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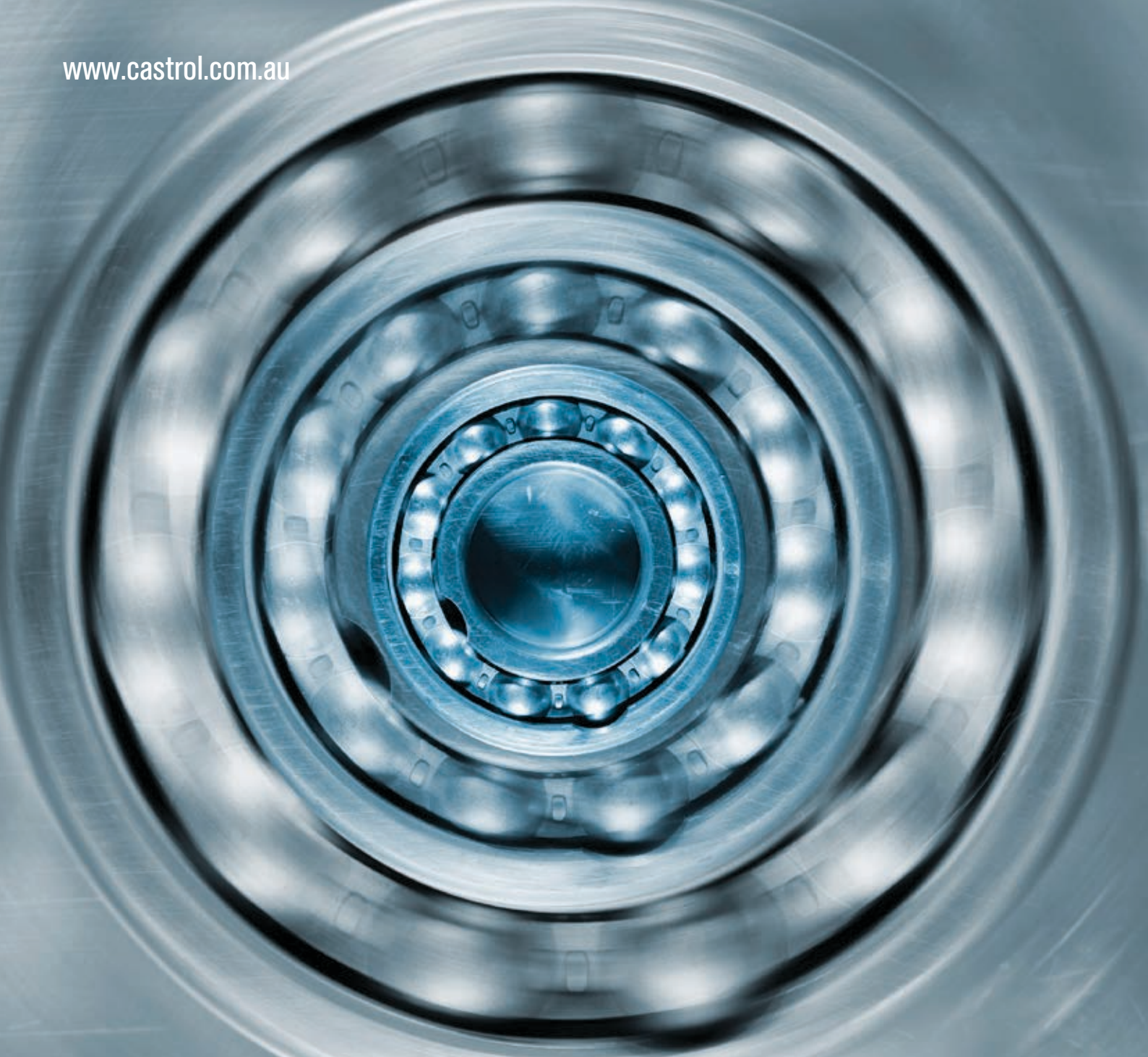

IT'S MORE THAN JUST GREASE.

IT'S MORE THAN JUST OIL. IT'S LIQUID ENGINEERING.

Castrol

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Technical Help Line Australia: 1300 557 998

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Customer Service and Orders: 1300 554 890

IT'S MORE THAN JUST GREASE

Castrol has a specifically formulated range of high performance greases developed to provide outstanding protection in a variety of applications.

Castrol supply an extensive range of greases to cover all operating conditions:

- heavy and shock loaded applications
- heavy duty mining
- wet and hot conditions
- high temperatures
- electric motor bearings

Other products include drill rod, anti-seize and general purpose applications.

For more specialist industrial greases, please refer to the Castrol Industrial Lubricants Brochure.

CASTROL PRODUCT	COLOUR	DESCRIPTION AND APPLICATIONS	NLGI (CONSISTENCY)	THICKENER	SUITABILITY FOR WET SERVICE (NOTE 1)	DROP POINT C (MIN)	4 BALL WELD POINT (KG)	BASE OIL VISCOSITY @ 40 C (CST)	GREASE OPERATING TEMP RANGE °C -40 -30 -20 0 100 200
AGRI GREASE ULTRA	DARK GREEN	• Multi-purpose high performance grease developed for use in a wide range of farm and associated machinery applications. This includes cars, trucks, 4WD's, pumps etc. • Engineered to provide protection of ball and roller bearings, especially onland/on-road, high load applications.	2	Lithium Complex	I	250	300	200	
MINEGREASE	DARK GREY	• For earthmoving/mining and industrial applications where high shock load protection is required as well as general greasing. • Used for a wide variety of heavy duty applications including plain and rolling element bearings, chassis point, joints and bucket pins where operating conditions may also involve vibration and water ingress. • Heavy duty lithium grease containing Molybdenum disulphide (3%) for enhanced load carry properties, suitable for all types of bearings found in heavy industry.	2	Lithium	I	175	>400	680	
MOLUB-ALLOY 777-2 ES	DARK GREY	• High performance rolling & sliding bearing grease with Moly. • Heavy-duty grease combining a lubricating solids package designed for demanding applications in primary industries where loads are high and speeds are low. • For earthmoving/mining applications where high shock load protection is required as well as general greasing. • Suitable for both journal and antifriction type bearings where shock is common. • Exceeds Bucyrus, Komatsu and P&H specifications.	2	Lithium	I	180	620	950	
PREMIUM HEAVY DUTY	BLUE	• High performance, multi-purpose bearing grease formulated for use over a wide range of operating temperature. • Suitable for high speed, high temperature bearings in disc brake wheels. • Also for heavy duty applications such as earthmoving and mining equipment, truck, trailer and bus wheel bearings, boat trailer and marine application.	2	Lithium Complex	I	250	315	200	
SPHEEROL AP 3	BROWN	• General purpose non-EP lithium grease suitable for plain and roller bearings. • High speed ball and roller bearing grease with very good anti-corrosion properties. Particularly suitable as an electric motor grease.	3	Lithium	I	175	-	120	
SPHEEROL BTX 2	DARK GREEN	• Contains extreme pressure, anti-oxidants and anti-wear additives with high temperature & load carrying capability. • Used in bucket pins, CV joints & universal joints. • Developed for use in a wide variety of heavy duty industrial and mining application including plain and rolling element bearings, chassis point, joints and bucket pins where operating conditions may also involve vibration and water ingress.	2	Lithium Complex	I	250	300	500	
SPHEEROL ELG	DARK GREY	• Designed for use in traction motor gears in the railway industry.	-	Lithium	I	-	>500	35,000	
SPHEEROL EPL 0**	BROWN	• Suitable for centralised lubrication systems and grease filled gearboxes. • Incorporates powerful rust inhibitors to protect components against corrosion. • Softer consistency makes it easier for pumping – ideal for colder temperatures or for long narrow grease lines.	0	Lithium	I	160	>250	180	
SPHEEROL EPL 1	BROWN	• Multi-purpose chassis lube, suitable for plain roller, ball bearings and chassis lubrication. • Softer consistency makes it easier for pumping – ideal for colder temperatures or for long narrow grease lines.	1	Lithium	I	190	>250	180	
SPHEEROL EPL 2	BROWN	• Multi-purpose, highly loaded, extreme pressure grease for general automotive, industrial and marine applications. • Suitable for chassis lube.	2	Lithium	I	180	>250	180	
SPHEEROL EPLX 200-2	BROWN	• High performance mulitpurpose grease used in general industrial machinery and construction equipment. • Formulated for use in grease-lubricated plain or rolling bearings. • Suitable for passenger car, truck, trailer and bus wheel bearings.	2	Lithium Complex	I	240	>250	200	
SPHEEROL EPLX-M 2	DARK GREY	• For moderate speed paper/steel mill bearings and construction, quarrying and mining equipment. • Fortified with 5% molybdenum disulphide to provide added wear protection of sliding components and chassis parts.	2	Lithium Complex	I	260	>250	320	
SPHEEROL FPG	BLUE	• Suited to general purpose greasing on centralised lubricating systems typically found on industrial plants such as coal wash plants, coal reclaimers etc.	2	Lithium	I	180	315	220	
SPHEEROL HTB 2	AMBER	• Suitable for high temperature applications eg. disc brake wheel bearings where peak temperature may rise suddenly. • The all-round properties make it suitable for various types of bearings, including temperature peaks up to 140°C.	2.5	Bentonite Clay	NR	Indefinite	150	500	
SPHEEROL JBG	BROWN	• Suitable for use in applications such as low to medium speed bearings, pins, universal joints, slideways on underground drill rigs. • Exceptional mechanical stability, provides rust and oxidation protection and is approved to specification AAR M-942 (revised 1992).	1.5	Lithium / Calcium	I	180	250	175	
SPHEEROL LMM	BLACK	• Multi-purpose extreme pressure grease with Molybdenum Disulphide. • For CV joints and ball joints. • Suited for use when anti-seize properties are required.	2	Lithium	I	180	>250	180	
SPHEEROL LYT 1	BLACK	• High operating temperature with excellent anti-seize properties, suitable as a drill rod thread grease for sealing threads on drill stems. • Also suitable for mining and other applications such as lubrication of bits and couplings at temp. up to 200°C. • Suitable for industrial applications including lubrication of threads and slideways.	1	Bentonite Clay	NR	250	-	500	
SPHEEROL PH	BROWN	• Suitable for auto body hardware, including door catches, boot and bonnet control mechanisms.	3	Calcium, Hydrated	C	90	-	110	
SPHEEROL RCG	BLACK	• Designed to protect rails and wheel flanges against wear on curved and tangent railway tracks.	2	Lithium		180	>250	500	
SPHEEROL SBX 1	BLACK	• Heavy duty grease developed primarily for off-highway construction and mining equipment where excessive loads/shock loads and as a consequence, elevated temperatures may regularly be experienced. • Contains a very heavy base oil suitable for low speed, high load bearings, high temperature, plain bearings, sugar milling and mining, bucket pins and general industrial applications. • Suitable for lower temperature pumping applications and it is more pumpable version of SBX 2.	1	Lithium Complex	I	260	>800	1000	
SPHEEROL SBX 2	BLACK	• Heavy duty grease developed primarily for off-highway construction and mining equipment where excessive loads/shock loads and as a consequence, elevated temperatures may regularly be experienced. • Contains a very heavy base oil suitable for low speed, high load bearings, high temperature, plain bearings, sugar milling and mining, bucket pins and general industrial applications.	2	Lithium Complex	I	250	>800	1000	
SPHEEROL SX 2	BROWN	• Multipurpose ship machinery lubricant, specifically developed to provide enhanced lubrication and protection for bearings, wire ropes and open gears usually found in marine environments. • Suitable for most journal bearings, wire ropes and open gears used in marine deck equipment and can be considered for roller, ball and needle bearings generally used in engine room equipment.	2	Calcium Sulpho-nate Complex	C	280	400	180	
SPHEEROL SY 1002	BROWN	• Synthetic multi-purpose EP grease for a wide range of heavy duty industrial applications where a combination of excellent oxidation stability & low temperature mobility are equally relevant. • Suitable for high-speed bearings, rail applications, electric motors.	2	Lithium Complex	I	260	347	100	
SPHEEROL SY 1501	AMBER	• Synthetic high temperature grease for heavy duty industrial applications operating at very slow speeds, high loads & high temperatures.	1	Lithium Complex	I	260	320	1500	
SPHEEROL SY 2202	AMBER	• Synthetic multi-purpose EP high temperature grease for a wide range of heavy duty industrial applications where a combination of excellent oxidation stability & low temperature mobility are equally relevant.	2	Lithium Complex	I	260	>316	220	
SPHEEROL SY 4601	AMBER	• Synthetic EP grease for arduous industrial applications involving low to medium operating speeds, high loads & a wide operating temperature range.	1.5	Lithium Complex	I	260	>315	460	
SPHEEROL ULTRATAK 2	RED	• Outstanding load carrying and anti-wear properties for applications including bucket pins, ball, roller and plain bearings under high load. • Contains special properties in wet conditions, dramatically decreasing water wash-out. • Also for heavy duty applications such as earthmoving and mining equipment, truck, trailer and bus wheel bearings, boat trailer and marine application.	2	Lithium Complex	C	200	800	500	

C = Continuous I = Intermittent NR = Not Recommended ** Also available in NLGI 00

■ **Note 1: Continuous – wet service means underwater operation or where the bearing is continuously washed with water. Intermittent – means where bearings are subjected to water from time to time (eg. boat trailer bearings splashed with water but not run underwater).**

■ **Note 2: Operating Temperature Range – The shaded area at the right of the operating range is intended for intermittent operation. For continuous operation more frequent grease replacement will be necessary. Some greases may soften significantly near the right area. The shaded area at the left of the operating range grease will become firmer and difficult to pump. Slow speed, plain bearing valve glands etc will operate satisfactorily in this region. High speed ball or roller bearings should not be run in this temperature range.**

Recommended Product	High temperature	Wheel Bearings	Constant velocity joints	Universal joints	Turntables	Kingpins	Chassis	Bonnet catches, door hinges, latches	Bearings – low speed	Bearings – heavy load	Bearings – severe vibration	Bearings – water resistance	Electric motors	Drill rod treads	Marine	Enclosed gears	Open gears	Tailbar couplings	Track rollers	Mining equipment	Centralised Systems	Pivot pins, hinge pins	Pin joints	Couplings	Fan bearings	Pinion bearings	Ball joints	Trunnion bearings	Splines	Ovens/foundries	Hydraulic rams	Journal bearings	Bucket pins	Anti-seize	Traction Motors	Rail and wheel flanges	Single Point Lubricators
Agri Grease Ultra	✔	✔	✔	✔	✔	✔	✔					✔										✔					✔		✔			✔					✔
Mine Grease			✔		✔	✔	✔		✔	✔	✔	✔					✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔				✔				✔
Molub-Alloy 777-2 ES					✔	✔			✔	✔	✔	✔					✔	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔				✔				
Premium Heavy Duty	✔	✔		✔	✔	✔	✔		✔			✔			✔					✔					✔		✔		✔			✔					✔
Spheerol AP 3													✔												✔												✔
Spheerol BTX 2	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔			✔					✔		✔	✔	✔			✔		✔				✔				
Spheerol ELG																					✔														✔		
Spheerol EPL 0 and EPL 00							✔									✔			✔		✔																
Spheerol EPL 1							✔														✔																
Spheerol EPL 2				✔		✔	✔														✔				✔							✔					
Spheerol EPLX 200-2	✔	✔		✔	✔	✔	✔					✔									✔				✔		✔		✔								✔
Spheerol EPLX-M 2	✔		✔	✔	✔	✔	✔			✔	✔	✔								✔		✔	✔				✔		✔				✔				✔
Spheerol FPG				✔		✔	✔			✔									✔		✔	✔	✔		✔						✔	✔					✔
Spheerol HTB 2	✔	✔		✔																																
Spheerol JBG				✔		✔	✔								✔						✔											✔					
Spheerol LMM			✔	✔	✔	✔	✔		✔	✔	✔									✔	✔	✔	✔	✔					✔				✔				
Spheerol LYT 1														✔																				✔			
Spheerol PH								✔																													
Spheerol RCG																					✔														✔		
Spheerol SBX 1	✔				✔	✔			✔	✔	✔	✔					✔	✔	✔	✔	✔		✔	✔		✔	✔	✔	✔	✔			✔			✔	
Spheerol SBX 2	✔				✔	✔			✔	✔	✔	✔					✔	✔		✔			✔	✔		✔	✔	✔	✔	✔			✔				
Spheerol SX 2	✔			✔		✔	✔		✔			✔			✔		✔			✔				✔	✔		✔		✔	✔		✔	✔				✔
Spheerol SY 1002	✔											✔	✔												✔												✔
Spheerol SY 1501	✔								✔	✔	✔	✔																	✔							
Spheerol SY 2202	✔	✔		✔	✔	✔	✔					✔													✔				✔								✔
Spheerol SY 4601	✔			✔	✔	✔	✔		✔	✔		✔																	✔							
Spheerol Ultratak 2	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔			✔					✔		✔	✔			✔		✔				✔				

GREASE APPLICATIONS

BALL JOINTS

Choose a No. 1 or No. 2 grease. Lithium or Calcium greases give good results, but specially fortified greases such as Molybdenum Disulphide (Moly) treated grades will permit extended service intervals should they be required.
We recommend Castrol Spheerol EPL2, Premium Heavy Duty, Castrol Spheerol LMM and Castrol Spheerol SBX2 Grease.

It is preferable to grease more frequently than to rely on factory filled long or extended life greases. The exclusion of dirt, grit and water and provision of rubber and metal seals will do much to preserve the life of these components.

WHEEL BEARINGS

The wide use of disc brakes calls for greases with greater resistance to bleed, particularly in heavier vehicles and under racing conditions. For such applications, we recommend Castrol Spheerol HTB 2 (Bentone based) or Castrol Premium Heavy Duty (Lithium Complex) which can be used at working temperatures above 175°C.

Refer to the manufacturers' recommendations regarding the frequency of repacking wheel bearings. Note that the style of driving, wheel balance and different road surfaces can all have a significant effect on the life of a grease. The nearside wheel bearings succumb more frequently to failure than the offside ones, owing to road camber and scuffing against the kerb.

UNIVERSAL JOINTS

The design of these vary, as does the lubricant and method of application.

A multi-purpose Lithium Complex grease covers most applications. We recommend Castrol Premium Heavy Duty for best results.

SHACKLES

A shackle lubricant should be able to be readily dispensed, adhere well without washing off and contain good anti-corrosion protection and low temperature properties.

All these properties can be met with a good quality multi-purpose Lithium Complex grease such as Castrol Premium Heavy Duty, except for rubber bushes which should not be lubricated with mineral oil based greases. Where shackles are subjected to severe vibration such as rough roads, use Castrol Spheerol SBX2 Grease.

CV JOINTS

Most modern CV joint designs require an E.P. fortified grease with high temperature properties, eg. Compound Lithium Complex greases.

STEERING BOXES

Manufacturers' recommendations should be followed because E.P. fortified lubricants are often specified. Usually lubricated by a semi-fluid grease or oil. If the steering box is grease lubricated, use Castrol Spheerol EPL0.

STARTERS, GENERATORS AND DISTRIBUTORS

Manufacturers' recommendations should be followed as bearings are often packed for life with a specialty grease. If repacking is required, we recommend Castrol Spheerol EPL2 or Castrol Premium Heavy Duty.

BRAKE AND CLUTCH HYDRAULIC MECHANISMS

These systems generally employ rubber washers and O-rings. As even small amounts of mineral oil on rubber can cause deterioration, do not use a conventional mineral oil based grease.

If metal components periodically in contact with fluid require a lubricant, only use a grease specifically designed for these components, such as Castrol Red Rubber Grease.

HAND POWER TOOLS

Good high temperature and tackiness properties are required, usually in an NLGI1 base to combat 'fling off' forces in high RPM applications.

MARINE/BOATING

For intermittent or indirect water contact, a water resistant grease will provide lubrication and rust protection while still retaining its structural properties eg. lithium or lithium complex with good corrosion inhibitors. We recommend Castrol Premium Heavy Duty Grease for boat trailer bearings. Owners must recognise that the entry of water into bearings causes rust and wear. We recommend cleaning and packing of bearings at least every 6 months.

Castrol Spheerol Ultratak 2 Grease is suitable for underwater operations or where the bearing is continuously washed with water.

THE PROPERTIES OF GREASE

COMPARATIVE GREASE BASE PROPERTIES

Grease base	Typical drop Point °c	Water resistance	Oxidation resistance	Rust protection	Pumpability	Oil separation	Other comments
Calcium	80-90	Excellent	Good	Fair	Good	Fair	
Calcium Anhydrous	135-140	Excellent	Good	Fair	Good	Good	
Lithium	175-205	Good	Good	Fair	Good	Good	Very tenacious
Lithium Complex	260-300	Very good	Good	Good	Good	Very good	Good for automotive disc brake wheel bearings.
Aluminium Complex	230-250	Excellent	Good	Good	Fair	Excellent	Not as good as Lithium and Lithium Complex for high temperature and high speed applications.
Calcium Complex	260-300	Excellent	Fair	Good	Poor	Excellent	
Organo Clay	Not melt	Fair	Good	Fair	Good	Good	Not compatible with ANY other high temperature grease.
Polymer Polyethylene	N/A	Excellent	Good	Good	Excellent	N/A	Adhesive and self-levelling. Good for fixing leaking seals.

- Note: All the properties of the grease types shown will be influenced by the way a grease is manufactured and by the type of base oils, additives and fillers used as outlined under Grease Design page 13.

HOW TO CHOOSE A GREASE

The correct choice of grease is a critical feature in cost effective lubrication.

On these pages are three methods which can be used, depending on the amount of information available and the nature of the application.

GENERAL APPLICATIONS

	Speed RPM	Base oil viscosity @ 40°c (cst)	Solid additives	Castrol products
Low Speed	<250	High >500	Can be helpful, eg, Borate, Moly, Graphite etc.	Spheerol SBX 1, Spheerol SBX 2, Spheerol BTX 2
Medium Speed	250 - 2000	Medium 150 - 220	Not usually necessary	Spheerol EPL 0, Spheerol EPL 1, Spheerol EPL 2, Premium Heavy Duty, Agri Grease Ultra, Spheerol LMM
High Speed	>2000	Low < 120	Definitely not	Spheerol AP3
Shock Load	<500	High > 500	Usually very helpful eg. Moly Graphite, Talc, Zinc	Spheerol SBX 1, Spheerol SBX 2, Spheerol BTX 2

Remember to consider the OPERATING TEMPERATURE.

SPECIFIC APPLICATIONS - 1

If the shaft diameter, speed and operating temperature are known for a bearing, it is possible to calculate the required base oil viscosity for optimum lubrication and then use this to select the appropriate grease.

* Note that both specific applications 1 & 2 are only applicable for greases with base oils with a VI of 85-100.

dN = the 'dN' factor

D = shaft diameter or inner bearing diameter in mm

Rpm = shaft/bearing speed in revs per minute

e.g. D = 28mm, speed=500rpm, operating temp. = 70 °C

dN = 28 x 500 = 14,000

DN FACTORS AND OPERATING TEMPERATURE

Base oil viscosity @ 40˚C as a function of operating temperature

Operating temperature	0 - 29˚C	30 - 59˚C	60 - 89˚C	90 - 120˚C
dN Range	Base Oil Viscosity at 40˚C (cSt)			
0 – 10,000	30	115	360	750
10,000 – 25,000	35	95	270	550
25,000 – 50,000	35	70	270	550
50,000 – 75,000	20	60	220	360
75,000 – 100,000	20	60	220	360
100,000 – 250,000	9	35	115	270
Above 250,000	9	35	95	270

Using the table above, a grease with a base oil viscosity at 40 °C of 270 cSt is required.

SPECIFIC APPLICATIONS - 2

If the inner and outer bearing diameters are known along with operating speed, then another, more specific method can be used, as below.

Note that both specific applications are only applicable for greases with base oils with a VI of 85 – 100.

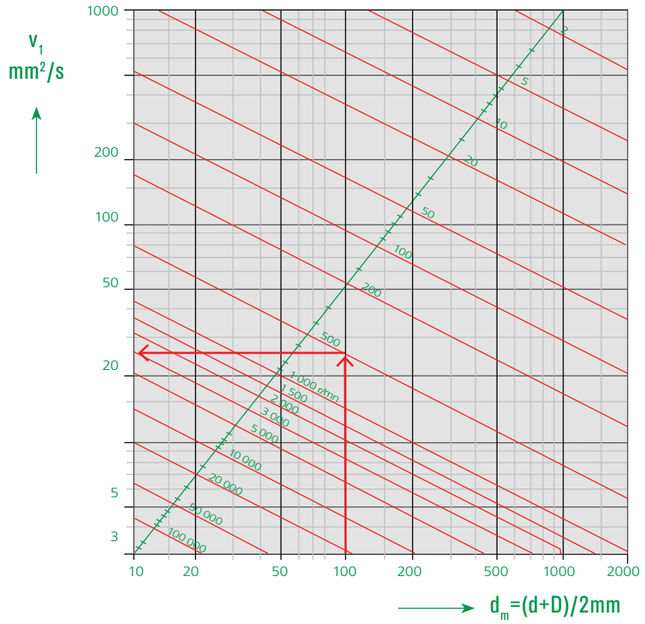
e.g.

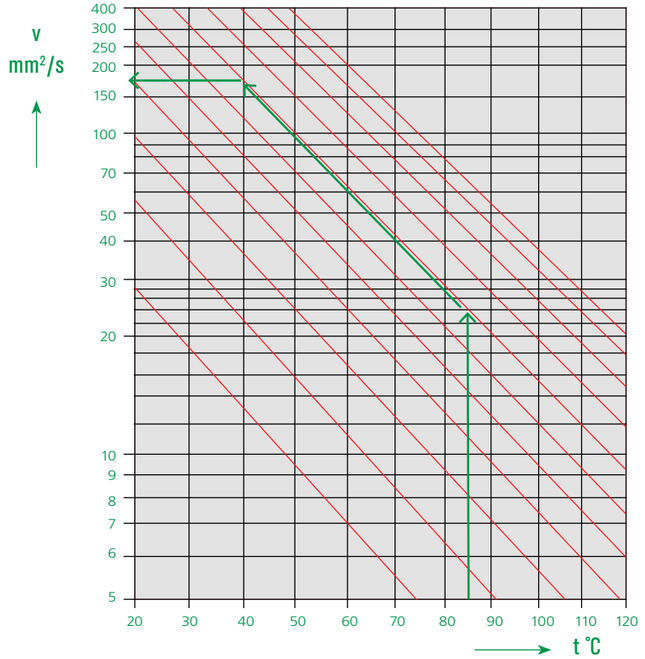
d = 75mm, D = 125mm, Speed = 500rpm

$$Dm = \frac{d + D}{2} = \frac{75 + 125}{2} = 100$$

Using the chart above, we get a required base oil viscosity of 25mm2/sec or 25 cSt, at the operating temperature.

If we know that the operating temperature of the bearing is 85 °C, then using the chart below we obtain the viscosity of the oil at 40 °C, necessary to give 26cSt at 85 °C. This value is about 175 cSt.





MIXING GREASES

NEVER MIX GREASES

Remove all old grease from the bearing before a new product is applied. This avoids the danger of INCOMPATIBILTY which is usually evident by excessive softening and leaking of grease out of the bearings, consequently diminishing their life. This is most likely to occur when a Bentone grease is mixed with any soap-based grease.

COMPATIBILITY GUIDE

	Aluminium Complex	Calcium	Calcium complex	Bentone Clay	Lithium	Lithium complex	Polyurea*	Calcium Sulphonate
Aluminium complex								
Calcium								
Calcium complex								
Bentone Clay								
Lithium								
Lithium complex								
Polyurea*								
Calcium Sulphonate								

Compatible Incompatible Borderline

*Exceptions are possible. Consult manufacturer of polyurea grease for specific details on compatibility with other greases.

WHAT YOU NEED TO KNOW ABOUT GREASE

WHAT IS A GREASE?

- Grease is like a sponge full of oil, with the sponge being the 'base' or 'thickener', holding the oil and additives in place.
- The oil content, typically 80-90% of the grease, provides most of the lubrication performance.
- To achieve the desired characteristics of a grease, careful selection of base lubricating oil viscosity, base type, additives and fillers is essential.
- A grease should be used in place of lubricating oil:
  - where it is not practical or economical to seal the component/s to be lubricated by an oil.
  - where there is no room for an oil reservoir.
  - to decrease frequency of lubrication.
  - where lubricant throw-off is likely to occur.
  - for intermittent operation. Oil drains away when a machine is stopped but a grease remains in place.
  - to suspend solid lubricants.
  - in worn bearings previously lubricated by oil to reduce noise and extend useful life.
  - soft greases can be used in place of oils in gearboxes with worn or ineffective seals.
- Greases don't perform the cooling and flushing operations associated with fluid lubricants, but are expected to possess the following properties:
  - provide adequate lubrication to reduce friction and to prevent harmful wear of bearing components.
  - protect against corrosion.
  - act as a seal to prevent entry of dirt and water.
  - resist leakage, dripping, or undesirable throw-off from the lubricated surfaces.
  - resist objectionable change in structure or consistency through mechanical working (in the bearing) during prolonged service.
  - not stiffen excessively to cause undue resistance to motion in cold weather.
  - have suitable physical characteristics for the method of application.
  - be compatible with elastomer seals and other materials of construction used in the lubricated portion of the mechanism.
  - tolerate some degree of contamination, such as moisture, without loss of significant characteristics.
- The main advantages of grease over a fluid lubricant where seals are not sufficient to hold a fluid, are its potentially longer life, convenience with regard to ease of application and simplified maintenance and design.

GREASE DESIGN

LUBRICATING OIL

- This is usually a mineral oil as they provide a wider range of viscosities. Synthetic oils can be used for extreme temperature applications, however they make the greases much more expensive.
- Greases required for high speed, light load applications should use light oils to reduce drag, although heavier oils might be necessary if prolonged high temperatures are likely to be experienced. At these temperatures, a light oil would evaporate too readily and have poor film strength.
- Greases required for low speed, high load applications should employ heavier oils for good load-carrying capacity.

BASE

- The 'base' of a grease is the thickener used to produce the grease structure. It solidifies the liquid to make it into a grease.
- A wide range of materials are used to thicken greases which include:
  - metallic soaps - Calcium (Lime), Sodium (Soda), Lithium, Aluminium and other metals.
  - metal soap plus complexing agent - Calcium Complex, Lithium Complex and Aluminium Complex.
  - non-soap greases - Organo Clay, Polyurea, Silica, Carbon Black, Dyes and Organic Polymers.
- Characteristics of the base, such as melting point, water resistance, texture and pumpability, determine the general characteristics of a grease.
- Molybdenum disulphide is NOT a grease base. It is an extreme pressure additive or filler and can be added to almost any base.

ADDITIVES AND FILLERS

- A variety of compounds may be added to the oil content of greases, generally in small concentrations, to improve specific properties.
- The main additive types are:
  - oxidation inhibitors.
  - corrosion and rust inhibitors.
  - extreme pressure agents/anti-wear additives.
  - adhesive or 'tacky' agents.
- Solid additives (non-dissolving) such as powders or flakes may be dispersed in grease to supplement certain performance characteristics.
- Materials like molybdenum disulphide (Moly) and graphite are used to enhance boundary (anti-seize) properties and extreme high temperature lubrication.
- Graphite and molybdenum disulphide are most beneficial in sliding applications such as plain bearings, shackles, bucket pins, turntables, gears, threads and slides.
- Generally, greases containing 5% or more of graphite and/or molybdenum disulphide are considered not suitable for high speed anti-friction bearings, for example above 1000rpm. A range of other solid materials may be added to enhance grease characteristics such as conductivity.
- Caution: Greases containing graphite should not be used on stainless steel, as it will reduce corrosion resistance of the stainless steel.

PROPERTIES OF A GREASE

TEXTURE AND STRUCTURE

- There are no standard test methods for quantitative definition of these properties. Changes in texture and structure affect the adhesiveness and ease of handling a grease.

STRUCTURAL STABILITY

- Refers to grease's ability to retain its manufactured consistency and texture, despite age, temperature, mechanical working or other influences, or its ability to return to its original state when a transient influence is removed.
- Structural stability can be measured by the standard grease worker or by the wheel bearing test rig.
- The standard grease worker is used for 60 double strokes and can be tested to 10,000 or 100,000 strokes and also be used to give an indication of the grease's structural stability over time.
- The greater the difference in results, the poorer the structural stability of the grease.
- A grease which possesses poor structural stability can lead to an overheated bearing. In the process of clearing the bearing, the grease receives so much mechanical working that it is liquefied, losing its lubrication properties and resulting in an increase to the temperature of the bearing.

OXIDATION RESISTANCE (TEST METHOD IP 142)

- This is the resistance to chemical deterioration in storage and service caused by exposure to heat and air. It depends on the stability of the individual grease components and can be improved by the use of anti-oxidants.
- High oxidation resistance is important wherever long storage or service life is required, or where there are high temperatures even for short periods.

FRICTION AND WEAR RESISTANCE

- Protection against friction and wear is influenced by the viscosity, type of fluid component and the structure/ consistency characteristics of the grease.
- These performance characteristics can be altered by the use of anti-wear and E.P. additives.

BLEEDING

- This is the separation of liquid lubricant from a grease. Slight bleeding may be desirable and indicative of good lubricating ability for anti-friction bearings.
- Temperature, storage conditions and pressure all affect the amount of oil separation occurring.
- Batch to batch variations of this feature will occur with identically formulated greases. A pail of grease showing bleeding or oil separation one day, may not exhibit oil loss on the next due to re-absorption.
- The surface of a pail or tin of grease should never left with hollows or depressions after use, but should be smoothed over.
- Likewise, pressure on grease in grease guns and other dispensing equipment should be released immediately after use.

PROTECTION FROM RUSTING

- To provide protection, a grease must demonstrate the ability to form and maintain a seal against the entrance of corrosive and other undesirable materials.
- Some greases are water resistant and waterproof, whereby they resist the washing effect of water and do not absorb it to any extent.
- Others can absorb varying amounts of water without appreciable damage to their structure or consistency and may provide better protection against corrosion than waterproof greases in service. However, some waterproof greases may permit the accumulation of free water in bearings.
- Where risk of water contamination is present, Bentone greases must be reinforced with corrosion inhibitors.

LOW TEMPERATURE PROPERTIES

- The low temperature properties of a grease are largely determined by the base oil in the grease and the thickener type. A base oil of good low temperature properties improves the low temperature properties of a grease.
- Low temperatures can have a considerable effect on a lubricating grease including:
  - its dispensing or pumpability properties, which may be seriously curtailed or stopped altogether.
  - it may be so solidified as to be incapable of providing lubrication.
- Freezing ambient temperatures are unusual in Australia. However, when they do naturally occur, or in refrigerated cool rooms, care must be taken to select the most appropriate type/grade of grease for the application.

PENETRATION

- Penetration is expressed as either a 'worked' or 'unworked' penetration.
- The difference between the two is that the 'worked' grease sample is subjected to physical shearing in a standard grease worker.
- The consistency of the grease measured under these conditions gives an indication of the grease consistency in service.
- The penetration does not necessarily give an indication of the pumpability of a grease. Two greases with identical penetration results but which contain mineral base oils of different viscosities, can exhibit very different pumpability characteristics.
- The degree of stiffness or consistency of a grease is measured by Penetration Numbers. This number indicates the depth (in tenths of a millimetre) that a standard metal cone penetrates the grease using the standard apparatus.

Penetration Apparatus
Test Methods :IP50, ASTM D217

The National Lubricating Grease Institute (NLGI) classifies greases according to the ASTM penetration:

NLGI Consistency No.	ASTM worked penetration at 25°C (77°F) (60 strokes)	Description
000	445-475	Almost Fluid
00	400-430	Extra Soft
0	355-385	Very Soft
1	310-340	Soft
2	265-295	Medium Soft
3	220-250	Medium
4	175-205	Hard
5	130-160	Very Hard
6	85-115	Extra Hard

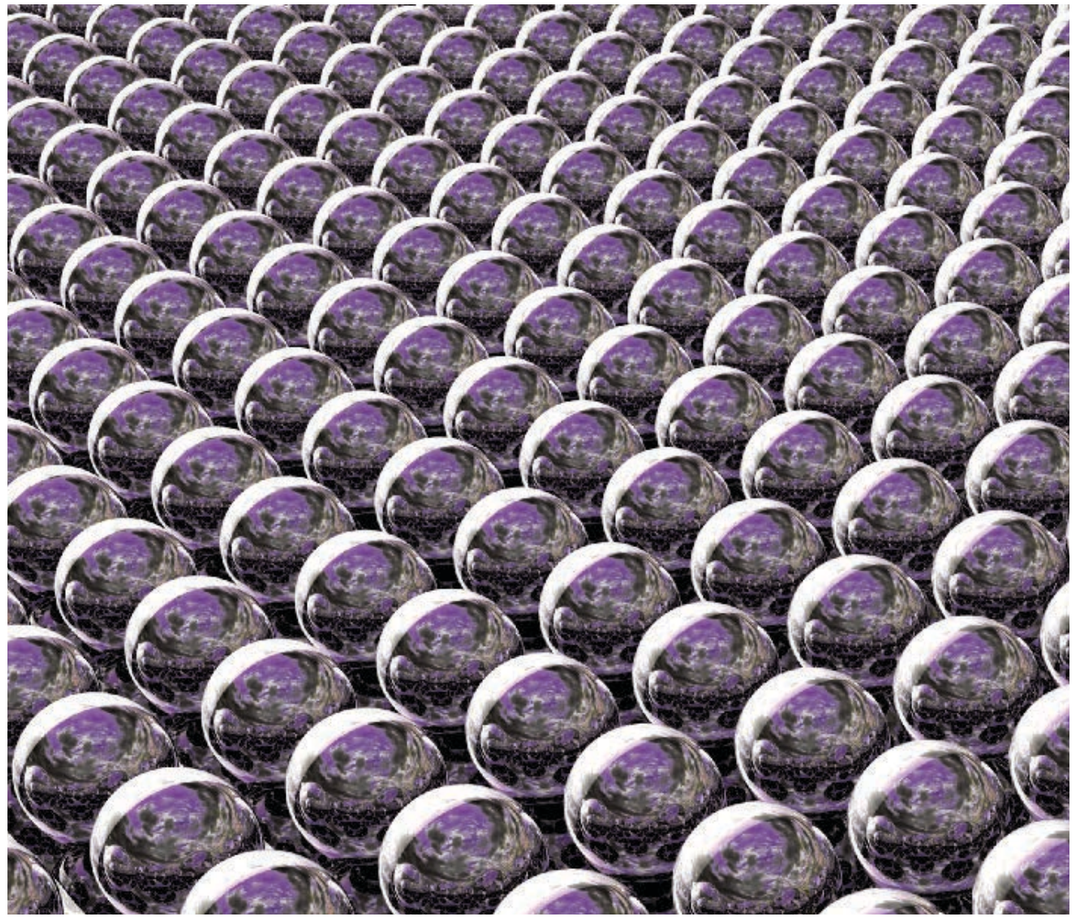
- It is now quite common to talk in terms of these grade numbers, instead of penetration units. The higher the consistency number, the stiffer the grease. A No. 3 grease would be used for large bearing, while a No. 2 and No. 1 grades would be for smaller ones.

DROP POINT

- This is the temperature at which the first drop falls from a quantity of grease when heated in a special apparatus under controlled conditions laid down by the Institute of Petroleum. (The ASTM use a similar method, D566-IP132).
- It gives an indication of the approximate melting point of the grease. In practice the maximum operating temperature should be at least 30°C below the Drop Point to maintain satisfactory results. Performance at high temperature also depends on other factors such as duration of exposure oxidation and thermal stability of base oils and additives, evaporation resistance, and design of the lubricated mechanism.

FOUR BALL WELD TEST

- ASTM Tests for measurement of extreme pressure properties of a Grease.
- ASTM D-2783
  - Objective: determination of load carrying properties of a grease.
  - Equipment: four-ball extreme pressure grease tester, microscope, timer, test balls, solvents.
- Summary of Test Procedure:
  A dry test ball is secured in a holder which is mechanically rotated during the test. Three test balls are immersed in the sample grease. The ball in the holder is rotated at 1800rpm and is brought into contact with the three balls immersed in the grease sample. The load on the balls is increased from 80kg in incremental steps up to a maximum possible load of 800kg. This is designed to stimulate the performance of the grease under actual load conditions in service.
  The test is terminated when the balls weld together. This is the point at which the grease fails to keep a lubricating film between the moving surfaces.
- Results are reported as:
  Weld Point and Load Wear Index.
  This is the index designating the load carrying property of the lubricant.



SAFE MAXIMUM OPERATING TEMPERATURE

- This is usually well below the quoted drop point because grease begins to soften long before this point through heat influences.
- If a grease is to operate consistently above 90°C, more frequent regreasing will be required. A complex grease will outperform its equivalent non-complex based greases in these situations, simply because the drop point of a complex grease is higher. They can work quite close to the drop point, (20 °C - 40 °C below) with frequent regreasing.
- The adjacent table is a guide to regreasing intervals for greases using mineral base oils, based on an eight hour day and continued operation at the temperatures shown.
- Where conditions are favourable (where frequent replenishment is possible, where seals are good, or where temperature peaks are irregular) these figures can be exceeded.
- Adverse factors must also be considered, such as large bearings, high speeds and shock loading. All these make additional demands on the grease.
- The particular type of service, bearing types and bearing speed should also be considered.

Continuous operating temperature °C	Regreasing interval*
80 °C	6 months
105 °C	3 months
150 °C	1 month
195 °C	1 week
220 °C	1 day

For mineral oil based greases only.
*based on an 8 hour day.

STORAGE AND HANDLING OF GREASES

- The same general precautions apply to handling of greases as they do to petroleum oils and lubricants.
- Some specific points that should be adhered to include:
  - replace lid tightly to prevent contamination
  - stand container on end - do not roll drums
  - store containers under cover – at least a tarpaulin to protect from weather
  - rotate stock - some greases have an actual shelf life and can deteriorate
- Avoid extreme temperature fluctuations as:
  - high temperatures (near steam coils) will cause oil separation and settling out of soap
  - low temperatures cause greases to stiffen and become difficult to handle
- Never mix different types of greases, as structure may be weakened by different types of thickeners
- Do not mix old grease with new grease
- Always use proper dispensing equipment

NOTES

Technical Help Line Australia:
1300 557 998
Customer Service and Orders:
1300 554 890
www.castrol.com.au

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