THE AEROSHELL BOOK
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The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this document the expressions “Shell”, “Group” and “Shell Group” are sometimes used for convenience where references are made to Group companies in general. Likewise, the words “we”, “us” and “our” are also used to refer to Group companies in general or those who work for them. These expressions are also used where there is no purpose in identifying specific companies.

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INTRODUCTION

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
- 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).

Examples of these changes include:

- MIL-H-5606G became MIL-PRF-5606H
- MIL-L-23699E became MIL-PRF-23699F
- MIL-T-83133D became MIL-DTL-83133E
- MIL-G-4343C became 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 Ministry of Defence 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 Ministry of Defence 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 materials, including metals, paints, varnishes, insulation materials, plastics and elastomers, 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.

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.

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 or online at www.shell.com/aviation
### Classification of Aeroshell Products and Product Reference

#### Aviation Turbine Fuels (Jet Fuels)

- Shell Jet A-1 2.1
- Shell Jet A 2.1
- Shell Jet B 2.1
- Shell TS-1 2.2
- Shell No.3 2.2
- Shell JP-4 2.4
- Shell JP-5 2.4
- Shell JP-8 2.4
- Shell JP-8 + 100 2.4
- Shell AeroJet 2.12

#### Aviation Gasolines (Avgas)

- Shell Avgas 100 2.5
- Shell Avgas 100LL 2.5

#### Additives

- AeroShell Performance Additive 101 2.14

#### Shell Water Detector

2.20

#### Piston Engine Oils

- AeroShell Oil 65 3.10
- AeroShell Oil 80 3.10
- AeroShell Oil 100 3.10
- AeroShell Oil 120 3.10

#### Ashless Dispersant Oils

- AeroShell Oil W80 3.12
- AeroShell Oil W100 3.12

#### Turbine Oils

- AeroShell Turbine Oil W120 3.12
- AeroShell Turbine Oil W15W-50 3.16
- AeroShell Turbine Oil W80 Plus 3.20
- AeroShell Turbine Oil W100 Plus 3.20

**Oils for Microlight/Sport Aircraft Engines**

- AeroShell Oil Sport Plus 2 3.22
- AeroShell Oil Sport Plus 4 3.24

**Oils for Aircraft Diesel Engines**

- AeroShell Oil Diesel 10W-40 3.26
- AeroShell Oil Diesel Ultra 3.28

#### Hydraulic Fluids

- AeroShell Fluid 4 6.10
- AeroShell Fluid 31 6.12
- AeroShell Fluid 41 6.16
- AeroShell Fluid 51 6.20
- AeroShell Fluid 61 6.24
- AeroShell Fluid 71 6.28
- AeroShell SSF and LGF 6.32

#### Turbine Oils

- AeroShell Grease 15 5.20
- AeroShell Grease 22 5.22
- AeroShell Grease 33 5.24
- AeroShell Grease 58 5.28
- AeroShell Grease 64 5.28

**Avionic Cooling Fluids**

- AeroShell Fluid 602 8.16

#### Preservatives

**Internal**

- AeroShell Fluid 2F 7.4
- AeroShell Fluid 2XN 7.6

**External**

- AeroShell Compound 05 7.8

#### Other Fluids

**Lubricating Oils**

- AeroShell Fluid 1 8.4
- AeroShell Fluid 3 8.6
- AeroShell Fluid 12 8.12
- AeroShell Fluid 18 8.14

**Gearbox Oils**

- AeroShell Fluid 5L-A 8.8
- AeroShell Fluid 5M-A 8.10
- AeroShell Fluid 5.8350 8.20

**Calibrating Fluids**

- AeroShell Calibrating Fluid 2 8.22

**De-icing Fluids**

- AeroShell Compound 06A 8.24
- AeroShell Compound 07 8.26

**Classifications**

- Class 1.12
- Class 1.13
### DISCONTINUED AEROSHELL GRADES

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>Specification</th>
<th>U.S.</th>
<th>British</th>
<th>Description/Superseded by</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Oil W65</td>
<td>J-1899</td>
<td>-</td>
<td>-</td>
<td>SAE Grade 30 ashless dispersant oil. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Oil Diesel 10W-40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Replaced by AeroShell Oil Diesel Ultra.</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 9</td>
<td>-</td>
<td>DEF STAN 91-97</td>
<td>-</td>
<td>A 9mm²/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>-</td>
<td>A 9mm²/s mineral turbine oil with an EP agent. There is no suitable alternative AeroShell Grade.</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 529</td>
<td>MIL-PRF-23699F Grade STD</td>
<td>-</td>
<td>-</td>
<td>Standard grade 5cSt turbine engine oil. AeroShell Turbine Oil 500 is a direct replacement.</td>
</tr>
<tr>
<td>AeroShell Turbine Oil 530</td>
<td>MIL-PRF-23699F Grade C/I</td>
<td>-</td>
<td>-</td>
<td>Corrosion inhibited synthetic turbine engine oil. No AeroShell alternative.</td>
</tr>
<tr>
<td>Shell Aviation Grease 7</td>
<td>MIL-G-23827B</td>
<td>DEF STAN 91-53</td>
<td>-</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 STAN91-54</td>
<td>-</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 11MS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High load aircraft grease. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Grease 16</td>
<td>MIL-G-25760A (Obsolete)</td>
<td>DTD.5579 (Obsolete)</td>
<td>-</td>
<td>Depending on application, AeroShell Greases 22, 33 or 58 may be suitable.</td>
</tr>
<tr>
<td>AeroShell Grease 17</td>
<td>MIL-G-21164D</td>
<td>-</td>
<td>-</td>
<td>Replaced by AeroShell Grease 64, but the two grades should not be mixed.</td>
</tr>
<tr>
<td>AeroShell Grease 22A</td>
<td>MIL-G-81322</td>
<td>-</td>
<td>-</td>
<td>Replaced by AeroShell Grease 22C, which in turn was replaced by AeroShell Grease 22CF.</td>
</tr>
<tr>
<td>AeroShell Grease 22C</td>
<td>MIL-G-81322</td>
<td>-</td>
<td>-</td>
<td>Replaced by AeroShell Grease 22CF.</td>
</tr>
<tr>
<td>AeroShell Grease 22CF</td>
<td>MIL-PRF-81322G</td>
<td>-</td>
<td>-</td>
<td>Advanced general purpose grease. AeroShell Grease 22 is direct replacement.</td>
</tr>
<tr>
<td>AeroShell Grease 23</td>
<td>MIL-G-81827A</td>
<td>-</td>
<td>-</td>
<td>High load capacity grease. Alternative grade was AeroShell Grease 23C.</td>
</tr>
<tr>
<td>AeroShell Grease 23C</td>
<td>MIL-G-81827A</td>
<td>-</td>
<td>-</td>
<td>Synthetic grease with molybdenum disulphide. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Grease 43C</td>
<td>SAE-AMS-G-4343</td>
<td>-</td>
<td>-</td>
<td>Pneumatic system grease. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Grease 33MS</td>
<td>MIL-G-21164D</td>
<td>-</td>
<td>-</td>
<td>Product re-named as AeroShell Grease 64</td>
</tr>
</tbody>
</table>
### DISCONTINUED AEROSHELL GRADES

<table>
<thead>
<tr>
<th>AeroShell Grade</th>
<th>Specification</th>
<th>Description/Superseded by</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroShell Fluid 1AC</td>
<td>AAF.3580D</td>
<td>A special hydraulic fluid. No direct alternative although some equipment manufacturers have approved alternative grades.</td>
</tr>
<tr>
<td>AeroShell Fluid 2T</td>
<td>MIL-C-6529C Type III</td>
<td>Corrosion preventive for turbine engines. AeroShell Fluid 2XN is the concentrate from which AeroShell Fluid 2T was made.</td>
</tr>
<tr>
<td>AeroShell Fluid 9</td>
<td>-</td>
<td>A piston engine storage oil. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Fluid 10</td>
<td>-</td>
<td>A wax thickened piston engine storage oil. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Fluid 14</td>
<td>-</td>
<td>A cleaning fluid. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Fluid 61 Type II</td>
<td>MIL-H-46170B</td>
<td>Preservative synthetic hydrocarbon hydraulic fluid dyed red. Alternative is AeroShell Fluid 61 Type I which is undyed.</td>
</tr>
<tr>
<td>AeroShell Fluid 634</td>
<td>MIL-PRF-63460D</td>
<td>Cleaning, preserving and lubricating fluid. No AeroShell alternative.</td>
</tr>
<tr>
<td>AeroShell Compound 01</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>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>MIL-M-7866C</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>De-icing fluid.</td>
</tr>
<tr>
<td>Shell Aviation Fluid S.7229</td>
<td>-</td>
<td>A compressor wash fluid. No AeroShell alternative.</td>
</tr>
</tbody>
</table>
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/home/content/aviation/products/lubricants/msds/ or at: www.epc.shell.com

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.

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.

- 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
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 and dust) 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.

■ 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 all 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.

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.

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 believed to present a fire risk, 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 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 packs) 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.

If 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 latest issue of NATO Standardization Agreement STANAG 3149 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 aviation piston engine oils (AeroShell Oils and W Oils)</td>
<td>4</td>
</tr>
<tr>
<td>AeroShell Oil Sport Plus 2</td>
<td>2</td>
</tr>
<tr>
<td>AeroShell Oil Sport Plus 4</td>
<td>4</td>
</tr>
<tr>
<td>AeroShell Oil Diesel Ultra</td>
<td>4</td>
</tr>
<tr>
<td>All mineral turbine engine oils</td>
<td>4</td>
</tr>
<tr>
<td>All synthetic turbine engine oils</td>
<td>6</td>
</tr>
<tr>
<td>All greases</td>
<td>3</td>
</tr>
<tr>
<td>AeroShell Fluids 4, 41, 31, 51</td>
<td>3</td>
</tr>
<tr>
<td>AeroShell Fluids 61, 71, 5SF, LGF</td>
<td>4</td>
</tr>
<tr>
<td>AeroShell Fluids 1, 2F, 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; in such situations it is doubtful that it makes economic sense to re-test the product and it should be downgraded or disposed of. 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 disposed of according to local environmental regulations.

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 lighting should be provided also an electricity connection and a water supply.

Good ventilation highly desirable.

A lock should be provided to secure the warehouse.

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.

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

A pump and other useful tools should be present.

The room must be dust-free, accordingly it should be tiled or treated with a suitable paint.
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. There is a particular problem present when refuelling types of aircraft which may exist in both turbine engine and piston engine forms. They look similar and the piston engine type may be turbo-charged, with large lettering on the cowlings saying “TURBO”. To add to the problem, there are now a number of diesel-engined aircraft appearing that require jet fuel but look like conventional piston-engined aircraft that would normally require Avgas.

To prevent misfuelling aircraft during overwing fuelling, Shell Aviation requires that at least 2 out of the following criteria are satisfied for each and every fuelling:

1. A grade selective nozzle shall be fitted.
2. There shall be a decal next to the fuelling point on the aircraft specifying the grade of fuel required.
3. A Fuel Order Form has been completed and signed by an authorised member of the aircraft crew.

If the grade marking or Fuel Order Form is not available, no fuel will be delivered.

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

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.

Identification 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 parts of the fuelling facility and associated equipment where an error might occur, no matter how remote the possibility, are identified and labelled 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 System 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.
**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.

Some of the hazard from the charging of the fuel itself is reduced by the use of a static dissipator additive. However, it is worth noting that a static charge may still accumulate on the aircraft during flight or on the ground due to air friction and in this case the presence of a static dissipator additive in the fuel cannot help. To minimise this hazard, it is necessary to ‘bleed off’ static electrical charges before they build up to a high enough potential to create a static spark. This can be accomplished by bonding the fuelling vehicle to the aircraft with a cable and allowing sufficient time for the charge to equalise 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 couplings do not need to be individually 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! !!