<td>Low temperature oil for aircraft weapons</td>
<td>DEF STAN 91-102</td>
<td>AeroShell Fluid 18*</td>
</tr>
<tr>
<td>MIL-PRF-15074E</td>
<td>MIL-C-15074D</td>
<td>-</td>
<td>Corrosion preventive – fingerprint remover</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-L-15719A</td>
<td>MIL-L-15719A</td>
<td>-</td>
<td>Lubricating grease (high temperature, electric motor, ball and roller bearings)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>MIL-PRF-16173E</td>
<td>MIL-C-16173D</td>
<td>–</td>
<td>Corrosion preventive, solvent cut back cold application</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>MIL-C-972</td>
<td>C-632</td>
<td>Grade 1 – hard film</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>MIL-C-19471</td>
<td>C-620</td>
<td>Grade 2 – soft film</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
<td>Grade 3 – soft film, water displacing</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
<td>Grade 4 – transparent film, non-tacky</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
<td>Grade 5 – low pressure steam removable</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-F-16884J</td>
<td>MILF-16884H</td>
<td>F-76</td>
<td>Alternative turbine/diesel engine fuel for use in certain Naval helicopters</td>
<td>DEF STAN 91-4</td>
<td>–</td>
</tr>
<tr>
<td>MIL-DTL-17111C</td>
<td>MILF-17111B</td>
<td>H-575</td>
<td>Power transmission fluid</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-17672D</td>
<td>MILH-17672C MILH-24459</td>
<td>H-573</td>
<td>Hydraulic fluid, petroleum inhibited</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-G-18709A</td>
<td>–</td>
<td>–</td>
<td>Ball and roller bearing grease. This specification cancelled – use DOD-G-24508 (see later in this section).</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-W-18723D (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>Waterproof solvent type aircraft wax. Specification now cancelled.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-H-19457D</td>
<td>MILH-19457C</td>
<td>H-580</td>
<td>Fire resistant phosphate ester hydraulic fluid</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-L-19701B</td>
<td>MIL-L-19701A</td>
<td>–</td>
<td>Semi-fluid lubricant for aircraft ordnance</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-O-19838</td>
<td>–</td>
<td>–</td>
<td>Installation and test of aircraft oil system – INACTIVE</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-G-21164D</td>
<td>MILG-21164C</td>
<td>G-353</td>
<td>Molybdenum disulphide grease, for low and high temperature</td>
<td>DEF STAN 91-57</td>
<td>AeroShell Grease 17</td>
</tr>
<tr>
<td></td>
<td>MILG-7187</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-21260E</td>
<td>MIL-L-21260D</td>
<td>–</td>
<td>Internal lubricating oil – combustion engine preservation. This specification covers a range of grades.</td>
<td>–</td>
<td>Consult local Shell Company</td>
</tr>
<tr>
<td>MIL-H-22072C</td>
<td>MILH-22072B</td>
<td>H-579</td>
<td>Catapult hydraulic fluid</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-L-22851D</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by SAE J-1899 (see later in this section)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-C-23112 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>Fire resistant corrosion preventive – superseded by MIL-H-19457</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-L-23398D</td>
<td>MIL-L-23398C</td>
<td>S-749</td>
<td>Lubricant, solid film air drying</td>
<td>(MIL-L-23398D)</td>
<td>–</td>
</tr>
<tr>
<td>MIL-C-23411A</td>
<td>–</td>
<td>–</td>
<td>CANCELLED – superseded by MIL-C-81309</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-G-23549C</td>
<td>MIL-G-23549B</td>
<td>–</td>
<td>General purpose grease</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MIL-PRF-23699F</td>
<td>MIL-L-23699E</td>
<td>–</td>
<td>Synthetic lubricating oil for aircraft gas turbines, 5 mm²/s viscosity</td>
<td>DEF STAN 91-101 Grade OX-27</td>
<td>AeroShell Turbine Oil 500</td>
</tr>
<tr>
<td>Grade STD</td>
<td>O-156</td>
<td>Grade STD (Standard)</td>
<td>–</td>
<td>AeroShell Turbine Oil 529</td>
<td></td>
</tr>
<tr>
<td>Grade C/I</td>
<td>O-156</td>
<td>Grade STD (Standard)</td>
<td>–</td>
<td>AeroShell Turbine Oil 531</td>
<td></td>
</tr>
<tr>
<td>Grade HTS</td>
<td>O-154</td>
<td>Grade C/I (Corrosion Inhibited grade)</td>
<td>–</td>
<td>AeroShell Turbine Oil 560</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>MIL-PRF-23827C (Type I &amp; Type II)</td>
<td>MIL-G-23827B, MIL-G-23827A, MIL-G-23827B, MIL-G-7421B, MIL-G-15793</td>
<td>G-354</td>
<td>Grease for aircraft instruments, gears and actuator screws</td>
<td>DEF STAN 91-53</td>
<td>AeroShell Grease 7 (Type II) AeroShell Grease 33 (Type I)</td>
</tr>
<tr>
<td>MIL-24131C</td>
<td>MIL-G-24131B</td>
<td>-</td>
<td>Colloidal graphite in isopropanol</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-24139A</td>
<td>MIL-G-24139A</td>
<td>G-450</td>
<td>Multi-purpose quiet service grease</td>
<td>DEF STAN 91-28 (Obsolete)</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>MIL-H-24469</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by MIL-L-17672</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-L-24478C</td>
<td>MIL-L-24478B</td>
<td>-</td>
<td>Lubricant, molybdenum disulphide in isopropanol</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-25017F</td>
<td>MIL-L-25017E</td>
<td>S-1747</td>
<td>Fuel soluble corrosion inhibitors for aviation turbine fuels</td>
<td>DEF STAN 68-251</td>
<td>-</td>
</tr>
<tr>
<td>MIL-DTL-25525E</td>
<td>MIL-F-25524D</td>
<td>-</td>
<td>Thermally stable aviation turbine fuel</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-25533C</td>
<td>MIL-G-25537B</td>
<td>G-366</td>
<td>Helicopter oscillating bearing grease</td>
<td>DEF STAN 91-51</td>
<td>AeroShell Grease 14</td>
</tr>
<tr>
<td>MIL-F-25558C (Obsolete)</td>
<td>MIL-F-25558B</td>
<td>-</td>
<td>Fuel, ramjet – Grade RJ-1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-P-25576C</td>
<td>MIL-R-25576B</td>
<td>-</td>
<td>Propellant – kerosine, Grade RP-1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-L-25681C</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by DOD-L-25681D (see entry later in this section)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-25760A (Obsolete)</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by MIL-G-81322A AeroShell Grease 16 still available for civil market meeting MIL-G-25760A and NATO Code G-361.</td>
<td>-</td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td>MIL-C-25769J</td>
<td>-</td>
<td>-</td>
<td>Specification cancelled, use MIL-C-87936</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-L-27251A</td>
<td>-</td>
<td>-</td>
<td>Low temperature aircraft surface cleaning compound. Specification now cancelled.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-F-27351</td>
<td>-</td>
<td>-</td>
<td>Specification now cancelled. Use MIL-PRF-7024E</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-27502 (Obsolete)</td>
<td>MIL-L-9236B</td>
<td>-</td>
<td>High temperature synthetic lubricating oil for aircraft gas turbines</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-27549</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-27601C</td>
<td>MIL-H-27601B</td>
<td>-</td>
<td>High temperature, petroleum base, hydraulic fluid for flight vehicles</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-27617F</td>
<td>MIL-G-27617E</td>
<td>G-397</td>
<td>Grease, fuel and oxidiser resistant</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-27686F</td>
<td>MIL-G-27686F, MIL-G-1350</td>
<td>S-748</td>
<td>Fuel system icing inhibitor (ethylene glycol monomethyl ether) – INACTIVE</td>
<td>DERD 2451 Grade AL-31 (Obsolete)</td>
<td>-</td>
</tr>
<tr>
<td>MIL-L-27694A (Obsolete)</td>
<td>MIL-L-27694</td>
<td>-</td>
<td>Lubricating oil, instrument</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-PRF-32033</td>
<td>VVL-800C</td>
<td>G-190</td>
<td>General purpose oil and preservative (water displacing, low temperature)</td>
<td>DEF STAN 91-79 (Obsolete)</td>
<td>AeroShell Fluid 18</td>
</tr>
<tr>
<td>MIL-PRF-38219D</td>
<td>MIL-PRF-38219C</td>
<td>-</td>
<td>Low volatility turbine fuel Grade JP-7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MIL-G-38220</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by MIL-G-27617</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>MIL-G-38277</td>
<td>–</td>
<td>–</td>
<td>OBSELETE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-38299C</td>
<td>MILF-38299B</td>
<td>–</td>
<td>Purging fluid for preserving fuel tanks of jet aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-C-38334A</td>
<td>MIL-C-38334</td>
<td>–</td>
<td>Corrosion removing compound prepaint for aircraft aluminium surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-C-43616B</td>
<td>MIL-C-43616B</td>
<td>–</td>
<td>Aircraft surface cleaning compound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-45983</td>
<td>–</td>
<td>–</td>
<td>Solid film heat cured lubricant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-46000C</td>
<td>MILL-46000B</td>
<td>O-158</td>
<td>Semi-fluid lubricating oil for automatic weapons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-46002C</td>
<td>MIL-P-46002B</td>
<td>–</td>
<td>Contact and volatile corrosion inhibited preservative oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-G-460003A</td>
<td>MILG-46003</td>
<td>–</td>
<td>Grease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-H-46004</td>
<td>MIL-H-535</td>
<td>H-535</td>
<td>Hydraulic fluid petroleum base for missiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-46010F</td>
<td>MIL-H-46010E</td>
<td>S-1738</td>
<td>Corrosion inhibiting heat cured solid film lubricant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-46147C</td>
<td>MILL-46147B</td>
<td>–</td>
<td>Corrosion inhibiting air cured solid film lubricant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-46150</td>
<td>–</td>
<td>–</td>
<td>Semi-fluid lubricant for weapons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-46156A</td>
<td>MILL-46156</td>
<td>–</td>
<td>Corrosion removing compound sodium hydroxide base - superseded by A-A-59261</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-46167C</td>
<td>MILL-46167B</td>
<td>O-184</td>
<td>Lubricating oil, IC Engine, Arctic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-63460D</td>
<td>MIL-L-63460C</td>
<td>S-758</td>
<td>Lubricant, cleaner and preservative for weapons and weapon systems</td>
<td></td>
<td>AeroShellFluid 634</td>
</tr>
<tr>
<td>MIL-H-81019D</td>
<td>MIL-H-81019C</td>
<td>–</td>
<td>Hydraulic fluid, petroleum base (ultra low temperature)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-L-81087C</td>
<td>MILS-81087B</td>
<td>H-536</td>
<td>Hydraulic fluid, chlorinated silicone – INACTIVE</td>
<td>(MIL-S-81087C)</td>
<td></td>
</tr>
<tr>
<td>MIL-C-81309E</td>
<td>MIL-C-81309D</td>
<td>–</td>
<td>Ultra thin film water displacing corrosion preventive compound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NLGI Grade 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NLGI Grade 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-81329D</td>
<td>MIL-81329C</td>
<td>S-1737</td>
<td>Lubricant, solid film, extreme environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-B-81744A</td>
<td></td>
<td></td>
<td>Lubricant migration deterring barrier coating solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-G-81827A</td>
<td>MIL-G-81827</td>
<td></td>
<td>Molybdenum disulphide grease with high load capacity, wide temperature range</td>
<td></td>
<td>AeroShell Grease 23C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NLGI Grade 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-81846A</td>
<td></td>
<td></td>
<td>OBSOLETE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-F-81912</td>
<td></td>
<td></td>
<td>Fuel for expendable turbine engine – INACTIVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-G-81937A</td>
<td>MIL-G-81937</td>
<td></td>
<td>Ultra clean instrument grease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-P-82522C</td>
<td>MIL-P-82522B</td>
<td></td>
<td>Propellant, jet engine, TH dimer Grade R-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-R-83055</td>
<td></td>
<td></td>
<td>General specification for aircraft windshield rain repellent dispensing systems. Specification now cancelled, use MIL-E-87145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-R-83056</td>
<td></td>
<td></td>
<td>Rain repellent applied in flight, aircraft windshield. Specification now cancelled, use MIL-R-81261</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-T-83133D</td>
<td>MIL-T-83133D</td>
<td>F-34, F-37, F-35</td>
<td>Aviation turbine fuel kerosine type JP-8 (freeze point –47°C)</td>
<td>DEF STAN 91-87</td>
<td>Shell JP-8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JP-8 +100 Jet-A-1</td>
<td>DEF STAN 91-91</td>
<td>Shell JP-8 +100</td>
</tr>
<tr>
<td>MIL-L-0083176A</td>
<td>MIL-L-83176</td>
<td></td>
<td>Instrument bearing lubricant. Specification now cancelled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-83282D</td>
<td>MIL-H-83282C</td>
<td>H-537</td>
<td>Fire resistant hydraulic fluid, synthetic hydrocarbon base</td>
<td>(MIL-PRF-83282D)</td>
<td>AeroShell Fluid 31</td>
</tr>
<tr>
<td>MIL-H-83306 (Obsolete)</td>
<td></td>
<td></td>
<td>Fire resistant hydraulic fluid, phosphate ester based. Specification is now cancelled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-83363C</td>
<td>MIL-G-83363B</td>
<td>G-396</td>
<td>Helicopter transmission grease PTFE</td>
<td>(MIL-G-83363B)</td>
<td></td>
</tr>
<tr>
<td>MIL-D-83411A (Obsolete)</td>
<td></td>
<td></td>
<td>De-icer/anti-icer fluid for runways and taxiways. Specification now cancelled, use AMS 1432</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-G-83414 (Obsolete)</td>
<td></td>
<td></td>
<td>Grease, aircraft gunmount. Specification now cancelled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-83483C</td>
<td>MIL-T-83483B</td>
<td></td>
<td>Anti-seize thread compound, molybdenum disulphide and petrolatum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-C-85054B</td>
<td>MIL-C-85054A</td>
<td></td>
<td>A clear water displacing corrosion preventive compound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>MIL-DTL-85470B</td>
<td>MIL-85470A</td>
<td>S-1745</td>
<td>High flash type fuel system icing inhibitor (di-ethylene glycol monomethyl ether)</td>
<td>DEF STAN 68-252 Grade AL-41</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>MIL-PRF-85570C</td>
<td>MIL-C-85570B</td>
<td></td>
<td>Aircraft exterior cleaning compound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-85704C</td>
<td>MIL-C-85704B</td>
<td></td>
<td>Aircraft turbine engine oil, polyphenyl ether base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-87100A</td>
<td>MIL-L-87100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-P-87107C</td>
<td>MIL-P-87107B</td>
<td></td>
<td>Propellant, high density synthetic hydrocarbon type Grade JP-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-DTL-87173B</td>
<td>MIL-P-87173A</td>
<td></td>
<td>Propellant, priming fuel ALCM engine Grade PF-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MILL-87177A</td>
<td>MILL-87177</td>
<td></td>
<td>Synthetic water displacing corrosion preventive compound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-87252C</td>
<td>MIL-C-87252B</td>
<td>S-1748</td>
<td>Coolant fluid, hydrolytically stable, dielectric</td>
<td></td>
<td>AeroShell Fluid 602</td>
</tr>
<tr>
<td>MIL-PRF-87257A</td>
<td>MIL-H-87257</td>
<td>H-538</td>
<td>Low temperature synthetic hydrocarbon fire resistant hydraulic fluid</td>
<td>(MIL-PRF-87257A)</td>
<td>AeroShell Fluid 51</td>
</tr>
<tr>
<td>MIL-C-87936A (Obsolete)</td>
<td></td>
<td></td>
<td>Water dilutable aircraft exterior surface cleaning compound – superseded by MIL-C-87937</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIL-PRF-87937C</td>
<td>MIL-C-87937B</td>
<td></td>
<td>Cleaning compound, Aerospace equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOD-G-24508A</td>
<td>DOD-G-24508</td>
<td></td>
<td>High performance ball and roller bearing grease</td>
<td></td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>DOD-PRF-24574</td>
<td></td>
<td></td>
<td>Lubricating fluid for low and high pressure oxidising gas mixtures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOD-L-25681D</td>
<td>MIL-L-25681C</td>
<td>S-1735</td>
<td>Molybdenum disulphide lubricating oil, silicone base</td>
<td>(DOD-L-25681D)</td>
<td></td>
</tr>
<tr>
<td>DOD-L-81846B</td>
<td>MILL-81846A</td>
<td></td>
<td>High flash point lubricating oil for instrument ball bearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOD-PRF-85336B</td>
<td>DOD-L-85336A</td>
<td></td>
<td>Lubricant, all weather (automatic weapons)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOD-G-85733</td>
<td></td>
<td></td>
<td>High temperature grease for catapult systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOD-L-85734</td>
<td></td>
<td></td>
<td>Synthetic ester oil for helicopter transmissions</td>
<td></td>
<td>AeroShell Turbine Oil 555</td>
</tr>
<tr>
<td>VVP-216C</td>
<td>VVP-216B</td>
<td></td>
<td>Penetrating oil – superseded by A-A-50493</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VVP-236A</td>
<td>VVP-236</td>
<td>S-743</td>
<td>Technical petrolatum</td>
<td>DEF STAN 91-38 Grade PX-7</td>
<td></td>
</tr>
<tr>
<td>SSG-659A</td>
<td>MILG-6711 SSG-659</td>
<td>S-732</td>
<td>Graphite powder – lubricating grade</td>
<td>DEF STAN 96-1</td>
<td></td>
</tr>
<tr>
<td>TIT-656C</td>
<td>TIT-656B</td>
<td></td>
<td>Tricresyl phosphate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VVG-671F</td>
<td>VVG-671E</td>
<td>G-408</td>
<td>Graphite grease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>P-D-680B</td>
<td>P-D-680A Type I, Type II</td>
<td>S-752, S-753</td>
<td>White spirit – superseded by MIL-PRF-680</td>
<td>BS.245</td>
<td>–</td>
</tr>
<tr>
<td>O-E-760D</td>
<td>O-E-760C Type I, Type II</td>
<td>S-738, S-753</td>
<td>Ethyl alcohol, denatured alcohol – superseded by A-A-59282, 51693, 53880</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>VVL-820C</td>
<td>VVL-820B, O-196 (Obsolete)</td>
<td>S-738, S-753</td>
<td>General purpose light oil. Cancelled, now use VV-L-800</td>
<td>–</td>
<td>Shell Vitrea Oil 22*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D770</td>
<td>TTI-735A Type I, Type II</td>
<td>S-737, S-738</td>
<td>Isopropyl alcohol</td>
<td>BS.1595.86</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>ASTM D910</td>
<td>– F-12, F-18 (Obsolete)</td>
<td>–</td>
<td>Aviation gasoline, various grades</td>
<td>DEF STAN 91-90</td>
<td>–</td>
</tr>
<tr>
<td>SAE AS1241</td>
<td>–</td>
<td>–</td>
<td>Fire resistant phosphate ester hydraulic fluid for aircraft</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SAE-AMS-2518A</td>
<td>MIL-5544C</td>
<td>S-720</td>
<td>Graphite-petrolatum anti-seize thread compound</td>
<td>DEF STAN 80-80</td>
<td>AeroShell Compound 08</td>
</tr>
<tr>
<td>SAE-AMS-3057</td>
<td>–</td>
<td>–</td>
<td>Lubricant, semi-fluid for aircraft gearboxes</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SAE-AMS-3151</td>
<td>–</td>
<td>–</td>
<td>Aircraft compass fluid</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SAE-AMS-G-4343</td>
<td>MIL-G-4343C</td>
<td>G-392</td>
<td>Grease for pneumatic systems</td>
<td>–</td>
<td>AeroShell Grease 43C</td>
</tr>
<tr>
<td>SAE-AMS-G-6032</td>
<td>MIL-G-6032D</td>
<td>G-363</td>
<td>Gasoline and oil resistant grease</td>
<td>DEF STAN 91-6</td>
<td>AeroShell Grease S.7108</td>
</tr>
<tr>
<td>SAE AS6625</td>
<td>MILS-6625A</td>
<td>–</td>
<td>Anti-icing spray equipment for aircraft windshield</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>SAE AS8660</td>
<td>MILS-8660C</td>
<td>S-736</td>
<td>Silicone compound</td>
<td>DEF STAN 68-69</td>
<td>–</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>SAE J-1899</td>
<td>MILL-22851D</td>
<td></td>
<td>Ashless dispersant aircraft piston engine oil</td>
<td>SAE J-1899</td>
<td>AeroShell Oil W65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-123</td>
<td>SAE Grade 30</td>
<td></td>
<td>AeroShell Oil W80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-125</td>
<td>SAE Grade 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-128</td>
<td>SAE Grade 50</td>
<td></td>
<td>AeroShell Oil W100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-162</td>
<td>SAE Grade 50</td>
<td></td>
<td>AeroShell Oil W100 Plus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAE Grade 60</td>
<td></td>
<td>AeroShell Oil W120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAE Grade Multigrade</td>
<td></td>
<td>AeroShell Oil W 15W-50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-115</td>
<td>SAE Grade 40</td>
<td></td>
<td>AeroShell Oil 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-117</td>
<td>SAE Grade 50</td>
<td></td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SAE Grade 60</td>
<td></td>
<td>AeroShell Oil 120</td>
</tr>
<tr>
<td>FMS-1071</td>
<td>–</td>
<td>–</td>
<td>Grease for aircraft sweep wing pivot hinge</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>BMS 3-11</td>
<td>–</td>
<td>–</td>
<td>Boeing material specification for phosphate ester hydraulic fluid</td>
<td>–</td>
<td>Skydrol 500 B4 or LD4</td>
</tr>
<tr>
<td>BMS 3-24A</td>
<td>BMS 3-24</td>
<td>–</td>
<td>Boeing material specification for general purpose grease</td>
<td>–</td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td>BMS 3-32</td>
<td></td>
<td>–</td>
<td>Boeing material specification for specially fortified hydraulic fluids for aircraft landing gear shock struts</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type I – preservative version</td>
<td></td>
<td>AeroShell SSF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type II – low temperature version</td>
<td></td>
<td>AeroShell LGF</td>
</tr>
<tr>
<td>BMS 3-33A</td>
<td>BMS 3-33</td>
<td>–</td>
<td>Boeing material specification for general purpose airframe grease</td>
<td>–</td>
<td>AeroShell Grease 33</td>
</tr>
<tr>
<td>BMS 3-34</td>
<td>–</td>
<td>–</td>
<td>Boeing material specification for grease for sealed-for-life bearings</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
NATO CODE NUMBERS

SCOPE OF LIST
These symbols are used to denote the products in current use by the NATO countries. This is not intended to be a comprehensive list of all NATO products, but is a selection comprising all aviation fuels, engine oils, hydraulic fluids, greases and allied products.

INTERPRETATION OF LIST
In the columns headed "British Specification" and "U.S. Specification" the specifications listed are the official specifications for the NATO Code Number. Where both the British and U.S. Specifications are listed for the same NATO Code Number this means that these specifications are officially equivalent and completely interchangeable for NATO applications.

Where an asterisk * appears in the last column of the list, the AeroShell grade recommended does not necessarily meet all the clauses of the official specifications, but is the nearest product marketed by Shell.

For easy reference, obsolete specifications are shown in both the current and superseded specification columns. In the former case, a suitable comment is made, namely, "OBSOLETE - superseded by..."
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C-608</td>
<td>Aircraft engine corrosion preventive oil – concentrate</td>
<td>MIL-C-6529C Type I</td>
<td>(MIL-C-6529C Type II)</td>
<td>ZX-21</td>
<td>AeroShell Fluid 2XN</td>
</tr>
<tr>
<td>C-609</td>
<td>Piston engine corrosion preventive oil</td>
<td>MIL-C-6529C Type II</td>
<td>–</td>
<td>OX-270 (Obsolete)</td>
<td>AeroShell Fluid 2F</td>
</tr>
<tr>
<td>C-610</td>
<td>Turbine engine corrosion preventive oil</td>
<td>MIL-C-6529C Type III</td>
<td>–</td>
<td>ZX-17 (Obsolete)</td>
<td>AeroShell Fluid 2T</td>
</tr>
<tr>
<td>C-612</td>
<td>OBsolete</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C-613</td>
<td>Temporary protective for aircraft engine cylinders</td>
<td>–</td>
<td>DEF STAN 81-205</td>
<td>PX-13</td>
<td>–</td>
</tr>
<tr>
<td>C-614</td>
<td>Short term protective at medium ambient temperatures – mixture of lanolin/white spirit</td>
<td>–</td>
<td>DEF STAN 80-217</td>
<td>PX-1</td>
<td>AeroShell Compound 02</td>
</tr>
<tr>
<td>C-615</td>
<td>Corrosion preventive oils for aircraft engines during storage</td>
<td>–</td>
<td>DEF STAN 91-40</td>
<td>PX-27</td>
<td>–</td>
</tr>
<tr>
<td>C-618</td>
<td>OBsolete</td>
<td>–</td>
<td>–</td>
<td>PX-3 (Obsolete)</td>
<td>–</td>
</tr>
<tr>
<td>C-620</td>
<td>Corrosion preventive, solvent cut-back, cold application – soft film</td>
<td>MILPRF-16173E Grade 2</td>
<td>–</td>
<td>–</td>
<td>AeroShell Compound 02*</td>
</tr>
<tr>
<td>C-627</td>
<td>Corrosion preventive, petrolatum, hot application – soft film</td>
<td>MIL-C-11796C Class 3</td>
<td>–</td>
<td>–</td>
<td>AeroShell Compound 05*</td>
</tr>
<tr>
<td>C-628</td>
<td>Corrosion preventive, petrolatum, hot application – soft film</td>
<td>–</td>
<td>DEF STAN 80-85</td>
<td>PX-11</td>
<td>AeroShell Compound 05</td>
</tr>
<tr>
<td>C-629</td>
<td>Temporary protective for preservation of aircraft spare parts</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>C-630</td>
<td>Soluble corrosion preventive oil</td>
<td>MIL-C-4339D</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C-632</td>
<td>Corrosion preventive, solvent cut-back, cold application – hard film</td>
<td>MIL-PRF-16173E Grade 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C-633</td>
<td>Corrosion preventive, petrolatum, hot application – hard film</td>
<td>MIL-C-11796C Class 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C-634</td>
<td>Water displacing corrosion preventive</td>
<td>-</td>
<td>DEF STAN 68-10</td>
<td>PX-24</td>
<td>-</td>
</tr>
<tr>
<td>C-635</td>
<td>Preservative oil of improved cleanliness for hydraulic equipment</td>
<td>MIL-PRF-6083F</td>
<td>DEF STAN 80-142</td>
<td>PX-26</td>
<td>AeroShell Fluid 71</td>
</tr>
<tr>
<td>C-638</td>
<td>High temperature synthetic corrosion protective oil for turbine engines</td>
<td>MIL-PRF-8188D</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C-639</td>
<td>OBSOLETE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C-654</td>
<td>Corrosion preventive, soft film hot application</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>F-12</td>
<td>Aviation gasoline – Grade 80/87</td>
<td>MIL-C-5572F (Obsolete) ASTM D910</td>
<td>DEF STAN 91-90</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>F-18</td>
<td>Aviation gasoline – Grade 100/130 Low Lead</td>
<td>ASTM D910</td>
<td>DEF STAN 91-90</td>
<td>AVGAS 100LL</td>
<td>Shell Avgas 100LL</td>
</tr>
<tr>
<td>F-34</td>
<td>Aviation turbine fuel – kerosine type with fuel system icing inhibitor (–47°C freeze point)</td>
<td>MIL-DTL-83133E Grade JP-8</td>
<td>DEF STAN 91-87</td>
<td>AVTUR/FSII</td>
<td>Shell JP-8 Special arrangements necessary</td>
</tr>
<tr>
<td>F-35</td>
<td>Aviation turbine fuel – kerosine type (–47°C freeze point)</td>
<td>MIL-DTL-83133E ASTM D1655</td>
<td>DEF STAN 91-91</td>
<td>AVTUR</td>
<td>Shell JET A-1 Shell AeroJet*</td>
</tr>
<tr>
<td>F-37</td>
<td>Aviation turbine fuel F-34 plus thermal stability additive S-1749</td>
<td>MIL-DTL-83133E</td>
<td>-</td>
<td>-</td>
<td>Shell JP-8 +100</td>
</tr>
<tr>
<td>F-40</td>
<td>Aviation turbine fuel – wide cut type with fuel system icing inhibitor</td>
<td>MIL-DTL-5624T Grade JP-4</td>
<td>DEF STAN 91-88</td>
<td>AVTAG/FSII</td>
<td>-</td>
</tr>
<tr>
<td>F-43</td>
<td>Aviation turbine fuel – high flash type (–46°C freeze point) replaced by F-44</td>
<td>-</td>
<td>DERD 2498 (Obsolete)</td>
<td>AVCAT</td>
<td>-</td>
</tr>
<tr>
<td>F-44</td>
<td>Aviation turbine fuel – high flash type (–46°C freeze point) with fuel system icing inhibitor</td>
<td>MIL-DTL-5624T Grade JP-5</td>
<td>DEF STAN 91-86</td>
<td>AVCAT/FSII</td>
<td>Shell JP-5 Special arrangements necessary</td>
</tr>
<tr>
<td>F-76</td>
<td>Alternative turbine/diesel engine fuel for use in certain Naval helicopters</td>
<td>MIL-F-16884J</td>
<td>DEF STAN 91-4</td>
<td>DIESO F-76</td>
<td>-</td>
</tr>
<tr>
<td>G-350</td>
<td>OBSOLETE – superseded by G-354</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G-352</td>
<td>OBSOLETE – superseded by G-354</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G-353</td>
<td>Synthetic molybdenum disulphide aircraft grease</td>
<td>MIL-G-21164D</td>
<td>DEF STAN 91-57</td>
<td>XG-276</td>
<td>AeroShell Grease 17</td>
</tr>
<tr>
<td>G-354</td>
<td>Synthetic aircraft grease for aircraft and instruments</td>
<td>MIL-PRF-23827C</td>
<td>DEF STAN 91-53</td>
<td>XG-287</td>
<td>AeroShell Grease 7 AeroShell Grease 33</td>
</tr>
<tr>
<td>G-355</td>
<td>Graphited aircraft grease</td>
<td>MIL-G-7187 (Obsolete)</td>
<td>DEF STAN 91-54</td>
<td>XG-285</td>
<td>-</td>
</tr>
<tr>
<td>G-357</td>
<td>Graphited synthetic grease for flexible cables</td>
<td>-</td>
<td>DEF STAN 91-85</td>
<td>XG-273</td>
<td>-</td>
</tr>
<tr>
<td>G-359</td>
<td>High temperature aircraft grease</td>
<td>MIL-G-3545C (Obsolete)</td>
<td>DTD. 878A (Obsolete)</td>
<td>XG-277 (Obsolete)</td>
<td>AeroShell Grease 5</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------</td>
<td>-------------------------------------------</td>
<td>----------------------------------</td>
<td>---------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>G-361</td>
<td>Wide temperature range synthetic aircraft grease</td>
<td>MIL-G-25760A (Obsolete)</td>
<td>DTD.5579 (Obsolete)</td>
<td>XG-292 (Obsolete)</td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td>G-363</td>
<td>Hydrocarbon resistant plug grease</td>
<td>SAE-AMS-G-6032</td>
<td>DEF STAN 91-6</td>
<td>XG-235</td>
<td>AeroShell Grease 5.7108</td>
</tr>
<tr>
<td>G-366</td>
<td>Helicopter oscillating bearing grease</td>
<td>MIL-G-25537C</td>
<td>DEF STAN 91-51</td>
<td>XG-284</td>
<td>AeroShell Grease 14</td>
</tr>
<tr>
<td>G-372</td>
<td>High temperature synthetic grease</td>
<td>MIL-G-25013E</td>
<td>DEF STAN 91-55 (Obsolete)</td>
<td>XG-300</td>
<td>AeroShell Grease 15</td>
</tr>
<tr>
<td>G-382</td>
<td>Aircraft general purpose grease</td>
<td>MIL-G-7711A (Obsolete)</td>
<td>DEF STAN 91-12</td>
<td>XG-271</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>G-394</td>
<td>Silicone based grease for pneumatic systems</td>
<td></td>
<td>DEF STAN 91-56</td>
<td>XG-315</td>
<td></td>
</tr>
<tr>
<td>G-395</td>
<td>Multi-purpose aircraft grease</td>
<td>MIL-PRF-81322F NLGI Grade 2</td>
<td>DEF STAN 91-52</td>
<td>XG-293</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>G-396</td>
<td>Aircraft grease PTFE</td>
<td>MIL-PRF-83363C</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>G-397</td>
<td>Grease fuel and oil resistant, liquid oxygen compatible</td>
<td>MIL-PRF-27617F Type I</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>G-398</td>
<td>Grease liquid oxygen compatible</td>
<td>MIL-PRF-27617F Type II</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>G-399</td>
<td>Grease liquid oxygen compatible</td>
<td>MIL-PRF-27617F Type III</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>G-403</td>
<td>All purpose grease</td>
<td>MIL-PRF-10924G</td>
<td>DEF STAN 91-27</td>
<td>XG-279</td>
<td></td>
</tr>
<tr>
<td>G-408</td>
<td>Graphite grease</td>
<td>VV-G-671F Grade 1</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>G-421</td>
<td>Grease, general use</td>
<td>–</td>
<td>DEF STAN 91-105</td>
<td>XG-291</td>
<td></td>
</tr>
<tr>
<td>G-450</td>
<td>Multi-purpose quiet service grease</td>
<td>MIL-PRF-24139A (Obsolete)</td>
<td>DEF STAN 91-28 (Obsolete)</td>
<td>XG-274 (Obsolete)</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>G-1350</td>
<td>Grease liquid oxygen compatible</td>
<td>MIL-PRF-27617F Type IV</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>H-515</td>
<td>Hydraulic fluid, petroleum base, improved cleanliness and performance</td>
<td>MIL-PRF-5606H</td>
<td>DEF STAN 91-48 Grade Superclean</td>
<td>OM-15</td>
<td>AeroShell Fluid 41</td>
</tr>
<tr>
<td>H-520</td>
<td>Hydraulic fluid, petroleum base, improved performance</td>
<td>–</td>
<td>DEF STAN 91-48 Grade Normal</td>
<td>OM-18</td>
<td>AeroShell Fluid 41*</td>
</tr>
<tr>
<td>H-535</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>H-536</td>
<td>Hydraulic fluid, chlorinated silicone</td>
<td>MIL-S-81087C (Type I)</td>
<td>MIL-S-81087C</td>
<td>OX-50</td>
<td></td>
</tr>
<tr>
<td>H-537</td>
<td>Hydraulic fluid, fire resistant synthetic hydrocarbon</td>
<td>MIL-PRF-83282D</td>
<td>(MIL-PRF-83282D)</td>
<td>OX-19</td>
<td>AeroShell Fluid 31</td>
</tr>
<tr>
<td>H-538</td>
<td>Low temperature synthetic hydrocarbon hydraulic fluid</td>
<td>MIL-PRF-87257A</td>
<td>(MIL-PRF-87257A)</td>
<td>OX-538</td>
<td>AeroShell Fluid 51</td>
</tr>
<tr>
<td>H-540</td>
<td>Petroleum hydraulic fluid</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>H-544</td>
<td>Preservative grade fire resistant synthetic hydrocarbon hydraulic fluid</td>
<td>MIL-PRF-46170C Type I</td>
<td>–</td>
<td>–</td>
<td>AeroShell Fluid 61</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>H-575</td>
<td>Inhibited petroleum hydraulic oil</td>
<td>MIL-PRF-17672D</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>H-578</td>
<td>Power transmission fluid</td>
<td>MILDL-17111C</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>H-579</td>
<td>Fire resistant hydraulic fluid, water glycol</td>
<td>MIL-H-22072C</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>H-580</td>
<td>Hydraulic fluid, phosphate ester fire resistant</td>
<td>MIL-H-19457D</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>O-113</td>
<td>Lubricating oil for aircraft piston engines – SAE 30</td>
<td>SAE J-1966 Grade SAE 30</td>
<td>–</td>
<td>OM-107 (Obsolete)</td>
<td>AeroShell Oil 65</td>
</tr>
<tr>
<td>O-115</td>
<td>Lubricating oil for aircraft piston engines – SAE 40</td>
<td>SAE J-1966 Grade SAE 40</td>
<td>SAE J-1966 Grade SAE 40</td>
<td>OM-170</td>
<td>AeroShell Oil 80</td>
</tr>
<tr>
<td>O-117</td>
<td>Lubricating oil for aircraft piston engines – SAE 50</td>
<td>SAE J-1966 Grade SAE 50</td>
<td>SAE J-1966 Grade SAE 50</td>
<td>OM-270</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td>O-123</td>
<td>Lubricating oil for aircraft piston engines – dispersant Grade SAE 40</td>
<td>SAE J-1899 Grade SAE 40</td>
<td>SAE J-1899 Grade SAE 40</td>
<td>OMD-160</td>
<td>AeroShell Oil W80</td>
</tr>
<tr>
<td>O-125</td>
<td>Lubricating oil for aircraft piston engines – dispersant Grade SAE 50</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>OMD-250</td>
<td>AeroShell Oil W100 Plus</td>
</tr>
<tr>
<td>O-128</td>
<td>Lubricating oil for aircraft piston engines – dispersant Grade SAE 60</td>
<td>SAE J-1899 Grade SAE 60</td>
<td>SAE J-1899 Grade SAE 60</td>
<td>OMD-370</td>
<td>AeroShell Oil W120</td>
</tr>
<tr>
<td>O-132</td>
<td>Mineral lubricating oil for aircraft turbine engines – petroleum Grade 1005</td>
<td>MIL-PRF-6081D Grade 1005</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>O-133</td>
<td>Mineral lubricating oil for aircraft turbine engines – petroleum Grade 1010</td>
<td>MIL-PRF-6081D Grade 1010</td>
<td>–</td>
<td>OM-10 (Obsolete)</td>
<td>AeroShell Turbine Oil 2</td>
</tr>
<tr>
<td>O-134</td>
<td>General purpose lubricating oil</td>
<td>–</td>
<td>DEF STAN 91-44</td>
<td>OM-13</td>
<td>AeroShell Fluid 1 (AeroShell Turbine Oil 1)</td>
</tr>
<tr>
<td>O-135</td>
<td>Mineral lubricating oil for aircraft turbine engines – 3mm/5s viscosity</td>
<td>–</td>
<td>DEF STAN 91-99</td>
<td>OM-11</td>
<td>AeroShell Turbine Oil 3</td>
</tr>
<tr>
<td>O-138</td>
<td>Mineral lubricating oil for aircraft turbine engines – 9mm/5s viscosity</td>
<td>–</td>
<td>DEF STAN 91-97</td>
<td>OM-71</td>
<td>–</td>
</tr>
<tr>
<td>O-140</td>
<td>Low temperature oil for aircraft controls</td>
<td>–</td>
<td>DTD.417B</td>
<td>OM-150</td>
<td>–</td>
</tr>
<tr>
<td>O-142</td>
<td>General purpose low temperature lubricating oil</td>
<td>MIL-PRF-7870C</td>
<td>DEF STAN 91-47</td>
<td>OM-12</td>
<td>AeroShell Fluid 3</td>
</tr>
<tr>
<td>O-147</td>
<td>Lubricating oil for aircraft instruments</td>
<td>MIL-PRF-6085D</td>
<td>DEF STAN 91-49</td>
<td>OX-14</td>
<td>AeroShell Fluid 12</td>
</tr>
<tr>
<td>O-148</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – 3mm/5s viscosity</td>
<td>MIL-PRF-7808L Grade 3</td>
<td>MIL-PRF-7808L Grade 3</td>
<td>OX-9</td>
<td>AeroShell Turbine Oil 308</td>
</tr>
<tr>
<td>O-149</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – 7.5 mm/5s viscosity</td>
<td>–</td>
<td>DEF STAN 91-98</td>
<td>OX-38</td>
<td>AeroShell Turbine Oil 750</td>
</tr>
<tr>
<td>O-150</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – 3mm/5s viscosity</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>O-152</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – corrosion inhibited 5 mm/5s</td>
<td>MIL-PRF-23699F Grade C/I</td>
<td>–</td>
<td>–</td>
<td>AeroShell Turbine Oil 531</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------</td>
<td>--------------------------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>O-153</td>
<td>Extreme pressure gear oil – light grade</td>
<td>MIL-PRF-6086E Grade L</td>
<td>DEF STAN 91-112 Grade Light</td>
<td>OEP-30</td>
<td>AeroShell Fluid SL-A</td>
</tr>
<tr>
<td>O-154</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – high thermal stability 5 mm²/s viscosity</td>
<td>MIL-PRF-23699F Grade HTS</td>
<td>-</td>
<td>-</td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td>O-155</td>
<td>Extreme pressure gear oil – medium grade</td>
<td>MIL-PRF-6086E Grade M</td>
<td>DEF STAN 91-112 Grade Medium</td>
<td>OEP-70</td>
<td>AeroShell Fluid SMA</td>
</tr>
<tr>
<td>O-156</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – 5 mm²/s viscosity standard grade</td>
<td>MIL-PRF-23699F Grade STD</td>
<td>DEF STAN 91-101 Ox-27</td>
<td>OX-27</td>
<td>AeroShell Turbine Oil 500</td>
</tr>
<tr>
<td>O-157</td>
<td>Low temperature oil for aircraft weapons</td>
<td>MIL-PRF-14107D</td>
<td>DEF STAN 91-102 Ox-24</td>
<td>AeroShell Fluid 18*</td>
<td></td>
</tr>
<tr>
<td>O-158</td>
<td>Low temperature lubrication of automatic weapons</td>
<td>MIL-L-46000C (MIL-L-46000C)</td>
<td>XG-485 (Obsolete)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>O-159</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – 7.5 mm²/s viscosity</td>
<td>-</td>
<td>-</td>
<td>AeroShell Turbine Oil 750*</td>
<td></td>
</tr>
<tr>
<td>O-160</td>
<td>Synthetic ester lubricating oil for aircraft turbine engines – 5 mm²/s viscosity</td>
<td>-</td>
<td>DEF STAN 91-100 Ox-26</td>
<td>AeroShell Turbine Oil 555</td>
<td></td>
</tr>
<tr>
<td>O-162</td>
<td>Lubricating oil for aircraft piston engines, ashless dispersant SAE 15W-50</td>
<td>SAE J-1899 SAE Multigrade</td>
<td>-</td>
<td>OMD-162</td>
<td>AeroShell Oil W 15W-50</td>
</tr>
<tr>
<td>O-163</td>
<td>Synthetic engine oil for military gas turbines</td>
<td>MIL-PRF-7808L Grade 4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>O-184</td>
<td>OBSOLETE – superseded by O-226</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>O-186</td>
<td>Gear lubricant for very cold ambient temperatures</td>
<td>MIL-L-2105D Grade 75</td>
<td>DEF STAN 91-59 OEP-38</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>O-190</td>
<td>General purpose oil and preservative, water displacing low temperature</td>
<td>MIL-PRF-32033</td>
<td>DEF STAN 91-79 Ox-18 (Obsole)</td>
<td>AeroShell Fluid 18</td>
<td></td>
</tr>
<tr>
<td>O-192</td>
<td>Preservative lubricating oil – medium</td>
<td>MIL-PRF-3150D</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>O-196</td>
<td>General purpose light oil</td>
<td>VV-L-820C (Cancelled)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>O-218</td>
<td>Lubricating oil, colloidal graphite</td>
<td>-</td>
<td>DEF STAN 91-30 Ox-32 (Cancelled)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>S-712</td>
<td>Aircraft compass liquid (mineral type)</td>
<td>MIL-L-5020C</td>
<td>OM-1</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>S-716</td>
<td>Anti-seize compound (lead free)</td>
<td>TT-S-1732 (Cancelled)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>S-717</td>
<td>Anti-seize compound for aircraft oxygen systems</td>
<td>MIL-L-5542E (Cancelled)</td>
<td>-</td>
<td>ZX-32 (Obsolete)</td>
<td></td>
</tr>
<tr>
<td>S-718</td>
<td>Aqueous colloidal graphite for screw threads of low pressure oxygen cylinders</td>
<td>DTD.900/4042A</td>
<td>ZX-24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-720</td>
<td>Aircraft grease for sparking plugs and other threads</td>
<td>SAE-AMS-2518A</td>
<td>DEF STAN 80-80 ZX-13</td>
<td>AeroShell Compound 08</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>S-722</td>
<td>Molybdenum disulphide anti-seize compound for heavily loaded surfaces</td>
<td>DEF STAN 80-81</td>
<td></td>
<td>ZX-38</td>
<td>AeroShell Grease S.4768</td>
</tr>
<tr>
<td>S-725</td>
<td>OBSOLETE – superseded by S-716</td>
<td>DEF STAN 96-1</td>
<td></td>
<td>ZX-20 (Obsolete)</td>
<td>–</td>
</tr>
<tr>
<td>S-732</td>
<td>Lubricating graphite</td>
<td>SS-G-659A</td>
<td>DEF STAN 68-69</td>
<td>XG-250</td>
<td>–</td>
</tr>
<tr>
<td>S-736</td>
<td>Insulating compound for use in assembly of ignition harness</td>
<td>DEF STAN 68-69</td>
<td></td>
<td>XG-250</td>
<td>–</td>
</tr>
<tr>
<td>S-738</td>
<td>Denatured ethyl alcohol (de-icing fluid) for aircraft windcreens and carburettors</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-740</td>
<td>Molybdenum disulphide powder</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-742</td>
<td>De-icing and defrosting fluid</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-743</td>
<td>Technical petrolatum</td>
<td>DEF STAN 68-62</td>
<td></td>
<td>XG-250</td>
<td>–</td>
</tr>
<tr>
<td>S-745</td>
<td>De-icing/defrosting fluid</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-746</td>
<td>Isopropyl nitrate</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-747</td>
<td>Methanol for use in methanol water mixtures and anti-freeze solutions</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-748</td>
<td>Fuel system icing inhibitor (ethylene glycol monomethyl ether)</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-749</td>
<td>Lubricant, solid film, air drying</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-752</td>
<td>White spirit, flashpoint 38°C</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-756</td>
<td>Transformer oil</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-757</td>
<td>Inhibited ethenol</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-758</td>
<td>Lubricant, cleaner and preservative for weapons</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-761</td>
<td>Multifunctional synthetic lubricant for weapons</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1712</td>
<td>Damping fluid, dimethyl silicone Grade 3</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1714</td>
<td>Damping fluid, dimethyl silicone Grade 10</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1716</td>
<td>Damping fluid, dimethyl silicone Grade 20</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1718</td>
<td>Damping fluid, dimethyl silicone Grade 50</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1720</td>
<td>Damping fluid, dimethyl silicone Grade 750</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1722</td>
<td>Damping fluid, dimethyl silicone Grade 2000</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1724</td>
<td>Damping fluid, dimethyl silicone Grade 750</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>S-1726</td>
<td>Damping fluid, dimethyl silicone Grade 2000</td>
<td>DEF STAN 91-38 Grade B</td>
<td>DEF STAN 91-89</td>
<td>AL-11</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>S-1728</td>
<td>Damping fluid, dimethyl silicone Grade 100000</td>
<td>VVD-1078B</td>
<td>DEF STAN 91-46</td>
<td>ZX-52</td>
<td>–</td>
</tr>
<tr>
<td>S-1730</td>
<td>OBSOLETE (Damping fluid, dimethyl silicone)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>S-1732</td>
<td>Damping fluid, dimethyl silicone Grade 200000</td>
<td>VVD-1078B</td>
<td>DEF STAN 91-46</td>
<td>ZX-53</td>
<td>–</td>
</tr>
<tr>
<td>S-1734</td>
<td>OBSOLETE (Damping fluid, dimethyl silicone)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>S-1735</td>
<td>Molybdenum disulphide lubricant, silicone base</td>
<td>DOD-L-25681D</td>
<td>(DOD-L-25681D)</td>
<td>OX-70</td>
<td>–</td>
</tr>
<tr>
<td>S-1737</td>
<td>Lubricant solid film, extreme environment</td>
<td>MIL-PRF-81329D</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>S-1738</td>
<td>Heat cured solid film lubricant</td>
<td>MIL-PRF-46010F Type 1</td>
<td>–</td>
<td>ZX-34</td>
<td>–</td>
</tr>
<tr>
<td>S-1739</td>
<td>Demineralised water</td>
<td>–</td>
<td>DEF STAN 68-253</td>
<td>WTA</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>S-1740</td>
<td>OBSOLETE</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>S-1746</td>
<td>De-icing/Defrosting fluid</td>
<td>–</td>
<td>DTD.900/4907</td>
<td>AL-34</td>
<td>–</td>
</tr>
<tr>
<td>S-1747</td>
<td>Corrosion inhibitor/lubricity additive for jet fuel</td>
<td>MIL-PRF-25017F</td>
<td>DEF STAN 68-251</td>
<td>AL-61</td>
<td>–</td>
</tr>
<tr>
<td>S-1748</td>
<td>Coolant fluid, hydrolytically stable, dielectric</td>
<td>MIL-PRF-87252C</td>
<td>–</td>
<td>–</td>
<td>AeroShell Fluid 602</td>
</tr>
<tr>
<td>S-1749</td>
<td>Jet fuel thermal stability improver additive</td>
<td>MIL-DTL-83133E</td>
<td>–</td>
<td>–</td>
<td>AeroShell Performance Additive 101</td>
</tr>
</tbody>
</table>
BRITISH JOINT SERVICE DESIGNATIONS

SCOPE OF LIST
This list comprises the British Joint Service Designations which cover aviation fuels, engine oils, hydraulic fluids, greases and allied products.

INTERPRETATION OF LIST
The Joint Service Designations are allocated to grades which meet British Specifications (or those U.S. Specifications which have been adopted by the U.K.) and are supplied to the British Services. Hence only British Specifications are shown. However, in some cases the British Ministry of Defence uses U.S. Specifications and these are included for completeness.

Where an asterisk * appears in the last column of the list, the AeroShell grade recommended does not necessarily meet all the clauses of the official specification, but is the nearest product marketed by Shell.

For easy reference, obsolete specifications are shown in both the current and superseded specification columns. In the former case, a suitable comment is made, namely, “OBSOLETE - superseded by…”
<table>
<thead>
<tr>
<th>Joint Service Designation</th>
<th>British Specification</th>
<th>NATO Code</th>
<th>Product and Application</th>
<th>AeroShell Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIESO F-76</td>
<td>DEF STAN 91-4</td>
<td>F-76</td>
<td>Alternative turbine/diesel engine fuel for use in certain Naval helicopters</td>
<td>–</td>
</tr>
<tr>
<td>73 AVGAS</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>80 NL AVGAS</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>91/96 AVGAS</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>AVGAS 80</td>
<td>DEF STAN 91-90</td>
<td>F-12</td>
<td>Aviation gasoline, Grade 80</td>
<td>–</td>
</tr>
<tr>
<td>AVGAS 100</td>
<td>DEF STAN 91-90</td>
<td>–</td>
<td>Aviation gasoline, Grade 100/130</td>
<td>Shell Avgas 100</td>
</tr>
<tr>
<td>AVGAS 100LL</td>
<td>DEF STAN 91-90</td>
<td>F-18</td>
<td>Aviation gasoline, Grade 100/130 (low lead)</td>
<td>Shell Avgas 100LL</td>
</tr>
<tr>
<td>AVTAG/FSII</td>
<td>DEF STAN 91-88</td>
<td>F-40</td>
<td>Wide cut gasoline type fuel, with fuel system icing inhibitor</td>
<td>–</td>
</tr>
<tr>
<td>AVTUR/FSII</td>
<td>DEF STAN 91-87</td>
<td>F-34</td>
<td>Kerosine type fuel (−47°C freeze point) with fuel system icing inhibitor</td>
<td>Shell JP-8 Special arrangements necessary</td>
</tr>
<tr>
<td>AVCAT (Obsolete)</td>
<td>DERD 2498 (Obsolete)</td>
<td>F-43</td>
<td>High flash kerosine type fuel (−46°C freeze point). Replaced by AVCAT/FSII</td>
<td>–</td>
</tr>
<tr>
<td>AVCAT/FSII</td>
<td>DEF STAN 91-86</td>
<td>F-44</td>
<td>High flash kerosine type fuel (−46°C freeze point) with fuel system icing inhibitor</td>
<td>Shell JP-5 Special arrangements necessary</td>
</tr>
<tr>
<td>AVPIN</td>
<td>DEF STAN 91-89</td>
<td>S-746</td>
<td>Turbine engine starter fuel (isopropyl nitrate)</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>British Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>AVTUR</td>
<td>DEF STAN 91-91</td>
<td>F-35</td>
<td>Aviation turbine fuel – kerosine type (~47°C freeze point)</td>
<td>Shell Jet A-1, Shell AeroJet*</td>
</tr>
<tr>
<td>WTA</td>
<td>DEF STAN 62-253</td>
<td>S-1739</td>
<td>Pure water for thrust augmentation</td>
<td>–</td>
</tr>
<tr>
<td>White Spirit</td>
<td>BS.245:76 Type 1</td>
<td>S-752</td>
<td>White spirit</td>
<td>Shell White Spirit</td>
</tr>
<tr>
<td>AL-3 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>Inhibited aircraft engine coolant and general purpose anti-freeze fluid</td>
<td>–</td>
</tr>
<tr>
<td>AL-5</td>
<td>DTD.406B</td>
<td>S-745</td>
<td>De-icing fluid</td>
<td>AeroShell Compound 07</td>
</tr>
<tr>
<td>AL-7</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>AL-8</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by AL-11</td>
<td>–</td>
</tr>
<tr>
<td>AL-9</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by AL-14</td>
<td>–</td>
</tr>
<tr>
<td>AL-11</td>
<td>BS.1595.86</td>
<td>S-737</td>
<td>Isopropyl alcohol anti-icing fluid</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>AL-14</td>
<td>BS.506:87</td>
<td>S-747</td>
<td>Methanol</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>AL-20</td>
<td>DEF STAN 68-108</td>
<td>–</td>
<td>Ethanol (used in DTD.406B)</td>
<td>–</td>
</tr>
<tr>
<td>AL-24 (Obsolete)</td>
<td>DEF STAN 68-253</td>
<td>–</td>
<td>Methanol/water mixture for certain aircraft piston engines</td>
<td>–</td>
</tr>
<tr>
<td>AL-26</td>
<td>DEF STAN 68-61</td>
<td>–</td>
<td>Coolant fluid – inhibited</td>
<td>–</td>
</tr>
<tr>
<td>AL-28</td>
<td>DEF STAN 68-253</td>
<td>S-1744</td>
<td>43.8% vol. Methanol/56.2% vol. Water mixture</td>
<td>Shell Methanol Mixture 45/55/0</td>
</tr>
<tr>
<td>AL-29</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>AL-31 (Obsolete)</td>
<td>DERD 2451 (Obsolete)</td>
<td>S-748 (Obsolete)</td>
<td>Fuel system icing inhibitor (ethylene glycol monomethyl ether). Superseded by AL-41</td>
<td>–</td>
</tr>
<tr>
<td>AL-32</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>AL-33</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>AL-34</td>
<td>DTD.900/4907</td>
<td>S-1746</td>
<td>For anti-icing and de-icing parked aircraft</td>
<td>–</td>
</tr>
<tr>
<td>AL-36</td>
<td>DTD.900/4939A</td>
<td>–</td>
<td>Windscreen washing fluid for certain aircraft</td>
<td>–</td>
</tr>
<tr>
<td>AL-38 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by AL-48</td>
<td>–</td>
</tr>
<tr>
<td>AL-39</td>
<td>DEF STAN 68-127</td>
<td>S-757</td>
<td>Anti-freeze, inhibited ethanediol</td>
<td>–</td>
</tr>
<tr>
<td>AL-40</td>
<td>DEF STAN 68-129</td>
<td>–</td>
<td>Methanol/water mixture for hydrogen generation</td>
<td>–</td>
</tr>
<tr>
<td>AL-41</td>
<td>DEF STAN 68-252</td>
<td>S-1745</td>
<td>High flash fuel system icing inhibitor (di-ethylene glycol monomethyl ether)</td>
<td>–</td>
</tr>
<tr>
<td>AL-48</td>
<td>DEF STAN 68-150</td>
<td>–</td>
<td>Mixture of AL-41 and AL-61</td>
<td>–</td>
</tr>
<tr>
<td>AL-61</td>
<td>DEF STAN 68-251</td>
<td>S-1747</td>
<td>Corrosion inhibitor/lubricity additive for jet fuel</td>
<td>–</td>
</tr>
<tr>
<td>OEP-30</td>
<td>DEF STAN 91-112 Grade L</td>
<td>O-153</td>
<td>EP gear lubricant of light viscosity</td>
<td>AeroShell Fluid 5L-A</td>
</tr>
<tr>
<td>OEP-38</td>
<td>DEF STAN 91-59</td>
<td>O-186</td>
<td>Gear lubricant for very cold ambient temperatures</td>
<td>–</td>
</tr>
<tr>
<td>OEP-70</td>
<td>DEF STAN 91-112 Grade M</td>
<td>O-155</td>
<td>EP gear lubricant of medium viscosity</td>
<td>AeroShell Fluid 5M-A</td>
</tr>
<tr>
<td>OEP-71</td>
<td>DEF STAN 91-97</td>
<td>O-136</td>
<td>Mineral lubricating oil for aircraft, 9 mm²/s viscosity</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>OEP-215</td>
<td>DTD.900/4981A</td>
<td>–</td>
<td>Helicopter gearbox oil for certain Westland helicopters</td>
<td>AeroShell Fluid S.8350</td>
</tr>
<tr>
<td>OF-4 (Obsolete)</td>
<td>DTD.900/4081A (Obsolete)</td>
<td>–</td>
<td>Proprietary aircraft hydraulic fluid (castor oil base). Specification now cancelled; replaced by OX-87</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>British Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>OM-1</td>
<td>MIL-L-5020C</td>
<td>S-712</td>
<td>Aircraft compass fluid, U.K. has adopted U.S. specification</td>
<td>–</td>
</tr>
<tr>
<td>OM-3</td>
<td>–</td>
<td>–</td>
<td>OBsolete</td>
<td>–</td>
</tr>
<tr>
<td>OM-10 (Obsolete)</td>
<td>–</td>
<td>O-133</td>
<td>Mineral lubricating oil for turbine engines, 2 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 2*</td>
</tr>
<tr>
<td>OM-11</td>
<td>DEF STAN 91-99</td>
<td>O-135</td>
<td>Mineral aviation turbine oil, 3 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 3</td>
</tr>
<tr>
<td>OM-12</td>
<td>DEF STAN 91-47</td>
<td>O-142</td>
<td>General purpose low temperature lubricating oil</td>
<td>AeroShell Fluid 3</td>
</tr>
<tr>
<td>OM-13</td>
<td>DEF STAN 91-44</td>
<td>O-134</td>
<td>Light lubricating oil</td>
<td>AeroShell Fluid 1 (AeroShell Turbine Oil 3)</td>
</tr>
<tr>
<td>OM-15</td>
<td>DEF STAN 91-48 Grade Superclean</td>
<td>H-515</td>
<td>Extreme low temperature mineral hydraulic fluid of improved cleanliness and performance</td>
<td>AeroShell Fluid 41 (European production only, U.S. production is equivalent)</td>
</tr>
<tr>
<td>OM-16</td>
<td>BS.148.84</td>
<td>S-756</td>
<td>Oil for electrical purposes</td>
<td>Shell Diala Oil B*</td>
</tr>
<tr>
<td>OM-18</td>
<td>DEF STAN 91-48 Grade Normal</td>
<td>H-520</td>
<td>Hydraulic fluid – petroleum base of improved performance</td>
<td>AeroShell Fluid 41* AeroShell Fluid 4 (European production only)</td>
</tr>
<tr>
<td>OM-21 (Obsolete)</td>
<td>BS.4475.75</td>
<td>–</td>
<td>Flushing oil. Specification now obsolete.</td>
<td>–</td>
</tr>
<tr>
<td>OM-22</td>
<td>BS.148.84</td>
<td>–</td>
<td>Transformer oil for aircraft electrical equipment [pour point –45°C max]</td>
<td>Shell Diala Oil B* or D*</td>
</tr>
<tr>
<td>OM-33</td>
<td>DEF STAN 91-39</td>
<td>H-576</td>
<td>General purpose hydraulic oil</td>
<td>–</td>
</tr>
<tr>
<td>OM-71</td>
<td>DEF STAN 91-97</td>
<td>O-138</td>
<td>Mineral lubricating oil for miscellaneous applications</td>
<td>–</td>
</tr>
<tr>
<td>OM-107 (Obsolete)</td>
<td>–</td>
<td>O-113</td>
<td>Lubricating oil for aircraft piston engines. SAE 30 Grade.</td>
<td>AeroShell Oil 65</td>
</tr>
<tr>
<td>OM-150</td>
<td>DTD.4179 (DEF STAN 91-114 in preparation)</td>
<td>O-140</td>
<td>Lubricating oil for aircraft controls</td>
<td>–</td>
</tr>
<tr>
<td>OM-170</td>
<td>SAE J-1966 Grade SAE 40</td>
<td>O-115</td>
<td>Lubricating oil for aircraft piston engines. SAE 40 Grade.</td>
<td>AeroShell Oil 80</td>
</tr>
<tr>
<td>OM-270</td>
<td>SAE J-1966 Grade SAE 50</td>
<td>O-117</td>
<td>Lubricating oil for aircraft piston engines. SAE 50 Grade.</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td>OM-370 (Obsolete)</td>
<td>SAE J-1966 Grade SAE 60</td>
<td>–</td>
<td>Lubricating oil for aircraft piston engines. SAE 60 Grade.</td>
<td>AeroShell Oil 120</td>
</tr>
<tr>
<td>OMD-160</td>
<td>SAE J-1899 Grade SAE 40</td>
<td>O-123</td>
<td>Lubricating oil for aircraft piston engines – ashless dispersant type. SAE 40 Grade.</td>
<td>AeroShell Oil W80</td>
</tr>
<tr>
<td>OMD-162</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>O-162</td>
<td>Lubricating oil for aircraft piston engines – ashless dispersant type. SAE 15W-50.</td>
<td>AeroShell Oil W15W-50</td>
</tr>
<tr>
<td>OMD-250</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>O-125</td>
<td>Lubricating oil for aircraft piston engines – ashless dispersant type. SAE 50 Grade.</td>
<td>AeroShell Oil W100 AeroShell Oil W100 Plus</td>
</tr>
<tr>
<td>OMD-270 (Obsolete)</td>
<td>DERD.2472B/2</td>
<td>O-127</td>
<td>OBsolete – Lubricating oil for aircraft piston engines.</td>
<td>–</td>
</tr>
<tr>
<td>OMD-370</td>
<td>SAE J-1899 Grade SAE 60</td>
<td>O-128</td>
<td>Lubricating oil for aircraft piston engines - ashless dispersant type SAE 60 Grade.</td>
<td>AeroShell Oil W120</td>
</tr>
<tr>
<td>OX-7</td>
<td>DEF STAN 91-94</td>
<td>–</td>
<td>Synthetic turbine oil 3 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 390</td>
</tr>
<tr>
<td>OX-9</td>
<td>MIL-PRF-7808L Grade 3</td>
<td>O-148</td>
<td>Synthetic turbine oil 3 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 308</td>
</tr>
<tr>
<td>OX-14</td>
<td>DEF STAN 91-49</td>
<td>O-147</td>
<td>Synthetic oil with additives – low volatility aircraft instrument oil</td>
<td>AeroShell Fluid 12*</td>
</tr>
<tr>
<td>OX-15</td>
<td>–</td>
<td>–</td>
<td>OBsolete – superseded by PX-26</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>British Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>OX-16</td>
<td>DTD.900/4386A</td>
<td>–</td>
<td>Silicone damping fluid</td>
<td>–</td>
</tr>
<tr>
<td>OX-18 (Obsolete)</td>
<td>DEF STAN 91-79 (Obsolete)</td>
<td>O-190</td>
<td>General purpose oil and preservative, water displacing low temperature</td>
<td>AeroShell Fluid 18</td>
</tr>
<tr>
<td>OX-20</td>
<td>DTD.900/4881D</td>
<td>–</td>
<td>Phosphate ester hydraulic fluid</td>
<td>–</td>
</tr>
<tr>
<td>OX-22</td>
<td>DEF STAN 91-93</td>
<td>O-291</td>
<td>Synthetic turbine oil for marine gas turbine engines</td>
<td>–</td>
</tr>
<tr>
<td>OX-23</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by OX-27</td>
<td>–</td>
</tr>
<tr>
<td>OX-24</td>
<td>DEF STAN 91-102</td>
<td>O-157</td>
<td>Low temperature oil for aircraft weapons</td>
<td>AeroShell Fluid 18*</td>
</tr>
<tr>
<td>OX-26</td>
<td>DEF STAN 91-100</td>
<td>O-160</td>
<td>Synthetic turbine oil 5 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 555</td>
</tr>
<tr>
<td>OX-27</td>
<td>DEF STAN 91-101 Grade OX-27</td>
<td>O-156</td>
<td>Synthetic turbine oil 5 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 500</td>
</tr>
<tr>
<td>OX-28</td>
<td>DEF STAN 91-101 Grade OX-28</td>
<td>–</td>
<td>Synthetic turbine oil 5 mm²/s viscosity for certain turbines</td>
<td>–</td>
</tr>
<tr>
<td>OX-30</td>
<td>DEF STAN 91-35</td>
<td>–</td>
<td>Emulsifying petroleum hydraulic fluid for use in certain types of radar equipment</td>
<td>–</td>
</tr>
<tr>
<td>OX-38</td>
<td>DEF STAN 91-98</td>
<td>O-149</td>
<td>Synthetic turbine oil 7.5 mm²/s viscosity</td>
<td>AeroShell Turbine Oil 750</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Joint Service Designation</th>
<th>British Specification</th>
<th>NATO Code</th>
<th>Product and Application</th>
<th>AeroShell Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>OX-87</td>
<td>DTD.900/6103A</td>
<td>–</td>
<td>Hydraulic fluid for certain aircraft</td>
<td>–</td>
</tr>
<tr>
<td>OX-125</td>
<td>DEF STAN 91-69 (Provisional)</td>
<td>–</td>
<td>Helicopter Transmission Lubricant (9 mm²/s)</td>
<td>–</td>
</tr>
<tr>
<td>OX-165</td>
<td>DEF STAN 91-71</td>
<td>–</td>
<td>Synthetic gear lubricating oil</td>
<td>–</td>
</tr>
<tr>
<td>OX-270 (Obsolete)</td>
<td>–</td>
<td>C-609</td>
<td>Corrosion preventive oil. Meets U.S. Specification MIL-C-6529C Type II.</td>
<td>AeroShell Fluid 2F</td>
</tr>
<tr>
<td>OX-275 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by PX-27</td>
<td>–</td>
</tr>
<tr>
<td>OX-320 (Obsolete)</td>
<td>DEF STAN 91-30</td>
<td>O-218</td>
<td>CANCELLED – lubricating oil, colloidal graphite</td>
<td>–</td>
</tr>
<tr>
<td>OX-538</td>
<td>(MIL-PRF-87257A)</td>
<td>H-538</td>
<td>Low temperature synthetic hydrocarbon hydraulic fluid</td>
<td>AeroShell Fluid 51</td>
</tr>
<tr>
<td>PX-1</td>
<td>DEF STAN 80-217</td>
<td>C-614</td>
<td>Lanolin/white spirit corrosion protective</td>
<td>AeroShell Compound 02</td>
</tr>
<tr>
<td>PX-2 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by PX-31</td>
<td>–</td>
</tr>
<tr>
<td>PX-3 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by PX-32 or PX-28</td>
<td>–</td>
</tr>
<tr>
<td>PX-4</td>
<td>DEF STAN 80-34</td>
<td>–</td>
<td>Corrosion preventive compound</td>
<td>–</td>
</tr>
<tr>
<td>PX-6</td>
<td>DEF STAN 91-38 Grade PX-6</td>
<td>–</td>
<td>Stiff tacky petrolatum. Used mainly as an ingredient of PX-11</td>
<td>–</td>
</tr>
<tr>
<td>PX-7</td>
<td>DEF STAN 91-38 Grade PX-7</td>
<td>S-743</td>
<td>Mineral petrolatum</td>
<td>–</td>
</tr>
<tr>
<td>PX-9 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by PX-28</td>
<td>–</td>
</tr>
<tr>
<td>PX-10 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by PX-24</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>British Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>PX-11</td>
<td>DEF STAN 80-85</td>
<td>C-628 (Obsolete)</td>
<td>Long term mineral jelly/beeswax protective</td>
<td>AeroShell Compound 05</td>
</tr>
<tr>
<td>PX-12</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by XG-250 for certain special applications</td>
<td>-</td>
</tr>
<tr>
<td>PX-13</td>
<td>DEF STAN 81-205</td>
<td>C-613</td>
<td>Wax thickened engine protective</td>
<td>-</td>
</tr>
<tr>
<td>PX-14</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by PX-4</td>
<td>-</td>
</tr>
<tr>
<td>PX-15</td>
<td>DEF STAN 80-145</td>
<td>-</td>
<td>Corrosion preventive</td>
<td>-</td>
</tr>
<tr>
<td>PX-19</td>
<td>DEF STAN 91-78</td>
<td>-</td>
<td>Soft film temporary protective</td>
<td>-</td>
</tr>
<tr>
<td>PX-24</td>
<td>DEF STAN 68-10</td>
<td>C-634</td>
<td>Water displacing and protective fluid. Also replaces PX-10 and PX-29</td>
<td>-</td>
</tr>
<tr>
<td>PX-25</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE</td>
<td>-</td>
</tr>
<tr>
<td>PX-26</td>
<td>DEF STAN 80-142</td>
<td>C-635</td>
<td>Preservative mineral hydraulic fluid</td>
<td>AeroShell Fluid 71*</td>
</tr>
<tr>
<td>PX-27</td>
<td>DEF STAN 91-40</td>
<td>C-615</td>
<td>Storage oil for piston engine preservation</td>
<td>-</td>
</tr>
<tr>
<td>PX-28</td>
<td>DEF STAN 80-143</td>
<td>-</td>
<td>Preservation for internal airframe surfaces</td>
<td>-</td>
</tr>
<tr>
<td>PX-29</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by PX-24</td>
<td>-</td>
</tr>
<tr>
<td>PX-30</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE</td>
<td>-</td>
</tr>
<tr>
<td>PX-31</td>
<td>DEF STAN 80-186</td>
<td>-</td>
<td>Corrosion preventive compound</td>
<td>-</td>
</tr>
<tr>
<td>PX-32</td>
<td>DEF STAN 80-83</td>
<td>-</td>
<td>Corrosion preventive compound for aircraft structures</td>
<td>-</td>
</tr>
<tr>
<td>PX-36</td>
<td>DEF STAN 91-103</td>
<td>-</td>
<td>Corrosion preventive, weapon cleaner, lubricant</td>
<td>-</td>
</tr>
<tr>
<td>XG-235</td>
<td>DEF STAN 91-6</td>
<td>G-363</td>
<td>Fuel and oil resistant grease</td>
<td>AeroShell Grease 5.7108</td>
</tr>
<tr>
<td>XG-250</td>
<td>DEF STAN 68-69</td>
<td>S-736</td>
<td>Compound for use in assembly of ignition harness</td>
<td>-</td>
</tr>
<tr>
<td>XG-261</td>
<td>-</td>
<td>-</td>
<td>Silicone grease</td>
<td>-</td>
</tr>
<tr>
<td>XG-265</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by XG-293</td>
<td>-</td>
</tr>
<tr>
<td>XG-271</td>
<td>DEF STAN 91-12</td>
<td>G-382</td>
<td>Aircraft general purpose grease</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>XG-273</td>
<td>DEF STAN 91-85</td>
<td>G-357 (Obsolete)</td>
<td>Lubrication of Bowden cables</td>
<td>-</td>
</tr>
<tr>
<td>XG-274</td>
<td>DEF STAN 91-28 (Obsolete)</td>
<td>G-450 (Obsolete)</td>
<td>Multi-purpose quiet service grease</td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td>XG-275</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by XG-287</td>
<td>-</td>
</tr>
<tr>
<td>XG-276</td>
<td>DEF STAN 91-57</td>
<td>G-353</td>
<td>Synthetic grease containing molybdenum disulphide.</td>
<td>-</td>
</tr>
<tr>
<td>XG-278</td>
<td>-</td>
<td>-</td>
<td>OBSOLETE – superseded by XG-287</td>
<td>-</td>
</tr>
<tr>
<td>XG-279</td>
<td>DEF STAN 91-27</td>
<td>G-403</td>
<td>All purpose grease</td>
<td>-</td>
</tr>
<tr>
<td>XG-284</td>
<td>DEF STAN 91-51</td>
<td>G-366</td>
<td>Aircraft anti-fret grease and helicopter general purpose grease</td>
<td>AeroShell Grease 14</td>
</tr>
<tr>
<td>XG-285</td>
<td>DEF STAN 91-54</td>
<td>G-355</td>
<td>Graphited grease for aircraft general use</td>
<td>-</td>
</tr>
<tr>
<td>XG-287</td>
<td>DEF STAN 91-53</td>
<td>G-354</td>
<td>Load carrying synthetic grease for aircraft gears</td>
<td>-</td>
</tr>
<tr>
<td>XG-291</td>
<td>DEF STAN 91-105</td>
<td>G-421</td>
<td>Grease, general use</td>
<td>-</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>British Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>XG-293</td>
<td>DEF STAN 91-52</td>
<td>G-395</td>
<td>Synthetic general purpose grease, wide temperature range</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>XG-294</td>
<td>DEF STAN 91-106</td>
<td>–</td>
<td>Grease, multi-purpose, elevated temperature range</td>
<td>–</td>
</tr>
<tr>
<td>XG-295 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by XG-287</td>
<td>–</td>
</tr>
<tr>
<td>XG-300</td>
<td>DEF STAN 91-55</td>
<td>G-372</td>
<td>Extreme high temperature ball and roller bearing grease. UK has adopted MILG-25013E</td>
<td>AeroShell Grease 15</td>
</tr>
<tr>
<td>XG-305</td>
<td>DEF STAN 91-64</td>
<td>–</td>
<td>Molybdenum disulphide grease</td>
<td>–</td>
</tr>
<tr>
<td>XG-315</td>
<td>DEF STAN 91-56</td>
<td>G-394</td>
<td>Silicone grease for metal to metal rubber lubrication</td>
<td>–</td>
</tr>
<tr>
<td>XG-329 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by XG-293</td>
<td>–</td>
</tr>
<tr>
<td>XG-344</td>
<td>DTD.900/4872A</td>
<td>–</td>
<td>Grease for certain turbine engine starters</td>
<td>–</td>
</tr>
<tr>
<td>XG-350 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by XG-271</td>
<td>–</td>
</tr>
<tr>
<td>XG-410</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by XG-235</td>
<td>–</td>
</tr>
<tr>
<td>XG-480 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>ZX-13</td>
<td>DEF STAN 80-80</td>
<td>S-720</td>
<td>Graphited anti-seize compound</td>
<td>AeroShell Compound 08</td>
</tr>
<tr>
<td>ZX-14 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by XG-235</td>
<td>–</td>
</tr>
<tr>
<td>ZX-17 (Obsolete)</td>
<td>–</td>
<td>C-610</td>
<td>Corrosion preventive oil for aircraft gas turbines</td>
<td>AeroShell Fluid 2T</td>
</tr>
<tr>
<td>ZX-20 (Obsolete)</td>
<td>DEF STAN 96-1 (Obsolete)</td>
<td>S-732</td>
<td>Graphite powder – lubricating grade</td>
<td>–</td>
</tr>
<tr>
<td>ZX-21 (Obsolete)</td>
<td>MIL-C-6529C Type I</td>
<td>C-608</td>
<td>Inhibited lubricating oil concentrate for engine protection. U.K. has adopted U.S. Specification.</td>
<td>AeroShell Fluid 2XN</td>
</tr>
<tr>
<td>ZX-24</td>
<td>DTD.900/4042A</td>
<td>S-718</td>
<td>Proprietary brand of aqueous colloidal graphite</td>
<td>–</td>
</tr>
<tr>
<td>ZX-28 G &amp; P (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>ZX-29 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE – superseded by PX-24</td>
<td>–</td>
</tr>
<tr>
<td>ZX-30</td>
<td>DTD.900/4639</td>
<td>–</td>
<td>Dry lubricating coating for certain metal parts</td>
<td>–</td>
</tr>
<tr>
<td>ZX-31 (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>OBSOLETE</td>
<td>–</td>
</tr>
<tr>
<td>ZX-33</td>
<td>DEF STAN 68-7</td>
<td>–</td>
<td>CANCELLED: Cleaning and lubricating compound.</td>
<td>–</td>
</tr>
<tr>
<td>ZX-34</td>
<td>SAE AS5272 Type 1</td>
<td>S-1738</td>
<td>Bonded dry film lubricant</td>
<td>–</td>
</tr>
<tr>
<td>ZX-35</td>
<td>DEF STAN 68-62</td>
<td>S-740</td>
<td>Molybdenum disulphide powder</td>
<td>–</td>
</tr>
<tr>
<td>ZX-36</td>
<td>DTD.900/4877A</td>
<td>–</td>
<td>Lubrication for fitting electrical cables in aircraft</td>
<td>–</td>
</tr>
<tr>
<td>ZX-38</td>
<td>DEF STAN 80-81</td>
<td>S-722</td>
<td>Anti-seize compound, molybdenum disulphide type</td>
<td>AeroShell Grease 5.4768</td>
</tr>
<tr>
<td>ZX-41</td>
<td>DEF STAN 91-46</td>
<td>S-1712</td>
<td>Damping fluid dimethyl silicone Grade 3</td>
<td>–</td>
</tr>
<tr>
<td>Joint Service Designation</td>
<td>British Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>ZX-42</td>
<td>DEF STAN 91-46</td>
<td>S-1714</td>
<td>Damping fluid dimethyl silicone Grade 10</td>
<td>–</td>
</tr>
<tr>
<td>ZX-43</td>
<td>DEF STAN 91-46</td>
<td>S-1716</td>
<td>Damping fluid dimethyl silicone Grade 20</td>
<td>–</td>
</tr>
<tr>
<td>ZX-44</td>
<td>DEF STAN 91-46</td>
<td>S-1718</td>
<td>Damping fluid dimethyl silicone Grade 50</td>
<td>–</td>
</tr>
<tr>
<td>ZX-45</td>
<td>DEF STAN 91-46</td>
<td>S-1720</td>
<td>Damping fluid dimethyl silicone Grade 100</td>
<td>–</td>
</tr>
<tr>
<td>ZX-46</td>
<td>DEF STAN 91-46</td>
<td>–</td>
<td>Damping fluid dimethyl silicone Grade 500</td>
<td>–</td>
</tr>
<tr>
<td>ZX-47</td>
<td>DEF STAN 91-46</td>
<td>–</td>
<td>Damping fluid dimethyl silicone Grade 1000</td>
<td>–</td>
</tr>
<tr>
<td>ZX-48</td>
<td>DEF STAN 91-46</td>
<td>S-1724</td>
<td>Damping fluid dimethyl silicone Grade 7500</td>
<td>–</td>
</tr>
<tr>
<td>ZX-49</td>
<td>DEF STAN 91-46</td>
<td>–</td>
<td>Damping fluid dimethyl silicone Grade 12500</td>
<td>–</td>
</tr>
<tr>
<td>ZX-50</td>
<td>DEF STAN 91-46</td>
<td>S-1726</td>
<td>Damping fluid dimethyl silicone Grade 20000</td>
<td>–</td>
</tr>
<tr>
<td>ZX-51</td>
<td>DEF STAN 91-46</td>
<td>–</td>
<td>Damping fluid dimethyl silicone Grade 60000</td>
<td>–</td>
</tr>
<tr>
<td>ZX-52</td>
<td>DEF STAN 91-46</td>
<td>S-1728</td>
<td>Damping fluid dimethyl silicone Grade 100000</td>
<td>–</td>
</tr>
<tr>
<td>ZX-53 (Obsolete)</td>
<td>DEF STAN 91-46</td>
<td>S-1732</td>
<td>Damping fluid dimethyl silicone Grade 200000</td>
<td>–</td>
</tr>
</tbody>
</table>
FRENCH SPECIFICATIONS

SCOPE OF LIST
This list covers French aviation specifications for aviation fuels, lubricants and allied products. The equivalent British and American specifications can be found elsewhere in this guide.

French specifications are being converted from Normes AIR (issued formerly by Delegation Generale pour l’Armement) to DCSEA (issued by Service des Essences des Armées). Since 1997, SEA has been responsible for writing these specifications.

Norme AIR have all been downgraded as non-suitable for new design. Nevertheless, they can still be used if there is no replacement specification.

According to SEA policy, it is no longer essential for a product to be manufactured in France to be approved to the French specification, either Norme AIR or DCSEA.
<table>
<thead>
<tr>
<th>French Specification</th>
<th>NATO Code</th>
<th>Product and Application</th>
<th>AeroShell Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR 1501 (Inactive)</td>
<td>C-614</td>
<td>Corrosion protective</td>
<td>AeroShell Compound 02</td>
</tr>
<tr>
<td>AIR 1502</td>
<td>C-629</td>
<td>Corrosion protective</td>
<td>–</td>
</tr>
<tr>
<td>AIR 1503/B Type A</td>
<td>C-615</td>
<td>Piston engine storage oil</td>
<td>–</td>
</tr>
<tr>
<td>AIR 1503/B Type B Concentrate (Inactive)</td>
<td>C-608</td>
<td>Piston engine storage oil</td>
<td>AeroShell Fluid 2XN</td>
</tr>
<tr>
<td>AIR 1503/B Type B (Inactive)</td>
<td>C-609</td>
<td>Piston engine storage oil</td>
<td>AeroShell Fluid 2F</td>
</tr>
<tr>
<td>AIR 1504/B</td>
<td>C-610</td>
<td>Turbine engine corrosion preventive</td>
<td>AeroShell Fluid 2T</td>
</tr>
<tr>
<td>AIR 1506/B (Obsolete)</td>
<td>C-635</td>
<td>Preservative mineral hydraulic fluid of improved cleanliness – superseded by DCSEA 535/A</td>
<td>AeroShell Fluid 71</td>
</tr>
<tr>
<td>AIR 3401/1 Grade 80/87 (Obsolete)</td>
<td>F-12 (Obsolete)</td>
<td>Aviation gasoline – Grade 80/87</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3401/1 Grade 100/130 (Obsolete)</td>
<td>F-18 (Obsolete)</td>
<td>Aviation gasoline – Grade 100/130 Low Lead – superseded by DCSEA 118/A</td>
<td>Shell AVGAS 100LL</td>
</tr>
<tr>
<td>AIR 3401/1 Grade 115/145 (Obsolete)</td>
<td>F-22 (Obsolete)</td>
<td>Aviation gasoline – Grade 115/145</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3404/C Grade F-43 (Obsolete)</td>
<td>F-43 (Obsolete)</td>
<td>Aviation turbine fuel – high flash type – superseded by DCSEA 144/A</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3404/C Grade F-44 (Obsolete)</td>
<td>F-44 (Obsolete)</td>
<td>Aviation turbine fuel – high flash type with fuel system icing inhibitor – superseded by DCSEA 144/A</td>
<td>Shell JP-5 Special arrangements necessary</td>
</tr>
<tr>
<td>French Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>AIR 3405/D Grade F-34 (Obsolete)</td>
<td>F-34</td>
<td>Aviation turbine fuel – kerosine type with fuel system icing inhibitor – superseded by DCSEA 134/A</td>
<td>Shell JP-B Special arrangements necessary</td>
</tr>
<tr>
<td>AIR 3405/D Grade F-35 (Obsolete)</td>
<td>F-35</td>
<td>Aviation turbine fuel – kerosine type – superseded by DCSEA 134/A</td>
<td>Shell Jet A-1 Shell AeroJet*</td>
</tr>
<tr>
<td>AIR 3407/B (Inactive)</td>
<td>–</td>
<td>Aviation turbine fuel – wide cut type with fuel system icing inhibitor</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3511/A</td>
<td>O-147</td>
<td>Low volatility aircraft instrument and general purpose oil</td>
<td>AeroShell Fluid 12</td>
</tr>
<tr>
<td>AIR 3512/A</td>
<td>O-138</td>
<td>Mineral turbine engine oil</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3513</td>
<td>–</td>
<td>Both AIR 3513 and AIR 3514 are very specialised. French Specifications required for a limited number of domestic applications. AIR 3513 specified a 3 mm/2/s synthetic oil and was originally covered by NATO Code O-148. By 1970 AIR 3513 was superseded by AIR 3514. Various AeroShell synthetic turbine oils are approved by brand name for the majority of engines for which AIR 3514 is specified.</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3514</td>
<td>O-150</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3515/B</td>
<td>O-135</td>
<td>3 mm/2/s mineral turbine engine oil</td>
<td>AeroShell Turbine Oil 3</td>
</tr>
<tr>
<td>AIR 3516/B</td>
<td>O-133</td>
<td>2 mm/2/s mineral turbine engine oil</td>
<td>AeroShell Turbine Oil 2</td>
</tr>
<tr>
<td>AIR 3517/B</td>
<td>O-159</td>
<td>7.5 mm/2/s synthetic turbine engine oil</td>
<td>AeroShell Turbine Oil 750</td>
</tr>
<tr>
<td>AIR 3520/B Grade H-515 (Obsolete)</td>
<td>H-515</td>
<td>Mineral hydraulic fluid of improved cleanliness – superseded by DCSEA 415/A</td>
<td>AeroShell Fluid 41</td>
</tr>
<tr>
<td>AIR 3520/B Grade H-520 (Obsolete)</td>
<td>H-520</td>
<td>Mineral hydraulic fluid – superseded by DCSEA 415/A</td>
<td>AeroShell Fluid 41 AerоShell Fluid 4</td>
</tr>
<tr>
<td>AIR 3525/B (Obsolete)</td>
<td>O-155</td>
<td>Extreme pressure oil for gearboxes – superseded by DCSEA 255/A</td>
<td>AeroShell Fluid 5A</td>
</tr>
<tr>
<td>AIR 3560/D Grade SAE 30 (Inactive)</td>
<td>O-113 (Obsolete)</td>
<td>Piston engine oil</td>
<td>AeroShell Oil 65</td>
</tr>
<tr>
<td>AIR 3560/D Grade SAE 40 (Inactive)</td>
<td>O-115 (Obsolete)</td>
<td>Piston engine oil</td>
<td>AeroShell Oil 80</td>
</tr>
<tr>
<td>AIR 3560/D Grade SAE 50 (Inactive)</td>
<td>O-117 (Obsolete)</td>
<td>Piston engine oil</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td>AIR 3565/A</td>
<td>S-743</td>
<td>Soft film protective</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3570 Grade SAE 40 (Inactive)</td>
<td>O-123 (Obsolete)</td>
<td>Ashless dispersant piston engine oil</td>
<td>AeroShell Oil W80</td>
</tr>
<tr>
<td>AIR 3570 Grade SAE 50 (Inactive)</td>
<td>O-125 (Obsolete)</td>
<td>Ashless dispersant piston engine oil</td>
<td>AeroShell Oil W100 AeroShell W100 Plus*</td>
</tr>
<tr>
<td>AIR 3570 Grade SAE 60 (Inactive)</td>
<td>O-128 (Obsolete)</td>
<td>Ashless dispersant piston engine oil</td>
<td>AeroShell Oil W120</td>
</tr>
<tr>
<td>AIR 3634</td>
<td>C-634</td>
<td>Corrosion preventive compound, water displacing</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3651/A (Methanol)</td>
<td>S-747</td>
<td>Methanol for use in methanol/water mixtures</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>AIR 3651/A (Water) (Inactive)</td>
<td>S-1739</td>
<td>Demineralised water</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>AIR 3651/A (60/40) (Inactive)</td>
<td>S-1741 (Obsolete)</td>
<td>Methanol/water mixture</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3651/A (50/50) (Inactive)</td>
<td>S-1742 (Obsolete)</td>
<td>Methanol/water mixture</td>
<td>–</td>
</tr>
<tr>
<td>French Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>AIR 3651/A (44/56)</td>
<td>S-1744</td>
<td>Methanol/water mixture</td>
<td>Shell Methanol Mixture 45/55/0</td>
</tr>
<tr>
<td>AIR 3652/B Grade S-748 (Obsolete)</td>
<td>S-748 [Obsolete]</td>
<td>Fuel system icing inhibitor</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3652/B grade S-1745 (Obsolete)</td>
<td>S-1745</td>
<td>High flash fuel system icing inhibitor for aviation turbine fuel (diethylene glycol monomethyl ether) – superseded by DCSEA 745/A</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3655/A</td>
<td>S-738</td>
<td>De-icing fluid</td>
<td>–</td>
</tr>
<tr>
<td>AIR 3660/A</td>
<td>S-737</td>
<td>De-icing fluid</td>
<td>AeroShell Compound 06A</td>
</tr>
<tr>
<td>AIR 4205/B</td>
<td>G-359</td>
<td>High temperature aircraft grease – superseded by DCSEA 359/A</td>
<td>AeroShell Grease 5</td>
</tr>
<tr>
<td>AIR 4206/B</td>
<td>G-355</td>
<td>Graphite grease – superseded by DCSEA 355/A</td>
<td>–</td>
</tr>
<tr>
<td>AIR 4207/A</td>
<td>G-361</td>
<td>Synthetic wide temperature range grease – superseded by DCSEA 361/A</td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td>AIR 4210/B</td>
<td>G-354</td>
<td>Synthetic grease – superseded by DCSEA 354/A</td>
<td>AeroShell Grease 7</td>
</tr>
<tr>
<td>AIR 4214/B (Obsolete)</td>
<td>G-363</td>
<td>Gasoline and oil resistant grease – superseded by DCSEA 363/A</td>
<td>AeroShell Grease 5.7108</td>
</tr>
<tr>
<td>AIR 4215/B (Obsolete)</td>
<td>G-382</td>
<td>Aircraft general purpose grease – superseded by DCSEA 382/A</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>AIR 4217/A</td>
<td>G-353</td>
<td>Molybdenum disulphide grease – superseded by DCSEA 353/A</td>
<td>AeroShell Grease 17</td>
</tr>
<tr>
<td>AIR 4222</td>
<td>G-395</td>
<td>Synthetic general purpose grease – superseded by DCSEA 395/A</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>AIR 4223</td>
<td>S-740</td>
<td>Molybdenum disulphide powder</td>
<td>–</td>
</tr>
<tr>
<td>AIR 4224</td>
<td>S-732</td>
<td>Graphite powder, lubricating</td>
<td>–</td>
</tr>
<tr>
<td>AIR 4225/B (Inactive)</td>
<td>G-350 [Obsolete]</td>
<td>Extreme pressure grease</td>
<td>–</td>
</tr>
<tr>
<td>AIR 4246</td>
<td>O-158</td>
<td>Lubricating oil, semi-fluid [−54°C to + 130°C]</td>
<td>–</td>
</tr>
<tr>
<td>AIR 4247/A</td>
<td>S-720</td>
<td>Graphited anti-seize compound</td>
<td>AeroShell Compound 08</td>
</tr>
<tr>
<td>AIR 8130</td>
<td>C-630</td>
<td>Corrosion preventive soluble oil</td>
<td>–</td>
</tr>
<tr>
<td>AIR 8132</td>
<td>C-620</td>
<td>Corrosion preventive</td>
<td>–</td>
</tr>
<tr>
<td>AIR 8136 (Inactive)</td>
<td>C-627</td>
<td>Petroleum jelly/beeswax mixture for general preservation</td>
<td>AeroShell Compound 05</td>
</tr>
<tr>
<td>DCSEA 202/B (Obsolete)</td>
<td>–</td>
<td>White spirit</td>
<td>–</td>
</tr>
<tr>
<td>DCSEA300 (Obsolete)</td>
<td>G-403</td>
<td>All purpose grease</td>
<td>–</td>
</tr>
<tr>
<td>DCSEA 501 Type I</td>
<td>S-758</td>
<td>Lubricant, cleaner and preservative</td>
<td>AeroShell Fluid 634</td>
</tr>
<tr>
<td>DCSEA 118/A</td>
<td>F-18</td>
<td>Aviation gasoline, grade 100/130</td>
<td>Shell Avgas 100LL</td>
</tr>
<tr>
<td>DCSEA 134/A</td>
<td>F-35</td>
<td>Aviation turbine fuel, kerosine type</td>
<td>Shell Jet A-1</td>
</tr>
<tr>
<td>DCSEA 134/A</td>
<td>F-34</td>
<td>Aviation turbine fuel with fuel system icing inhibitor</td>
<td>Shell JP-8</td>
</tr>
<tr>
<td>DCSEA 144/A</td>
<td>F-44</td>
<td>Aviation turbine fuel, high flash point type, with fuel system icing inhibitor</td>
<td>Shell JP-5 (special arrangements necessary)</td>
</tr>
<tr>
<td>DCSEA 255/A</td>
<td>O-155</td>
<td>Extreme pressure oil for transmissions</td>
<td>AeroShell Fluid 5M-A</td>
</tr>
<tr>
<td>DCSEA 299/A</td>
<td>O-156</td>
<td>5mm ± 0.5/s synthetic turbine engine oil</td>
<td>AeroShell Turbine Oils 500, 529, 560</td>
</tr>
<tr>
<td>French Specification</td>
<td>NATO Code</td>
<td>Product and Application</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>DCSEA 353/A</td>
<td>G-353</td>
<td>Synthetic molybdenum disulphide grease</td>
<td>AeroShell Grease 17</td>
</tr>
<tr>
<td>DCSEA 354/A</td>
<td>G-354</td>
<td>Synthetic grease for airframe and instruments</td>
<td>AeroShell Grease 7</td>
</tr>
<tr>
<td>DCSEA 355/A</td>
<td>G-355</td>
<td>Graphited aircraft grease</td>
<td>–</td>
</tr>
<tr>
<td>DCSEA 359/A</td>
<td>G-359</td>
<td>Mineral Grease</td>
<td>AeroShell Grease 5</td>
</tr>
<tr>
<td>DCSEA 361/A</td>
<td>G-361</td>
<td>Wide temperature range synthetic aircraft grease</td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td>DCSEA 363/A</td>
<td>G-363</td>
<td>Gasoline and oil resistant grease</td>
<td>AeroShell Grease S.7108</td>
</tr>
<tr>
<td>DCSEA 382/A</td>
<td>G-382</td>
<td>Aircraft general purpose mineral grease</td>
<td>AeroShell Grease 6</td>
</tr>
<tr>
<td>DCSEA 392/A</td>
<td>G-392</td>
<td>Synthetic grease for pneumatic systems</td>
<td>AeroShell Grease 43C</td>
</tr>
<tr>
<td>DCSEA 395/A</td>
<td>G-395</td>
<td>Multipurpose synthetic aircraft grease</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>DCSEA 415/A</td>
<td>H-520</td>
<td>Mineral hydraulic fluid</td>
<td>AeroShell Fluid 4</td>
</tr>
<tr>
<td>DCSEA 415/A</td>
<td>H-515</td>
<td>Mineral hydraulic fluid</td>
<td>AeroShell Fluid 41</td>
</tr>
<tr>
<td>DCSEA 437/A</td>
<td>H-537</td>
<td>Synthetic hydrocarbon hydraulic fluid</td>
<td>AeroShell Fluid 31</td>
</tr>
<tr>
<td>DCSEA 502/A</td>
<td>S-761</td>
<td>Multifunctional synthetic lubricant for weapons</td>
<td>–</td>
</tr>
<tr>
<td>DCSEA 535/A</td>
<td>C-635</td>
<td>Preservative mineral hydraulic fluid</td>
<td>AeroShell Fluid 71</td>
</tr>
<tr>
<td>DCSEA 745/A</td>
<td>S-1745</td>
<td>Fuel system icing inhibitor, high flash point type</td>
<td>–</td>
</tr>
<tr>
<td>DCSEA 745/A</td>
<td>XS-1745</td>
<td>Mixture of S-1745 with anti-corrosion additive</td>
<td>–</td>
</tr>
</tbody>
</table>
RUSSIAN SPECIFICATIONS

SCOPE OF LIST
This list is comprised of Russian Aviation Specifications which cover aviation engine oils, hydraulic fluids, greases and allied products. The list is composed of two parts, firstly a listing of specifications and then secondly a listing of grade names.

In Russia lubricants are governed by State Standards and are designated under a series of specifications including:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOST</td>
<td>Gozudarstuyeny Standart</td>
</tr>
<tr>
<td>VTU-(BTY)</td>
<td>Temporary Technical Conditions</td>
</tr>
<tr>
<td>TU-(TY)</td>
<td>Technical Conditions</td>
</tr>
<tr>
<td>MRTU</td>
<td>Inter Republic Technical Conditions</td>
</tr>
</tbody>
</table>

INTERPRETATION OF LIST
In this list where a grade is shown in brackets it indicates that the grade is an industrial grade. Where an asterisk* appears in the last column of the list, the AeroShell grade recommended does not necessarily meet all the clauses/requirements of the Russian Specifications, but is the nearest product marketed by Shell.

Any grade marked with brackets or an asterisk has not necessarily been tested for suitability as a replacement. Shell Companies have not been able to test samples of Russian aviation lubricants using U.S. or British test methods nor have Shell Companies been able to test AeroShell grades in full scale hardware tests prescribed by the Russian Authorities.

For this reason Shell Companies make no representation as to the fitness or suitability of any AeroShell lubricant listed in this List. Responsibility for evaluation of an AeroShell Grade as a suitable alternative is that of the customer or operator. Although the information set forth herein is presented in good faith and believed to be correct at time publication Shell Companies make no representation as to the completeness or accuracy thereof.

This information is included in this publication upon the condition that the customer/operator using this information will make their own determination as to suitability for their purpose prior to use. In no event will Shell Companies be responsible for damages of any nature whatsoever resulting from the use or reliance upon the information. Nothing contained in this section is to be construed as a recommendation to use any product.
<table>
<thead>
<tr>
<th>Specification GOST</th>
<th>Grade Name</th>
<th>AeroShell Grade</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>782-59</td>
<td>Grease UN</td>
<td>AeroShell Compound 05*</td>
<td>Technical vaseline for protection of metal surfaces against corrosion</td>
</tr>
<tr>
<td>982-68 (Supersedes 982-56)</td>
<td>TK</td>
<td>AeroShell Turbine Oil 3*</td>
<td>Transformer oil</td>
</tr>
<tr>
<td></td>
<td>TKP</td>
<td>AeroShell Turbine Oil 3*</td>
<td>Transformer oil with anti-oxidant additive</td>
</tr>
<tr>
<td>1013-49 (Superseded by 21743-76)</td>
<td>MS-14</td>
<td>AeroShell Oil 80</td>
<td>Aircraft piston engine oils</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil W80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil W100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS-20</td>
<td>AeroShell Oil 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MK-22</td>
<td>AeroShell Oil W100</td>
<td></td>
</tr>
<tr>
<td>1033-73</td>
<td>US-1</td>
<td>Shell Alvania Grease RL1*</td>
<td>Medium melting point multi-purpose grease</td>
</tr>
<tr>
<td></td>
<td>US-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1631-61 (Obsolete)</td>
<td>1-13</td>
<td>Shell Retinax EP2*</td>
<td>High temperature grease for roller bearings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shell Nerita HV*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shell Albida RL2, 3*</td>
<td></td>
</tr>
<tr>
<td>1642-50</td>
<td>Spindle Oil AV</td>
<td>Shell Vitrea Oil 22*</td>
<td>Highly refined spindle oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shell Tellus Oil 22*</td>
<td></td>
</tr>
<tr>
<td>1805-76</td>
<td>MVP</td>
<td>–</td>
<td>Instrument oil</td>
</tr>
<tr>
<td>1957-72</td>
<td>UT (Constalin-1)</td>
<td>Shell Nerita Grease AV*</td>
<td>Calcium based multi-purpose grease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shell Alvania Grease RL2* or RL3*</td>
<td></td>
</tr>
<tr>
<td>2712-75</td>
<td>AMS-1</td>
<td>–</td>
<td>Lubrication of mechanisms</td>
</tr>
<tr>
<td></td>
<td>AMS-3</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>2967-52</td>
<td>Grease AF-70</td>
<td>Shell Alvania Grease RL2*</td>
<td>Instrument grease</td>
</tr>
<tr>
<td>3005-51</td>
<td>Gun grease</td>
<td>Shell Ensis Fluid S* or SX*</td>
<td>Corrosion protection of mechanisms</td>
</tr>
<tr>
<td>3276-74 (Obsolete)</td>
<td>GOH-54p</td>
<td>AeroShell Grease 6*</td>
<td>Lubricant and protective</td>
</tr>
<tr>
<td>Specification GOST</td>
<td>Grade Name</td>
<td>AeroShell Grade</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>3333-80</td>
<td>USsA</td>
<td>–</td>
<td>Graphite grease</td>
</tr>
<tr>
<td>4003-53</td>
<td>Hypoid Gear oil</td>
<td>(Shell Spirax G 140*)</td>
<td>Hypoid gear oil</td>
</tr>
<tr>
<td>4366-76</td>
<td>Press Solidol S, Solidol S</td>
<td>(Shell Alvania Grease RL2*)</td>
<td>Multi-purpose, high melting point</td>
</tr>
<tr>
<td>5546-66</td>
<td>HF-12-18</td>
<td>(Shell Clavus Oil 32*)</td>
<td>Refrigeration oil for Fron system in Mi-8 helicopter</td>
</tr>
<tr>
<td>5573-67 (Obsolete)</td>
<td>NK 50 (HK-50)</td>
<td>AeroShell Grease 5*, AeroShell Grease 16, AeroShell Grease 22</td>
<td>High temperature wheel bearing grease</td>
</tr>
<tr>
<td>6267-74</td>
<td>CIATIM 201</td>
<td>AeroShell Grease 22, AeroShell Grease 6*</td>
<td>Multi-purpose grease</td>
</tr>
<tr>
<td>6457-66</td>
<td>MK-8</td>
<td>AeroShell Turbine Oil 3, AeroShell Turbine Oil 3SP, AeroShell Turbine Oil 2*, AeroShell Turbine Oil 3SP</td>
<td>3 mm **/s mineral turbine oil</td>
</tr>
<tr>
<td>6794-78</td>
<td>AMG-10</td>
<td>AeroShell Fluid 41</td>
<td>Mineral hydraulic fluid</td>
</tr>
<tr>
<td>7171-78</td>
<td>Gasoline Proof Grease BU</td>
<td>AeroShell Grease S.7108</td>
<td>Gasoline and oil resistant grease</td>
</tr>
<tr>
<td>7903-74</td>
<td>BM-4 (VM-4)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>8313-76</td>
<td>–</td>
<td>–</td>
<td>Fuel anti-icing additive</td>
</tr>
<tr>
<td>8551-74</td>
<td>CIATIM 205</td>
<td>(Shell Compound S.6800*)</td>
<td>Anti-seize grease/compound</td>
</tr>
<tr>
<td>8773-73</td>
<td>CIATIM 203</td>
<td>AeroShell Grease 22, AeroShell Grease 6*</td>
<td>Grease for high load mechanisms</td>
</tr>
<tr>
<td>9320-60 (Superseded by 21743-76)</td>
<td>MS-205</td>
<td>AeroShell Oil 100, AeroShell Oil W100</td>
<td>Aircraft piston engine oils</td>
</tr>
<tr>
<td>9433-80</td>
<td>CIATIM 221</td>
<td>AeroShell Grease 15*, AeroShell Grease 22</td>
<td>Multi-purpose engine grease</td>
</tr>
<tr>
<td>9762-61</td>
<td>Grease MS-70</td>
<td>(Shell Rhodina Grease RL2*)</td>
<td>–</td>
</tr>
<tr>
<td>10227-86</td>
<td>TS-1</td>
<td>Shell TS-1</td>
<td>Jet fuel</td>
</tr>
<tr>
<td>10328-63</td>
<td>MK-6</td>
<td>AeroShell Turbine Oil 2*</td>
<td>Mineral turbine oil</td>
</tr>
<tr>
<td>10586-63</td>
<td>PVK Grease</td>
<td>(Shell Alvania Grease RL1*)</td>
<td>Grease lubrication and corrosion protection</td>
</tr>
<tr>
<td>10817-64</td>
<td>VNII NP-44-2, VNII NP-44-2C</td>
<td>–</td>
<td>Petroleum oils for turbo-prop applications</td>
</tr>
<tr>
<td>10877-64</td>
<td>K-17</td>
<td>(Shell Ensis Fluid S* or SX*)</td>
<td>Preservative grease</td>
</tr>
<tr>
<td>10957-64</td>
<td>Lubricant No. 6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>11110-75</td>
<td>CIATIM 202</td>
<td>AeroShell Grease 22, AeroShell Grease 6*</td>
<td>Instrument and roller bearing grease</td>
</tr>
<tr>
<td>11122-66</td>
<td>VNII NP-25</td>
<td>–</td>
<td>Bearing and pivot lubricant</td>
</tr>
<tr>
<td>11552-65</td>
<td>MS-6</td>
<td>AeroShell Turbine Oil 2*</td>
<td>Mineral turbine oil</td>
</tr>
<tr>
<td>12030-66</td>
<td>VNII NP-223</td>
<td>(Shell Alvania Grease RL3*)</td>
<td>Lubrication of roller bearings</td>
</tr>
<tr>
<td>12031-66</td>
<td>VNII NP-262</td>
<td>(Shell Retinax EPX2*)</td>
<td>Lubrication of bearings of electric spindles</td>
</tr>
<tr>
<td>12246-66</td>
<td>VNII NP-7</td>
<td>AeroShell Turbine Oil 750*, Synthetic turbine oil</td>
<td></td>
</tr>
<tr>
<td>12308</td>
<td>T-6V, T-6</td>
<td>–</td>
<td>Military jet fuels</td>
</tr>
<tr>
<td>13076-86</td>
<td>VNII NP 50-1.4F</td>
<td>AeroShell Turbine Oil 390, AeroShell Turbine Oil 560</td>
<td>Synthetic turbine oil</td>
</tr>
<tr>
<td>Specification GOST</td>
<td>Grade Name</td>
<td>AeroShell Grade</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------</td>
<td>-------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>14068-79</td>
<td>VNII NP-232</td>
<td>AeroShell Grease S.4768</td>
<td>Anti-seize compound</td>
</tr>
<tr>
<td>15171-70</td>
<td>AKOR-1</td>
<td>AeroShell Fluid 2XN*</td>
<td>Preservative additive</td>
</tr>
<tr>
<td>15866-70</td>
<td>PFMS-4</td>
<td>–</td>
<td>Organosilicone fluid</td>
</tr>
<tr>
<td>16422-70</td>
<td>CIATIM 208</td>
<td>–</td>
<td>Transmission grease</td>
</tr>
<tr>
<td>16564-71</td>
<td>RT</td>
<td>Shell Jet A-1</td>
<td>Jet aircraft fuel</td>
</tr>
<tr>
<td>16728-71</td>
<td>VNII NP-403</td>
<td>–</td>
<td>Hydraulic oil</td>
</tr>
<tr>
<td>18179-72</td>
<td>OKB-122-7</td>
<td>AeroShell Grease 6*</td>
<td>General purpose grease</td>
</tr>
<tr>
<td></td>
<td>OKB-122-5 [132-08]</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OKB-122-14 [132-20]</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OKB-122-16 [132-21]</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OKB-122-4 [132-07]</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>18852-73</td>
<td>VNII NP-246</td>
<td>AeroShell Grease 15*</td>
<td>High temperature grease</td>
</tr>
<tr>
<td>19537-74</td>
<td>PVK</td>
<td>AeroShell Compound 05*</td>
<td>Soft film protective</td>
</tr>
<tr>
<td>19774-74</td>
<td>VNII NP-207</td>
<td>AeroShell Grease 22</td>
<td>Multi-purpose grease</td>
</tr>
<tr>
<td>19782-74</td>
<td>VNII NP-225</td>
<td>–</td>
<td>Molybdenum disulphide grease</td>
</tr>
<tr>
<td>20734-75</td>
<td>7-50C-3</td>
<td>–</td>
<td>Silicone hydraulic fluid</td>
</tr>
<tr>
<td>21743-76</td>
<td>MS-14</td>
<td>AeroShell Oil 80</td>
<td>Aircraft piston engine oils</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil W80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS-20</td>
<td>AeroShell Oil 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil W100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS-20S</td>
<td>AeroShell Oil 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil W100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MK-22</td>
<td>AeroShell Oil 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Oil W100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS-20P</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>21791-76</td>
<td>MAS-8N</td>
<td>–</td>
<td>Synthetic oils</td>
</tr>
<tr>
<td></td>
<td>MAS-14N</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAS-30NK</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>23907-79</td>
<td>–</td>
<td>–</td>
<td>De-icing fluids</td>
</tr>
<tr>
<td>24300-80</td>
<td>LZ-31</td>
<td>–</td>
<td>Grease</td>
</tr>
<tr>
<td>24926-81</td>
<td>VNII NP-282</td>
<td>–</td>
<td>Grease</td>
</tr>
<tr>
<td>Specification TU</td>
<td>Grade Name</td>
<td>AeroShell Grade</td>
<td>Remarks</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>6020.531-69</td>
<td>PFMS-4S</td>
<td>–</td>
<td>Specialised grease</td>
</tr>
<tr>
<td>6029.917-79</td>
<td>PFMS-4S</td>
<td>–</td>
<td>Specialised grease</td>
</tr>
<tr>
<td>110100.69</td>
<td>MD-BF</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>38-00180-75</td>
<td>IPM-10</td>
<td>AeroShell Turbine Oil 390*</td>
<td>Synthetic turbine oil. See also TU 38.1011299-90</td>
</tr>
<tr>
<td>38-001116-73</td>
<td>Grease No. 9</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>38-1-158-68</td>
<td>VNII NP-225</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>38-1-230-66</td>
<td>Grease OKB-122-7</td>
<td>AeroShell Grease 6*</td>
<td>Believed to be superseded by GOST 18179-72</td>
</tr>
<tr>
<td></td>
<td>Grease OKB-122-7-5</td>
<td>AeroShell Grease 22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grease OKB-122-8</td>
<td>AeroShell Grease 6*</td>
<td></td>
</tr>
<tr>
<td>38-101-295-75</td>
<td>36/1</td>
<td>AeroShell Turbine Oil 390</td>
<td>Synthetic turbine oils (see also TU38.101384-78)</td>
</tr>
<tr>
<td></td>
<td>36/1K</td>
<td>AeroShell Turbine Oil 390</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3-V</td>
<td>AeroShell Turbine Oil 500*</td>
<td></td>
</tr>
<tr>
<td>38-101-295-85</td>
<td>B3-V</td>
<td>AeroShell Turbine Oil 560</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 500*</td>
<td></td>
</tr>
<tr>
<td>38-101-297-78</td>
<td>VNII NP 235</td>
<td>AeroShell Grease 15*</td>
<td>High temperature grease</td>
</tr>
<tr>
<td>38-101-384-78</td>
<td>36/1Ku-A</td>
<td>AeroShell Turbine Oil 390</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 500*</td>
<td></td>
</tr>
<tr>
<td>38-101-419-79</td>
<td>CIATIM 221S</td>
<td>–</td>
<td>Grease</td>
</tr>
<tr>
<td>38-101-722-85</td>
<td>MN-7.5U</td>
<td>AeroShell Turbine Oil 750</td>
<td>Synthetic turbine oil</td>
</tr>
<tr>
<td>38-101-740-80</td>
<td>NGJ-4</td>
<td>Skydrol 500B4 or LD4</td>
<td>Phosphate ester hydraulic fluid</td>
</tr>
<tr>
<td>38-101-950-83</td>
<td>ERA (VNII NP 286M)</td>
<td>AeroShell Grease 22</td>
<td>Multi-purpose grease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 6*</td>
<td></td>
</tr>
<tr>
<td>38-101-1181-88</td>
<td>MS-8RK</td>
<td>AeroShell Turbine Oil 390</td>
<td>Mineral preservation oil for engines</td>
</tr>
<tr>
<td>38-101-1299-90</td>
<td>IPM-10</td>
<td>AeroShell Turbine Oil 390*</td>
<td>Synthetic turbine engine oil</td>
</tr>
<tr>
<td>38-401-5812-91</td>
<td>VNII NP 50-1-4U</td>
<td>AeroShell Turbine Oil 390</td>
<td>Synthetic turbine engine oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
<td></td>
</tr>
<tr>
<td>38-401-121-75</td>
<td>VNII NP 286M</td>
<td>AeroShell Grease 22</td>
<td>Grease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 6*</td>
<td></td>
</tr>
<tr>
<td>38-401-286-82</td>
<td>VNII NP 50-1-4U</td>
<td>AeroShell Turbine Oil 390</td>
<td>Synthetic turbine engine oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
<td></td>
</tr>
<tr>
<td>38-401-337</td>
<td>PTS-225</td>
<td>–</td>
<td>Synthetic turbine engine oil</td>
</tr>
<tr>
<td>301-04-010-92</td>
<td>LZ-240</td>
<td>AeroShell Turbine Oil 560</td>
<td>Synthetic turbine engine oil</td>
</tr>
<tr>
<td>Specification OCT/CTY/VT</td>
<td>Grade Name</td>
<td>AeroShell Grade</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------</td>
<td>-----------------</td>
<td>---------</td>
</tr>
<tr>
<td>OCT 6-08-431-75</td>
<td>Grade C-1</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>OCT 38-01145-80</td>
<td>I-13</td>
<td>(Shell Retinax EP2*) (Shell Nerita HV*) (Shell Albida RL2, 3*)</td>
<td>Obsolete</td>
</tr>
<tr>
<td>OCT 38-01163-78</td>
<td>MS-8P</td>
<td>AeroShell Turbine Oil 3SP</td>
<td>Mineral turbine engine oil</td>
</tr>
<tr>
<td>OCT 38-01180-80</td>
<td>CIATIM 221S CIATIM 221C</td>
<td>AeroShell Grease 22</td>
<td>Grease</td>
</tr>
<tr>
<td></td>
<td>OCT 38-01294-83</td>
<td>IPM-10</td>
<td>AeroShell Turbine Oil 390*</td>
</tr>
<tr>
<td></td>
<td>OCT 38-1355-84</td>
<td>CT (HK-50) ST</td>
<td>AeroShell Grease 5* AeroShell Grease 16 AeroShell Grease 22</td>
</tr>
<tr>
<td>OCT 95-510.77</td>
<td>Grease No. 8</td>
<td>–</td>
<td>Anti-seize grease</td>
</tr>
<tr>
<td>CTY 36-13-719-61</td>
<td>PFMS-4S</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>VT UNP-18-58</td>
<td>CIATIM 221S</td>
<td>AeroShell Grease 22</td>
<td>Grease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade Name</th>
<th>Specification</th>
<th>AeroShell Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF-70</td>
<td>Refer to ‘Grease AF-70’</td>
<td>–</td>
</tr>
<tr>
<td>AKOR-1</td>
<td>GOST 15171-70</td>
<td>AeroShell Fluid 2XN*</td>
</tr>
<tr>
<td>AMG-10</td>
<td>GOST 6794-78</td>
<td>AeroShell Fluid 41</td>
</tr>
<tr>
<td>AMS-1</td>
<td>GOST 2712-75</td>
<td>–</td>
</tr>
<tr>
<td>AMS-3</td>
<td>GOST 2712-75</td>
<td>–</td>
</tr>
<tr>
<td>AV</td>
<td>Refer to ‘Spindle Oil AV’</td>
<td>–</td>
</tr>
<tr>
<td>BM-4 (VM-4)</td>
<td>GOST 7903-74</td>
<td>–</td>
</tr>
<tr>
<td>BU</td>
<td>Refer to ‘Gasoline Proof Grease’</td>
<td>–</td>
</tr>
<tr>
<td>C-1</td>
<td>OCT 6-08-431-75</td>
<td>–</td>
</tr>
<tr>
<td>CIATIM 201</td>
<td>GOST 6267-74</td>
<td>AeroShell Grease 22 AeroShell Grease 6*</td>
</tr>
<tr>
<td>CIATIM 202</td>
<td>GOST 11110-75</td>
<td>AeroShell Grease 22 AeroShell Grease 6*</td>
</tr>
<tr>
<td>CIATIM 203</td>
<td>GOST 8773-73</td>
<td>AeroShell Grease 22 AeroShell Grease 6*</td>
</tr>
<tr>
<td>CIATIM 205</td>
<td>GOST 8551-74</td>
<td>(Shell Compound S.6880*)</td>
</tr>
<tr>
<td>CIATIM 208</td>
<td>GOST 16422-70</td>
<td>–</td>
</tr>
<tr>
<td>CIATIM 221</td>
<td>GOST 9433-80</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>CIATIM 221S (221C)</td>
<td>TU 38-101-419-79 VT UNP-18-58 OCT 38-01180-80</td>
<td>–</td>
</tr>
<tr>
<td>Grade Name</td>
<td>Specification</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>CT (HK-50) or ST</td>
<td>OCT 38-1355-84</td>
<td>AeroShell Grease 5*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>ERA (VNII NP 286M)</td>
<td>TU 38-101-950-83</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td>Gasoline Proof Grease</td>
<td>GOST 7171-78</td>
<td>AeroShell Grease 5.7108</td>
</tr>
<tr>
<td>GOi54p</td>
<td>GOST 3276-74</td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td>Grease No. 8</td>
<td>OCT 95-310-77</td>
<td>-</td>
</tr>
<tr>
<td>Grease No. 9</td>
<td>TU 38-001116-73</td>
<td>-</td>
</tr>
<tr>
<td>Grease AF-70</td>
<td>GOST 2967-52</td>
<td>(Shell Alvania Grease RL2*)</td>
</tr>
<tr>
<td>Grease MS-70</td>
<td>GOST 9762-61</td>
<td>(Shell Spirax G 140*)</td>
</tr>
<tr>
<td>Grease UN</td>
<td>GOST 782-59</td>
<td>AeroShell Compound 05*</td>
</tr>
<tr>
<td>Gun Grease</td>
<td>GOST 3005-51</td>
<td>(Shell Ensis Fluid S or SX*)</td>
</tr>
<tr>
<td>HF-12-18</td>
<td>GOST 5546-66</td>
<td>(Shell Clevo Clavus Oil 32*)</td>
</tr>
<tr>
<td>HK-50 (NK-50)</td>
<td>GOST 5573-67</td>
<td>AeroShell Grease 5*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>Hypoid Gear Oil</td>
<td>GOST 4003-53</td>
<td>(Shell Spirax G 140*)</td>
</tr>
<tr>
<td>I-13</td>
<td>GOST 1631-61</td>
<td>(Shell Retinax EP2*)</td>
</tr>
<tr>
<td></td>
<td>OCT 38-01145-80</td>
<td>(Shell Nerita HV*)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Shell Albida RL2, 3*)</td>
</tr>
<tr>
<td>IPM-10</td>
<td>TU 38-00180-75</td>
<td>AeroShell Turbine Oil 390*</td>
</tr>
<tr>
<td></td>
<td>OCT 38-01294-83</td>
<td>AeroShell Turbine Oil 390*</td>
</tr>
<tr>
<td></td>
<td>TU 38-101-1299-90</td>
<td>AeroShell Turbine Oil 390*</td>
</tr>
<tr>
<td>K-17</td>
<td>GOST 10877-64</td>
<td>(Shell Ensis Fluid SDC*)</td>
</tr>
<tr>
<td>Lubricant No. 6</td>
<td>GOST 10957-64</td>
<td>-</td>
</tr>
<tr>
<td>LZ-31</td>
<td>GOST 24300-80</td>
<td>-</td>
</tr>
<tr>
<td>LZ-240</td>
<td>TU 38-401-579-86</td>
<td>AeroShell Turbine Oil 500*</td>
</tr>
<tr>
<td></td>
<td>301-04010-92</td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td></td>
<td>301-04015-91</td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td>CT (HK-50)</td>
<td>OCT 38-1355-84</td>
<td>AeroShell Grease 5*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>MD-BD</td>
<td>TU 11-100-69</td>
<td>-</td>
</tr>
<tr>
<td>MAS-8N</td>
<td>GOST 21791-76</td>
<td>-</td>
</tr>
<tr>
<td>MAS-14N</td>
<td>GOST 21791-76</td>
<td>-</td>
</tr>
<tr>
<td>MAS-30NK</td>
<td>GOST 21791-76</td>
<td>-</td>
</tr>
<tr>
<td>MN 7.5U (or MH 7.5u)</td>
<td>TU 38-101-722-85</td>
<td>AeroShell Turbine Oil 750</td>
</tr>
<tr>
<td>MK-6</td>
<td>GOST 10328-63</td>
<td>AeroShell Turbine Oil 2*</td>
</tr>
<tr>
<td>MK-8</td>
<td>GOST 6457-66</td>
<td>AeroShell Turbine Oil 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 2*</td>
</tr>
<tr>
<td>MK-8P</td>
<td>GOST 6457-66</td>
<td>AeroShell Turbine Oil 3SP</td>
</tr>
<tr>
<td>MK-22</td>
<td>GOST 1013-49</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td></td>
<td>GOST 21743-76</td>
<td>AeroShell Oil W100</td>
</tr>
<tr>
<td>MS-6</td>
<td>GOST 11552-65</td>
<td>AeroShell Turbine Oil 2*</td>
</tr>
<tr>
<td>Grade Name</td>
<td>Specification</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>MS-8</td>
<td></td>
<td>AeroShell Turbine Oil 3</td>
</tr>
<tr>
<td>MS-8P</td>
<td>OCT 38-01163-78</td>
<td>AeroShell Turbine Oil 3SP</td>
</tr>
<tr>
<td>MS-8RK</td>
<td>TU 38-1011-181-88</td>
<td>AeroShell Turbine Oil 3SP</td>
</tr>
<tr>
<td>MS-14</td>
<td>GOST 1013-49</td>
<td>AeroShell Oil 80</td>
</tr>
<tr>
<td></td>
<td>GOST 21743-76</td>
<td>AeroShell Oil W80</td>
</tr>
<tr>
<td>MS-20</td>
<td>GOST 1013-49</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td></td>
<td>GOST 21743-76</td>
<td>AeroShell Oil W100</td>
</tr>
<tr>
<td>MS-20P</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>MS-20S</td>
<td>GOST 9320-60</td>
<td>AeroShell Oil 100</td>
</tr>
<tr>
<td></td>
<td>GOST 21743-76</td>
<td>AeroShell Oil W100</td>
</tr>
<tr>
<td>MS-70</td>
<td>Refer to ‘Grease MS-70’</td>
<td>-</td>
</tr>
<tr>
<td>MVP</td>
<td>GOST 1805-76</td>
<td>-</td>
</tr>
<tr>
<td>NGJ-4</td>
<td>TU 38-1017-40-80</td>
<td>Skydrol 500B4 or LD4</td>
</tr>
<tr>
<td>NGJ-5U</td>
<td>TU 38-401-811-90</td>
<td>Skydrol 500B4 or LD4</td>
</tr>
<tr>
<td>OKB-122-3</td>
<td>GOST 4216-55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GOST 18375-73</td>
<td>-</td>
</tr>
<tr>
<td>OKB-122-4</td>
<td>GOST 4216-55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GOST 18375-73</td>
<td>-</td>
</tr>
<tr>
<td>OKB-122-5</td>
<td>GOST 4216-55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GOST 18375-73</td>
<td>-</td>
</tr>
<tr>
<td>OKB-122-7</td>
<td>GOST 18179-72</td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td></td>
<td>TU 38-1-230-66</td>
<td>-</td>
</tr>
<tr>
<td>OKB-122-7-5</td>
<td>TU 38-1-230-66</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>OKB-122-8</td>
<td>TU 38-1-230-66</td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td>OKB-122-14</td>
<td>GOST 4216-55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GOST 18375-73</td>
<td>-</td>
</tr>
<tr>
<td>OKB-122-16</td>
<td>GOST 4216-55</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>GOST 18375-73</td>
<td>-</td>
</tr>
<tr>
<td>PFMS-4</td>
<td>GOST 15866-70</td>
<td>-</td>
</tr>
<tr>
<td>PFMS-4S</td>
<td>TU 60-025-31-69</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>TU 60-02-917-79</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>CITY 36-13719-61</td>
<td>-</td>
</tr>
<tr>
<td>Press Solidol S</td>
<td>GOST 4366-76</td>
<td>(Shell Alvania Grease RL2*)</td>
</tr>
<tr>
<td>PTS-225</td>
<td>TU 38.401337</td>
<td>-</td>
</tr>
<tr>
<td>PVK</td>
<td>GOST 10586-63</td>
<td>(Shell Alvania Grease RL1*)</td>
</tr>
<tr>
<td></td>
<td>GOST 19537-74</td>
<td>AeroShell Compound 05</td>
</tr>
<tr>
<td>RT</td>
<td>GOST 16564-71</td>
<td>Shell Jet A-1*</td>
</tr>
<tr>
<td>Solidol S</td>
<td>GOST 4366-76</td>
<td>(Shell Retinax A*)</td>
</tr>
<tr>
<td>Spindle Oil AV</td>
<td>GOST 1642-50</td>
<td>(Shell Vitrea Oil 22* or Tellus Oil 22*)</td>
</tr>
<tr>
<td>T-6</td>
<td>GOST 12308</td>
<td>-</td>
</tr>
<tr>
<td>T-8V</td>
<td>GOST 12308</td>
<td>-</td>
</tr>
<tr>
<td>TK</td>
<td>GOST 982-68</td>
<td>AeroShell Turbine Oil 3*</td>
</tr>
<tr>
<td>TKP</td>
<td>GOST 982-68</td>
<td>AeroShell Turbine Oil 3*</td>
</tr>
<tr>
<td>Grade Name</td>
<td>Specification</td>
<td>AeroShell Grade</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>TS-1</td>
<td>GOST 10227-86</td>
<td>Shell TS-1</td>
</tr>
<tr>
<td>UN</td>
<td>Refer to ‘Grease UN’</td>
<td></td>
</tr>
<tr>
<td>US-1</td>
<td>GOST 1033-73</td>
<td>(Shell Alvania Grease RL1*)</td>
</tr>
<tr>
<td>US-2</td>
<td>GOST 1033-73</td>
<td>(Shell Alvania Grease RL2*)</td>
</tr>
<tr>
<td>USsA</td>
<td>GOST 3333-80</td>
<td>(Shell Alvania Grease RL2* or RL3*)</td>
</tr>
<tr>
<td>UT</td>
<td>GOST 1957-72</td>
<td>(Shell Nerita Grease HV*)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Shell Alvania Grease RL2* or RL3*)</td>
</tr>
<tr>
<td>VM-4</td>
<td>Refer to ‘BM-4’</td>
<td></td>
</tr>
<tr>
<td>VNII NP 7</td>
<td>GOST 12246-66</td>
<td></td>
</tr>
<tr>
<td>VNII NP 25</td>
<td>GOST 11122-65</td>
<td></td>
</tr>
<tr>
<td>VNII NP 442</td>
<td>GOST 10817-64</td>
<td></td>
</tr>
<tr>
<td>VNII NP 442-C</td>
<td>GOST 10817-64</td>
<td></td>
</tr>
<tr>
<td>VNII NP 50-1-4f</td>
<td>GOST 13076-86</td>
<td>AeroShell Turbine Oil 390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td>VNII NP 50-1-4U</td>
<td>TU 38-401-286-82</td>
<td>AeroShell Turbine Oil 390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td>VNII NP 207</td>
<td>GOST 19774-74</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td>VNII NP 223</td>
<td>GOST 12030-66</td>
<td>(Shell Alvania Grease RL3*)</td>
</tr>
<tr>
<td>VNII NP 225</td>
<td>GOST 19782-74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TU 38-1-158-68</td>
<td></td>
</tr>
<tr>
<td>VNII NP 232</td>
<td>GOST 14068-79</td>
<td>AeroShell Grease 5.4768</td>
</tr>
<tr>
<td>VNII NP 235</td>
<td>TU 38-101-297-78</td>
<td>AeroShell Grease 15*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VNII NP 246</td>
<td>GOST 18852-73</td>
<td>AeroShell Grease 15*</td>
</tr>
<tr>
<td>VNII NP 262</td>
<td>GOST 12031-66</td>
<td>(Shell Retinax EPX2*)</td>
</tr>
<tr>
<td>VNII NP 282</td>
<td>GOST 24926-81</td>
<td></td>
</tr>
<tr>
<td>VNII NP 286M (ERA)</td>
<td>TU 38-401-121-75</td>
<td>AeroShell Grease 22</td>
</tr>
<tr>
<td></td>
<td>TU 38-101-950-83</td>
<td>AeroShell Grease 6*</td>
</tr>
<tr>
<td>VNII NP 403</td>
<td>GOST 16728-71</td>
<td></td>
</tr>
<tr>
<td>7-50C-3</td>
<td>GOST 20734-75</td>
<td></td>
</tr>
<tr>
<td>36/1</td>
<td>TU 38-101-295-75</td>
<td>AeroShell Turbine Oil 390</td>
</tr>
<tr>
<td>36/1 KUA</td>
<td>TU 38-101-295-75</td>
<td>AeroShell Turbine Oil 390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td>36/1 KUA</td>
<td>TU 38-101-384-78</td>
<td>AeroShell Turbine Oil 390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 500*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AeroShell Turbine Oil 560</td>
</tr>
<tr>
<td>132-07</td>
<td>GOST 18375-73</td>
<td></td>
</tr>
<tr>
<td>132-08</td>
<td>GOST 18375-73</td>
<td></td>
</tr>
<tr>
<td>132-19</td>
<td>GOST 18375-73</td>
<td></td>
</tr>
<tr>
<td>132-20</td>
<td>GOST 18375-73</td>
<td></td>
</tr>
<tr>
<td>132-21</td>
<td>GOST 18375-73</td>
<td></td>
</tr>
</tbody>
</table>
AEROSHELL PRODUCTS/SPECIFICATIONS

SCOPE OF LIST
This list is comprised of all current AeroShell Grades, namely: aviation oils, fluids, greases and other Shell products used in aircraft, i.e. aviation fuels and specialised products.

INTERPRETATION OF LIST
For each AeroShell Grade listed the relevant U.S. and U.K. Specifications, NATO Code Number and Joint Service Designation are listed. Details of the product and application are also given and where appropriate comments are included.

Where an asterisk* appears alongside either the U.S. or U.K. Specification in the list, it means that the AeroShell Grade is not necessarily fully approved to that specification but that it meets the requirements of that specification.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AVIATION FUEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shell Avgas 100</td>
<td>ASTM D910</td>
<td>DEF STAN 91-90</td>
<td>–</td>
<td>AVGAS 100</td>
<td>Fuel for aircraft piston engines Grade 100/130</td>
<td>–</td>
</tr>
<tr>
<td>Shell Avgas 100LL</td>
<td>ASTM D910</td>
<td>DEF STAN 91-90</td>
<td>F-18</td>
<td>AVGAS 100LL</td>
<td>Fuel for aircraft piston engines Grade 100/130 Low Lead</td>
<td>–</td>
</tr>
<tr>
<td>Shell JP-8</td>
<td>MIL-DTL-83133E Grade JP-8</td>
<td>DEF STAN 91-87</td>
<td>F-34</td>
<td>AVTUR/FSII</td>
<td>Aviation turbine fuel, kerosine type with FSII</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>Shell JP-8 +100</td>
<td>MIL-DTL-83133E Grade JP-8 +100</td>
<td>–</td>
<td>F-37</td>
<td>–</td>
<td>Aviation turbine fuel, JP-8 + thermal stability additive S-1749</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>Shell Jet A-1</td>
<td>MIL-DTL-83133E ASTM D 1655</td>
<td>DEF STAN 91-91</td>
<td>F-35</td>
<td>AVTUR</td>
<td>Aviation turbine fuel kerosine type</td>
<td>–</td>
</tr>
<tr>
<td>Shell JP-5</td>
<td>MIL-DTL-5624T Grade JP-5</td>
<td>DEF STAN 91-86</td>
<td>F-44</td>
<td>AVCAT/FSII</td>
<td>Aviation turbine fuel, high flash kerosine type with FSII</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>Shell Jet A</td>
<td>ASTM D1655</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Aviation turbine fuel, freeze point –40°C</td>
<td>Normally only available in the USA</td>
</tr>
<tr>
<td>Shell Jet B</td>
<td>ASTM D6613</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Aviation turbine fuel, wide cut</td>
<td>Normally only available in Canada meeting CAN/CGSB 3.23</td>
</tr>
<tr>
<td>Shell AeroJet</td>
<td>ASTM D1655*</td>
<td>DEF STAN 91-91*</td>
<td>F-35*</td>
<td>–</td>
<td>Aviation turbine fuel, kerosine type with FSII</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>AEROSHELL ADDITIVES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Performance Additive 101</td>
<td>(MIL-DTL-83133E)</td>
<td>–</td>
<td>S-1749</td>
<td>–</td>
<td>Fuel additive to improve thermal stability of aviation turbine fuel</td>
<td>This additive when added to JP-8 makes grade JP-8 +100</td>
</tr>
<tr>
<td><strong>PISTON ENGINE OILS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Oil W65</td>
<td>SAE J-1899 Grade SAE 30</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Ashless dispersant aircraft piston engine oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Oil W100</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>O-125 [Obsolete]</td>
<td>OM-250</td>
<td>Ashless dispersant aircraft piston engine oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Oil W100 Plus</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>SAE J-1899 Grade SAE 50</td>
<td>–</td>
<td>–</td>
<td>Ashless dispersant aircraft piston engine oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Oil W120</td>
<td>SAE J-1899 Grade SAE 60</td>
<td>SAE J-1899 Grade SAE 60</td>
<td>O-128 [Obsolete]</td>
<td>OM-370</td>
<td>Ashless dispersant aircraft piston engine oil</td>
<td>–</td>
</tr>
<tr>
<td><strong>TURBINE ENGINE OILS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Turbine Oil 3</td>
<td>–</td>
<td>DEF STAN 91-99</td>
<td>O-135</td>
<td>OM-11</td>
<td>Mineral aviation turbine oil 3 mm²/s viscosity</td>
<td>Acceptable substitute for AeroShell Fluid 1</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 3SP</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Mineral aviation turbine oil 3 mm²/s viscosity</td>
<td>Analogue to Russian Grade MS-8P</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 308</td>
<td>MIL-PRF-7808L Grade 3</td>
<td>(MIL-PRF-7808L Grade 3)</td>
<td>O-148</td>
<td>OX-9</td>
<td>Synthetic ester aviation turbine oil 3 mm²/s viscosity</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 390</td>
<td>–</td>
<td>DEF STAN 91-94</td>
<td>–</td>
<td>OX-7</td>
<td>Synthetic ester aviation turbine oil 3 mm²/s viscosity</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 500</td>
<td>MIL-PRF-23699F Grade STD</td>
<td>DEF STAN 91-101 Grade OX-27</td>
<td>O-156</td>
<td>OX-27</td>
<td>Synthetic ester aviation turbine oil 5 mm²/s viscosity</td>
<td>–</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>TURBINE ENGINE OILS (Contd.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Turbine Oil 529</td>
<td>MIL-PRF-23699F Grade STD</td>
<td>DEF STAN 91-101*</td>
<td>O-156</td>
<td>OX-27*</td>
<td>Synthetic ester aviation turbine oil 5 mm²/s viscosity</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 531</td>
<td>MIL-PRF-23699F Grade C/I</td>
<td>–</td>
<td>O-152</td>
<td>–</td>
<td>Corrosion inhibited synthetic ester turbine engine oil 5 mm²/s viscosity</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 555</td>
<td>DOD-L-85734</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Synthetic ester oil for helicopter transmissions</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 560</td>
<td>MIL-PRF-23699F Grade HTS</td>
<td>DEF STAN 91-100</td>
<td>O-160</td>
<td>OX-26</td>
<td>High load synthetic ester aviation turbine oil 5 mm²/s viscosity</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 570</td>
<td>–</td>
<td>DEF STAN 91-98</td>
<td>O-149</td>
<td>OX-38</td>
<td>Synthetic ester aviation turbine engine oil 7.5 mm²/s viscosity</td>
<td>–</td>
</tr>
</tbody>
</table>

<p>| <strong>AVIATION GREASES</strong> | | | | | | |
| AeroShell Grease 6 | MIL-G-7711A* (Obsolete) | DEF STAN 91-12 | G-382 | XG-271 | Aircraft general purpose grease | Still available for civil market meeting obsolete U.S. and U.K. Specifications |
| AeroShell Grease 7 | MIL-PRF-23827C (Type II) | – | G-354 | – | Synthetic grease for aircraft | – |
| AeroShell Grease 11MS | – | – | – | – | High load aircraft grease | Recommended for landing gear applications on certain Boeing aircraft |
| AeroShell Grease 14 | MIL-G-25537C | DEF STAN 91-51 | G-366 | XG-284 | Helicopter general purpose grease | – |</p>
<table>
<thead>
<tr>
<th>AeroShell Grease 15</th>
<th>MIL-G-25013E</th>
<th>DEF STAN 91-55</th>
<th>G-372</th>
<th>XG-300</th>
<th>Extreme high temperature grease</th>
<th>–</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AVIATION GREASES (Contd.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Grease 17</td>
<td>MIL-G-21164D</td>
<td>–</td>
<td>G-353</td>
<td>–</td>
<td>Synthetic ester aircraft grease with molybdenum disulphide</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Grease 22</td>
<td>MIL-PRF-81322F</td>
<td>NLGI Grade 2</td>
<td>DEF STAN 91-52</td>
<td>G-395</td>
<td>XG-293</td>
<td>Synthetic general purpose aircraft grease</td>
</tr>
<tr>
<td>AeroShell Grease 23C</td>
<td>MIL-G-81827A</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Synthetic grease with molybdenum disulphide</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Grease 33</td>
<td>MIL-PRF-23827C</td>
<td>(Type I)</td>
<td>–</td>
<td>–</td>
<td>General purpose airframe grease</td>
<td>Approved to Boeing Specification BMS 3-33A</td>
</tr>
<tr>
<td>AeroShell Grease S.4768</td>
<td>–</td>
<td>DEF STAN 80-81</td>
<td>S-722</td>
<td>ZX-38</td>
<td>Anti-seize compound</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Compound 08</td>
<td>SAE-AMS-G-2518A</td>
<td>DEF STAN 80-80</td>
<td>S-720</td>
<td>ZK-13</td>
<td>Graphited anti-seize compound</td>
<td>–</td>
</tr>
<tr>
<td><strong>HYDRAULIC FLUIDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Fluid 4</td>
<td>MIL-H-5606A* (Obsolete)</td>
<td>DTD.585* (Obsolete)</td>
<td>–</td>
<td>–</td>
<td>Mineral hydraulic fluid</td>
<td>Still available meeting obsolete U.S. and U.K. Specifications European production only</td>
</tr>
<tr>
<td>AeroShell Fluid 31</td>
<td>MIL-PRF-83282D</td>
<td>DEF STAN 91-48 Grade Normal</td>
<td>H-520</td>
<td>OM-18</td>
<td>Mineral hydraulic fluid</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 41</td>
<td>MIL-PRF-5606H</td>
<td>DEF STAN 91-48 Grade Superclean</td>
<td>H-515</td>
<td>OM-15</td>
<td>Mineral hydraulic fluid of improved cleanliness</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 51</td>
<td>MIL-PRF-87257A</td>
<td>(MIL-PRF-78257A)</td>
<td>H-538</td>
<td>OK-538</td>
<td>Low temperature synthetic hydrocarbon fire resistant hydraulic fluid</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 61 Type I</td>
<td>MIL-PRF-46170C</td>
<td>Type I</td>
<td>–</td>
<td>H-544</td>
<td>Preservative synthetic hydrocarbon fire resistant hydraulic fluid</td>
<td>–</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>HYDRAULIC FLUIDS (Contd.)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Fluid 71</td>
<td>MIL-PRF-6083F</td>
<td>DEF STAN 80-142*</td>
<td>C-635</td>
<td>PX-26*</td>
<td>Preservative mineral hydraulic fluid of improved cleanliness</td>
<td>Approved to U.S. Specification equivalent to U.K. Specification</td>
</tr>
<tr>
<td>AeroShell SSF</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Fluid based on MIL-PRF-6083 for use in landing gear shock struts</td>
<td>Approved to Boeing Specification BMS 3-32 Type I</td>
</tr>
<tr>
<td>AeroShell LGF</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Fluid based on MIL-PRF-5606 for use in landing gear shock struts</td>
<td>Approved to Boeing Specification BMS 3-32 Type II</td>
</tr>
<tr>
<td><strong>OTHER FLUIDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Fluid 1</td>
<td>–</td>
<td>DEF STAN 91-44</td>
<td>O-134</td>
<td>OM-13</td>
<td>Light lubricating oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 3</td>
<td>MIL-PRF-7870C</td>
<td>DEF STAN 91-47</td>
<td>O-142</td>
<td>OM-12</td>
<td>General purpose lubricating oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 5MA</td>
<td>MIL-PRF-6086E Grade Medium</td>
<td>DEF STAN 91-112 Grade Medium</td>
<td>O-155</td>
<td>OEP-70</td>
<td>Extreme pressure gear oil of medium viscosity</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 18</td>
<td>MIL-PRF-32033</td>
<td>DEF STAN 91-79*</td>
<td>O-190</td>
<td>OX-18*</td>
<td>Light lubricating oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 602</td>
<td>MIL-PRF-87252C</td>
<td>–</td>
<td>S-1748</td>
<td>–</td>
<td>Avionic cooling fluid</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 634</td>
<td>MIL-PRF-63460D</td>
<td>–</td>
<td>S-758</td>
<td>–</td>
<td>Cleaning, preserving and lubricating fluid</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid S.8350</td>
<td>–</td>
<td>DTD.900/4981A</td>
<td>–</td>
<td>OEP-215</td>
<td>Helicopter gearbox oil</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Calibrating fluid 2</td>
<td>MIL-PRF-7024E Type II</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Special run Stoddard Solvent</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Compound 06A</td>
<td>TI-735A Grade B</td>
<td>BS.1595.86</td>
<td>S-737</td>
<td>AL-11</td>
<td>Isopropyl alcohol de-icing fluid</td>
<td>Equivalent to ASTM D770</td>
</tr>
<tr>
<td>AeroShell Compound 07</td>
<td>–</td>
<td>DTD.406B</td>
<td>S-745</td>
<td>AL-5</td>
<td>Glycol/alcohol mixture</td>
<td>–</td>
</tr>
<tr>
<td><strong>PRESERVATIVES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AeroShell Fluid 2F</td>
<td>MIL-C-6529C Type II</td>
<td>–</td>
<td>C-609</td>
<td>OX-270 (Obsolete)</td>
<td>Inhibited lubricating oil for internal protection of piston engines during storage</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Fluid 2T</td>
<td>MIL-C-6529C Type III</td>
<td>–</td>
<td>C-610</td>
<td>ZX-17 (Obsolete)</td>
<td>Corrosion preventive for turbine engines which use mineral turbine oil</td>
<td>–</td>
</tr>
</tbody>
</table>
### PRESERVATIVES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Fluid 2XN</td>
<td>MIL-C-6529C</td>
<td>MIL-C-6529C Type I</td>
<td>C-608</td>
<td>ZX-21</td>
<td>Concentrate for AeroShell Fluid 2F and 2T</td>
<td>–</td>
</tr>
<tr>
<td>AeroShell Compound 02</td>
<td>MIL-PRF-16173E</td>
<td>DEF STAN 80-217</td>
<td>C-614</td>
<td>PX-1</td>
<td>Quick drying lanolised fluid giving temporary protection against corrosion</td>
<td>U.S. Specification acceptable substitute. NATO symbol of substitute C-620</td>
</tr>
<tr>
<td>AeroShell Compound 05</td>
<td>MIL-C-11796C</td>
<td>DEF STAN 80-85</td>
<td>C-628</td>
<td>PX-11</td>
<td>Petroleum jelly/beeswax mixture for general preservation</td>
<td>U.S. Specification acceptable substitute. NATO symbol of substitute C-627</td>
</tr>
</tbody>
</table>

### OTHER PRODUCTS

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell Methanol Mixture 45/55/0</td>
<td>–</td>
<td>DEF STAN 68-253</td>
<td>S-1744</td>
<td>AL-28</td>
<td>Methanol/water mixture for use in certain engines</td>
<td>Also meets Rolls-Royce MSRR.9359</td>
</tr>
<tr>
<td>Shell Methanol</td>
<td>OM-232J</td>
<td>BS.506.66</td>
<td>S-747</td>
<td>AL-14</td>
<td>Methanol for use in methanol/water mixtures</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>Shell Demineralised Water</td>
<td>–</td>
<td>DEF STAN 68-253</td>
<td>S-1739</td>
<td>WTA</td>
<td>Water for thrust augmentation on some gas turbines</td>
<td>Special arrangements necessary</td>
</tr>
<tr>
<td>Shell Water Detector</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Method for detecting water in jet fuel</td>
<td>–</td>
</tr>
</tbody>
</table>