

LUBRICATION Training Manual

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1. Introduction

This and subsequent lubrication training sessions are designed to provide a basic understanding of lubrication principles and applications to workstation equipment.

The subjects covered are designed to provide a "working knowledge" of lubricant types, purpose and application, compatibility's, housekeeping and automatic lubrication systems.

More detailed information is available on specific subjects such as gearing, bearings, automatic lube system components and lubricant design and will be provided on request of individuals. If any subject within this program requires further discussion following completion of the training seminar, we would be pleased to provide clarification.

1.1. Fundamentals of lubrication

For applications at a typical industry, the majority of applications will be divided into three categories. These are;

- Oils
- Greases
- Compounds

1.1.1. Oils

Oils are by far the most important of all products used on site. They are formulated with specific base stocks and additive packages to perform to a given level.

The finished product also forms the basis for other products such as greases and compounds. The most important thing to remember when discussing oil lubricants is that the oil is essentially the medium which performs the lubrication function.

It provides, in all cases a fluid wedge between moving parts (ie bearings, gears, slides) that are in relative motion.

The design of the oil is the most critical component of any finished lubricant.

To explain the makeup of various oil lubricants we must separate their individual components and discuss them.

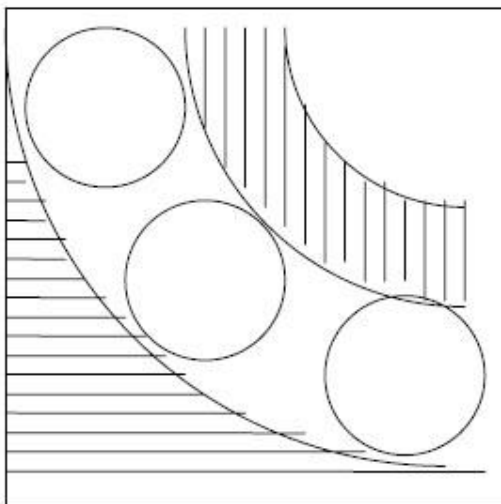


Figure 1. Bearing Cross Section

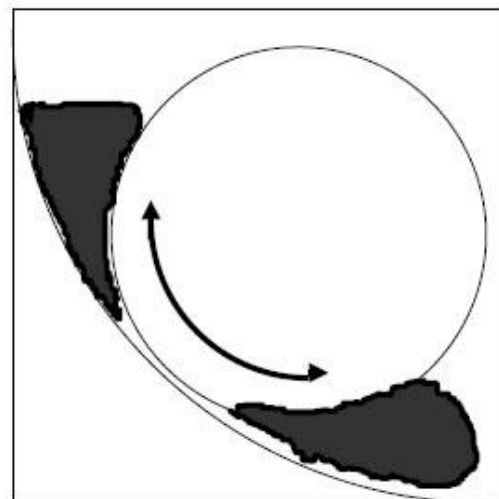


Figure 2. Lubricant Wedge

TECHNICAL INFORMATION**Base Fluids**

There are many types of lubricant base fluids available and generally the design of the equipment, the operating environment, operating temperature, ambient temperature, speed, load and cost of the base fluid will determine which base fluid is chosen.

The most common base fluids are;

- Mineral Paraffin Based Products**
- Napthene Based Products**

Paraffin based products exhibit high film strength but contain relatively high levels of carbon and residual waxes.

Napthene based products contain very low levels of residual contaminants but have lower film strength than paraffin oils. Sometimes a blend of both types will be used to attempt to obtain the best characteristics of both types.

**Synthetics - SHC type
- Diester type**

Polyalphaolefins are more commonly known as **SHC** or synthetic hydrocarbons. They are synthetic fluid which most closely resembles mineral oils (paraffin's) and exhibit the good qualities of the minerals with practically none of the shortcomings. They have excellent thermal stability, low pour points and are compatible with most mineral oils. (Though mixing with minerals will decrease their effectiveness). Their limitations are generally that they have very limited detergency and that they may have adverse effects on some common seal materials, plus higher cost than mineral oils.

Diesters and Polyolesters are organic esters which have been in use since the 1940's. They are very clean lubricants and exhibit excellent thermal and oxidation resistance but have a more severe effect on seal materials than most other synthetics. They are typically used in high temperature chain & compressor applications

There are many other types of synthetics, these can include:

- PAG Polyalkaleneglycol**
- SI Silicone**
- F/CL Halogenated**

Viscosity & Viscosity Index.

Regardless of fluid type chosen, the **viscosity** at operating and ambient temperature is the most critical feature of the lubricant for a particular application.

Some general rules are;

- use **High Viscosity** base fluid products for slow moving, heavily loaded and/or high temperature applications.
- use **Low Viscosity base fluid products** for fast moving, lightly loaded and/or low temperature applications.

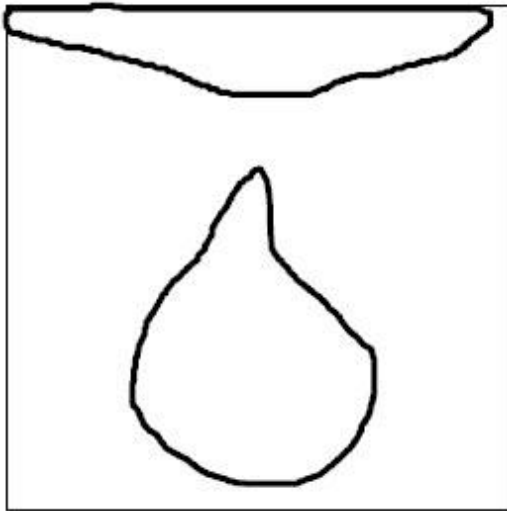


Figure 1. High Viscosity Fluids Flow Slowly

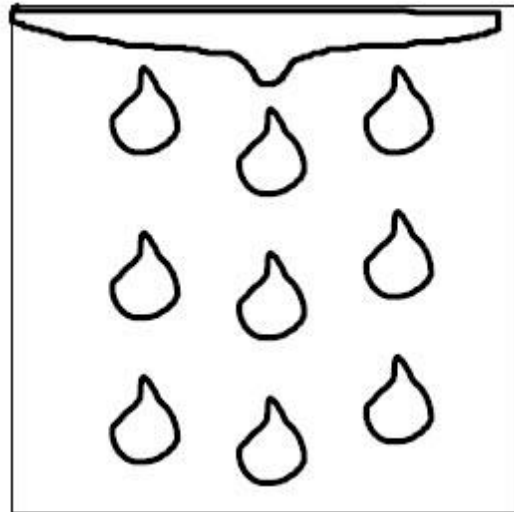


Figure 2. Low Viscosity Fluids Flow Quickly

The purpose of any lubricant is to separate moving parts. The degree of separation is generally accepted to be required to be between 1.5 to 4 times the combined surface roughness of the finished metal components. Large (comparatively) roughly finished open gearing requires a higher viscosity. Fast moving highly polished bearings or gears require a lower viscosity.

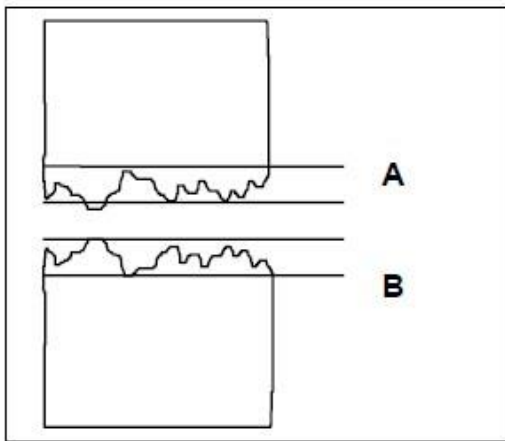


Figure 1. High Viscosity Fluids

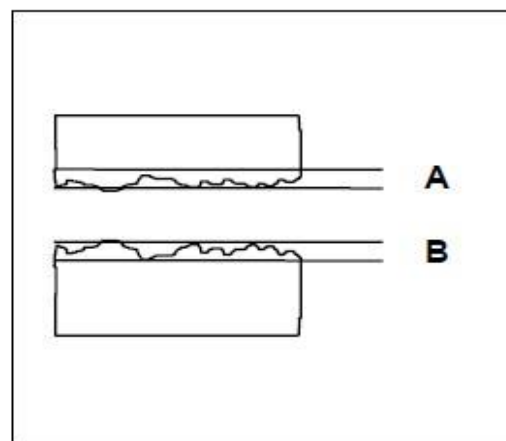


Figure 2. Low Viscosity Fluids

If the incorrect viscosity base fluid is used to lubricate machinery, operational problems will usually occur. These can be; overheating of bearings in applications where too high a viscosity is used ; accelerated wear of bearings and gears when too low a viscosity is used.

Viscosity Index is the amount or rate at which a fluid changes viscosity at either high or low temperatures. It is particularly important in cold climates or in hot environments. Minerals generally have a low VI while synthetics have varying degrees of higher VI.

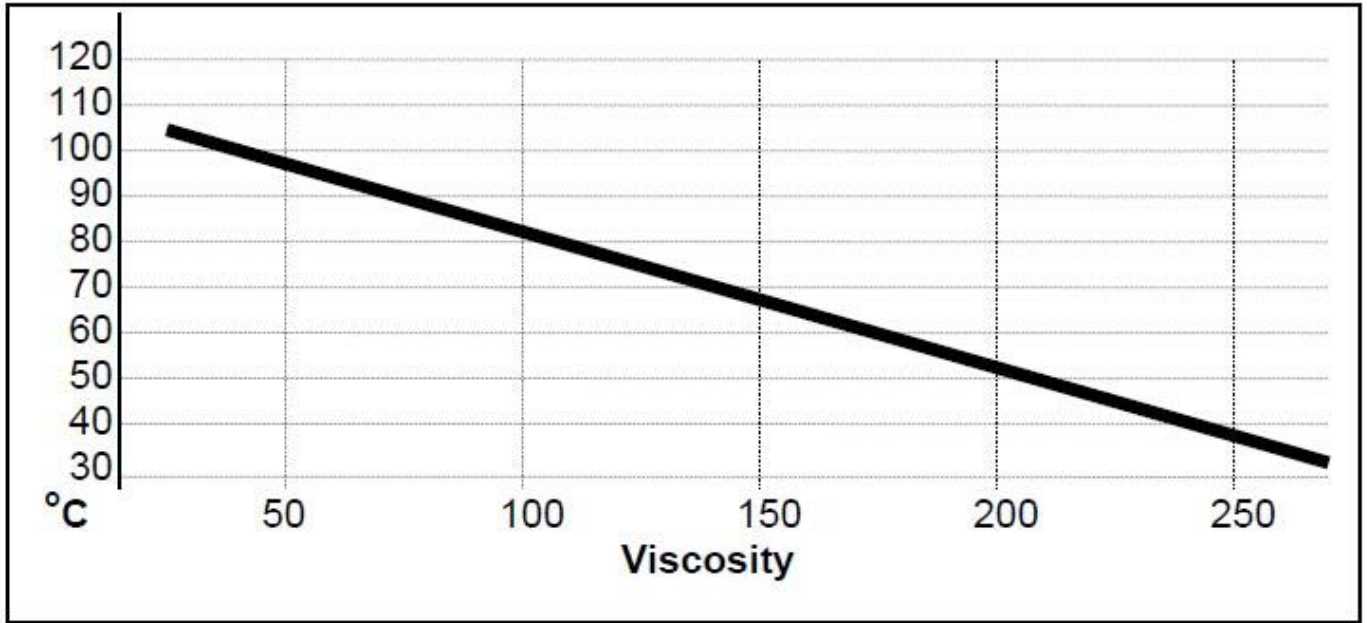


Figure 1. Low Viscosity Index Oil

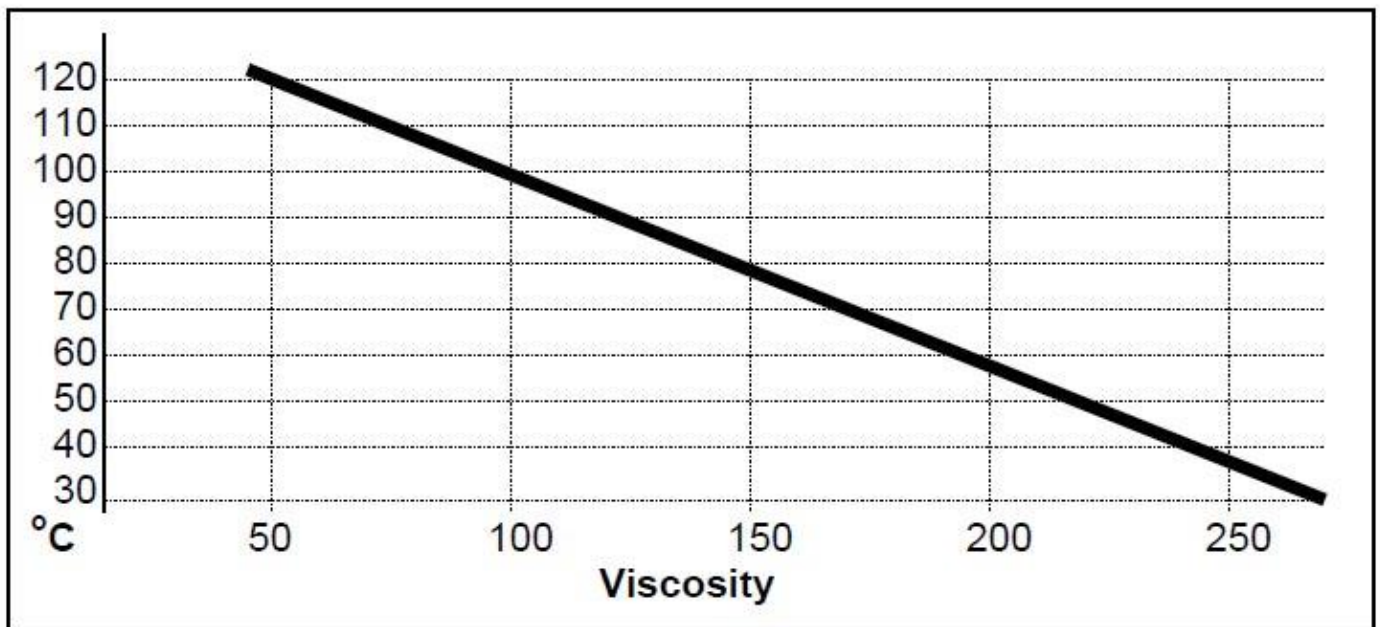


Figure 2. High Viscosity Index Oil

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Viscosity's of different oil lubricants are classified by several authorities. The most common are;

- ❑ ISO International Standards Organisation. Measures in cSt @ 40°C.
- ❑ SAE Society of Automotive Engineers. Measures in SUS (Saybolt universal seconds @ 100°F/210°F).
- ❑ AGMA American Gear Manufacturers Association. Measures in a numbered sequence for separate ISO or SAE requirements and identifies the need for extreme pressure additives.

1500	300	N/A	
1000	250	8A	
680	190	8	
460	140	7	
320	120	6	
220	90	5	50
150	85W	4	40
100	N/A	3	30
68	80W	2	20
46	N/A	1	
32	75W	N/A	10W
ISO @ 40°C	SAE Gear Oils	AGMA Gear Oils	SAE Crankcase Oils

Viscosity Comparison Chart

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Additives

Additives are chemical, mineral or solid compounds that are "added" to the base fluid to enhance or change its properties. There are two classifications of additives; performance and non performance.

Performance additives generally enhance the performance of the lubricant.

Non performance additives are generally included to keep the product in place or to extend it's useful service life under adverse conditions.

The most common "**non performance**" additives designed to extend the life of the lubricant are;

- | | | |
|----|--------------------------------------|--|
| 1. | anti oxidants | : to extend the life of the oil |
| 2. | rust and corrosion inhibitors | : to protect the equipment |
| 3. | pour point depressants | : for low temperatures |
| 4. | tackiness additives | : to keep lube in place |
| 5. | wetting agents | : to assist oil flow |
| 6. | detergent dispersants | : to keep equipment clean |
| 7. | antifoam additives | : to prevent air bubbles |
| 8. | viscosity index improvers | : for low or high temperatures
and to increase adhesion |

Additives

The most common "**performance**" additives are used to increase the ability of the lube to protect the equipment under adverse conditions and/or high loads. They are;

Anti-wear additives

which form films or layers that penetrate or coat the metal surfaces. most common are zinc compounds though some phosphate compounds are also used.

Extreme pressure additives

these are commonly mineral salts in solution in the oil. under extreme pressure when the oil film and anti-wear additives cannot support the load, they convert to acids and etch into the base metal and form very tenacious anti-weld layers.

they also become corrosive if the acid system is not neutralised by other additives

Solid film additives

these are commonly molybdenum, graphite, zinc oxide, mica, tungsten, calcium fluoride. but may also be exotic materials such as ptfе (du pont's teflon) or antimony. they are placed onto the metal's surface roughness by the pressure of the moving parts and form layers of solids which are laminar in construction.

As pressure contacts them, they shear internally to present a very low friction surface which has very high load carrying ability.

Plastic deformation additives

these are chemicals in solution that under pressure and local heat, bond to the base metal and form anti-weld surfaces that will not allow local welding. The resultant temperature increase causes the surface profile of the gears or bearings to deform via an "annealing" process until the surface finish of the metal is vastly improved. They provide similar results to solid film lubricants but the surface improvement is

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permanent, whereas the solid film layers are eventually worn away.

Summary - Review – Oils

Base Fluid	➔	mineral
	➔	synthetic
Viscosity	➔	operating environment
Additives	➔	non performance
	➔	performance
Operation	➔	fluid film operates
	➔	fluid film fails
	➔	anti-wear system operates
	➔	extreme pressure system operates
	➔	extreme pressure system fails
	➔	solid film system operates (or)
	➔	plastic deformation system operates

(this is a simplified explanation, in practice all of the systems combine to prevent failure).

Oil Compatibility's

When two oils are mixed together there will be a reaction. If the base fluids are similar or identical in chemical composition the reaction may be minimal and the result will be a reduction or increase in viscosity (the most important quality of an oil) and a reduction in performance toward the level of the lesser quality product. If the oils are of a different chemical composition (eg mineral with PAG synthetic) the reaction will be severe.

The general consequences of mixing different, incompatible base fluids can be;

- Formation of hard crystal deposits
- Formation of gel substances
- Increased oxidation rates
- Layer separation in the unit

This can (and probably will) result in;

- Blocked filters
- Overheating
- Production loss
- Lubricant starvation
- Equipment failure

Even if the products are partially compatible the consequences of, for example mixing a low viscosity oil with a high viscosity oil (eg Hydraulic Fluid with Gear Oil) will be a rapid decrease in available viscosity in the unit and dramatically increased wear rates.

Do not mix different oils without prior discussion with your lube supplier. If oils are accidentally mixed, immediately stop the equipment, drain out and refill with new oil.

1.1.2. Greases

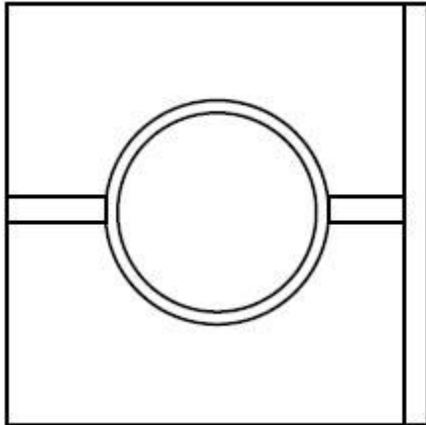
A grease is a dispersion of solid or semi solid additives (sometimes called soaps or thickeners) in the base fluid (oil plus additives). The purpose of grease is to present the lubricant to moving parts and allow the thickener to act as a sponge under pressure to release the base fluid as required by the moving parts.

Where Should We Use A Grease?

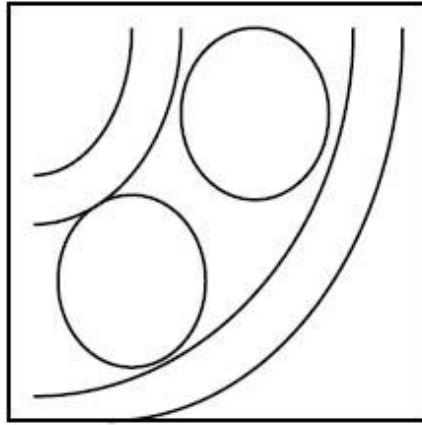
Greases are used when an oil cannot adequately stay in place due to design considerations of the equipment. They may also be used when it is desirable to;

- Seal out Contaminants
- Prevent Lubricant Squeeze Out
- Resist High Temperatures

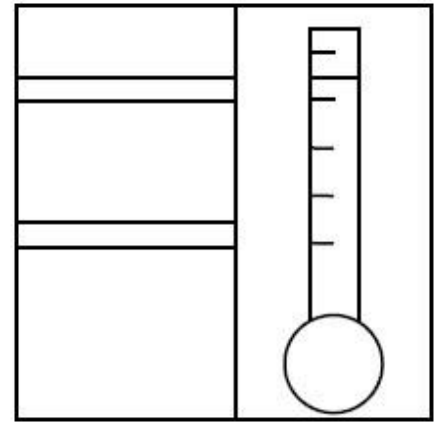
TECHNICAL INFORMATION



Seal Out Contaminants



Resist Squeeze Out



Resist High Temp

A grease is (generally) made up of

- Base Oil (70% to 90%)
- Thickener (5% to 15%)
- Additives (3% to 10%)

As the base oil plus additives are the only components which are lubricants, greases are generally not as efficient as oils, as lubricants.

Grease Types - Greases are generally defined as;

- Soap Types
- Non Soap Types

The soap types are by far the most common with the lithium soaps accounting for approximately 60% of all greases used. A brief explanation of the different types and their **primary** applications is as follows;

Soap Greases

Type	Purpose	Max Temp °C
Lithium	General Purpose	177°C
Lithium 12 Hydroxy-stearate	General Purpose Plus	182°C
Lithium Complex	High Performance General Purpose	260°C +
Calcium Hydrate	Water Resistant	79°C
Calcium Anhydrous	Water Resistant	138°C
Calcium Complex	Water Resistant/High Temp	260°C +
Aluminium	High Temperature	260°C
Sodium	Rust Inhibition, Fibrous	163°C
Barium	Waterproof	177°C

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Non Soap Greases

Type	Purpose	Max Temp °C
Silica Gel	High Temperature	177°C
Organo Clay	High Temperature	177°C
Carbon Black	High Temperature	260°C
Polyurea	High Temperature	177°C

Grease Additives - In addition to the additives used in oils, greases contain some specific additives. These are commonly;

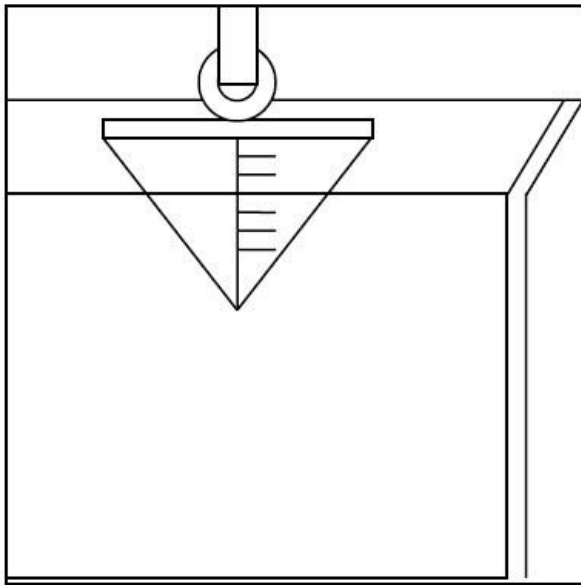
- Soaps, Thickeners
- Rust Inhibitors
- Dyes
- Perfumes

Grease Ratings

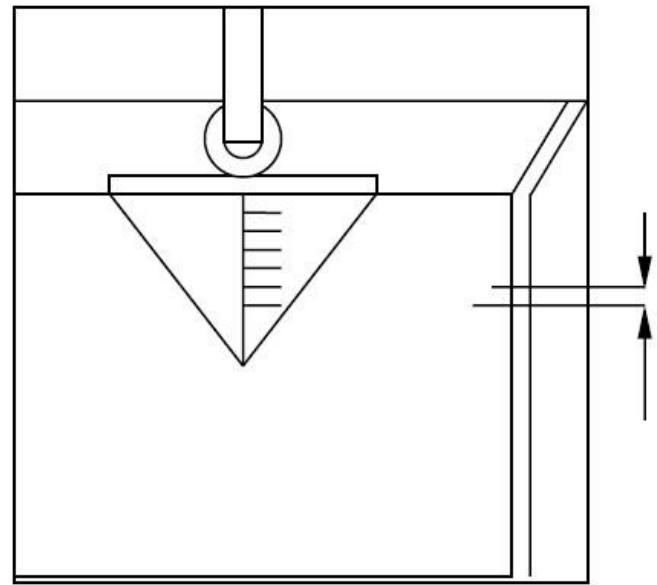
There are standards by which greases are rated for; Pump-ability, Consistency and Speed. The most common rating is NLGI, which stands for the National Lubricating Grease Institute. Each consistency stage is given a number and a manufactured tolerance. They are;

NLGI #	ASTM WORKED PENETRATION	UNIT
000	445 - 475	MM
00	400 - 430	MM
0	355 - 385	MM
1	310 - 340	MM
2	265 - 295	MM
3	220 - 250	MM
4	175 - 205	MM
5	130 - 160	MM
6	85 - 115	MM

The ASTM number indicates the depth that a special test cone penetrates the grease in measurements of mm/10 (1/10 of 1 mm). The most common grades you will see on site are; **00, 0, 1, 2.**



Stiff Grease Cone Penetrates Less



Soft Grease Cone Penetrates More

To clarify, a #000 grease looks a lot like an oil and a #6 grease looks like a solid wax compound. The correct NLGI grade is important. If too high it will not pump through automatic lubrication equipment. If too low, it may run out of bearings.

Summary - Review – Greases

- Base Fluid**
 - mineral
 - synthetic

- Viscosity**
 - operating environment

- Additives**
 - non performance
 - performance

- Considerations**
 - application
 - equipment
 - temperature
 - shock/squeeze out
 - water
 - contaminants
 - application method/equipment
 - NLGI grade

Grease Compatibility's

When two greases are mixed together there will be a reaction. If of the same basic type the reaction may be minimal (resulting in a grease that has the characteristics of the lesser quality product). If the greases have different makeup (thickeners, base fluids, additives) the reaction may be extreme. The most common reaction related failures experienced are;

- The thickeners react to increase the NLGI. The grease turns into a "wax" or "rubber" like compound, will not flow and the bearing can fail.
- The thickeners react to decrease the NLGI. The grease turns liquid and runs out of the bearing, the bearing can fail.
- The products or base fluids react and form hard deposits, the grease will not flow, lube lines are blocked and the bearing will fail.

All of these reactions will cause machinery failure and lost production. Do not mix grease compounds.

1.1.3 Open Gear Compounds

An open gear compound is a product that is formulated to perform under the most severe of conditions. These conditions are usually;

- intermittent speeds
- shock loading
- surge loading
- low operating speeds
- changes of direction of rotation
- in the presence of contaminants
- subject to extremes of temperatures
- high loads

All of these conditions require that a very specialized product is used to ensure gear tooth protection and required service life.

Open gear compounds, in the drum as supplied appear as either greases, asphaltic compounds or as very high viscosity oils. This is required to allow the product to be pumped (or delivered) usually through automatic lubrication systems.

Open Gear Lubricant Types

The major classifications of open gear compounds are as follows;

- Asphaltic Compounds
- Oil Compounds
- Diluent Cutback Compounds
- Grease Compounds
- Solvent Cutback Compounds

The type used at Tooheys is a grease based compound

TECHNICAL INFORMATION

Grease Compounds

Grease Compounds (sometimes referred to as "Multi-service Compounds") are similar to the greases discussed previously but with much higher base fluids and special additives to promote adhesion to gear surfaces. The most common of the multi-service or grease compounds is a Lithium or Lithium derivative product.

They offer convenience, ease of application and moderate to good gear protection provided that the correct product is used. The disadvantages of grease OG compounds is that they attract abrasive contaminants, are very badly affected by oil and sometimes water contamination and have relatively poor adhesion to gear teeth. This can be a consideration in mining equipment where shock, surge and reversing loads tend to push the lubricant off the gear teeth. Grease multi-service compounds can be a good option provided that they are correctly formulated for the intended application or where there is a likelihood of product cross contamination. As with any "Multi-service" product you must balance the issues of convenience with performance.

Summary - Review - Open Gear Compounds

Base Fluids	:	mineral
	:	synthetic
	:	combination mineral/synthetic
Viscosity	:	high to very high
Additives	:	performance
	:	non performance
Considerations	:	application
	:	equipment
	:	dispensing method
	:	adhesion
	:	temperature
	:	shock/squeeze out
	:	water
	:	contaminants
	:	convenience
	:	cost

Open Gear Compatibility's

Open gear compounds are generally unable to be purged on changeover of products due to equipment design and or production demands. Some reaction may take place and supervision is required during changeover.

The major source of problems with open gear compounds is contamination of the compounds with other products. Leaking gear cases can result in oil mixing with the OG product. Excessive grease or oil contamination can result in loss of adhesion of OG compounds to the gear surface. This can in turn result in bare metal showing on the gear components and rapid wear of the equipment.

Any contamination of this nature should be immediately reported and corrective action taken.

In the interim period prior to repair, the OG feed rates must be increased to cope with the contamination.

Do not allow cross contamination of open gear compounds to occur.

Module 1.1 Fundamentals of lubrication Review

Q1. *List the three (3) major lubricant types*

- A 1. -----
 2. -----
 3. -----

Q2. *What are the two (2) most common mineral oil types*

- A 1. -----
 2. -----

Q3. *What is the most critical feature of a lubricant*

- A 1. -----

Q4. *Explain the term “Viscosity Index”*

- A -----

Q5. *Supply the equivalent viscosity for:*

- A 1. ISO 220 ----- (SAE)
 2. SAE 85W ----- (ISO)
 3. AGMA 7 ----- (ISO)

Q6. Provide three (3) reasons for using a grease instead of an oil

- A 1. -----
2. -----
3. -----

Q7. What is the most common soap type grease thickener

- A 1. -----

Q8. What NLGI grade is a grease worked penetration of ASTM 275 mm/10

- A 1. -----

Q9. Provide one reaction of mixing different greases together

- A 1. -----

Q10. An open gear compound uses a (high/low) base fluid viscosity

- A -----

1.2. Lubricants on site

The lubricants used at the Auburn site can be classified into the three (3) groups as previously discussed. There will be an on-going effort to rationalise the number of suppliers and products. The aim of this rationalisation is to have the minimum number of products in use, to avoid confusion and contamination of the equipment with the wrong product. The three (3) lubricant types (and products) are;

Oils

Name	Application
CBC 600 chain oil	Chain lubricant for conveyor drive and other chains within the plant
Molub Alloy chain oil 22 aerosol	Chain lubricant for conveyor drive and other chains within the plant
WD40 spray	Light penetrating oil based lubricant for short term lubrication of slides and for use as an anti-seize lube for seized or rusted parts
Mobil SHC 629	Synthetic gear and circulating oil for use on Kronos labeller oil circulation systems and suitable for use as a gear oil for gearboxes that specify an ISO150 (SAE 85) viscosity
Molub Alloy 90	ISO220 (SAE90) gear oil for conveyor and machine gearboxes Throughout the plant. Contains dark solid film additives.
Should not be used in equipment that has sight glasses or clear level inspection tubes.	
Shell Omala 220	ISO220 (SAE90) gear oil for conveyor and machine gearboxes throughout the plant that specify an ISO220 (SAE90) viscosity

Name	Application
Molub Alloy 140	ISO460 (SAE140) gear oil for conveyor and machine gearboxes throughout the plant. Contains dark solid film additives.
Should not be used in equipment that has sight glasses or clear level inspection tubes.	
Shell Omala 320	ISO320 (SAE120) gear oil for conveyor and machine gearboxes throughout the plant that specify an ISO320 (SAE120) viscosity
Shell Omala 460	ISO460 (SAE140) gear oil for conveyor and machine gearboxes throughout the plant that specify an ISO460 (SAE140) viscosity
Mobil 634	ISO460 (SAE140) gear oil for conveyor and machine gearboxes throughout the plant that specify an ISO460 (SAE140) viscosity
Shell Omala 680	ISO680 (SAE190) gear oil for conveyor and machine gearboxes throughout the plant that specify an ISO680 (SAE190) viscosity
Shell Tellus 32	ISO32 (SAE10) hydraulic and circulating oil for use in hydraulic systems and some light chain lube Systems
Tribol 772	ISO46 (SAE15) hydraulic and circulating oil for use in hydraulic systems and some light chain lube systems
Shell Tellus 46	ISO46 (SAE15) hydraulic and circulating oil for use in hydraulic systems and some light chain lube systems

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Name	Application
Shell Tellus 68	ISO68 (SAE25) hydraulic and circulating oil for use in hydraulic systems and some light chain lube systems
Mobil Pyrolube 830	High temperature oven chain oil for use in Kister oven chain lubricators
Shell Ondina 68	Food grade machinery oil for use in Simplamatic rinser central oil Systems
Metalube 1040	Low viscosity, high detergent oil for use in gearboxes and hydraulic systems to break down gums and varnishes prior to draining of old oil
Castrol flushing oil	Low viscosity, high detergent oil for use in gearboxes and hydraulic systems to break down gums and varnishes prior to draining of old oil
H4000 silicone spray	Clear food contact spray for slides on machinery where an oil would cause problems with product contamination

Greases

Name	Application
Castrol EPLO Light	NLGI#0 grease for use on Kisters bearing lube systems
Optimol PD0	NLGI#0 grease for use on Schaeffer palletiser and infeed conveyor grease systems
Fiske lubriplate 630AAA food grease	NLGI#0 food grade grease for use on Filler bearing lube systems
Chemsearch NC123 chain grease	General purpose chain lubricant for all conveyors and other drive chains plus small open gear applications

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<i>Name</i>	<i>Application</i>
Molub Alloy BRB572	General purpose ISO150 (SAE85) base fluid grease for use on electric motors
Molub Alloy 860-220-2	General purpose ISO220 (SAE90) base fluid grease for use on conveyor and other bearings throughout the plant
Molub Alloy 823FM2	NLGI#2 food grade grease for use on crowner elements and for general bearing lubrication where a food grade grease is specified
Shell FMG	NLGI#2 food grade grease for use for general bearing lubrication where a food grade grease is specified

Open gear compounds

<i>Name</i>	<i>Application</i>
Molub Alloy 412-1	Barium complex waterproof open gear compound for use on Filler drive open gears and for use on other open gear applications

Module 1.2 Lubricants on site Review

Q1. List three (3) gear oils used on site

- A 1. -----
 2. -----
 3. -----

Q2. What type of oil is Shell Tellus 46

A -----

Q3. Where is Mobil Pyrolube 830 used

A -----

Q4. List the three (3) food grade greases used on site

- A 1. -----
- 2. -----
- 3. -----

2. Equipment, methods & procedures

2.1 Automatic lube systems

Major equipment on the site will use automatic dispensing equipment to lubricate the machine. The use of automatic lube systems provides for:

- Continuous Supply of Lubricant
- Reduction of Manpower Requirements
- Metered Volumes of Lubricant
- Economy of Application
- Maximum Protection of Equipment

The purpose of this section of the training program is to provide a basic working knowledge of how the system is designed and operates

Lincoln type

There are Lincoln automatic lubrication systems fitted to the AC1 filler, AB2 filler and to the AB1 palletiser. These systems operate automatically and only require routine top up of lubricant and inspection. A summary of the system is as follows:

Design & Operation

Reservoir/Pump

The system has a lubricant reservoir that contains sufficient grease to allow operation for a period of several days. As lubricant is consumed, the level in the glass container drops toward the base of the unit. The system must be topped up before it is allowed to empty. The system is topped up either by direct transfer with a hand pump to a connection at the base of the reservoir, or by manual adding of grease to the reservoir.

Metering valves

The system uses metering valves to distribute an equal amount of grease to each bearing (or other component) each time the system activates. These valves are located at different locations around the machine and are connected to the system by rigid steel or copper tubes. They are usually mounted in blocks of several valves at a location that is located mid way between several bearings.

Timer (or PLC)

The system operates by applying grease to each bearing via the metering valves at pre-determined intervals. These intervals are adjustable, and are controlled by an independent timer assembly, or may be controlled by a central PLC (programmable logic control). For example, if the timer is set at 60 minute/60 second cycles, the system will start up every 60 minutes and pump grease to the bearings for a period of 60 seconds. By controlling the frequency of start up, the time of operation, and the settings or size of the metering valves we can provide more or less grease to the bearings within the machine.

Maintenance

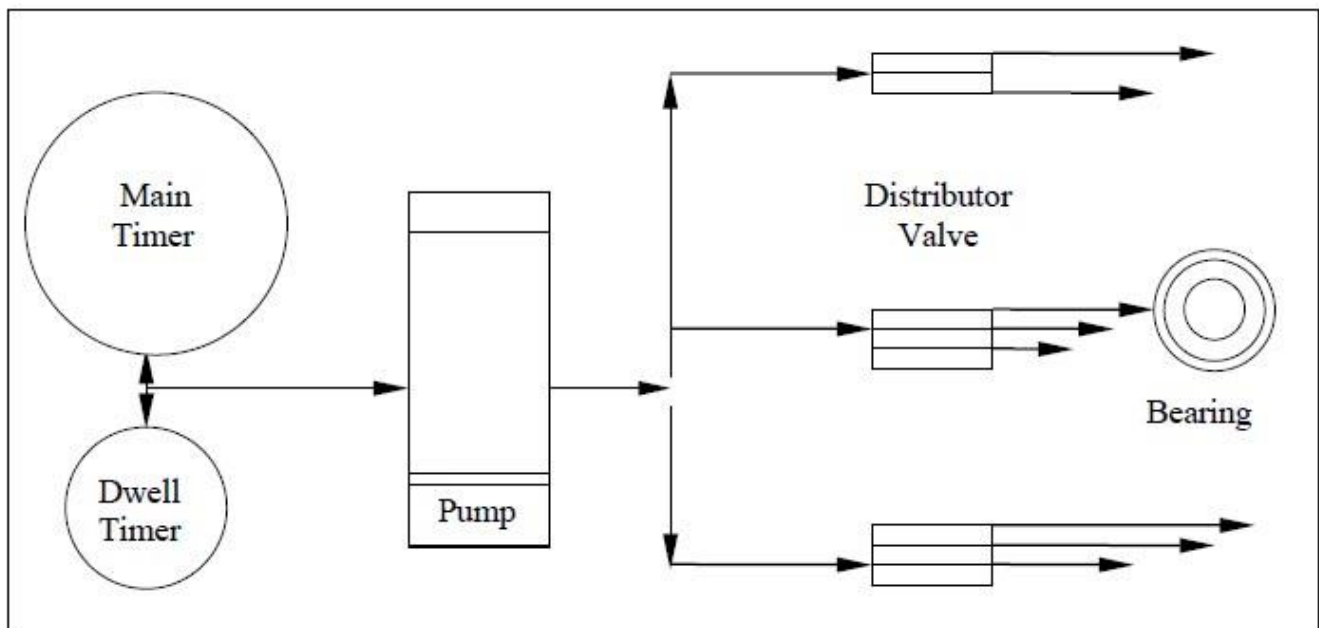
Requirements of these systems will be indicated in the task sheets for the machine. In summary these will be;

○ **Technicians**

- Routine top up of the lubricant reservoir
- Checking that the system is working
- Looking for grease leaks
- Looking for broken lines

○ **Fitters**

- Testing of system
- Tracing lube lines for damage
- Looking for over/under supply



Tecalemit type

There are two types of Tecalemit systems being progressively fitted to each major piece of equipment within the bottling and canning lines

Tecalemit SLP type

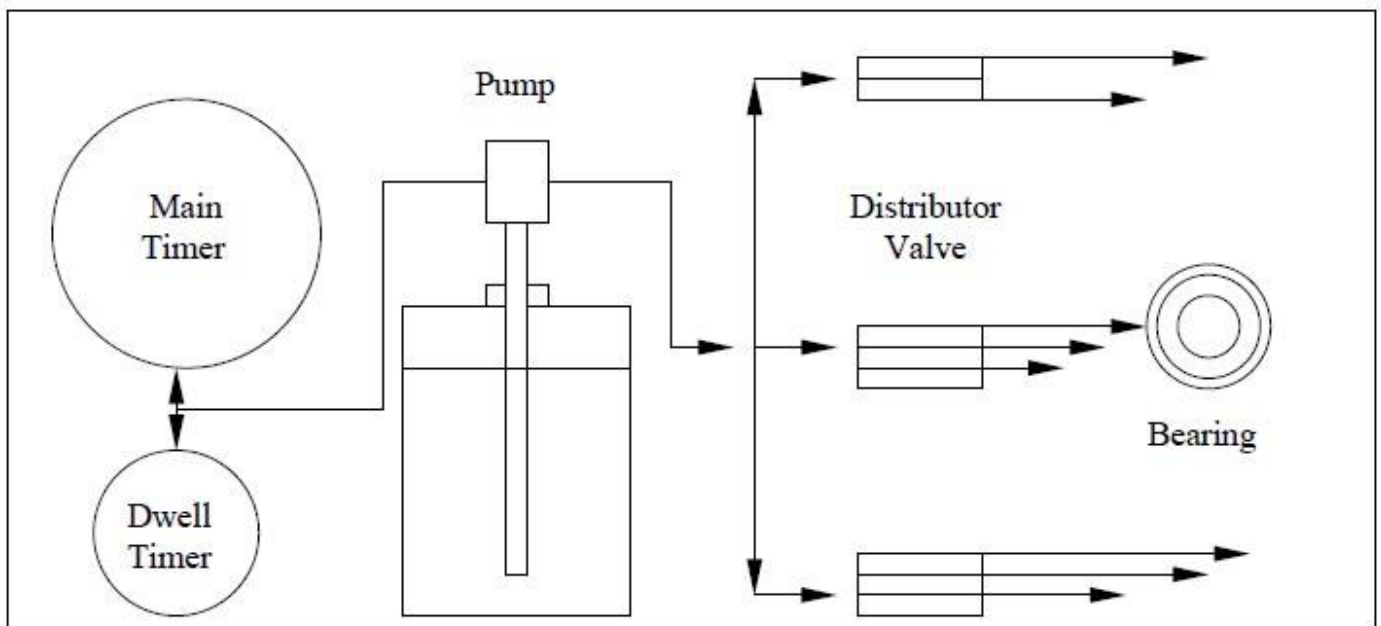
The Tecalemit **single line progressive** (SLP) type system is similar in layout to the Lincoln system. The major difference is that grease is supplied “progressively” from one point to the next in the metering valve system until all points (bearings) have been supplied with grease. This represents one “cycle” of the system.

With the SLP system depending on delivery of grease to each point before grease can travel to the next point, the system is subject to shutdown if any point is blocked or damaged. For this reason, we have installed a system monitor to each of the SLP type systems to detect if the system has a damaged lube point.

The controller that times the lube cycle also monitors the system’s performance. If a fault is detected the system activates a flashing light and audible alarm. If this alarm is activated, it means that the system will not supply any more grease until the fault has been rectified.

Do not ignore or switch off the alarm or severe damage to the machine can result through lack of grease supply

The controller also monitors the grease level in the reservoir via a low level switch assembly. If the machine technician allows the level to drop below a certain point due to lack of maintenance per the schedule, the same flashing light and audible alarm will be activated. As with the system fault alarm **do not ignore or switch off the alarm or severe damage to the machine can result through lack of grease supply**



Tecalemit XGS type

Design & Operation

Reservoir/Pump

The system has a lubricant reservoir that contains sufficient grease to allow operation for a period of several days. As lubricant is consumed, the level in the glass container drops toward the base of the unit. The system is topped up by direct transfer with a hand grease gun

Metering valves

The system uses metering valves to distribute an equal amount of grease to each bearing (or other component) each time the system activates. These valves are located on the rotary manifold of the pump assembly

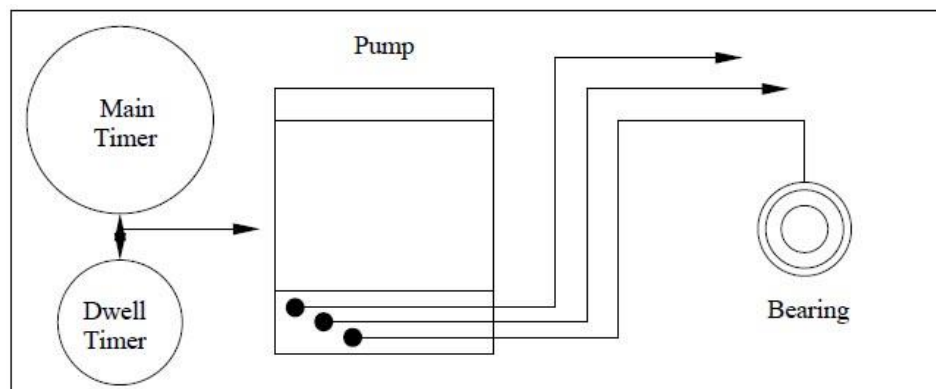
Timer (or PLC)

The system operates by applying grease to each bearing via the independent timer assembly as for the other two system types.

Maintenance

Requirements of these systems will be indicated in the task sheets for the machine. In summary these will be;

- **Technicians**
 - Routine top up of the lubricant reservoir
 - Checking that the system is working
 - Looking for grease leaks
 - Looking for broken lines
- **Fitters**
 - Testing of system
 - Tracing lube lines for damage
 - Looking for over/under supply



Pulsarlube

For grease applications within the plant where it is desirable to have automatic grease application, but where the cost of a fully integrated lube system cannot be justified, semi automatic lubricators (Pulsarlube) are used.

Design & Operation

These units operate by generating a non flammable gas within the unit that exerts pressure on a dispensing piston. The rate of gas generation determines how long the unit lasts. This generation rate is determined by the amount of electrical current that is fed from batteries contained within the unit to the gas generating cell.

The rate of discharge (and how long the unit lasts) is indicated by the colour of the unit. All of the units contain the same amount of grease, so a quicker dispensing unit will supply more grease to the bearing than a slower unit. The standard frequencies are:

Colour	Lasts	Volume	Equivalent to
<i>Yellow</i>	12 months	0.7cc/day	fortnightly greasing
<i>Blue</i>	6 months	1.4cc/day	weekly greasing
<i>Red</i>	3 months	2.8cc/day	3 day greasing
<i>Green</i>	2 months	4.2cc/day	2 day greasing
<i>Orange</i>	1 month	8.3cc/day	daily greasing

As the units run out of grease they have to be replaced. The procedure for replacement is:

○ **Removal**

- unscrew unit counter clockwise
- turn off switch located under top cap
- dispose of properly to waste bin

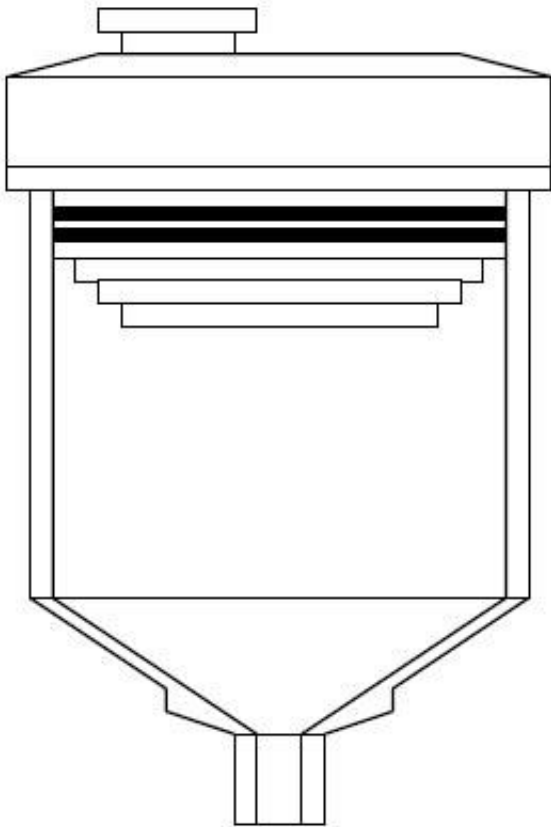
○ **Installation**

- wipe grease fitting clean
- remove base cap and dispose of properly
- screw unit clockwise into fitting
- turn on switch located under top cap
- make sure red light is flashing
- screw clear cap back on firmly
- record installation date
- mark line at level of top piston ring

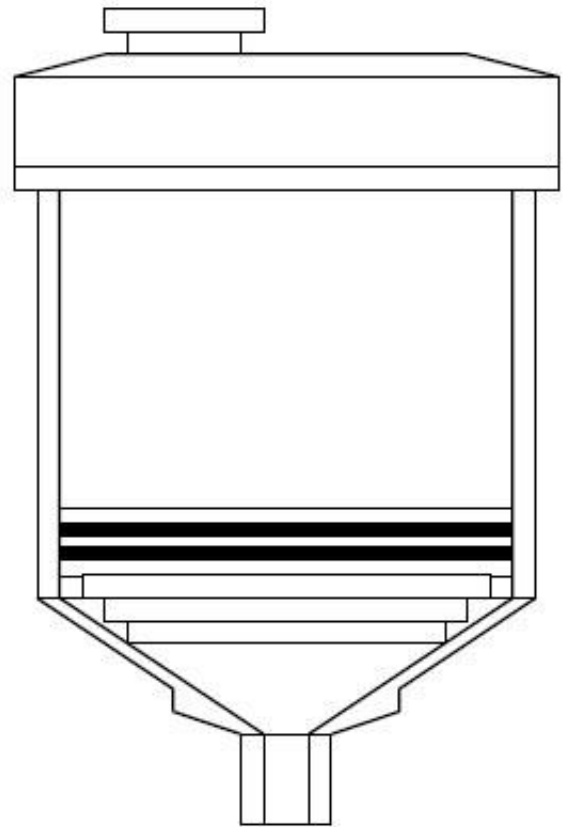
Maintenance

Maintenance of the Pulsarlube unit is minimal. Per schedules, the unit should be inspected to make sure that it has not been damaged and that it is still working correctly. The procedure for this is:

- Check the unit for impact damage or leaking lines
- Make sure that the light is flashing
- Check piston position and mark current position



New Unit - Full



Empty Unit - Replace

2.2 Manual systems

Grease guns

Grease guns used within the site will be of two types:

Cartridge type (450 gram)

With the cartridge type, grease is exhausted when the pumping action becomes too easy. The procedure for replacing the cartridge is:

- Withdraw the follower rod until it “clicks” into place
- Unscrew top or bottom cover (depending on type)
- Remove cartridge
- Insert new cartridge
- Refit cover
- Reposition follower rod

The only routine maintenance required with these guns is to ensure that the grease jaws of the nipple fitting at the end of the gun has not worn. Wear in this area is indicated by leakage of grease as the gun is operated. If this condition is noticed on more than several nipples during greasing, the end fitting assembly should be replaced.

Container type (2 kilo)

With the container type the gun is remotely mounted to allow the technician to grease more than one nipple without having to re-locate the grease reservoir each time. Grease is topped up by removing the top of the container and either scooping grease from a larger container, or by replacing the grease tin itself (if available stocks)

The container type has several advantages over the cartridge type. These are:

- The gun has a pressure valve. This allows the technician to either apply a lot of grease quickly with increased effort; or to apply a smaller amount of grease at higher pressure more easily.
- The reservoir can be placed in the area to be greased and more than one nipple can be greased without moving the container. This can be an advantage where you have to grease a lot of points in a confined area.

Oil containers

Oil containers used within the plant will be for topping up gear units (fitters) and routine top up of sight glass lubricators (see following section) The two practical sizes to use are 2.5 litre and 20 litre. Convenience for the job that you are doing will determine which size is used.

Aerosol cans

Aerosol cans are used within the site for:

- chain lube
- silicone spray
- de-watering or anti-seize

As with any aerosol (pressurised) container, some care needs to be exercised when using them. Guidelines are:

- do not puncture or incinerate even when empty
- do not aim toward yourself (or others)

Drip oilers

Drip oilers are used throughout the plant on equipment where a constant supply of oil is required in small volumes. They may be connected to a chain oil system (in which case no aerosol application is required) or simply mounted above the equipment to allow the oil to fall onto the equipment.

These units generally require frequent top up due to the small reservoir size. Top up is indicated on the task schedules and should be followed closely. Top up is achieved by opening the top spring loaded cap of the oiler and pouring oil into the unit until it is full.

Hand operated pumps

Several machines within the site utilise oil and grease systems that require manual operation by the technician. Typically these are located to small chain drives (Mitsubishi packers) and to fluid grease systems (Kisters).

Operation of these systems involves manual cranking of the lubricator handle per instructions provided on the task sheets (or in the operation manuals). In the case of the Kisters lubrication systems, a light is fitted to provide an indication that the system:

- Requires lubrication (as for AB2)
- Has received sufficient lubrication (as for AB1 & AB3)

2.3 Oil sampling

Why sample oils and greases?

Oils and greases are routinely sampled to provide information to engineering staff, to allow them to make decisions on the condition of the equipment sampled. The two major areas of information that are provided by oil sampling are:

- The condition of the oil to determine when it needs to be changed
- The condition of the equipment

While the condition of the oil is not relevant to small oil systems where it is less expensive to replace the oil on a routine basis, it is very important on large critical systems. Economies should be realised where possible, and routine throwing away of oil is expensive (and possibly even environmentally undesirable)

More important to the smooth running of the plant is the ability to predict the condition of the equipment by analysing the condition of the oil. In almost all equipment, the oil can be tested for the levels of wear debris to indicate the wear rate of the components within the equipment.

While one sample will not provide much of an indication, routine samples at regular intervals can provide a very accurate picture of mechanical conditions that, if left unattended, can lead to unscheduled failure of bearings or other parts.

Methods & procedures

The accuracy of the laboratory test report is directly proportional to the representative quality of the sample.

Unless the sample taken is representative of the bulk of the lubricant in its working environment, then all that follows is meaningless.

It is important that sample takers are trained and supplied with good quality oil sampling guns, bottles and labels. Extreme care and good judgement are necessary

to ensure the samples represent the general character and average condition of the lubricant to be tested.

TECHNICAL INFORMATION**A few fundamentals should be followed closely:**

- Suitable sample containers should always be available and these should be clean and dry.
- In dusty environments care should be exercised to make certain that airborne contaminants do not enter the container or the sampled lubricant. Sample as quickly as possible and seal immediately at all times.
- Oils should be sampled while in circulation and at operating temperature, or immediately after the unit has stopped.
- Generally, if when the unit is sampled the oil or fluid is hot, it will be representative.

Don't collect samples from units that have stopped for long periods.

- In circulating systems the lubricant should be sampled from a point in the system which will be indicative of its condition as supplied to the lubricated parts e.g. after a full flow filter, not before.
- When taking grease samples, to carry out most tests, 500 grams of sample is required. While this can be difficult, you should collect the largest sample possible up to 500 grams. Smaller samples will mean that only the most basic test for grease identification has to be omitted when a small sample is received.

If there is an instance where a piece of plant or equipment suffers a mechanical failure, **all relevant lubricant samples must be taken immediately** (i.e. a representative sample from the equipment and, if possible, a sample of unused lubricant from the container) It is also helpful if samples or photographs of the failed or damaged components can be collected to assist interpreting the causes of failure.

Module 2. Automatic lube systems Review

Q1. Provide three (3) reasons for using automatic lube systems

- A 1. -----
 2. -----
 3. -----

Q2. List two (2) automatic lube system Technician tasks

- A 1. -----
 2. -----

Q3. If a lube line blocks with a Single Line Progressive type system, lubricant will continue to be delivered to the bearing. (true/false)

- A -----

Q4. What two (2) potential faults does the system controller monitor

- A 1. -----
 2. -----

Q5. What indicates how long a Pulsarlube unit lasts:

- A -----

Q6. Describe the eight (8) steps involved with installing a Pulsarlube

- A 1. -----
 2. -----
 3. -----
 4. -----
 5. -----
 6. -----

TECHNICAL INFORMATION

Q7. Describe the three (3) maintenance requirements for a Pulsarlube

- A 1. -----
2. -----
3. -----

Q8. What are the two (2) sizes of grease guns used on site

- A 1. -----
2. -----

Q9. Describe two (2) guideline when using aerosol cans of lubricant

- A 1. -----
2. -----

Q10. What maintenance do drip oilers generally require

- A -----

3. Safety & Housekeeping

3.1 Safety

Lubricant exposure

Modern lubricants as used within the site have to be formulated to reduce health risks associated with exposure to them in use. Additives such as lead, antimony, chlorinated solvents etc., that were previously used are actively being phased out. This has the end result of presenting products that are much more “operator friendly” than those previously used. Safety data material for all products used on site are held on record. If you have any inquiries regarding these sheets you should contact the appropriate occupational health and safety people for your section/site.

Some precautions still need to be observed when using lubricant products, most of which are based on common sense. A summary of these include:

Ingestion Avoid the possibility of ingesting lubricants. Apart from not eating them directly, care should be taken to wash hands after exposure to avoid transfer from hands to food.

Ingestion Summary

- ✓ Do not ingest
- ✓ Wash hands properly after exposure
- ✓ Wash hands properly before eating

TECHNICAL INFORMATION

Inhalation It is unlikely that lubricant products are of a light enough viscosity to be able to be inhaled. However when working on or near air atomising equipment (air line lubricators) or when using aerosol cans of light grade lubricants (eg: WD40, light chain oils etc.) care should be taken to direct the spray stream away from yourself. If you are particularly sensitive to mineral and synthetic oil products, thought should be given to the use of a disposable respirator mask.

Inhalation Summary

- ✓ Avoid inhaling fumes or spray mist
- ✓ Direct spray away from yourself
- ✓ Avoid spraying in a confined area
- ✓ Use disposable respirator if sensitive to irritation

Exposure Mineral oils are not generally regarded as toxic in themselves. They can however contain additives that may cause allergic reactions in people with sensitive skin. They can additionally remove the skins protective barrier (lanolin) and result in accelerated drying out of skin, which may in turn result in dermatitis conditions in people with sensitive skin.

If subject to skin irritations, it is recommended that a protective cream is used prior to lubricant exposure. Equally, when washing hands after lubricant exposure, a suitable barrier cream can be used to protect people with sensitive skin.

Contamination of clothing can result in skin irritations, caused by prolonged contact of the clothing to your skin. If protective clothing (uniforms or otherwise) become heavily contaminated, change to clean clothing as soon as practical.

If lubricant application results in eye contact, there is the potential for eye irritation to result. In these cases immediate steps should be taken to receive preventative medical treatment per normal procedures for the site. Your safety officer will be able to explain these procedures should you require further information.

Exposure Summary

- ✓ Avoid excessive exposure
- ✓ Use barrier cream before use
- ✓ Use barrier/moisturiser after washing
- ✓ Change contaminated clothing
- ✓ Seek medical attention for eye contact

TECHNICAL INFORMATION**High pressure air**

High pressure air (up to 130 psig/884Kpa/8.8Kg/CM₂) is used to operate grease pumps, air line lubricators and other systems. High pressure air should be treated with respect. Injuries associated with skin, eye and other contact can be serious. Care should be exercised when working with high pressure air as used in lubrication systems. Some guidelines when using or working with this equipment are:

- ! Ensure that loose or leaking lines are repaired
- ! Never aim air stream at yourself or others
- ! Wear suitable protective clothing as necessary

High pressure grease & oil

High pressure grease and oil (up to 3,000 psig/44,100 Kpa/204 Kg/CM₂) is used to operate grease distributor blocks and hydraulic systems. High pressure fluids must be treated with respect. Injuries associated with skin, eye and other contact can be serious. Care should be exercised when working with high pressure fluids as used in lubrication systems. Some guidelines when using or working with this equipment are:

- ! Never use pressure gauges or other diagnostic equipment that is rated below the operating pressure of the system
- ! Ensure that system faults with piping, hoses, connectors or other parts associated with high pressure fluids are reported and repaired promptly
- ! Wear suitable protective clothing when operating or working on high pressure fluid equipment

3.2 Housekeeping**Checking Oil Levels**

Oil levels in enclosed reservoirs and gear cases will be checked either via a dipstick or level plug dependant on machine design. When checking with dipsticks withdraw dipstick, wipe clean then reinsert and check again to avoid false readings. Use clean cloth to avoid introducing contaminants into reservoir. When using level plugs, a flow of oil out of the reservoir indicates the correct level. Wipe spilt oil from reservoir after checking.

Top Up

Top up of low oil levels will be via a filler cap at the top of the reservoir. Ensure that all built up dirt around the filler cap is cleaned off prior to removing cap. Ensure that transfer pumps, hoses and oil storage containers are clean and free of contaminants to avoid introducing foreign materials into the reservoir. Clean off spilt oils after top up.

TECHNICAL INFORMATION

Sampling

The ideal sampling method is by sample gun from the working zone of the reservoir.

All sample collection equipment **must** be kept clean or false analysis results will occur. Refer to sample analysis procedure instructions provided

Cleaning up spills

Clean up spilt oil and grease as soon as possible after the contamination is noticed. Oil and grease spills present a safety hazard and their clean up should be given priority. Suitable materials should be used to clean up spills.

Suggested materials are:

- Absorbent media (kitty litter type) to soak up large spills
- Rags to absorb small quantities
- Degreasing fluid to remove oily films

Clean Up Of Spent Lubricant

Due to automatic lubrication of the machines, used lube will build-up around gear sets, bearings, slides and sheaves. Regular cleanup is required to ensure a safe environment and to avoid dirt build-up that can contaminate machine components.

Particular attention should be paid to bearing grease collection trays, floor areas under machines. Leaking distributor blocks, fittings and hoses should be reported as soon as possible to affect repairs and avoid further contamination of the machine.

Module 3. Safety & Housekeeping Review

Q1. Provide three (3) precautions to avoid ingestion of lubricants

- A
1. -----
 2. -----
 3. -----

Q2. List two (2) precautions to avoid inhalation of lubricants

- A
1. -----
 2. -----

Q3. If you are exposed to lubricants, list two (2) actions that should be taken

- A
-

Q4. What are two (2) guidelines when working with high pressure air

- A 1. -----
2. -----

Q5. What are the three (3) guidelines when working with high pressure fluids

- A 1. -----
2. -----
3. -----

Q6. Describe two (2) methods of checking oil levels

- A 1. -----
2. -----

Q7. Describe one (1) precaution when topping up oils

- A 1. -----

Q8. Describe two (2) suitable materials for cleaning up oil spills

- A 1. -----
2. -----