Component	Lubricant	Packaging	Volvo Art.no.
SECTION 7. HUB			
Wheel bearings: greased	Lube grease Li/EP	cartridge 400 g	116 1251-2
Wheel bearings: oiled, **front**	**Engine oil**		
Wheel bearings: oiled, **rear**	**Final drive oil GL-5**		
SECTION 8. BODY			
Wiper shaft	Lube grease Li/EP	tube 80 g	116 1241-3
Rearview mirror retainer	"	"	"
Door hinges	"	"	"
Door stops	"	"	"
Seat rails	"	"	"
Lock buttons	Vaseline/Bushing paste	tin 100 g	116 1153-0
Lock cylinders	Lock oil/All-roud spray	aerosol 0.18 l	116 1036-7
Lock washers	Vaseline/Bushing paste	tin 100 g	116 1153-0
Striker plates	"	"	"
Lock mechanism	Low-temperature grease	tube 125 g	116 1236-3
SECTION 9. MISCELLANEOUS			
Hydraulic pump:			
Driven splines	Molybdenum disulphide grease	tin 250 g	116 1078-9
Other parts	Hydraulic oil	barrel 208 l	116 1114-2
		can 4 l	116 1115-9
		bottle 1 l	116 1116-7
Robson drive:			
Joints	Lube grease Li/EP	tube 80 g	116 1241-3
Other parts	Hydraulic oil	barrel 208 l	116 1114-2
		can 4 l	116 1115-9
		bottle 1 l	116 1116-7
Bogie lift:			
Joints	Lube grease Li/EP	tube 80 g	116 1241-3
Other parts	Hydraulic oil	barrel 208 l	116 1114-2
		can 4 l	116 1115-9
		bottle 1 l	116 1116-7
Fifth wheels	Lube grease Li/EP	cartridge 400 g	116 1251-2
Plate	"	"	"
Cranes:			
Joints	Lube grease Li/EP	tube 80 g	116 1241-3
Other parts	Hydraulic oil	barrel 208 l	116 1114-2
		can 4 l	116 1115-9
		bottle 1 l	116 1116-7
Trailer coupling	Lube grease Li/EP	cartridge 400 g	116 1251-2
Tipper cylinder:			
Pin, ball	Lube grease Li/EP	tube 80 g	116 1241-3
Joints	"	"	"
Other parts	Hydraulic oil	barrel 208 l	116 1114-2
		can 4 l	116 1115-9
		bottle 2 l	116 1116-7

Lubricants for central lubrication

For vehicles with central lubrication we recommend the following:

GREASE LUBRICATION

Li/MoS_2-grease NLGI No. 1, that is, grease on a lithium base with molybdenum disulphide additive and with consistency NLGI No. 1.

OIL LUBRICATION (Not suitable for vehicles with rubber spacers in the springs)

Oil type	Final drive oil
Quality	API-GL-5 (MIL-L-2105 B or C)
Viscosity	SAE 80W/90

Lubricants for climate unit

Vacuum pump:			
Filler station	Vacuum pump oil	bottle 0.5 l	116 0049-1
Air conditioning compressor	AC compressor oil (dewaxed)	"	116 0048-3

Freon 12 (dichlordifluormethane) is used as the cooling medium.

The following can be purchased from Volvo

Engine oil SAE 15W/40 Volvo Drain Specification	barrel 208 l	116 1278-5*
Final drive oil SAE 85W/140 GL-5	barrel 208 l	116 1279-3*
Gearbox oil SAE 80W/90 GL-1	barrel 208 l	116 1280-1*
SAE 80W GL-4 (only ZF gearboxes)	barrel 208 l	116 1281-9*
Synthetic oil (thermo oil) for gearboxes and thermo fans	barrel 208 l	116 1245-4
	barrel 25 l	116 1243-9
Anti-freeze, type C	barrel 208 l	112 9702-5*
	can 5 l	133 3755-5
	bottle 1 l	112 9700-9

*Not kept in stock for direct delivery.

Lubricating oils

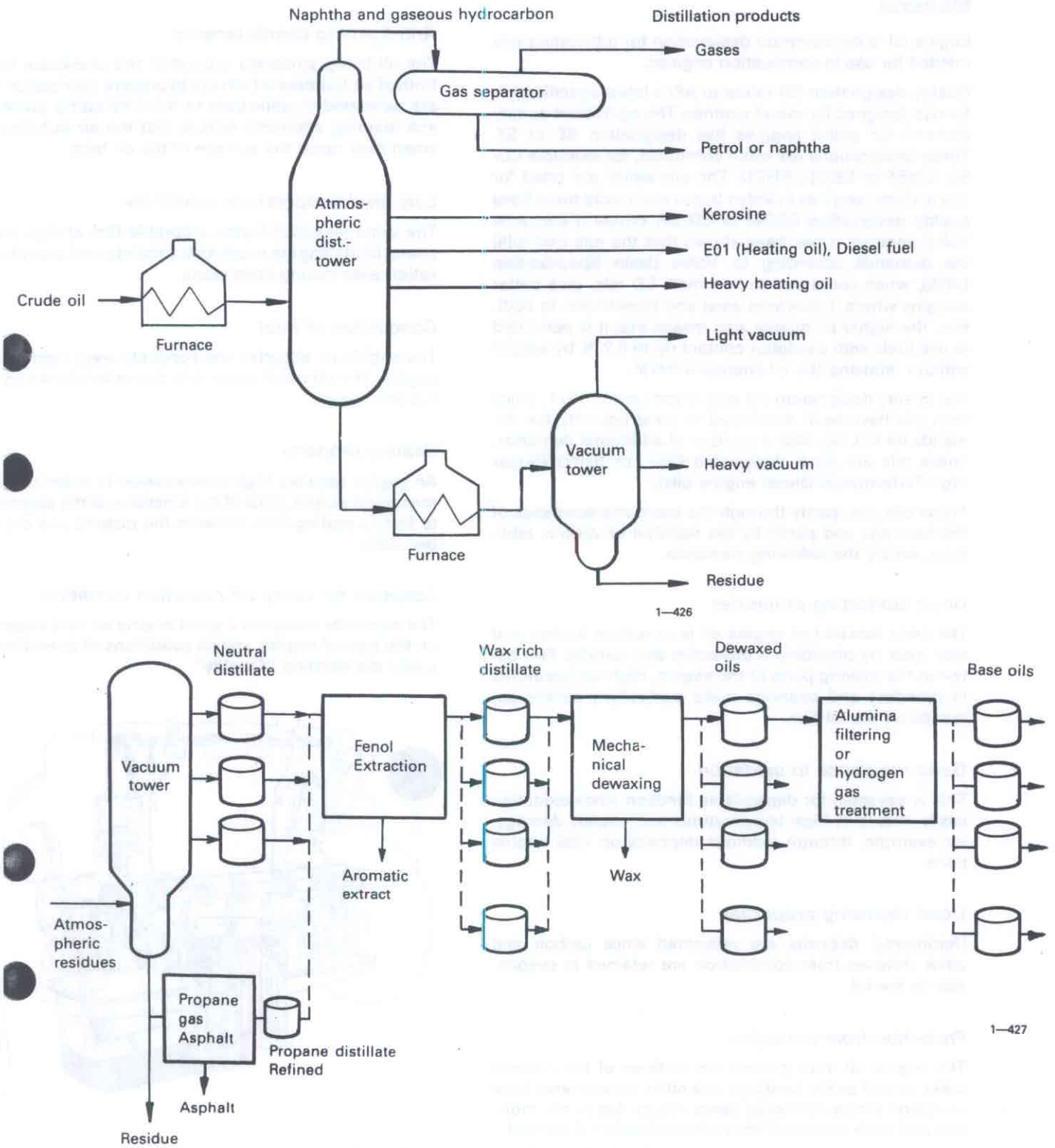


Diagram showing lube oil production phases

Lubricating oil is produced by the repeated distillation of crude oil, also called petroleum, which is obtained by drilling through the crust of the earth. The lubricating oil obtained through distillation still contains in its original form components which oxidize easily and must be removed by refining.

All engine oils and other high grade lubricating oils are subject to solvent extraction. Further treatment includes extremely thorough filtration before the lubricating oils are finally blended and provided with different types of special additives for each grade of oil, depending on its range of use.

ENGINE OIL

General

Engine oil is the common designation for lubricating oils inteded for use in combustion engines.

Quality designation CD refers to API's latest specification for oils designed for diesel engines. The equivalent quality demand for petrol engines has designation SE or SF. These designations are often combined, for example CD/SE, CD/SF or SE/CD, SF/CD. The oils which are rated for use in diesel engines in Volvo buses and trucks **must have quality designation CD/SE or CD/SF.** Where it concerns Volvo engines, it has been shown that the oils that fulfil the demands according to **Volvo Drain Specification (VDS),** when compared to "normal" CD oils, give better margins where it concerns wear and cleanliness. In addition, the higher oil quality also means that it is permitted to use fuels with a sulphur content up to 0.7 % by weight without reducing the oil change interval.

The quality designation CD was introduced in 1971. Since then oils have been developed to meet not only the demands for CD, but also a number of additional demands. These oils are often designated CD+, or SHPD (Super High Performance Diesel engine oils).

These oils can, partly through the basic characteristics of the base oils and partly by the addition of various additives, satisfy the following demands.

Good lubricating properties

The main function of engine oil is to reduce friction and also wear by providing a protective and durable film between the moving parts of the engine. High temperatures in cylinders and bearings make particularly severe demands on the oil film.

Good resistance to oxidation

This is essential for dependable function since oxidation easily occurs at high temperatures and causes damage, for example, through resinous deposits on vital engine parts.

Good cleansing properties

Detrimental deposits are prevented since carbon and other residues from combustion are retained in suspension in the oil.

Protection from corrosion

The engine oil must protect the surfaces of the cylinder walls as well as the bearings and other components from corrosion which otherwise easily occurs due to the moisture and acids produced from the combustion of the fuel.

Anti-foaming characteristics

The oil being splashed around in the crankcase forms a froth of air bubbles which could prevent lubrication if they are permitted to penetrate to the lubricating points. The anti-foaming additives ensure that the air bubbles burst when they reach the surface of the oil bath.

Low level temperature sensitivity

The same oil which forms a durable film at high temperatures in the engine must also circulate and provide lubrication even during cold starts.

Conduction of heat

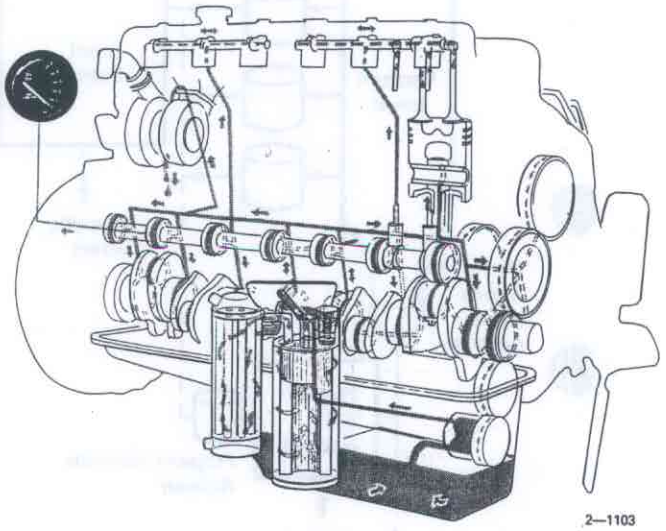
The engine oil absorbs and conducts away heat from the engine. The oil must retain this characteristic when it has become warm.

Sealing property

An engine requires high compression in order to provide maximum output. One of the functions of the engine oil is to form a sealing film between the pistons and the cylinder walls.

Adaption for every oil operation condition

The demands made on a good engine oil vary depending on the type of engine and its conditions of operation under the heading **"Quality".**



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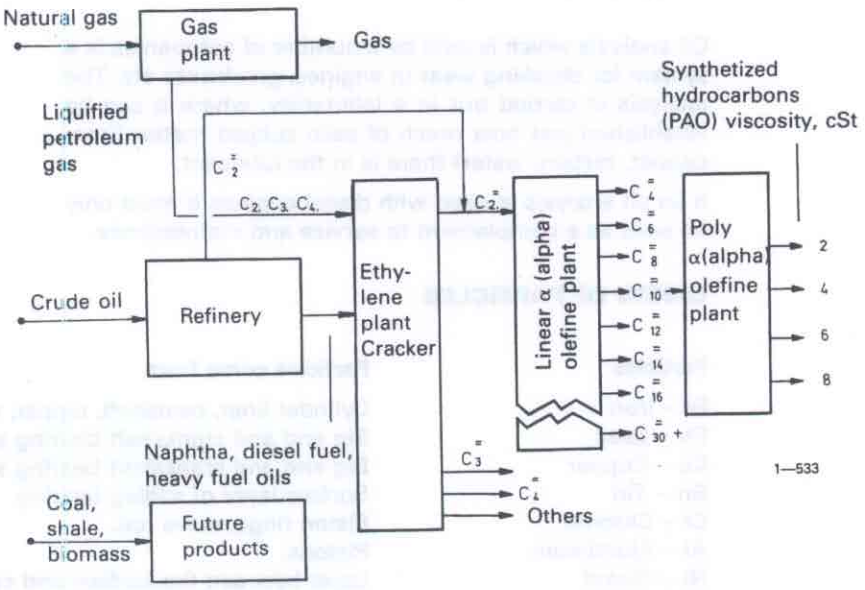
SYNTHETIC ENGINE OILS

General

Synthetic engine oils have been on the market for a number of years. Attention was drawn to this type of oil, particularly during the cold winter of 1978-79, for its pumpability during very cold conditions.

The characteristics of many chemical products have been studied where it concerns the production of synthetic oils in order to assess their suitability as a lubricant. The most common of these chemical products are hydrocarbons, esters, polyglycols, phosphate esters, silicones etc. The oil companies have then chosen a suitable base product for further development, for example poly α(alpha) olefines, diesters and polyolesters.

A study of the characteristics contained in different synthetic fluids, when compared with paraffin-based mineral oils, shows that no product has excellent characteristics right through the range, see table below.



Poly – α (alpha) – olefine process

Characteristics	Mineral oil (Paraffin base)	Polyalpha olefines	Polyol-esters	Poly-glycols	Phosphate esters
Viscosity/Temperature-dependent	2	3	3	4	1
Low temperature characteristics	1	3	3	3	2
High temperature oxidation stability (with additives)	2	4	5	3	2
Miscibility with mineral oils	5	5	2	1	2
Low evaporation	2	5	5	3	3
Dissolving ability for additives	5	3	4	2	3

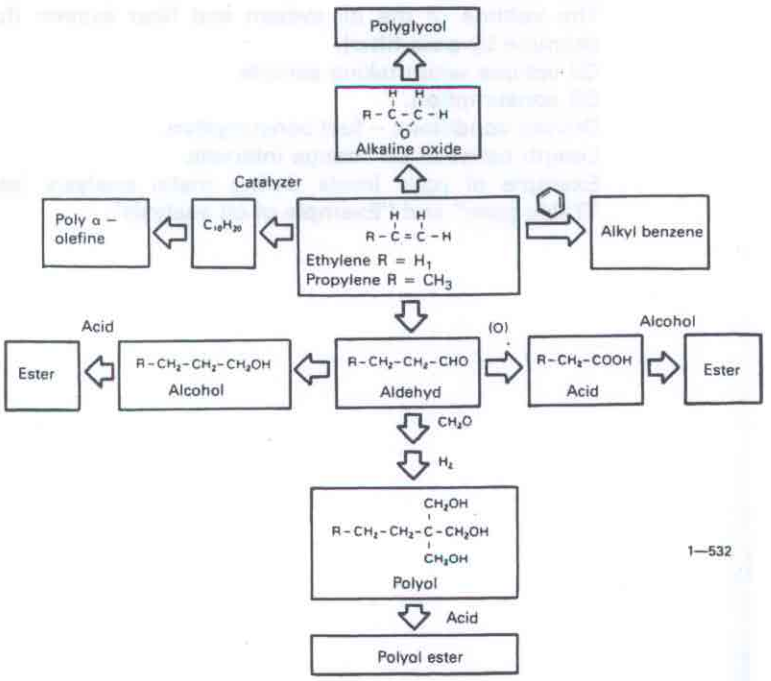
Scale: 1 = Poor, 2 = Acceptable, 3 = Good, 4 = Very good, 5 = Excellent.

The most common usage areas for the above named synthetic products are:

Poly-alpha-olefines: Engine oils, transmission oils, turbine and compressor oils, lubricating grease and hydraulic fluids.
Organic esters: Same as above plus oil for jet engines.
Polyglycols and phosphate esters: Fire resistant hydraulic fluids.

The advantages one can expect from synthetic lubricants are as follows:

Improved fuel economy
Extended oil change intervals
Better cold starting through better pumpability of the oils
Cleaner engines



Oil analysis (oil X-ray) of lubricating oil from diesel engines

Oil analysis which is sold by a number of companies is a system for checking wear in engines, gearboxes etc. The analysis is carried out in a laboratory, where it can be established just how much of each subject matter (iron, copper, carbon, water) there is in the lubricant.

If an oil analysis is used with diesel engines it must only be seen as a complement to service and maintenance.

Some points to note with regard to oil analysis of engines:

The company that sells the analysis supplies information which must be checked and evaluated before any repair operation is commenced on the engine.

Why?

- One must know where the particles (subject matter) originate from. See list below.

ORIGIN OF PARTICLES

Particles	Particles come from
Fe – Iron	Cylinder liner, camshaft, tappet, valve guides, crankshaft.
Pb – Lead	Big end and crankshaft bearing shells. (All types of sliding bearings.)
Cu – Copper	Big end and crankshaft bearing shells. (All types of sliding bearings.)
Sn – Tin	Surface layer of sliding bearing.
Cr – Chrome	Piston rings, valve rod.
Al – Aluminium	Pistons.
Ni – Nickel	Layer between the surface and copper layers on the sliding bearing.
Si – Silicone (T)	Sand, dirt etc (T = Total).
Si – Silicone (Y)	Sand, dirt etc (Y = External).
Carbon – Coal	Carbonized oil. Combustion residues.
H_2O – Water	Coolant water, condensation water.
Fuel dilution	Incomplete combustion.

- The analysis values which are compared with each other must always come from the same engine.
- A more detailed evaluation is to be based on the internal relationship between the different part results (metal content).
  NOTE! The final evaluation is however made by oneself.
- The metal content ppm (parts per million) level depends on:
  The volume of the oil system and filter system (for example by-pass filter).
  Oil volume when taking sample.
  Oil consumption.
  Driving conditions – fuel consumption.
  Length between oil change intervals.
  Example of ppm levels during metal analysis (see "Table ppm" and "Example of oil analysis".

Table of ppm (parts per million)

Fe	30–200
Pb	5– 40
Cu	3– 20
Sn	3– 20
Cr	3– 20
Ni	0– 5
Al	5– 30
Si	3– 20
H_2O	Should not occur, see text.
Fuel dilution	Should not occur. Fuel dilution of a temporary nature can be accepted, see example in text.

NOTE! A sudden increase of any ppm level, even within the stated values, is a sign which must be interpreted, see example in the text.

EXAMPLE OF AN OIL ANALYSIS

The 5 latest analyses.

DATE:		791013	791110	791215	800209	800414		800414	
Fe	PPM	109.3	56.6	154.4	120.0	100.0	PPMC	109.9	GREEN
Pb	PPM	9.4	10.8	8.2	15.2	9.0	PPMC	9.9	GREEN
Cu	PPM	8.2	5.5	7.7	7.7	8.3	PPMC	9.1	GREEN
Sn	PPM	4.8	5.4	3.2	8.5	6.2	PPMC	6.8	GREEN
Cr	PPM	13.4	6.5	16.7	13.2	5.6	PPMC	6.2	GREEN
Al	PPM	8.6	6.6	9.1	8.2	6.3	PPMC	6.9	GREEN
Ni	PPM	1.2	1.9	0.5	2.4	0.9	PPMC	1.6	GREEN
Si-T	PPM	8.4	5.8	7.1	8.2	4.9	PPMC	5.4	GREEN
Si-Y	PPM	6.7	4.5	5.3	6.6	3.6	PPMC	4.0	GREEN
CARBON	A.S.	OK	OK	OK	OK	OK	A.S.	OK	GREEN
H_2O	%	OK	OK	OK	OK	0.10	%	0.10	ORANGE
FUEL	%	OK	OK	OK	OK	OK	%	OK	GREEN
DILUTION				OK		Latest analysis		For data processing + Colour code	

Examples:

A new engine has a tendency to indicate high Fe (iron), Pb (lead) and Cu (copper) content during running in.

Reason: The particles from the manufacturing process (foundry sand, foundry filings, etc) score the bearings at this stage.

- Scoring of this kind does not necessitate any remedy. Experience shows that scoring nearly always occurs during the running in period.

Wait to see whether oil analyses nos. 2 and 3 give any indication that the oil's particles have altered to any extent.

Fe (IRON)

The Fe (iron) content, (or any other individual metal) may suddenly indicate high values after, for example, subsequent tests such as the 3rd, or 4th.

NOTE! Await the results of the next test.

Reason: Sampling was incorrectly carried out.

- With a cold engine the Fe drops to the bottom. The sample was taken too quickly.
- The engine was warm but has been switched off for some time so that the Fe has dropped to the bottom. The sample was taken after the first oil ejection and not a second or so immediately after the engine was switched off.
- Wear may be abnormal, but it is uncertain where this is.

Fe (IRON)

If the Fe and other metals are proportionally high.

NOTE!

- First and foremost this must be weighed against the oil change interval.
- The change interval for the oil type is too long for this engine and driving conditions.
- Recommend a shorter interval, or a better quality oil. Also await the next test results after making this change.
- Do not draw any hasty conclusions that the Fe causes cylinder lining scoring or anything else which may be attributed to Fe.
- If Cr (chrome), Al (aluminium) and Fe are high without increasing the oil change interval, then we can suspect a seized piston.

Si (SILICONE)

Sand, etc.

– Older engine.
Reason: If the Si value is high this will increase not only Fe but also Pb (Cu) and Cr.
– Air filtration unsatisfactory.
– Leakage in intake line.

NOTE! Al + Si = Piston material.

Often piston skirt damage indicates high Si and also Al. Minor skirt damage does not necessitate any remedial action since this gradually disappears.

No action need be taken with a new engine where it concerns Fe, Pb, Cu, for the same reason as for earlier example.

CARBON

If the value is over the normal.

– Oil change interval too long, or low oil quality.
– Poor combustion:
Exhaust pressure governor jammed.
Nozzles.
Advance injection angle (α) faulty.
Oil escape, ring, valve guide etc.

H_2O (WATER)

If the test indicates H_2O.

– Condensation – Sample taken after running engine warm for too short a time.
– Exhaust pressure governor incorrectly used, that is, not used when running the engine warm and sample taken after this.
– Starting heater not functioning correctly and sample taken after faulty start procedure.

NOTE!
– Water leakage results in increased Pb (possibly also Cu). If leakage continues, this also causes increase in Fe and Cr.

FUEL DILUTION

Incomplete combustion due to:

– Exhaust pressure governor incorrectly used, that is, not used when running engine warm and sample taken after this.
– Starting heater does not function correctly and sample taken after faulty start procedure.
– Idling without exhaust pressure governor.
– Nozzles.
– Advance injection angle (α) faulty.

Recommendations:
Service prescribes a programme of **regular maintenance** (Preventive Maintenance). Oil analysis may only be supplementary to maintenance.

– Select high quality oils.
– Follow Volvo's recommendations for oil change intervals.

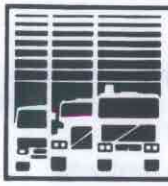
NOTE! The degree of blockage for the **filters** are not given in test results.

– Change the filters according to Volvo's recommendations. In other words, change the filters when changing the oil.

We don't recommend that an engine be disassembled simply on the basis of the oil analysis values. Use instead these values as an indicator that something unusual is happening.

Combine the oil analysis with other diagnostic methods, to further comfirm what the unusual can be.

VOLVO



Preventive Maintenance

TRANSMISSION OIL

General

The main part of transmission oil is composed of base oil, usually consisting of straight mineral oil. The applications for the oil can be increased by the addition of chemical or other additives.

In recent times even synthetic oils are being used. These are either a blending with mineral oil, so-called semi-synthetics or 100% synthetics.

Temperature and viscosity characteristics

The object is to obtain an oil with good temperature characteristics, i.e., thinner at lower temperatures and thicker at higher temperatures relative to other oils. This is in the main achieved by the following methods:

A) By adding small amounts of additives, often not more than 1%, one is able to make a thick oil flow more easily at lower temperatures. This is the most usual way to achieve moderate improvements in temperature characteristics with for example oils in the 80W/90 or 85W/140 viscosity range.

B) By adding polymers of different types to a thin base oil one is able to make the oil thicker, which is most noticeable in the hot temperature area. This type of additive is called a viscosity index improver (V.I. improver) and as much as a 30% dosage can sometimes be used. They often have a large effect on the viscosity and are included in such oils as 75W/90 or 80W/140.

One should however observe caution for two reasons:

1) Transmissions and rear axles can be compared with effective grinders which grind down the polymers to shorter molecule chains, resulting in the oil becoming thinner.

The low molecular polymers are somewhat less sensitive, as they are shorter from the beginning, but even these are ground down in the same way.

The breakdown of the oil is caused by the high contact loading and sliding movements in the transmissions and rear axles. These are therefore more sensitive than engines and it is for this reason that mineral oil-based multigrade oils must not be used in Volvo transmissions.

2) The increase in viscosity one obtains when measuring in a viscosimeter, where the measuring conditions can be compared to emptying a bottle by holding it upside down, is not equivalent to a similar increase in viscosity in the teeth engagement and roller bearing. This is due to the very high contact loading and the considerable sliding movement. The rule of thumb is that one can only reckon with a third of the viscosity increase. The oil film is therefore thinner than one perhaps may have expected, which should be taken as a warning, particularly with high temperatures.

If oils with V.I. improver are used, for example 80W/140, one must be in a position to check the additives which have been added to the oils during the blending process. Volvo has approved 80W/140 oil for use in the Nordic countries. The advantages with an 80W/140 oil when compared to an 85W/140 oil is that the 80W/140 oil flows more easily at low temperatures.

C) Many synthetic oils, for example those mentioned earlier, have of course good temperature-viscosity qualities, which is very important when operating at very low temperatures, –30°C (–22°F) or colder.

At so low temperatures the synthetic oils have complete supremacy with regard to flow characteristics. Consequently synthetic oils are a solution with for example sluggish gear changing in extreme cold or if the transmission never reaches a normal working temperature. AB Volvo Parts Division stock a synthetic oil, Volvo thermo oil, which is intended for these conditions. Where it concerns fuel consumption, the effect of these oils is in most instances immeasurable, even if tendencies towards fuel saving are discernable.

Sulphur and phosphor additives (EP additives)

Oils to quality API-GL-4 and GL-5 contain chemical compounds with sulphur and phosphor being the main active components. These compounds are adapted in such a way that when the temperature rises on the teeth surface, due to sliding movements and high contact loading, the compounds react with the metal surface and build a thin surface film which in the main is composed of sulphide of iron. This prevents surface-to-surface contact with seizing as a result. The technology involved in making the compounds react at the correct temperature is one of the secrets of the additive manufacturers.

The negative characteristics of sulphur-phosphor compounds are:

Relatively poor thermal stability – if oil is subjected to high temperature for a long period (approx. 100°C, 212°F) black deposits similar to tar or carbonized coal are formed. At first the oil appears black and gradually the deposits form. The result being that the additives wear out at the same pace as the deposits form.

Aggressivity towards copper and brass – the sulphur reacts more powerfully with copper and copper alloy (brass) than with iron. Sometimes the attack is corrosive and sometimes takes the form of a black coating in an otherwise clean environment.This means that one must be careful with oil cooler, oil strainers and brass synchromesh. Certain plastics, for example, nylon and sealing material such as nitrile rubber are also attacked and become brittle.

Chemical polishing – synchromesh, in the first place made of steel/brass but even of steel/molybdenum can be polished through a dual chemical and mechanical effect. The result being that one obtains either long changing times or so-called cut through.