GREASES

AEROSHELL GREASES

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, aluminium, 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-G-23827 (latest issue); the equivalent British Specification is:
DEF STAN 91-53 (latest issue).

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 17

AeroShell Grease 16
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 turbine engined or composite turbine/piston engined aircraft fleets. All airframe lubrication of subsonic civil aircraft and a high proportion of auxiliary equipment lubrication requirements can be met. Grease containing molybdenum disulphide (AeroShell Grease 17) is particularly effective for lubricating heavily loaded sliding steel surfaces.

AeroShell Grease 16 has a high temperature performance of +204°C. This coupled with its good load carrying properties, make it suitable for multi-purpose applications in civil aircraft operating for long periods at supersonic 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 here 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

	Typical mean Hertz load (kg)
AeroShell Grease 7	60
AeroShell Grease 11 MS	57
AeroShell Grease 16	57
AeroShell Grease 17	60
AeroShell Grease 22 (& 22CF)	39 (35)
AeroShell Grease 33	60

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

EXTREME TEMPERATURE GREASES

	Useful operating temperature range
AeroShell Grease 7	–73 to +149°C
AeroShell Grease 15	–73 to +232°C
AeroShell Grease 16	–54 to +204°C
AeroShell Grease 17	–73 to +149°C
AeroShell Grease 22	–65 to +204°C
AeroShell Grease 22CF	–54 to +177°C
AeroShell Grease 23C	–62 to +177°C
AeroShell Grease 33	–73 to +121°C

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

HIGH TEMPERATURE GREASES WHICH HAVE GOOD LOAD CARRYING ABILITY

	Useful maximum temperature
AeroShell Grease 5	+177°C
AeroShell Grease 7	+149°C
AeroShell Grease 16	+204°C
AeroShell Grease 17	+149°C
AeroShell Grease 22	+204°C
AeroShell Grease 22CF	+177°C
AeroShell Grease 23C	+177°C

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

AeroShell Grease 6
AeroShell Grease 14

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 it's excellent anti-fret properties it is especially recommended for the lubrication of helicopter main and tail rotor bearings.

GREASE CONTAINING SOLID LUBRICANTS

AeroShell Grease 11 MS – (with 5% molybdenum disulphide)
AeroShell Grease 17 – (with 5% molybdenum disulphide)
AeroShell Grease 23C – (with 5% molybdenum disulphide)

AeroShell Grease 17 is suitable for lubrication of slow moving infrequently operated mechanisms, e.g. inertia and cartridge starter gears, clutch plates, chains, selector valve gears, etc.

AeroShell Grease 17 is not subject to any speed restrictions and is widely accepted as an advanced multi-purpose grease.

AeroShell Grease 23C is suitable for use in heavily loaded splines and sliding surfaces and anti-friction bearings.

SPECIAL GREASES

AeroShell Grease 14
AeroShell Grease 43C
AeroShell Grease S.7108

Apart from its general purpose application for helicopters AeroShell Grease 14 is also recommended when anti-fret

and anti-corrosion properties are required, e.g. splines.

AeroShell Grease 43C is a pneumatic system grease.

AeroShell Grease S.7108 is a gasoline and oil resistant grease.

ANTI-SEIZE PRODUCTS

AeroShell Compound 08
AeroShell Grease S.4768

Anti-seize products are needed for application to threaded fittings and splines. They are based on various materials such as zinc oxide, mica, graphite or molybdenum disulphide. For aircraft use, graphite anti-seize compounds, such as AeroShell Compound 08, are generally considered to be the most suitable type for spark plug threads, propeller splines, pipe fittings, etc.

AeroShell Grease S.4768 is an anti-seize product/compound containing 50% molybdenum disulphide; suitable for use at temperatures up to +350°C.

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 23

Synthetic Ester
AeroShell Grease 7
AeroShell Grease 17

Silicone Oil
AeroShell Grease 15

Mixed Synthetic Hydrocarbon and Ester
AeroShell Grease 33

Mixed Mineral and Synthetic
AeroShell Grease 16

TYPES OF THICKENER

Microgel
AeroShell Grease 5
AeroShell Grease 6
AeroShell Grease 7
AeroShell Grease 16
AeroShell Grease 17
AeroShell Grease 22
AeroShell Grease 11 MS

Clay Thickener
AeroShell Grease 22CF

Lithium Complex
AeroShell Grease 33

AeroShell Grease 23C AeroShell Grease 43C

Calcium Soap

AeroShell Grease 14

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 Authority (FAA) regulations state that only greases qualified for specific applications can be used in certified aircraft. Therefore, in aviation it is the responsibility of the aircraft owner or designated representative to determine which greases should be used.

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 requirement. 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 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.

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

Compatibility Rating:

Very Good – Good – Fair – Poor – Very Poor.

COMPATIBILITY AND MISCIBILITY OF GREASES

In practice the miscibility of greases is important when switching over from one kind of grease to another. In this connection the miscibility of the base oil and that of the thickener have to be considered. Thus mineral oil based greases should never be mixed with synthetic oil based greases, and 'Microgel' or clay thickened greases should never be mixed with lithium complex thickened greases. In some cases different greases approved to the same specifications may be incompatible with each other.

GREASE RELUBRICATION

When changing from one grease to another, or when relubricating a grease lubricated component it is recommended that the old grease is purged out of the system prior to filling with new grease. One of the advantages of purging the old grease out of the system is that it will also remove contaminants such as water, dust and dirt from the system. Wherever possible use of a grease gun or grease in cartridges is recommended. If grease in tins is used it is important that wooden scrapers are not used and the tin lid is put back on firmly immediately the grease has been removed in order to prevent contamination by airborne dust and 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.