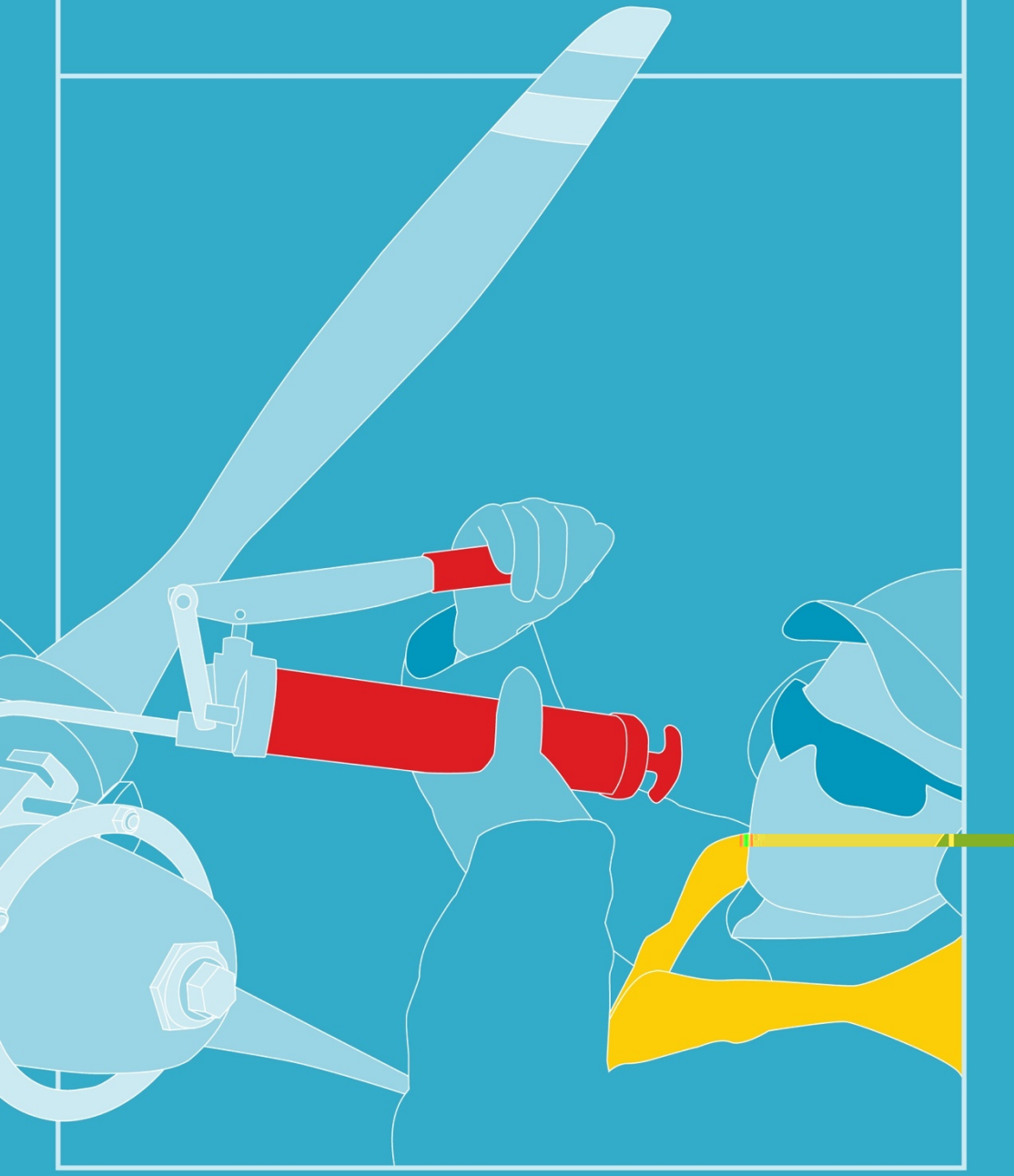
AEROSHELL GREASES



5. AEROSHELL GREASES

ABOUT 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".

So how is a grease made?

All greases consist basically of a base oil, a thickener (essentially a lattice which gives the stable semi solid consistency) and performance improving additives. Varying these three basic ingredients leads to different greases suitable for a vast range of applications. However, in broad terms, a typical grease would consist of about 80% - 90% base oil, 10% - 15% thickener and about 5% - 10% additives.

When they are used as lubricants, greases behave like oils in many ways. They reduce friction by providing a film which separates moving surfaces and it is actually oil that carries out this lubrication rather than the grease itself. However, unlike oils, greases have the advantage that they tend to stay where they are put.

They are less likely than oils to leak out of a machine and less likely to flow away from the surface that they lubricate under the effect of gravity or centrifugal forces. At the same time, and this can be significant in many airframe applications, greases can form an effective seal against moisture and solid contaminants.

Within the aviation industry, there are many grease lubricated applications covering a very wide range of performance requirements. Those requirements are being increasingly stretched through new technology developments and extended service intervals.

Many different grease formulations have been developed to meet specific requirements. One of Shell's recent objectives, as a major supplier of aviation greases, has been the development of wide performance range products where a single grease can cover a multitude of applications.

Greases, depending on the thickening agent, are broadly classified as either soap-based or non-soap-based. 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 and water solubility 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. These thickening agents were developed for greases needing superior high temperature performance characteristics. Shell's search for thickeners without the limitations of the simple soap-type, led to a family of proprietary technologies including our 'Microgel®' and Lithium-Complex systems.

Microgel® greases rely on an inorganic grease thickening agent, based on hectorite clay, which has several advantages over simple soap-type thickeners. It provides the AeroShell greases in which it is used with excellent physical properties, as shown below. Those properties make them particularly suitable for multi-purpose as well as specialised applications.

1. No melting point, within any conceivable temperature range for aircraft greases.
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 tenacious waterproofing agents developed by Shell.
5. Low oil separation or 'bleeding', because of the high gelling efficiency.

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, the most widely used specification in the aviation industry today is the general purpose grease to MIL-PRF-23827.

In the early 2000's the Boeing Company introduced a multi-purpose grease specification (BMS 3-33) to replace many of the different greases previously required in support of Boeing aircraft. This has led to the development of the accompanying specification SAE AMS3052. The only grease to meet the most challenging set of requirements of the initial BMS 3-33A specification has been AeroShell Grease 33.

This ground breaking grease, based on a Lithium-Complex thickener system, has a superior capacity to accommodate a wide range of proprietary performance additives. This thickener system now forms the basis for future grease developments in the AeroShell grease family.

Detailed information for each AeroShell grease is given in this section.

Base Oils

Aeroshell Grade	Base Oil		
	Mineral	Synthetic	
		Hydrocarbon	Ester
AeroShell Grease 5	✓		
AeroShell Grease 6	✓		
AeroShell Grease 7			✓
AeroShell Grease 14	✓		
AeroShell Grease 22		✓	
AeroShell Grease 33		✓	✓
AeroShell Grease 58		✓	
AeroShell Grease 64		✓	✓

Choosing a base oil for a grease is essentially determined by the type of application the grease will be used for. For example, with mineral oil based greases, if the application involves heavy load conditions a heavy viscosity base oil will be used (for example in AeroShell Grease 5 which is commonly used in General Aviation as an undercarriage wheel bearing grease).

However, high viscosity mineral oils do not perform well at low temperature as they become too thick, and so for more general use a lighter base oil will be used. This is the case with the general purpose AeroShell Grease 6 which has an operating temperature range of -40°C to +121°C (-40°F to +250°F) compared with -18°C to +149°C (-0.4°F to +300°F) for AeroShell Grease 5.

There are few airframe applications which exceed the 121°C (250°F) limit of AeroShell Grease 6, but wheel bearings using AeroShell Grease 5 will sometimes be exposed to high temperatures with high rolling friction and hard braking which takes into account the 149°C (300°F) upper limit for this grade.

It is therefore important to use the correct grade for the correct use.

Greases which are required to operate over a very wide temperature range are often base on synthetic oils, often derived from esters rather then mineral oils. However, these oils are more aggressive to seal materials and should not be used unless specified for your aircraft. An example of a grease with a synthetic base oil is another multipurpose grease, AeroShell Grease 7, which is used extensively on commercial aircraft where there is frequent exposure to extremely low temperatures at altitude. AeroShell Grease 7 has an operating temperature range of –73°C to +121°C (–99°F to 250°F)002E

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

Thickening Agents

Aeroshell Grade	Thickener		
	Microgel	Lithium Complex	Calcium Soap
AeroShell Grease 5	✓		
AeroShell Grease 6	✓		
AeroShell Grease 7	✓		
AeroShell Grease 14			✓
AeroShell Grease 22	✓		
AeroShell Grease 33		✓	
AeroShell Grease 58		✓	
AeroShell Grease 64		✓	

The amount and type of thickening agent used in making a grease has the biggest effect on its consistency, that is its softness or stiffness. The thickener does not perform any lubrication - that is the job of the oil - but it does hold the oil in a lattice rather like a sponge. Again like a sponge, when pressure or stress is applied, oil is released which then lubricates the mechanism and, when the stress is released, the thickener and oil return to a semi-solid state.

The consistency of greases can vary from very soft, semi-fluid cream like consistencies through to hard wax-like solids. The consistency is measured by allowing a standard

metal cone to sink into the grease and measuring its penetration. This is often called the Unworked Penetration value of the grease.

Most greases tend to soften slightly when heavily worked and the ability of the grease to resist changes in consistency during working is an important characteristic, particularly if vibration is present. This "Working Stability" is quantified by working the grease with perforated mechanical plunger and measuring it penetration value afterwards, the result often being referred to as the "Worked Penetration" value of the grease. The difference between the worked and unworked penetration values gives an indication of the working stability of the grease.

The majority of aviation greases have unworked penetration values of around 260 to 320, which is the normal consistency suitable for roller bearings, but also can be suited to fretting and sliding type applications as demonstrated by AeroShell Grease 14, the leading multi purpose Helicopter grease.

The common types of thickeners are generally "soap" based or "clay" based. A soap is a sal.4 (r)3(l)2.473 (ua)-2.7 12 (e)-3.2 (d)7.7w (s)-4.h (n)15.3 (e)-3. (in) (n)13. (a)-5. m7 (e)1t

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
Acylonitrile	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 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 was amended to divide approved greases into Type I (soap-based) and Type II (clay-based).

GREASE SERVICING

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.

Grease Changeover

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. The latest issues of the following publications can be consulted for advice:

- Boeing Service Letter 707-SL-20-012-C/727-SL-20-022C/737-SL-20-027-C/747-SL-20-044-C/757-SL-20-022-C/767-SL-20-022-C/777-SL-20-006-C "Summary of Most Commonly Used Greases on Boeing Airplanes"
- 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.

Operational Advice for Re-Greasing

When re-greasing a bearing with a grease gun, always apply enough grease for fresh, clean grease to be seen coming out of the bearing. This ensures that the bearing purged of the old, degraded grease which can then be wiped off and discarded.

The inspection or assembly of new bearings should be as follows:

- Wear protective gloves - not just for your own safety but also to prevent oil from your fingers from effecting the lubrication of the raceway.
- Remove the old bearing, clean off the old grease and rinse in a degreasing bath. Remove traces of old grease from the bearing housing and grease channels. If old grease cannot be removed from nipples, drillings and cut outs by cleaning alone, then apply fresh grease to the grease nipple and purge the channels whilst the bearing is removed.
- Inspect the old bearing and replace if outside limits.
- Having inspected the new or serviceable bearing, rinse the bearing through with Iso Propyl Alcohol (IPA) or a similar solvent to remove any traces of finger marks. The grease from your fingers can prevent some of the grease additives from bonding effectively with the bearing surfaces and so should be removed.
- Pack the bearing with fresh grease prior to assembly. Ensure that the race is full and wipe off any excess.
- Assemble the bearing to the manufacturer's instructions and using the correct tooling. Remember more bearings fail through improper assembly or misalignment than for any other reason.

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.

The majority of aviation grease specifications call for greases to be evaluated in the following tests:

- Drop point
- Penetration at 25°C (77°F), unworked/worked
- Evaporation loss in 22 hours (temperature varies according to specification)
- Corrosion, copper strip at 100°C (212°F)
- Water resistance at 40°C (104°F)

- 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.

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.

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.

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

NOTES

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 –18°C to +149°C (–0.4°F to +300°F).

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. magnetos, generators and starters. For the lubrication of rolling bearings which are required to start at temperatures as low as –18°C (–0.4°F) an adequate period should be allowed for the grease to channel.

SPECIFICATIONS

U.S.	Meets MIL-G-3545C (Obsolete)
British	Meets DTD.878A (Obsolete)
French	Equivalent DCSEA 359/A
Russian	-
NATO Code	G-359
Joint Service Designation	XG-277 (Obsolete)

PROPERTIES	MIL-G-3545C	TYPICAL
Oil type	-	Mineral
Thickener type	-	Microgel
Base oil viscosity mm^2/s		
@ 40°C (104°F)	-	500 to 525
@ 100°C (212°F)	-	32
Useful operating temperature range °C (°F)	Up to 149 (300)	–18 to +149 (–0.4 to +300)
Drop point °C (°F)	177 (350) min	260+ (500+)
Worked penetration @ 25°C (77°F)	250 to 300	284
Bomb oxidation pressure drop @ 99°C (210°F)		
100 hrs psi	10 max	5
500 hrs psi	25 max	9
Oil separation @ 100°C (212°F), in 30 hrs %m	5 max	2.6
Water washout @ 41°C		

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 (–40°F to +250°F).

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 (–40°F to +250°F).

SPECIFICATIONS

U.S.	Approved MIL-PRF-24139A Meets MIL-G-7711A (Obsolete)
British	Meets DEF STAN 91-012 (Obsolete)
French	Equivalent DCSEA 382/A
Russian	-
NATO Code	G-382 (Aircraft Grease), G-450 (Naval Grease, obsolete)
Joint Service Designation	XG-271 (Obsolete), XG-274 (Obsolete)

PROPERTIES	MIL-PRF-24139A	TYPICAL
Oil type	Mineral	Mineral
Thickener type	-	Microgel
Base oil viscosity mm^2/s		
@ 40°C (104°F)	-	35
@ 100°C (212°F)	-	5.5
Useful operating temperature range °C (°F)	-	–40 to +121 (–40 to +250)
Drop point °C (°F)	149 (300) min	> 300 (572)
Worked penetration @ 25°C (77°F)	265 to 300	295
Unworked penetration @ 25°C (77°F)	-	287
Worked stability (100,000 strokes)	355 max	270
Bomb oxidation pressure drop @ 99°C (210°F)		
100 hrs lb/in^2	10 max	4
500 hrs lb/in^2	25 max	15
Oil separation @ 100°C (212°F), in 30 hrs %m	-	0.7
Water resistance / washout @ 38°C (100°F) %m	5 max	3.2
Evaporation loss in 22 hrs @ 121°C (250°F) %m	-	1.3
Mean Hertz Load kg	30 min	35
Anti-friction bearing performance @ 121°C (250°F) hrs	2000	2000+
Copper corrosion 24 hrs @ 100°C (212°F)	Must pass	Passes
Apparent viscosity @ 0°C ± 0.5°C (32°F ± 1°F)	250 max	121
Dirt count	Must pass	Passes
Low temperature torque g-cm @–6.7°C (+20°F)		
Starting	4500 max	Below 3100
Running	1500 max	Below 380
Bearing protection 2 days @ 51°C (124°F)	Must pass	Passes
Colour	-	Golden Yellow

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 +121°C (–99°F to 250°F).

APPLICATIONS

AeroShell Grease 7 satisfies nearly all the airframe grease requirements of turbine engine 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 +121°C (–99°F to 250°F).

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

U.S.	Approved MIL-PRF-23827C (Type II)
British	-
French	-
Russian	-
Joint Service Designation	-
COMAC	Approved to QPL-CMS-OL-302

PROPERTIES		MIL-PRF-23827C (Type II)	TYPICAL
Oil type		Synthetic	Synthetic ester (Diester)
Thickener type		Clay	Microgel
Base oil viscosity	mm^2/s		
@–40°C (–40°F)		-	1150
@ 40°C (104°F)		-	10.3
@ 100°C (212°F)		-	3.1
Useful operating temperature range	°C (°F)	-	–73 to +121 (–99 to +250)
Drop point	°C (°F)	165 (329) min	300+ (572+)
Worked penetration @ 25°C (77°F)		270 to 310	296
Unworked penetration @ 25°C (77°F)		200 min	283
Bomb oxidation pressure drop @ 99°C (210°F)			
100 hrs	kPa	70 max	62
500 hrs	kPa	105 max	96.5
Oil separation @ 100°C (212°F), in 30 hrs	%m	5 max	3
Water resistance / washout test @ 38°C (100°F)	%m	20 max	2.5
Evaporation loss in 22 hrs @ 100°C (212°F)	%m	2.0 max	1.3
Mean Hertz Load	kg	30 min	43
Anti-friction bearing performance @ 121°C (250°F)	hrs	-	2460
Copper corrosion 24 hrs @ 100°C (212°F)		Must pass	Passes
Rust preventive properties 48 hrs @ 52°C (125°F)		Must pass	Passes
Low temperature torque @ –73°C (–99°F)			
Starting	Nm	1.00 max	0.30
Running 1 hr	Nm	0.1 max	0.03
Dirt count		Must pass	Passes
Colour		-	Beige
Worked stability		270 – 375	Average 285

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 +75°C (–65°F to +167°F).

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

U.S.	Approved MIL-G-25537C
British	Approved DEF STAN 91-051
French	-
Russian	-
NATO Code	G-366
Joint Service Designation	XG-284

PROPERTIES	MIL-G-25537C	TYPICAL
Oil type	-	Mineral
Thickener type	-	Calcium Soap
Base oil viscosity mm^2/s		
@ 40°C (104°F)	-	12.5
@ 100°C (212°F)	-	3.1
Useful operating temperature range °C (°F)	-	–54 to +75 (–65 to +167)
Drop point °C (°F)	140 (284) min	147 (297)
Worked penetration @ 25°C (77°F)	265 to 305	284
Unworked penetration @ 25°C (77°F)	200 min	276
Bomb oxidation pressure drop @ 99°C (210°F)		
100 hrs MPa	0.0345 max	0.0192
400 hrs MPa	0.1378 max	0.113
Oil separation @ 100°C (212°F), in 30 hrs %m	5.0 max	4.2
Water stability / washout dmm	-	51
Evaporation loss in 22 hrs @ 100°C (212°F) %m	7.0 max	6.5
Low temperature torque Nm @ –55°C (–67°F)		
Starting	1.47 max	0.53
Running	0.196 max	0.03
Copper corrosion 24 hrs @ 100°C (212°F)	Must pass	Passes
Dirt count	Must pass	Passes
Colour	-	Tan

AEROSHELL GREASE 22

AeroShell Grease 22 is a versatile advanced general-purpose grease composed of a synthetic hydrocarbon oil thickened with Microgel®. 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 –54°C to +177°C (–65°F to +350°F).

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

U.S.	Approved MIL-PRF-81322G Approved DOD-G-24508A
British	Meets DEF STAN 91-052 (Obsolete)
French	Approved DCSEA 395/B
Russian	Analogue of CIATIM 201 and 203, VNII NP 207, ERA (VNII NP 286M) and ST (NK-50)
NATO Code	G-395
Joint Service Designation	XG-293
COMAC	Approved to QPL-CMS-OL-301

PROPERTIES		MIL-PRF-81322G NLGI Grade 2	TYPICAL
Oil type		-	Synthetic Hydrocarbon
Thickener type		-	Microgel
Base oil viscosity	mm^2/s		
@ –40°C (–40°F)		-	7500
@ 40°C (104°F)		-	30.5
@ 100°C (212°F)		-	5.7
Useful operating temperature range	°C (°F)	-	–54 to +177 (–65 to +350)
Dropping point	°C (°F)	232(450) min	> 300 (572)
Worked penetration @ 25°C (77°F)		256 to 320	283
Bomb oxidation pressure drop @ 99°C (210°F)			
@ 100 hrs	kPa (psi)	83 (12) max	27 (4)
@ 500 hrs	kPa (psi)	172 (25) max	69 (10)
Oil separation @ 177°C (350°F), in 30 hrs	%m	2.0 to 8.0	5.8
Water washout @ 41°C (106°F)	%m	20 max	2.0
Evaporation loss in 22 hrs @ 177°C (350°F)	%m	10 max	1.1
Anti-friction bearing performance @ 177°C (350°F)	hrs	400 min	> 400
Load carrying capacity	kg	30 min	40
Copper corrosion 24 hrs @ 100°C (212°F)		Must pass	Passes
Colour		-	Amber

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 (–99°F to +250°F).

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 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. That performance level has largely been adopted as the SAE AMS3052 specification, which is in turn the basis for the Airbus AIMS 09-06-002 specification.

AeroShell Grease 33 is approved to BMS 3-33C and offers the improved performance properties required by this specification and the other specifications mentioned above. AeroShell Grease 33 can be used for routine lubrication on Boeing aircraft where MIL-PRF-23827C is specified and where the obsolete BMS 3-24 is specified.

AeroShell Grease 33 can also be used for routine lubrication in applications where MIL-PRF-23827C and BMS 3-33C are 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 (250°F) 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

U.S.	Approved MIL-PRF-23827C (Type I)
British	-
French	Equivalent DCSEA 354/B
Russian	-
NATO Code	G-354
Joint Service Designation	-
SAE	Exceeds AMS3052A
Boeing	Approved BMS 3-33C
Airbus	Approved AIMS 09-06-002
COMAC	Approved QPL-CMS-OL-302

PROPERTIES	BMS 3-33C AIMS 09-06-002 SAE AMS3052A	TYPICAL
Oil type	Synthetic Hydrocarbon/Ester	Synthetic Hydrocarbon/Ester
Thickener type	Lithium Complex	Lithium Complex
Base oil viscosity mm^2/s @ –40°C (–40°F) @ 40°C (104°F) @ 100°C (212°F)	 - - -	 1840 14.2 3.4
Useful operating temperature range °C (°F)	–73 to +121 (–99 to +250)	–73 to +121 (–99 to +250)
Dropping point °C (°F)	205 (401) min	227 (440)
Worked penetration @ 25°C (77°F)	265 to 315	297
Bomb oxidation pressure drop from 758 kPa (110 psi) @ 99°C (210°F) @ 100 hrs kPa (psi) @ 500 hrs kPa (psi)	 70 (10) max 105 (15) max	 3.5 (0.5) 34 (5)
Oil separation @ 100°C (212°F), in 30 hrs %m	8 max	2
Water washout @ 79°C (174°F) %m	7.5 max	< 6
Evaporation loss 500 hr @ 121°C (250°F) %m	10 max	< 10
Anti-friction bearing performance @ 121°C (250°F) hrs	1000 min	> 1200
Load carrying capability LWI @ 27°C (80°F) kg	60 min	> 60
Copper corrosion 24 hrs @ 100°C (212°F)	1B max	Passes
Colour	Blue-green	Green

NOTES

AEROSHELL GREASE 58

AeroShell Grease 58 is an advanced general purpose and wheel bearing grease composed of a synthetic base fluid and a lithium complex soap thickener. AeroShell Grease 58 possesses outstanding combination high performance characteristics including high load carrying, corrosion protection, mechanical stability, oxidation resistance and wear resistance.

The useful operating temperature range is –54°C to +175°C (–65°F to +347°F).

APPLICATIONS

AeroShell Grease 58 has been developed to exceed the requirements of the SAE AMS3058 Wide Temperature Range Lithium Complex Aircraft Wheel Bearing Grease specification. It is 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 and corrosive fluids are required.

AeroShell Grease 58 is the latest member of the AeroShell Lithium Complex Grease portfolio which includes AeroShell Greases 33 and 64.

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.

SPECIFICATIONS

U.S.	Approved SAE AMS3058
British	-
French	-
Russian	-
NATO Code	-
Joint Service Designation	-
Airbus	Approved AIMS 09-06-003

PROPERTIES	SAE AMS3058	TYPICAL
Oil type	Synthetic Hydrocarbon/Ester	Synthetic Hydrocarbon/Ester
Thickener type	Lithium/ Lithium Complex	Lithium Complex
Base oil viscosity mm^2/s		
@ 100°C (212°F)	Report	12
@ 40°C (104°F)	165 max	100
Useful operating temperature range °C (°F)	–54 to +175 (–65 to +347)	–54 to +175 (–65 to +347)
Drop point °C (°F)	250 (482) min	265 (509)
Worked penetration @ 25°C (77°F)	265 to 305	295
Bomb oxidation pressure drop @ 99°C (210°F)		
@ 100 hrs kPa (psi)	35 max	15
@ 500 hrs kPa (psi)	105 max	40
Oil separation 30 hrs @ 175°C (347°F) %m	8 max	4
Copper corrosion 24 hrs @ 100°C (212°F) %m	1b max	1b
Evaporation loss in 22 hrs @ 175°C (347°F) %m	10 max	4.9
Water washout @ 79°C (174°F) %m	15 max	5
Dynamic rust prevention @ 25°C (77°F) 3% NaCl 7 days	1/1 max	0/0
Extreme pressure weld load kg	315 min	350
Colour	-	Yellow
Low temperature torque dry @ –54°C (–65°F)		
Starting torque Nm	2.0 max	0.7
Running torque Nm	0.5 max	0.15
Roll stability 10% water 1/10 mm	–20 to +50	0

AEROSHELL GREASE 64

AeroShell Grease 64 comprises AeroShell Grease 33 fortified with 5% molybdenum disulphide. It possesses the enhanced anti-wear and anti-corrosion properties of AeroShell Grease 33 with the added EP (Extreme Pressure) properties provided by the addition of a solid lubricant.
The useful operating temperature range is –73°C to +121°C (–99°F to +250°F).

NOTE: AeroShell Grease 64 was previously branded as AeroShell Grease 33MS. Responding to customer requests, to avoid confusion with AeroShell Grease 33 it was decided to rebrand AeroShell Grease 33MS as AeroShell Grease 64.

APPLICATIONS

AeroShell Grease 33 has established itself as the answer to most of the airframe's General Purpose, airframe greasing requirements, being approved for use in Boeing, Airbus and many other aircraft types. It sets the standard with exceptional anti-corrosion and anti-wear performance while allowing aircraft operators to shrink their grease inventory and reduce the risk of misapplication. However, there remains a small number of highly loaded, sliding applications on the airframe where the additional boost of molybdenum disulphide will always be required. To address this need, Shell Aviation has developed AeroShell Grease 64. Sharing the same advanced grease technology as its parent, AeroShell Grease 64 also possesses the extreme pressure (EP) characteristics provided by molybdenum disulphide.

AeroShell Grease 64 contains a synthetic oil and must not be used with incompatible seal materials.

SPECIFICATIONS

U.S.	Approved MIL-G-21164D
British	Equivalent DEF STAN 91-057
French	Equivalent DCSEA 353/A (Obsolete)
Russian	-
NATO Code	G-353
Joint Service Designation	XG-276
COMAC	Approved QPL-CMS-OL-311

PROPERTIES		MIL-G-21164D	TYPICAL
Oil type		-	Synthetic Hydrocarbon/Ester
Thickener type		-	Lithium Complex
Base oil viscosity	mm^2/s		
@ –40°C (–40°F)		-	1840
@ 40°C (104°F)		-	14.2
@ 100°C (212°F)		-	3.4
Useful operating temperature range	°C (°F)	-	–73 to +121 (–99 to +250)
Drop point	°C (°F)	165 (329) min	234 (453)
Worked penetration @ 25°C (77°F)		260 to 310	289
Unworked penetration @ 25°C (77°F)		200 min	281
Worked stability (100,000 strokes)		260 to 375	305 to 310
Bomb oxidation pressure drop from 758 kPa (110 psi) @ 99°C (210°F)			
@ 100 hrs	kPa (psi)	68.9 (10) max	19 (2.75)
@ 500 hrs	kPa (psi)	103.4 (15) max	34.5 (5.0)
Oil separation @ 100°C (212°F), in 30 hrs	%m	5 max	1.5
Water resistance test loss @ 40°C (104°F)	%m	20 max	3.39
Evaporation loss in 22 hrs @ 100°C (212°F)	%m	2 max	0.81
Low temperature torque @ –73°C (–99°F)			
Starting	Nm	0.98 max	0.5
Running 1 hr	Nm	0.098 max	0.06
Anti-friction bearing performance @ 121°C (250°F)	hrs	1000 min	> 1000 (on all four runs)

Table continued

Table continued

PROPERTIES	MIL-G-21164D	TYPICAL
Extreme pressure properties load wear index	50 min	81.7
Copper corrosion 24 hrs @ 100°C (212°F)	1b max	1b
Rust prevention/bearing protection 2 days @ 52°C (125°F)	Must pass	Passes, no corrosion
Storage stability 6 months @ 40°C (104°F)		
Unworked penetration	200 min	226
Worked penetration	-	289
Change in penetration from original	30 max	8
Colour	-	Dark grey

NOTES