Thickeners

Thickeners are divided into soaps and non-soaps, and give lubricating greases their typical properties as well. Soap greases can be divided into simple and complex soap greases, each of which are referred to by the name of the cation on which the soap is bases (e.g. lithium, sodium, calcium, barium, or aluminium soap greases).

These metal soaps are made from fatty acids, which are products obtained from animal or vegetable oils and fats.

These fatty acids are a mixture of a wide variety of chemically defined fatty acids. They are split into fatty acids and glycerides by hydrolytic decomposition. The fatty acids are then combined with the corresponding metal hydroxides to form the metal soaps used as thickeners for lubricating grease production.

Additives

Additives counteract wear and corrosion, provide additional friction reducing effects, improve the adhesion of the grease, and prevent damage under boundary and mixed friction conditions.

Additives therefore affect the quality, potential applications, and ultimately the practical value of the grease. Additives can be solid, polar, or polymeric.

Solid Additives

Graphite, Molybdenum Disulfide, Zinc Sulfide, talc, polytetrafluoroethylene, etc. are incorporated into greases in powder form or as pigments. They act in the boundary and mixed friction regions. Solid additives improve running-in and emergency operating characteristics.

Polar Additives

Polar substances are hydrocarbon molecules which behave in an electrically non-neutral way because of their molecular structure (i.e. by incorporating other elements such as oxygen, sulfur, or chlorine), and are retained on metal surfaces as if they were magnetic. The presence of polar substances increases adhesion of the lubricant film, since pure hydrocarbons are "non-polar".

Polymer Additives

The correlation between temperature and the viscosity of mineral oils can be influenced by additives. These additives consist of organic polymers with molecular weights of between 10,000 and 200,000. At moderate temperatures their chain-like molecules are tangled together, but at high temperatures they extend into elongated threads. By simultaneously switching to a low-viscosity base oil with a higher viscosity index (VI), the viscosity-temperature curve can be flattened. The presence of polymers makes the viscosity of a base oil dependent on the shear rate.

Polymers generally improve the wear protection offered by lubricants. Polymers used as adhesion additives for greases include polyisobutylenes, olefin polymers, and others. They improve the grease's adhesion to surfaces.

Additive	Typical Compounds	Purpose
Extreme Pressure Additives (E.P)	Sulfur, chlorine and phosphorus compounds, sometimes combined with graphite or MoS_2	Protect metal surfaces against cold welding
Anti-wear Additives	Organic phosphates or phosphites, zinc dithiophosphates, graphite, MoS_2	Reduce wear of metal surfaces
Corrosion Inhibitors	Organic compounds containing active sulfur, phosphorus or nitrogen, such as phosphites, metal salts or thiophosphoric acid, sulfated waxes, or terpenes	Protect against corrosive attack on bearing materials or metallic contact surfaces
Anti-oxidants (Anti-aging)	Phenols, aromatic amines, sulfated phenols, zinc dithiophosphates	Delay oxidative decomposition
Friction-reducing Additives (Friction Modifiers)	High molecular weight compounds such as fatty oils, oxidised waxes or graphite and MoS_2	Reduce friction under boundary and mixed friction conditions
Adhesion Improvers (Tackifiers)	Polyisobutylenes, olefin polymers, latex	Improve surface adhesion

The best approach is not to put connections and equipment underneath items of plant. Instead use extended nozzles so valves and instruments can be fitted beside tanks and vessels. Where for process reasons or cost consideration connections and equipment are needed under an item of plant, provide sufficient space and clearance to give the tradesman quick, easy and safe access.

FINGERS, HANDS, LEGS AND BODY ACCESS

Don't use the minimum access requirements provided in USA Navy literature when building production plants. If plant reliability, low maintenance cost and industry best safety statistics are the goals then design for the man on the street and not a fit and healthy young naval recruit.

Repairs mean people have to be able to get their body to every location around the piece of equipment to be fixed. Maintainers and operators have to get fingers to bolts and nuts. Electricians have to fault-find equipment. Alignment adjustments require easy positioning of tools. If freedom of access to do these jobs is restricted, the jobs will be done poorly and the maintainer can do nothing to improve the situation.

TAKE THE LONG TERM, FOUR DIMENSIONAL VIEW

Once a 100-kilogram, 1-tonne or 10-tonne item is mounted in place it is there for the life of the plant. If neighbouring plant is mounted too close or support structures prevent access right up to the machine it will cause years of frustration and wasted money. This is because the only choice left to the maintainers is to pull the plant apart to make room to get to the repair.

Access is a four-dimensional concept. Height, depth, width and time are equally all-important factors for reliable maintenance and operation. Build in safe and plentiful access while the project is being designed. Leave space for people's fingers and bodies. It will produce the best results in the long term.

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V E E - B E L T   D R I V E S

ABSTRACT
Vee-belt drives. The article discusses the use of vee-belt drives. It covers some basic theory of friction drives and lists 11 factors to be considered when using vee-belt drives. A friction drive connects two shaft-mounted pulleys by a belt that is drawn taut enough to grip each shaft and turn them. The belt is pulled tight to create friction with the pulleys. As the drive pulley turns, the belt moves the connected driven pulley. Keywords: belt tension, friction drive, coefficient of friction.

FRICTION DRIVES

Figure 1 show elevation and plan views of a twin vee-belt drive arrangement.

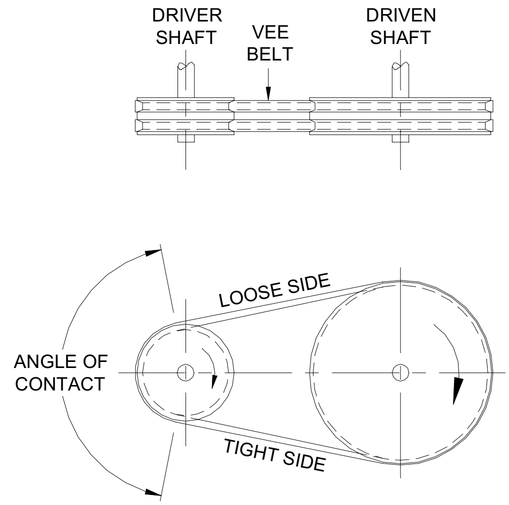

Figure No. 1. Twin vee-belt drive arrangement.

The success of the drive depends on maintaining frictional contact between belt and pulleys. Vee-belt drive friction is dependent on several factors. These are –

- Tight side and loose side belt tensions.
- The coefficient of friction between the belt material and the pulley material.
- The total angle of contact around the pulley, which depends on the pulley diameters and their distance apart.
- The centrifugal force lifting the belt off the pulley produced by the rotation of the pulley.
- The angle of the vee in the pulley which acts to wedge the belt in place. It is usually between 17^o and 19^o.

THE ADVANTAGES OF VEE-BELTS

Vee-belts offer a number of advantages in their use.

- Easy, flexible equipment designs, as tolerances are not critical.
- Reduce shock and vibration transmission.
- Changing pulley sizes changes the driven shaft speed.
- They require no lubrication.
- Maintenance is easy provided unrestricted access is available to the drive arrangement.
- The pulley alignment is quickly done with a straight edge or a string line spanning across both pulley faces.
- Setting the belt tension is readily achieved by jacking the pulleys apart and measuring the transverse distance the belt can move.
- Higher shaft torsional loads are handled by using multiple belt pulleys.
- In an overload situation the belts slip and the equipment is protected.
- A jockey pulley can be installed to increase the angle of contact and allow transfer of more power. It can be mounted on either the tight or loose belt side and adjusted inwards to provide more angle of contact.

THE BELT

Conventional vee-belts are made of rubber reinforced with imbedded plastic, fibreglass or steel cords. The cross-sectional area of the belt depends on the power to be transmitted through the belt. Multiple belts are used in combination to transmit large amounts of power.

THE PULLEY

Pulleys can be cast iron or steel. The vee groves are machined into the solid billet. The pulley is usually keyed to the shaft. They must be balanced.

TORQUE LIMITING

In overload situations it is necessary to protect the equipment from major damage. One option is to size the chain so it purposefully snaps, it is also practical to install shear pins through the sprocket and shaft that shear through when the drive is overloaded and allow the sprocket to spin on the shaft. A third option is to install a torque limiter clutch within the sprocket.

The clutch has internal surfaces that are forced together and drive the shaft under normal load conditions. But when overloaded the clutch slips and the sprockets do not drive the shaft with as much force. This function is also useful on sudden start-ups and allows the shaft to come up to full speed slowly as the friction on the clutch permits gradual speed up of the shaft.

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OVER-CURRENT AND OVERLOAD SITUATIONS

As the load on an electric motor increases, the spinning rotor starts to slip more and slow down. The electric current draw rises as the motor tries to maintain speed. The higher current flow causes more heat to develop inside the motor. The heat builds up and can destroy the motor's internals. The motor fails due to being overloaded. Here again current detection can be used to shut the motor down and protect it and/or raise an alarm.

Overloads are likely in bulk materials handling situations such as bucket elevators and screw feeders. Where equipment has to combat a dragging, digging or scraping action as part of the process, sudden overloads should be expected. Over-load protection should be incorporated into the original design.

ALLOW FOR THE OPERATING REQUIREMENTS

There are times when motors are required to free wheel for a short period or there will be a short, temporary overload situation. An example is when a pump sending liquid into one tank is required to send liquid into an alternate tank. For a short period both tank's valves may be closed. It is often better to keep the pump running for a few seconds against a deadhead rather than to put it off and restart it. In this case the motor current will intentionally drop low but do not want the undercurrent protection to stop the motor.

The timer is used to prevent the motor shutting down unnecessarily. Observations are made of normal operating duty current draws and delays to permit normal operation, such as high current draw at start-up, are set into the timer. The current protection only activates after the timer counts out in the presence abnormal loads.

There is one issue to be weary of when using current protection. It is possible to have a 'false' load on the motor. As long as a motor experiences 'normal' loads the current stays within the permitted operating band. Should this load be the result of a part failing, e.g. a collapsed bearing or a slipping vee-belt, then the current could still be in its working band and the protection will not operate.

Current protection is a cheap, simple way to protect your equipment against those unexpected and unforeseeable errors that happen.

HIGH GEARING RATIOS

When electrical current detection is used on highly geared drives (above about 50:1) it tends to become insensitive to sudden changes in load. By the time the unexpected load condition is transferred through the drive to the motor, the torque involved is very much reduced. There will be an eventual effect on the motor current but it may not last long enough to trigger the protective systems. The problem can be overcome if torque detection is also incorporated into the load protection methodology.

With torque, electric current, electric voltage and shaft speed detection and control all incorporated into a variable speed drive (VSD) it is possible to control the loads on high geared mechanical drives. They can be slowed, sped-up or stopped electronically if unplanned load conditions occur.

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begins to rattle and bounce about. In the case of roller bearings the rollers are smashed into the raceways and start hammering the metal. The metal surfaces dimple and roughen (brinell) and failure happens soon after.

6. **High Temperatures**

Temperature rise causes lubricant viscosity to fall and lube films to thin. External sources may also cause temperature rise.

Is the process radiating heat onto the bearing housing, or is there hot, direct sunshine on the bearing housing, preventing internally generated heat from dissipating (shedding) out of the bearing? Is the process heat being transferred down the shaft and into the bearing? Is the bearing housing covered in dust, dirt, rags or rubbish and the heat cannot escape? Does it need an extra flow of cooling air to remove the heat? If oil lubrication is used should an oil cooler be installed? Does the housing need more surface area for radiation and convection cooling?

Keep the lubricant cooled to the temperature of the required viscosity.

Do all these six things right and you won't have problems due to poor lubrication. It will need constant vigilance but the pay-off is long-lived plant operating with few problems.

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