VOLVO SERVICE

PART 1

Service and maintenance

C 3-series

SERVICE MANUAL

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Group 12. Lubricating

Group 14. Rustproofing

GROUP 12 LUBRICATING

GENERAL

LUBRICATING OIL

Lubricating oil is produced by the repeated distillation of crude oil, for example petroleum obtained by drilling through the crust of the earth. The lubricating oil obtained through distillation still contains in its original condition easily oxidizing components which must be removed by refining. All engine oils and other high-grade lubricating oils are subjected to solvent extraction. Further treatment includes extremely thorough filtering before the lubricating oils are finally mixed and provided with special additives of different types for each grade of oil, depending on its range of use.

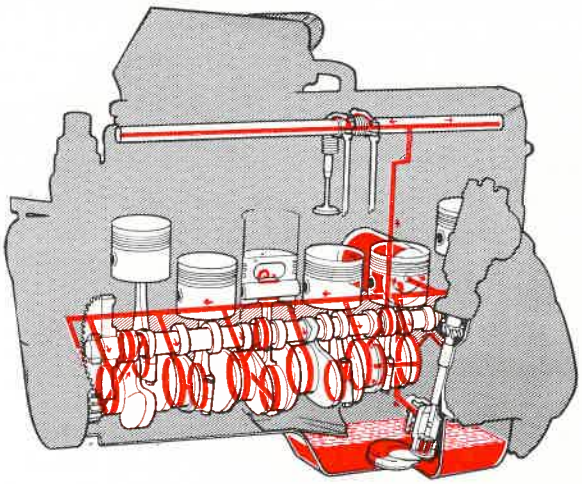


Fig. 12—2. Lubricating system, engine

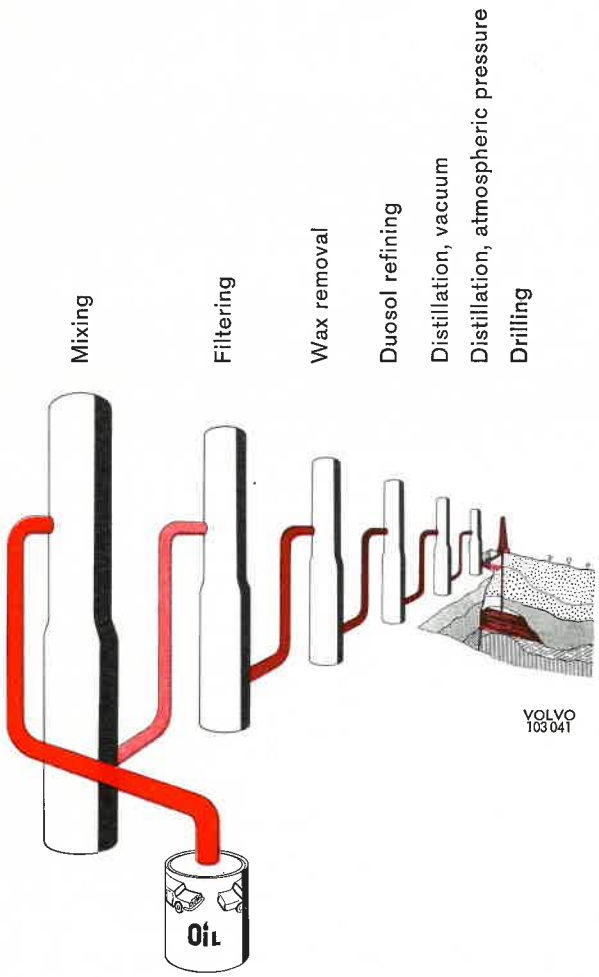


Fig. 12—1. The principle used in the production of lubricating oil

TYPE

Engine oil

Engine oil is the common designation for lubricating oils intended for use in combustion engines. Through the characteristics of the basic oil and also through various additives, these oils can satisfy the following demands.

Good lubricating properties

The main function of the engine oil is to reduce friction and also wear by providing a protective and durable film between the moving parts in the engine. Particularly the high temperatures in the cylinders and bearings make 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 were 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.

A low level of temperature sensitivity
The same oil which forms a durable film at the highest temperatures in the engine must also circulate and provide lubrication even during cold starts.

ADAPTATION for every condition of operation
The demands made on a good engine oil vary depending on the type of engine and its conditions of operation. See also under the heading "Quality".

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.

Conduction of heat
The engine oil is to absorb and conduct away heat from the engine. The oil must retain this characteristic when it has become warm.

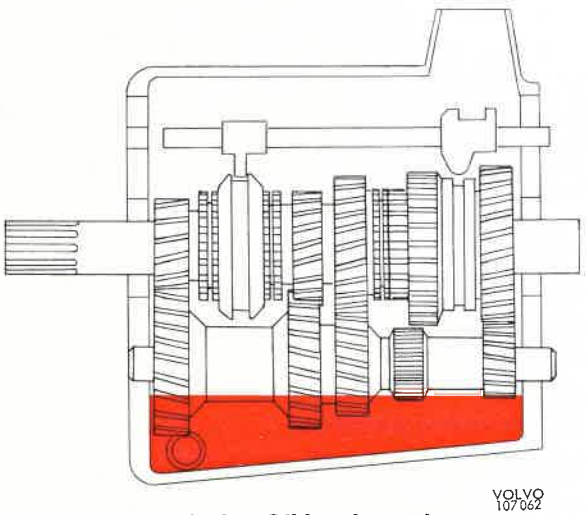


Fig. 12—3. Oil level, gearbox

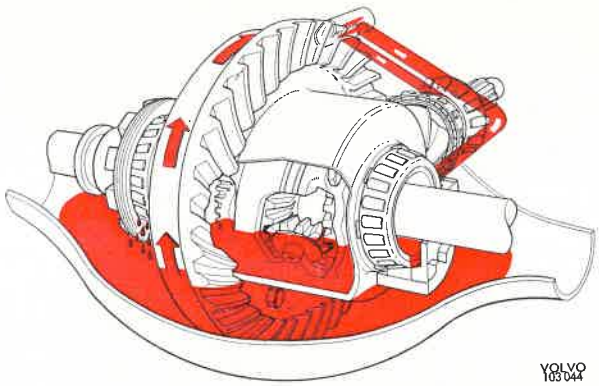


Fig. 12—4. Oil circulation, final drive

Power transmission oil

GEARBOX OIL
Gearbox oil, or so-called regular oil, consists of straight mineral oil. It is used in manual gearboxes where gear tooth loading is relatively low and, therefore, does not require special film-reinforcing additives. Oxidation inhibitors, rust-proofing additives, antifoaming agent and other additives to sink the lowest pour point should, however, be included in order to improve the characteristics of these oils.

FINAL DRIVE OIL
The design of hypoid gears makes such severe demands on the film between the teeth that pure mineral oil cannot satisfy them. That is why lubricating oil for gears of this type has chemical additives able to ensure suitable lubrication. These additives usually consist of sulphur and phosphor and, in the case of SCL oils, sulphur, chlorine and lead. The oil has also inhibitors added to it which give it good resistance to oxidation, a low solidification point and also less tendency to foam. Oil of this type is known as hypoid oil or EP (Extreme Pressure) oil. In addition to this the oil can also be treated with special additives for final drives including a differential brake.

ATF OIL

Very great demands are made on oil for power steering installations and these demands coincide in many respects with the demands made on oils for automatic transmissions. For example the oil must have a very low sensitivity to temperature, i.e. variations in temperature must influence the viscosity of the oil to the lowest possible extent. In addition to this the oil must have good cleansing characteristics since deposits, for example on valves, have an immediate detrimental effect on the function of the unit. Foaming must not occur since the function of the unit demands a constant flow of oil. Anti-oxidation and anti-corrosive qualities must also be the very best.
ATF means Automatic Transmission Fluid.

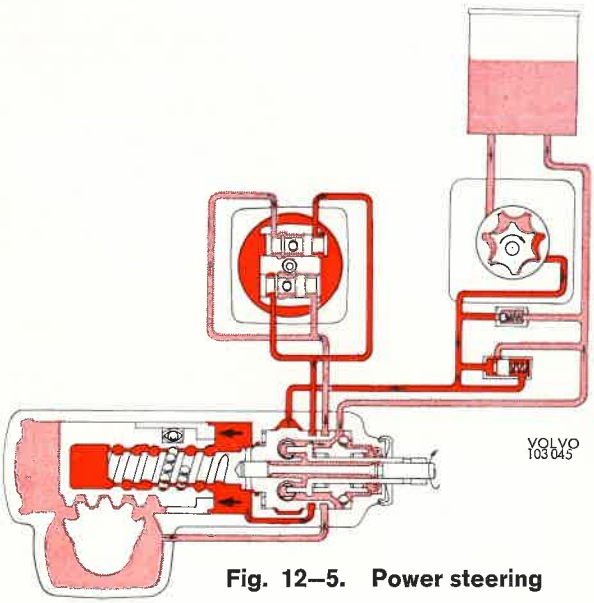


Fig. 12–5. Power steering

QUALITY

General

From both technical and economical points of view, it is important to select the correct oil for each particular purpose. The demands made on the correct lubricating oil are not merely dependent on the part of the vehicle where the oil is to be used but also on design and operating conditions. The rapid advances made during recent years have made necessary the introduction of standard specifications in order to state the type of oil concerned.

The following concerns some modern standards concerning the demands made on the **quality** of **lubricating oil. It is then the** responsibility of the oil manufactures themselves to ensure that their various products correspond to the demands made. For this reason it is therefore advisable to use only well-known makes of oil.

The API system

ENGINE OILS

API (The American Petroleum Institute) originally divided engine oils up into Regular, Premium and HD-oils. Regular indicated a straight mineral oil, Premium indicated that the oil contained a certain amount of protective additives and HD meant that the oil also contained a certain amount of cleansing additives. This system is now out-of-date and has been replaced by a new API system. The new system is not concerned with providing any description of the various oil types but states the different types of operating conditions for both carburettor and diesel engines. Primary consideration has thereby been given to the type of driving and engine design.

When the range of use of an oil is stated by using the letters of the API system, these letters are preceded by the words "For Service". For example, if an oil can be used for many different ranges of use, it is defined as "For Service CC, CD".

The official API text states the following for engine oils.

Earlier systems (1960)

Petrol engines

ML (Motor Light)

Typical for petrol (gasoline) and other carburettor engines operating under very favourable conditions where the engines do not make any special demands on lubrication and are not designed in such a way as to be sensitive to the occurrence of deposits.

MM (Motor Moderate)

Typical for petrol (gasoline) and other carburettor engines operating under moderate conditions where difficulties concerning deposits and bearing corrosion can occur when the temperature of the crankcase oil is high.

MS (Motor Severe)

Typical for petrol (gasoline) and other carburettor engines where good lubrication is essential to prevent deposits, wear and corrosion. The demands made on lubrication and the extent of the demands vary with different makes and models, the characteristics of the fuel used and particularly the conditions of operation and driving.

Diesel engines

DG (Diesel Good)

Typical for Diesel engines with operating conditions which, due to the fuel, lubricant or engine design features, give rise to neither particularly great wear nor abnormal deposits.

DM (Diesel Moderate)

Typical for Diesel engines operating under difficult conditions or using fuel of a type which normally results in deposits and wear.

DS (Diesel Severe)

Typical for Diesel engines operating under extremely severe conditions and the design of which or the fuel being used can result in extreme wear or abnormal deposits.

Later systems (1970)

Petrol engines

SA

Typical for engines working under such favourable conditions that special protection by way of additives in the oil is not necessary. This class lacks special quality requirements.

SB

Typical for engines working under such favourable conditions that only insignificant protection is required by way of additives in the oil. Oils which meet the demands in this service class provide only a certain protection against wear as well as protection against bearing corrosion and oxidation of the oil.

SC

Typical for petrol engines of **1964 to 1967 year models** which work under conditions that come under the instructions of the engine manufacturers for these year models. Oils which meet the demands in this service class counteract the formation of deposits at high and low temperatures, wear and corrosion in petrol engines.

SD

Typical for petrol engines of **1968 to 1970 year models** which work under conditions that have been approved according to the warranty terms of the engine manufacturers. Can also apply to 1971 and later models according to the recommendations of the maker.

Oils which meet the demands in this service class provide better protection against deposits at high and low temperatures, wear and corrosion in petrol engines, compared with oils referred to Class SC and can, therefore, be used also when SC is recommended.

SE

Typical for petrol engines of **year model 1971 and later** and which work under the warranty terms of the engine manufacturers. Oils in this service class provide better protection against oxidation, high temperature deposits and corrosion in petrol engines compared with oils in Classes SD and SC and can thus also be used when these are recommended.

Diesel engines

CA

Typical for diesel engines which work under favourable to averagely difficult conditions with fuel of high quality. Can also include petrol engines in favourable operation. These oils provide protection against bearing corrosion and high temperature deposits in aspirated engines with the use of such fuel which does not impose particular demands for protection against wear and deposits.

CB

Typical for diesel engines which work under favourable to averagely difficult conditions but with lower fuel quality, which imposes greater demands on protection against wear and deposits. Can also include petrol engines in favourable operation. These oils provide necessary protection against bearing corrosion and against high temperature deposits in aspirated engines with the use of fuel containing a higher degree of sulphur.

CC

Typical for aspirated engines with high litre output and light supercharged diesel engines which work under averagely difficult to difficult conditions. Also includes individual petrol engines with extra high, special demands. These oils provide protection against high temperature deposits in the above-mentioned engines but also protection against corrosion and low temperature deposits in petrol engines.

CD

Typical for high-speed, supercharged diesel engines with high output, which demand effective protection against wear and deposits. These oils provide protection against bearing corrosion and against high temperature deposits, irrespective of the quality of the fuel.

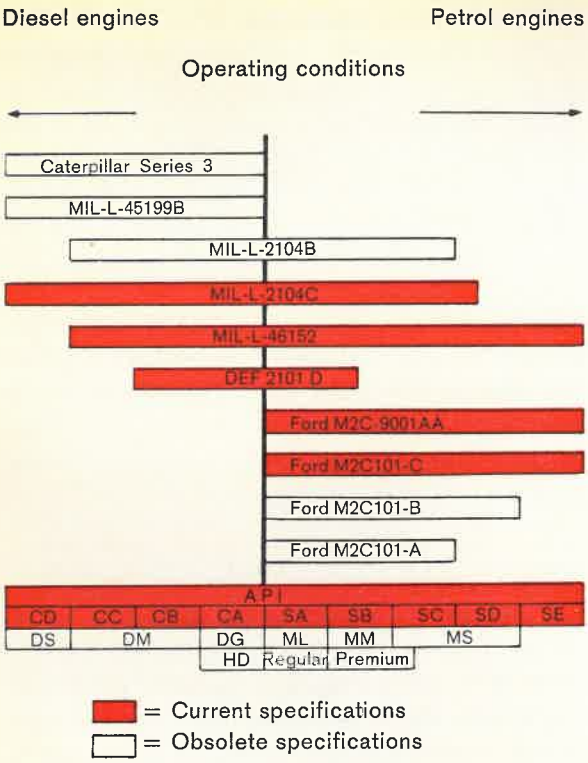


Fig. 12—6. Comparisons

POWER TRANSMISSION OILS

In its Publication 1560 issued in January 1966, API stated a classification system for power transmission oils with the following classifications depending on the operating conditions of the oils.

API-GL-1

concerns oils for motor vehicles with bevel spiral gear assemblies, worm gears and manual gearboxes operating under such conditions of low surface pressures and frictional speeds that pure mineral oil can be used with satisfactory result. Oxidation inhibitors and rustproofing agents, antifoam agent and additives to depress the lowest pour point are often used in order to improve the characteristics of these oils.

API-GL-2

concerns oils for motor vehicles with worm gears operating under such conditions of loading, temperature and frictional speeds that oils according to API-GL-1 are not satisfactory.

API-GL-3

concerns oils for manual gearboxes and final drives with bevel spiral gear assemblies operated under moderately difficult conditions concerning speed and loading. These operating conditions require a lubricant with a more durable film than oils according to API-GL-1 but not up to the specifications for API-GL-4 below.

API-GL-4

concerns oils for gear assemblies, particularly hypoid gears in vehicles which are operated under conditions of high speed/low torque and low speed/high torque.

API-GL-5

concerns oils for gears, particularly hypoid gears in vehicles operated under conditions of high speed/impact loading, high speed/high torque.

API-GL-6

concerns oils for hypoid gears with large shaft displacement (more than 50 mm=2″ or almost 25% of the crown wheel diameter) in cars and other types of vehicles that are driven at high speed and in severe conditions.

If a lubricant is suitable for more than one of the above-mentioned classes, this is stated. The classification does not include fluids for automatic gearboxes, torque converters, differential brakes, etc. which require special lubricants.

American military specifications (MIL)

ENGINE OILS

The original API classification became insufficient in the long run and the American army therefore made up its own specifications. This system specifies the quality of the oil partly in general terms and partly in engine tests with demands on the chemical characteristics of the oil.

MIL-L-2104A

For these specifications the oils are tested in special engines using Diesel fuel with at least 0.35 per cent sulphur content. They must satisfy certain standards concerning oxidation, corrosion, deposits, etc. The specifications also require certain standards concerning chemical analysis values.

MIL-L-2104B

This is the specification now valid which replaced MIL-L-2104A during the 1960's. The difference is primarily that the new specification makes greater demands on the cleansing properties of the oil.

MIL-L-46152
This specification replaced MIL-L-2104B in 1972. It has been developed for diverse types of vehicles but does not apply to turbo-engines. MIL-L-46152 combines the demand on high-class diesel engine oil with the maximum demand on oil for carburettor engines.

MIL-L-45199B
The American military specification for "Series 3 oils" where the oils are also tested in a petrol (gasoline) engine.

Caterpillar series 3
The caterpillar Tractor Company makes special demands on the lubricating oils to be used in its engines. The specification series 3 was produced during 1956 and designates oils corresponding to the high demands made for Caterpillar Diesel engines, for certain other heavily loaded high-speed Diesel engines, compressor-supercharged (Turbo) Diesel engines and in cases where the Diesel fuel has a high sulphur content.

MIL-L-2104C
This specification replaced MIL-L-45199B in 1972 and has, among other things, great demands on rustproofing.

TRANSMISSION OILS
MIL-L-2105
If an oil is to correspond to this specification, it must be a product which has been tested and found to satisfy certain clearly defined demands based on full-scale tests. During the tests checks are made of separation, foaming, corrosion, oxidation, bearing capacity and miscibility. The specification concerns primarily final drive oils.

MIL-L-2105B
Development in the motor vehicle industry has resulted in the fact that more and more power is being transmitted through the final drive. In order to meet this, more severe demands must be made also on the lubricant. In 1962 specification MIL-L-2105B was issued and according to this the oils are subjected to tests on the whole identical with MIL-L-2105 but with more severe demands.

Other quality standards

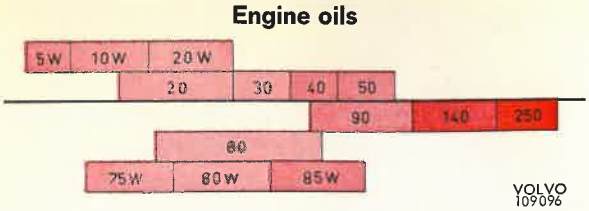
ATF-OILS
The first, more generally used quality standard for this oil was General Motors Automatic Transmission Fluid, Type A of the year 1951. This standard has been subsequently modified and, among other things, Suffix A was added in 1957. Oil according to this standard has been designated by us in our recommendations as "ATF, Type A".
In 1967, General Motors issued a new standard "Dexron", which presumes more modern and more extensive tests with rather more stringent demands.
Ford has its own standards of which the latest, M2 C33-F, prescribes among other things an entirely different friction characteristic compared with other oils for automatic transmissions. Oil which meets this standard has been designated in our recommendations, ATF, Type F.

VISCOSITY

The viscosity of a liquid is an expression of its internal friction and states its resistance to movement. The thicker a liquid is, the higher its viscosity. In the case of lubricating oils, viscosity is one of the most significant analysis factors and is often used for classification.
Many different systems are available to state the viscosity of an oil. The most usual is kinematic viscosity which can be calculated after measuring the rate of flow and density. The kinematic viscosity is stated in Centistokes (cSt). In addition to this there are also empirical units such as Engler degrees (E), this being a measurement of how much faster water runs out of a certain container compared with the oil in question. Saybolt Universal Seconds (SUS) specify the time in seconds during which 60 ml of oil passes through a short capillary tube. A similar method is Redwood (R).
The various units describing viscosity are not mutually proportional but can be converted to each other with the help of tables.

The SAE system

The best known classification system for engine and transmission oils is the SAE system. This system is based on viscosity and pays no respect to quality or composition.
The SAE-system was worked out in the USA and ratified in 1926 by the Society of Automotive Engineers (SAE). The different SAE numbers indicate a viscosity range within which the oil in question can be grouped. Certain of the SAE numbers are followed by the letter W which indicates that the oil is suitable for winter use.



Power transmission oils

Fig. 12—7. Viscosity ranges

There are two series of SAE numbers for lubricating oils. One of these designates engine oils and consists of the following numbers: 5W, 10W, 20W, 20, 30, 40 and 50. The other series designates transmission oils and the most usual are: 75W, 80W, 85W, 80, 90, 140 and 250. The following tables show the SAE standards for these series.

Viscosities for engine oils according to SAE

SAE No.	At 0°F (–18°C)		At 210°F (99°C)	
	Viscosity in Centistokes			
	min.	max.	min.	max.
5W	–	1300	–	–
10W	1300	2600	–	–
20W	2600	10500	–	–
20	–	–	5.7	9.6
30	–	–	9.6	12.9
40	–	–	12.9	16.8
50	–	–	10.8	22.7

Viscosities for transmission oils according to SAE

SAE No.	At 0°F (–18°C)		At 210°F (99°C)	
	Viscosity in Centistokes			
	min.	max.	min.	max.
75W	–	3400[1])	4.2	–
80W	–	32000[1])	7.0	–
85W	–	–	11.0	–
75	–	3250	–	
80	–	21700	–	
90	–	–	14.0	25.0
140	–	–	25.0	43.0
250	–	–	43.0	–

The new viscosities SAE 75 W, 80 W and 85 W are indicated by viscosity 150 000 cP at max. temperatures of –40, –26 and –12°C (–40, –15 and –10°F). This approx. value is obtained if calculiated to centistoke at –18°C (0°F).

As the tables show, the SAE numbers for transmission oils do not constitue a direct continuation of the engine oils. A direct comparison can only be carried out between all oils standardized at the same temperature. Fig. 7 gives some idea of the mutual location of the oil viscosity ranges on condition that the viscosity index is about 100.

Viscosity index

The viscosity of all fluids varies with temperature. It decreases as the temperature rises and increases as the temperature falls. Mineral oils can have widely differing characters concerning temperature sensitivity. This characteristic is stated by means of the viscosity index (VI). This value is provided by practical experience obtained by determining the viscosity of the oil at two temperatures and then making a comparison with reference tables. The lower the change in viscosity, the higher the viscosity index.

In a temperature-viscosity diagram, an oil with a high viscosity index has a flatter line than an oil with a low viscosity index. The diagram below indicates two normal oils with a viscosity index of about 100 in the form of unbroken lines. If an oil according to SAE 10W has a viscosity index of about 140, the broken line, at 99°C (210°F) it will have such a high viscosity that it there satisfies the demands for SAE 30. An oil of this type is called multigrade and has therefore the designation SAE 10W-30.

High quality basic oils, improved refining methods and special additives have provided the possibility for certain lubricating oils to obtain such a high viscosity index that they satisfy the demands for more than one SAE number. Generally accepted technical designations in this connection are:

Single grade oil which only covers one SAE rating.

Double-grade oil which covers two adjacent SAE ratings.

Multigrade oil which covers three SAE ratings.

Super multigrade oil which covers more than three SAE ratings.

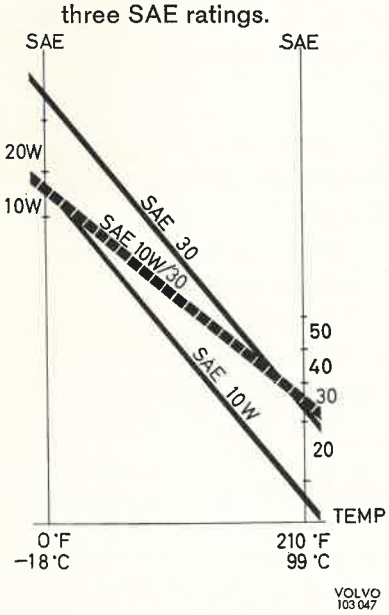


Fig. 12—8. Viscosity – temperature diagram

LUBRICATING GREASE

Lubricating grease consists of a mixture of oil and one or more soaps. The character of the grease and its range of application depend partly on the component mineral oil, partly on the type of metal included in the soap and also on the additives. The many types of lubricating grease available can be classified partly according to the method of production (metal base) and partly according to the range of use.

In principle, lubricating grease is manufactured by mixing a component that can be saponified (grease) during heating with a saponification component (metal hydroxide) until a soap is formed. Mineral oil is then added during stirring until the required consistency is obtained. Additives to improve the characteristics of the grease are then mixed in. Finally the grease is passed through a homogenizing and filtering plant.

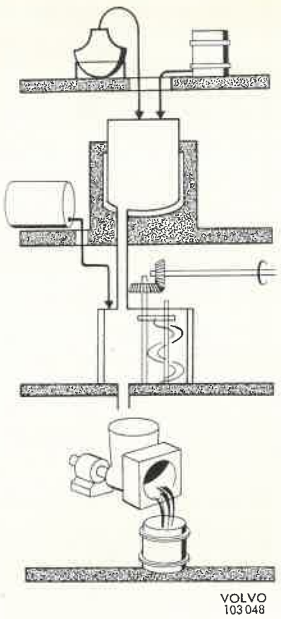


Fig. 12–9. The principle used in the manufacture of grease

TYPE CLASSIFICATION ACCORDING TO MANUFACTURING METHOD

Aluminium grease

This grease is transparent and has a smooth, butter-like structure. Fibre length is very short and the grease is therefore designated as being "short". The grease is free from water and insoluble in water. Its resistance to cold is good and the grease can be used at temperatures down to –60°C (–75°F). The pour point is about 80°C (175°F) and the upper limit for operating temperature about 40°C (105°F). Its corrosion-protective characteristics are not the very best.

Calcium grease

Calcium grease is semi-transparent and has a smooth, butter-like structure. Its ductility is limited and therefore this grease is described as being short. The grease contains about 2% water and is water-resistant. The pour point is about 95°C (203°F) and the normal range of use of the oil is between –25°C (–13°F) and +50°C (122°F).

Lithium grease

This grease is transparent and has a smooth structure. It is often yellow-brown to violet in colour. Its ductility is limited and the grease is therefore described as being short. Lithium grease is resistant to both water and heat. It has good cold-resistance and can be used in temperatures down to about –60°C (–75°F). Its pour point is about 180°C (360°F) and the upper limit for its operating temperature about 100°C (212°F).

Sodium grease

Sodium grease is not transparent and has a fibrous structure. Its ductility is great and fibre length is about 1 mm. This grease is therefore described as being long. It is free from water but relatively soluble in water. The most outstanding characteristic of sodium grease is its resistance to heat. Its pour point is about 180°C (360°F) and the normal range of use is between –25°C (–13°F) and +100°C (212°F).

Lead grease

Lead grease usually contains oils with a high viscosity. It has long fibres, is insoluble in water and is also relatively heat-resistant. Lead grease has good EP characteristics and is used for the lubrication of heavily loaded gears and other units. It is normally used in combination with calcium or lithium grease.

Silicon grease

This grease is made of silicon oil which is a synthetic product. The viscosity of oil of this type is relatively independent of temperature and for this reason silicon grease can normally be used over a wide range of temperature. In addition to this it has great resistance to chemicals.

Molybdenum disulphide grease and paste

Molybdenum disulphide is a modern additive with extremely good lubricating characteristics. Greases containing additives of this type are called molybdenum disulphide greases and are very practical under such conditions as high temperature. Pure finely powdered molybdenum disulphide together with a thickener makes up molybdenum disulphide paste. This paste is used for special purposes, for example as assembly paste.

Graphite grease

Graphite is a designation of a form of pure carbon characterized by the fact that microcrystals separate out along determined cleavage surfaces under the effect of slight friction. This is used as an additive in lubricant. A grease with a high percentage of graphite is called graphite grease.

TYPE CLASSIFICATION ACCORDING TO RANGE OF USE

Long-duration grease for wheel bearings

Long-duration grease is primarily intended for the lubrication of wheel bearings. One of the reasons why such high demands are made on this grease is that it is desirable to have as long a period as possible between repacking operations. Preferably the grease should last for the entire life of the bearing.

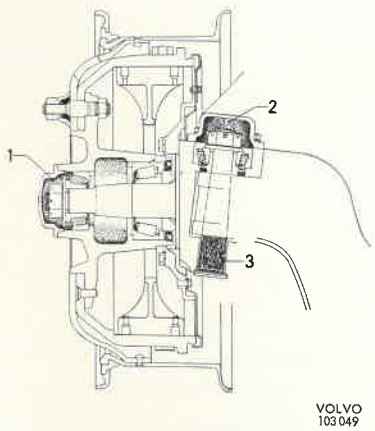


Fig. 12–10. Types of grease

1. Long-duration grease
2. Universal grease
3. Chassis grease

Universal grease

In universal grease or multi-purpose grease, an attempt has been made by the careful choice of the components and through the use of higs-class additives to satisfy as far as possible the various demands made on a motor vehicle lubricating grease. This means that universal grease can to a great extent replace various types of special grease. In general, however, special grease is of an even higher quality within its respective range of application.

Other greases

Chassis grease for lubricating certain parts of the vehicle's chassis such as propeller shafts, U-bolts, king pins, ball joints, etc, is used on, e.g., trucks and older cars. Its distinguishing characteristics are toughness and a high degree of adhesion. **Heat-resistant ball bearing grease** is intended for lubricating ball bearings and roller bearings, for example, clutch bearings and king pin bearings, and also in coolant pumps. The grease should have a high drip point and resistance to oxidation. This grease is nowadays replaced by universal grease in our lubrication recommendations.

TESTING

The characteristics of lubricating grease are determined through carefully standardized procedures. These can be divided up into laboratory tests and also rig tests.

Laboratory tests

ACID VALUE AND BASE VALUE

These are determined in order to find out whether there are any free acids or free bases in the sample and, if so, how large these quantities are. It makes possible determination of the characteristic of the grease or an appraisal of its degree of purity.

WATER CONTENT

Water content refers to the relative amount of water contained by the grease.

POUR POINT

The pour point is the temperature at which the first drop of a particular grease drops from the nipple in a special test apparatus when the rate of heating is about 1°C (1.8°F) per minute.

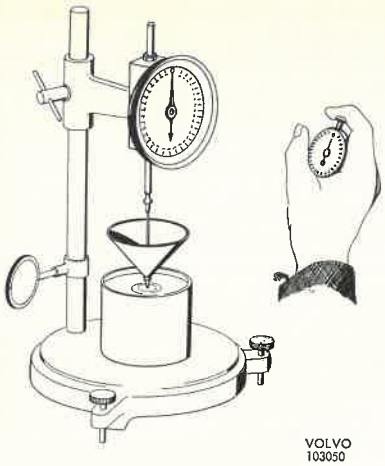


Fig. 12—11. Measuring penetration

PENETRATION

The penetration of a lubricating grease is taken to mean the depth to which a cone with a fixed dimension and under a loading of 150 grams penetrates into the grease during a period of 5 seconds. The penetration depth is stated in tenths of a mm and the grease is classified according to its consistency on the NLGI scale.

NLGI value	Penetration
000	445—475
00	400—430
0	355—385
1	310—340
2	265—295
3	220—250
4	175—205
5	130—160
6	85—115

CORROSION

The determination of corrosion concerns the appraisal of the tendency of a lubricating grease to cause chemical attack on a metal. This test is carried out by the examination of a strip of copper which has been maintained in the grease for a period of 24 hours at a temperature of 100°C (212°F).

HEAT STABILITY

This test is intended to determine the tendency of the component oil in a lubricating grease to separate out at an elevated temperature. The method is based on heating a certain sample quantity in a wire mesh cone under static conditions at the temperature and for the period stated in the data sheet for the respective lubricating grease. The quantity of oil separating out is then calculated in the form of per cent by weight.

Rig testing

In order to determine the operating characteristics of grease there are many rig test methods which, as far as possible, are identical with practical conditions. Methods of this type have been worked out, for example, by ASTM (The American Society for Testing Materials) and SKF (The Swedish Ballbearing Factory). The following characteristics of a grease are normally registered.

LUBRICATION

This property can be determined, for example in an SKF test rig R2F where, in test operation 2, the grease is tested at room temperature for 667 hours at 2500 rpm and with a constant radial bearing loading of 850 kg (1875 lb). On completion of the test, the bearings are examined for wear and the grease is examined concerning consistency, oxidation and deposits. Test number 4 A is carried out at a temperature of 120—125°C (250—260°F) for 600 hours at 500 rpm and 850 kg (1875 lb) loading. This test is used for the rejection of grease with insufficient lubricating characteristics, shearing stability and oxidation stability.

MECHANICAL STRENGTH

This refers to the capacity of the grease to retain its consistency and structure during long periods of operation, for example in bearings. There are many forms of test apparatuses to determine this characteristic, for example ASTM D217 and SKF WBG. On completion of the test, an examination is made concerning grease leakage and also the condition of the grease.

PUMPING CHARACTERISTICS

The degree to which a grease can be pumped is of interest since it is often necessary to force grease through constricted channels, for example when using a grease gun. This characteristic can be stated with the help, for example, of the Carter method by which a standardized grease gun is used to measure the rate of flow of the grease at constant pressure and at different temperature.

CORROSION-PROTECTIVE CHARACTERISTICS

Many test methods have been developed in order to examine the corrosion-protective characteristics of lubricating grease. One factor common to all these methods is that bearings packed with grease are run for certain periods together with water. Testing makes possible an evaluation of the capacity of the grease to prevent corrosion in the presence of water both under operating conditions and when stationary.

EXTREME PRESSURE LUBRICATION

Testing of the EP characteristics of a grease is to find out whether the grease maintains its lubricating properties even under high loading. Tests of this type can be carried out in the Timken test machine where a hardened steel ring rotates against a test block of steel. The degree of wear on the test block is then measured.

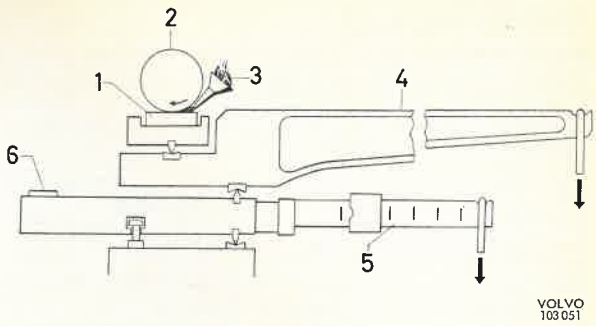


Fig. 12—12. The principle of the Timken test machine

1. Test block
2. Rotating steel ring
3. Grease
4. Lever for loading
5. Lever for measuring friction
6. Spirit level

STANDARDS

The standards given below are taken from Volvo Group Standards and are our minimal requirements for production.

From a practical point of view, it is suitable to have a common grease for all lubricating points lubricated with a grease gun. For this reason, we recommend in the lubricating chart the following grease for all lubricating nipples:

Lubricating grease on lithium base with EP-additive and consistency NLGI No. 2.

This means that all grease which meets the following standards for either durable grease for wheel bearings, molybdenum disulphide grease or universal grease with EP-properties can be used. But not, on the other hand chassis grease.

Long-duration grease for wheel bearings

Volvo Group designation: Lubricating grease 97815				
Soap	Lithium/Lead	Operating temperature °C (°F)	max.	+120 (+250)
Pour point °C (°F), min.	180 (360)		min.	–30 (–22)
Penetration at 25°C (77°F)	280	Consistency at +20°C (68°F)	Short fibres, smooth adhesive	
Penetration deviation, max.	± 15	Homogeneous characteristics	The grease must not contain lumps of hard particles and no significant amount of oil must separate out during the time the grease is stored.	
NLGI No.	2			
Water content, % max.	0			
Heat stability[1]), 100 h/80°C (176°F)	Oil separation 5 %			

[1]) Test method 4910, 3002

Special demands

The grease is to satisfy the demands made on testing in the "SKF Wheel Bearing Grease Testing Ring" and according to SIS 155130 (Emcor method) and also in accordance with the long-duration tests in the "SKF Grease Testing Machine, R2F". This means that the grease must be able to provide dependable lubrication during both vibrations and extremely heavy loading, i.e. it must not be thrown out of the bearing with poor lubrication or no lubrication at all as a result. Neither must it weaken to cause risk of leakage or cause corrosion on the various parts of the bearing.

Universal grease

Volvo Group designation: 97870				
Soap	Lithium	Operating temperature, °C (°F)	max.	+100 (+212)
Pour point °C (°F), min.	180 (360)		min.	–30 (–22)
Penetration at 25°C (77°F)	280	Consistency at +20°C (68° F)	Short fibres, smooth adhesive	
Penetration deviation, max.	± 15	Homogeneous characteristics	The grease must not contain lumps of hard particles and no significant amount of oil must separate out during the time the grease is stored.	
NLGI No.	2			
Water content, % max.	0.1			
Heat stability[1]), 50 h/100°C (212°F)	Oil separation 5%			

[1]) Test method 4910, 3002

Special demands

The grease is to satisfy the demands made when testing according to SIS 155130 (Emcor method) and also have good mechanical stability, i.e. it must not weaken and cause risk of leakage.
The grease must not contain fillers of any type such as lime, clay, asbestos, etc.

Molybdenum disulphide grease

Volvo Group designation: Lubricating grease 97865				
Soap	Lithium +3% molybdenum disulphide	Operating temperature, °C (°F)	max.	+100 (+212)
Pour point °C (°F), min.	170 (340)		min.	–25 (–13)
Penetration at 25°C (77°F)	280	Consistency at +20°C (68° F)	Short fibres, good metal adhesion	
Penetration deviation, max.	± 15	Homogeneous characteristics	The grease must not contain lumps of hard particles and no significant amount of oil must separate out during the time the grease is stored.	
NLGI No.	2			
Water content, % max.	0.1			
Heat stability[1]), 50 h/100°C (212°F)	Oil separation 5%			

[1]) Test method 4910, 3002

Special demands

The grease must satisfy the demands made when testing according to SIS 155130 (Emcor method).
The grease must not contain fillers of any type such as lime, clay, chalk, asbestos, etc. It must be suitable for lubricating points where high temperatures prevail and where demands are made concerning the highest film strength.

SERVICE OILS

BRAKE FLUID

Brake fluid originally consisted of a solvent and castor oil. The disadvantages with this simple form of brake fluid were that it had a low boiling point and a solidifying point which was as high as −15°C (−5°F). Development soon made considerably greater demands on brake fluid and certain standards were worked out. The best known of these standards are those worked out by SAE (the Society of Automotive Engineers) which are being continually revised and published in the "SAE Handbook". The first accepted standard SAE 70 R1 was published for the first time in 1946. In 1958 SAE 70 R3 was issued with more severe demands. In 1968 J 1703 was published with somewhat altered standards.

The brake fluid of today consists of a mixture of various glycols, the lubricating capacity of which has been improved by the addition of castor oil derivatives or synthetic lubricants. In addition to this, corrosion-protective and oxidation-proofing characteristics have been improved by means of various additives. The manufacturers have a wide range of variations possible in the composition of brake fluid and can thereby match the characteristics so that they correspond to the standards. The brake fluid manufacturers are responsible for this and usually state on the label which standard the fluid satisfies. AB Volvo stipulates for its products only brake fluid which satisfies the demands according to SAE J 1703. Brake fluid with designation DOT 3 or DOT 4 can also be used.

OTHER FLUIDS

Given below is a definition of some of the many fluids used on vehicles.

Anti-freeze generally consists of ethylene glycol together with anti-corrosive and anti-foam additives. AB Volvo prescribes for its products anti-freeze with copper inhibitor, see "anti-freeze standards", in other words, Volvo's red anti-freeze 283241-8 or corresponding. Another anti-freeze which meets the requirements according to British Standard BS 3151, type B with copper inhibitor can, however, be used. Glycol of British Standards 3150, 3152 and MIL-E-5559 should not be used. The fluid is suitably mixed with 50% water and this provides protection against frost down to −35°C (−41°F) and provide protection against rusting when used in the engine cooling system.

Windscreen washer fluid is mixed with water and used in windscreen washers. Most of the types used remove dirt and protect against freezing.

Rustproofing fluid contains a film former, chemical additives and solution. After the fluid has been sprayed or painted on the surface to be protected against rust, the solution evaporates and leaves a thin, non-drying skin of the base and the additives. This skin can be oily, greasy or waxy depending on where it is to be used.

Preservative oil is a rustproofing oil for internal protection, for, e.g. engines which are not used for lengthy periods of time. The oil neutralizes the remaining combustible products and provides a lubricating but non-drying protective skin.

Lock oil is sprayed into locks for de-freezing frozen locks and to counteract anticipated freezing.

Lock fluid is a plastic product which remains fluid as long as it has contact with air. When it is no longer in contact with air, e.g., on a covered bolt, it becomes rigid and ensures reliable locking. The hardening time can be shorted with special activating fluid.

Rust oil is used for jamming bolts, hinges, locks, etc. It has an anti-rust effect and provides a certain lubrication at the same time.

Shock absorber fluid lubricates sliding surfaces and dampens the movements of the shock absorbers. It has a high viscosity index and a low lowest fluid point. Since shock absorbers are nowadays maintenance-free and cannot be dismantled, this fluid is not topical from a servicing point of view.

Flushing oil was a special cleaning oil previously used in connection with changing oil in engines and transmissions. We definitely advice that such oil is not used in our vehicles since oil residues of this kind have a destructive effect on the ordinary oil. Any flushing should be carried out with the same type of oil subsequently used in the component concerned.

Hydraulic oil is a mineral oil or synthetic oil which, e.g., is used as a lubricant and pressure-transmission agent in loading apparatuses and tipping systems. Even if the requirements for these oils remind us of those required by ATF oil, they can, however, be set lower and for this reason hydraulic oils are considerably cheaper than ATF oil.

REFERENCE LIST OF WORDS

Certain concepts and terms referring to lubricants and used in workshops

A

Absolute viscosity A measurement of the viscosity of the fluid. Calculated after measuring the rate of flow and forces. Stated in poise (P) or centipoise (cP).

Acid refining Production process.

Acid value The amount of free acids in the lubricant.

Additive Additives of various types are used to improve certain characteristics of the basic oil.

Additives Ingredients used in the production of petroleum products in order to give them certain characteristics.

Aluminium grease Lubricating grease with an aluminium base.

API The American Petroleum Institute.

API system A classification system for lubricating oils depending on conditions of operation.

Areometer An apparatus used to measure density.

Ash content The percentage of non-combustible material.

ASTM The American Society for Testing Materials.

Automatic oil Cutting oil used on machine tools.

B

Barium grease Lubricating grease with a barium base.

Basic number The amount of free bases in the lubricant.

Boundary lubrication A form of lubrication between material surfaces which are extremely close to each other and usually under extreme pressure. EP lubricant is used in such cases.

C

Calcium grease Lubricating grease with a calcium base.

Carburization index The residue after the carburetion of petroleum products.

Centipoise (cP) The unit of absolute viscosity.

Centistokes (cSt) The unit of kinematic viscosity.

Central lubrication The lubrication of several lubricating points from one apparatus on the vehicle.

Chassis grease Lubricating grease for motor vehicles. Outstanding characteristics toughness and a high degree of adhesion.

Chlorinated oil An oil containing chlorine.

Circulation lubrication Lubrication with an oil pump in a closed system.

Cleveland Open Cup (COC) An apparatus to determine the flash point.

Cohesion A property of a lubricant to withstand mechanical breakdown.

Compounded Designation of mineral oil which contains grease, fatty oil or wax.

Compounding agent Grease, fatty oil or wax which is mixed with mineral oil.

Consistency In the case of lubricating grease this refers to stiffness, adhesion, etc.

Corrosion The attack on material through chemical or electro-chemical reaction with the surroundings.

Crude oil A description of petroleum as it is taken out of the ground.

D

DEF Defence Specification (Great Britain).

Demulsification The separation of oil from water.

Density Weight per unit of volume.

Detergent An additive which has a cleansing effect and contributes to keeping sludge particles in suspension.

Diesel fuel oil Fuel for Diesel engines.

Di-ester lubricating oil Synthetic lubricating oil.

Dispersal The distribution of very finely divided solid particles or droplets in a fluid.

Distillation Evaporation by boiling and condensation by cooling.

Double-grade oil Lubricating oil which covers two adjacent SAE ratings.

Dynamic viscosity See Absolute viscosity.

E

Emulsification The capacity to form an emulsion with water.

Emulsion A finely-divided mixture of one fluid in another.

Engine oil Lubricating oil intended for the cylinders and bearings in combustion engines.

Engine fuel oil See Diesel fuel oil.

Engler degrees A measurement of viscosity.

EP Extreme Pressure.

EP lubricant Lubricant with special additives to increase its capacity to withstand high surface pressure.

Ester lubricating oil Synthetic lubricating oil.

F

Fat oil Oil of animal or vegetable origin.

Film strength The capacity of a lubricant to form and maintain a thin layer which prevents metallic contact.

Flash point The lowest temperature at which an inflammable fluid evaporates to such an extent that the vapours can be ignited.

Fuel oil See Diesel fuel oil.

G

Gel A liquid or solid body including a finely-divided component which forms an internal structure in the body. Lubricating grease is an example of a gel.

Gel former A substance which swells in a liquid to form a gel.

Graphite A form of pure carbon.

Graphite grease A lubricating grease containing a large proportion of graphite.

Grease Originally a natural chemical compound of fatty acids and glycerine. Can be of animal or vegetable origin or produced synthetically.

H

HD Heavy Duty

HD oil An old API classification of engine lubricating oil intended for service operating conditions.

Heat stability The tendency of a lubricating grease to separate oil under certain conditions.

Hydraulic oil A mineral oil or synthetic oil used as hydraulic fluid.

Hydraulic film The pressure-transferring medium in a hydraulic system.

Hydrodynamic lubrication A type of lubrication in which movement of the sliding surfaces produces a liquid film with sufficient pressure to separate the surfaces concerned.

Hydrostatic lubrication A type of lubrication in which lubricant is fed in under sufficient pressure to separate the surfaces resting against each other.

Hypoil oil Lubricating oil specially intended for hypoid gears.

I

Inhibitor An additive which delays or prevents a certain chemical reaction.

IP The Institute of Petroleum, England.

K

Kinematic viscosity A measure of the viscosity of a liquid. Calculated after measuring the rate of flow and density. Quoted in Centistokes.

L

Lanoline Refined wool fat.

Lard oil Animal fat oil.

Lead grease Lubricating grease with a lead base.

Lead naphthenate Lead soap, used for example in EP lubricant.

Lithium grease Lubricating grease with a lithium base.

Long-duration grease High-class lubricating grease specially indended for wheel bearings.

Lowest pour point The lowest temperature at which a petroleum product can flow. Usually stated as 3°C (5.4°F) above solidification point.

Lubricating grease Plastic lubricant which is produced by thickening a lubricating oil with the help of a gel former.

M

MIL The collective designation for the specifications set up by the American military authorities.

Mineral oil Oil produced from natural or synthetic petroleum.

Mixed base grease Lubricating grease based on two or more metallic soaps.

Mixed base oil Mineral oil consisting of naphthalene base oil and paraffin base oil.

Multigrade oil Lubricating oil which covers several SAE ratings.

Multi-purpose grease Lubricating grease which is intended to replace several different types.

Multi-purpose oil Lubricating oil which is intended to replace several different types.

N

Naphthalene base oil Mineral oil which primarily contains or is characterized by napthene hydrocarbons.

Neutralization value The collective name of the basic value and the acid value.

NLGI The National Lubricating Grease Institute, USA. This institute has worked out systems for the classification of lubricating grease with respect to penetration.

O

Operating temperature The temperature of the lubricating point. Min. and max. state the limits within which a lubricating grease can satisfy the demands made upon it.

Oxidation A chemical reaction during the absorption of oxygen.

Oxidation inhibitor An additive to prevent or delay oxidation.

P

Paraffin base oil Mineral oil which mainly contains or is characterized by paraffin hydrocarbons.

Penetration A measure of the consistency of lubricating grease.

Pensky-Martens (PM) An apparatus for the determination of flash point.

Petroleum A substance occurring in the crust of the earth mainly consisting of a mixture of various types of hydrocarbons.

Poise The unit of absolute viscosity.

Premium oil An oil API classification of engine lubricating oil, the range of which is between regular oil and HD oil.

Pressure lubrication A lubricating method, where the lubricant is fed to the lubricating points under pressure.

Pyknometer An apparatus for the determination of specific gravity of a liquid.

R

Refining A production process.

Redwood A British unit of measurement stating viscosity.

Regular oil An old API classification of engine lubricating oil without additives.

Rust inhibitor An additive which prevents or delays the formation of rust.

S

SAE The Society of Automotive Engineers, USA.

SAE classes A system made up by SAE for classification of lubricating oils depending on viscosity.

Saponification The hydrolysis of grease by the action of alkalis.

Saponification number This states the content of saponifiable substance.

Saybolt viscosity An American unit of measurement to state viscosity.

SCL oil Final drive oil with additives of sulphur, chlorine and lead.

Sediment Solid particles which collect at the bottom in a liquid.

Silicons Organic derivatives of polysiloxens. Available in the form of silicon grease and silicon oil which are characterized by a high index of viscosity and good stability at high temperatures.

SIS Swedish Industrial Standards.

Shale oil Crude oils produced by the pyrolysis of oil shales.

Sludge A description of the deposits resulting from oxidation, for example in engine lubricating oil.

Sligh index A measurement of the resistance to oxidation of an oil.

Soap Chemical compounds of fatty acids and metals. Soaps are used as gel formers in the production of lubricating grease.

Soda grease Lubricating grease with a sodium base.

Sodium grease Lubricating grease with a sodium base. Also called soda grease.

Solvent refining A production process.

SSU (SUS) Saybolt Universal Seconds.

Staeger index An expression for the resistance to oxidation of an oil.

Solidification point See the lowest pour point.

Stokes The unit for kinematic viscosity.

Splash lubrication A lubricating system in which rotating machine components splash oil to the lubricating points.

Synthetic lubricating oils Chemical compounds produced synthetically.

T

Thixotropy When a material becomes soft while being worked and returns to its original consistency when left alone, this is known as thixotropy.

Transmission oil Lubricating oil for the power transmission units such as gearbox and rear axle.

Turbidity point The temperature at which an oil, when being cooled down, starts to become cloudy or turbid due to precipitation.

U

Ubbelohdes viscosimeter An apparatus for the determination of kinematic viscosity.

V

Viscosity The thicker a liquid is, the higher its viscosity.

Viscosity index (VI) The measurement of the degree to which the viscosity of an oil changes with temperature. The lower the change in viscosity, the higher the viscosity index.

W

Waste oil Used lubricating oil.

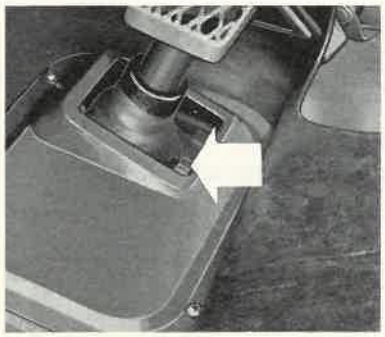
Water content The relative amount of water in lubricating grease.

Wool fat A fatty substance obtained in the degreasing of wool.

SERVICING

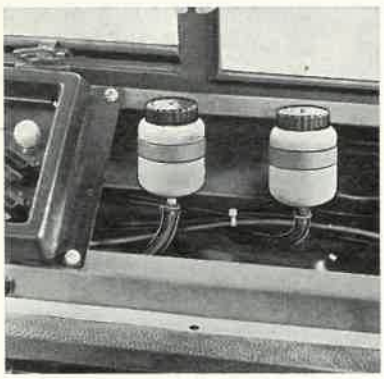
The lubricating chart indicates suitable intervals for checking levels, changing oil, also with regard to the amount of oil involved, its type, quality, viscosity, etc. The importance of the designations can be seen from the general instructions given on the previous pages.
When oil is about to be changed, it should be drained immediately after the vehicle has been driven since the oil is still warm and viscous.

Clean all lubricating nipples and areas round the filler holes to ensure that no dirt accompanies the lubricant on its way to bearing surfaces. Replace faulty lubricating nipples and plugs with new ones. The texts and pictures below give a number of supplementary instructions. The numbering is the same as that used on the lubricating chart.



VOLVO
115197

1. Steering gear
Check the oil level by removing the filler plug. The oil should be level with the filler hole. If the oil is to be replaced, suck up the old oil with an oil syringe which is inserted through the filler hole.



VOLVO
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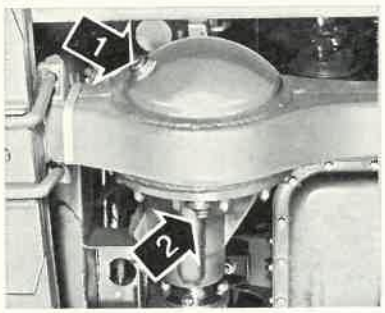
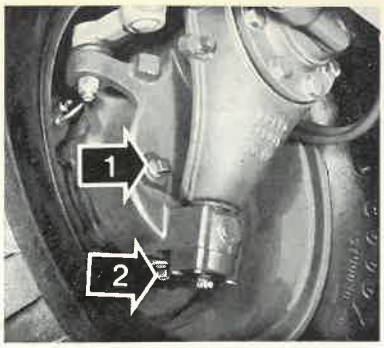
2. Brake fluid container
The brake fluid level can be checked after having removed the cover and by visually inspecting the transparent containers. It is not necessary to take off the cap. These containers should be almost full.



VOLVO
115198

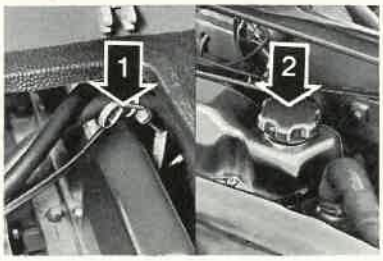
3. Front differential carrier
To check the oil level in the differential carrier, remove the filler plug (1). The oil should be level with the hole.
To change the oil in the front differential carrier, remove the drain plug from the drain hole (2).



VOLVO
115199

4. Front wheel carrier

The oil should be level with the filler hole (1). To change the oil here, remove the plug from the drain hole (2).

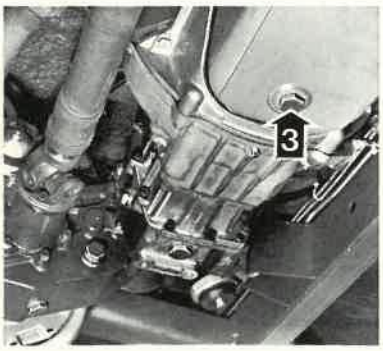


VOLVO
115 200

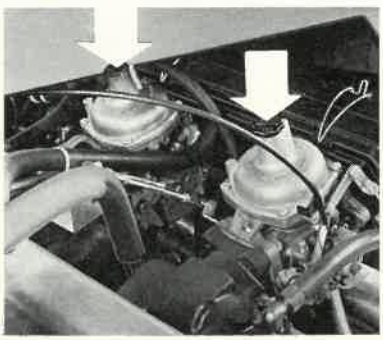
5. Engine

Check the oil level with the dipstick (1). The level should be between the MIN and MAX marks on the stick. Top up by filling through the filler hole (2) in the rocker arm cover.

To change the oil in the engine, first drain the old oil through the hole (3) in the bottom of the engine oil sump.



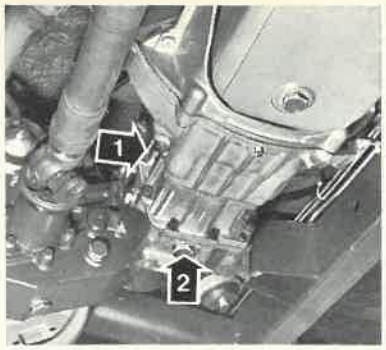
VOLVO
115 201



VOLVO
115 202

6. Carburettors

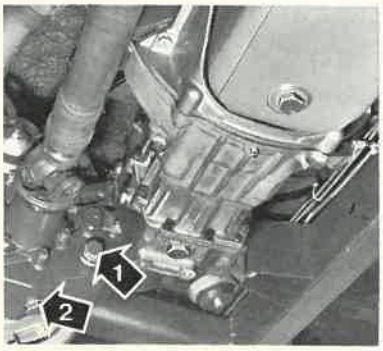
Check the oil level in the centre spindles of the carburettors by removing the plugs. The level should be up to about 6 mm (1/4″) from the edge of the spindle.



VOLVO
115203

7. Gearbox

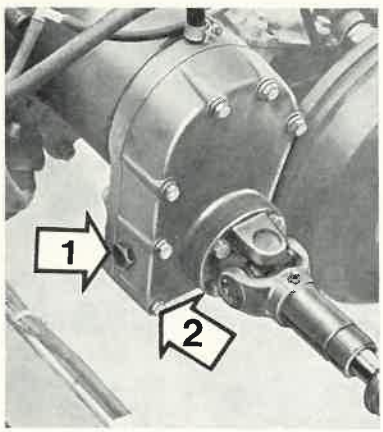
The oil should be level with the filler hole (1).
To change the oil in the gearbox, drain the old oil by removing the plug from the drain hole (2).



VOLVO
115204

8. Auxiliary gearbox

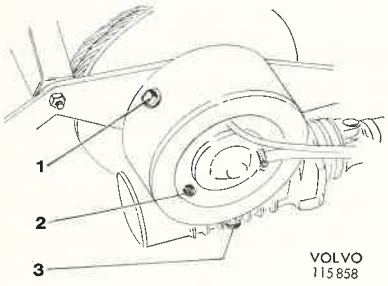
The oil should be level with the filler hole (1).
The oil in the auxiliary gearbox is changed by removing the plug from the drain hole (2).



VOLVO
115857

9. Power take-off

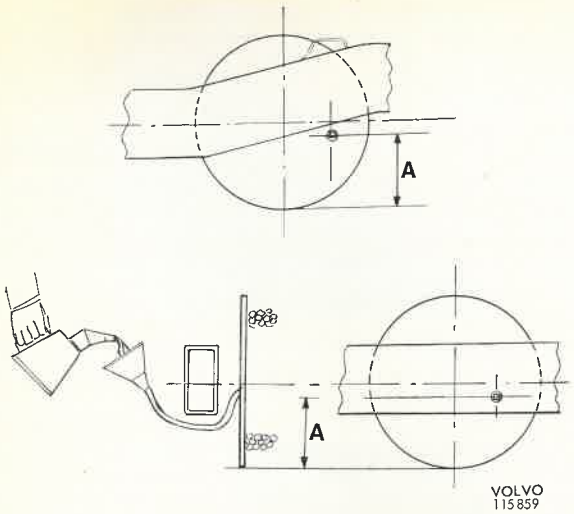
The oil should be level with the filler hole (1).
The oil is changed by removing the plug from the drain hole (2).



VOLVO
115858

10. Winsch housing

The oil should be level with the level hole (2).
The oil is changed by removing the plug from the drain hole (2). Top up by filling through the filler hole (1).

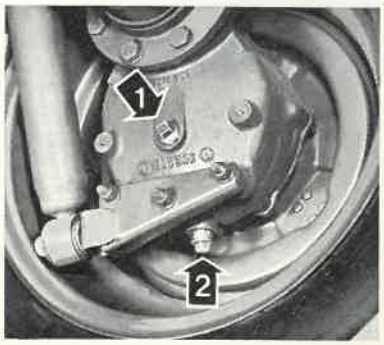


A=122 mm (5")

11. Planetary gear (in winding drum)

The oil should be level with the filler hole when it is turned to 122 mm (5″) above the drum flange diameter, see picture. Since filling is difficult on a 3-axle vehicle dut to the frame, a hose should be used, see picture.

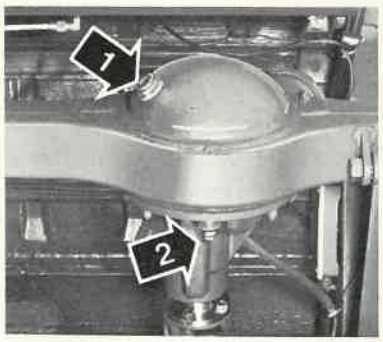
Oil is drained by turning the winding drum so that the plug is at the bottom.



12. Rear wheel carrier

The oil should be level with the filler hole (1)

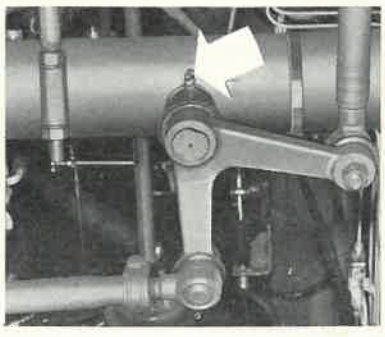
To change the oil in the rear wheel carrier, remove the plug from the drain hole (2).



13. Rear differential carrier

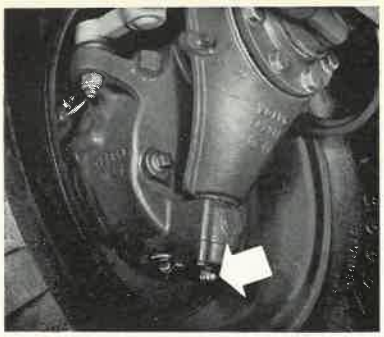
The oil should be level with the filler hole (1).

To change the oil in the rear differential carrier, remove the plug from the drain hole (2).



14. Intermediate lever

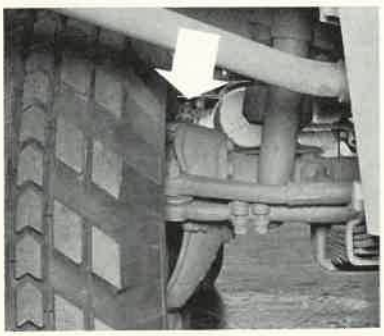
The intermediate lever has a lubricating nipple. Grease this until the grease squeezes out at the lower end of the shaft. Greasing is facilitated if the steering wheel is turned at the same time.



VOLVO
115 208

15. Lower steering knuckle joint

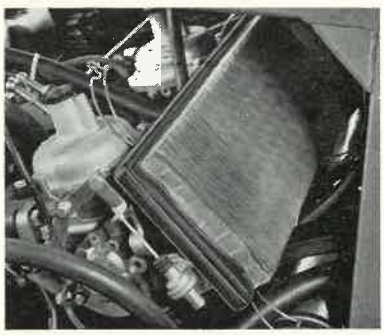
The lower steering knuckle joint has a lubricating nipple. Grease this until the grease squeezes out.



VOLVO
115 209

16. Upper steering knuckle joint

The upper steering knuckle joint has a lubricating nipple. Lubricate it until grease squeezes out.

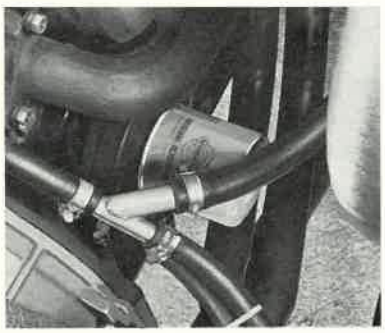


VOLVO
115 210

17. Air cleaner

To replace the cleaner, release the four clamps securing the upper part of the cleaner. Remove the upper part and change the paper insert.

Make sure that the upper part of the cleaner is properly fitted on after the replacement.



VOLVO
115 211

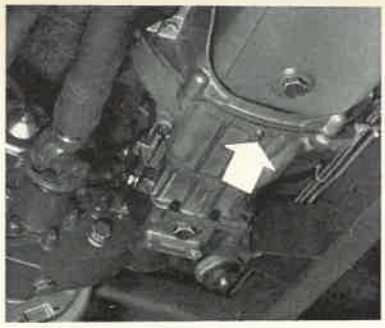
18. Oil filter

Before replacing it, clean round the filter to ensure that no dirt gets into the lubricating system when the filter is removed.

Use the special tool and unscrew the filter.

Collect the oil in a vessel.

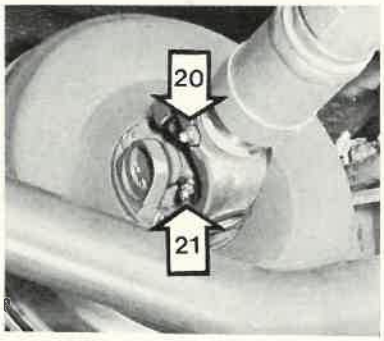
Moisten the gasket on the new filter with oil. Screw tight the filter hand until it is tight. When the engine has been run for about 5 minutes, check for oil leakage.



VOLVO
115212

19. Clutch casing

Drain the clutch casing each time the oil in the engine is changed.



VOLVO
115213

20. Slip joint

There are one lubricating nipple on each propeller shaft. Grease them until the grease squeezes out at the end of the sleeve.

21. Universal joints

There are one lubricating nipple on each universal joint. Grease them until the grease squeezes out at all four bearing shells. If the grease does not squeeze out – rotate the propeller shaft.

INSTRUCTIONS FOR LUBRICATING CHART

SYMBOLS

ENGINE OIL
Quality: API Service SE
Viscosity: SAE 20 W/30 or SAE 30

GEARBOX OIL
Quality: API-GL-1
Viscosity: SAE 85 W/90 or SAE 80/90

FINAL DRIVE OIL
Quality: API-GL-5 or MIL-L-2105 B
Viscosity: SAE 90 or SAE 80/90

AUTOMATIC TRANSMISSION FLUID

ENGINE OIL, Oil can

BRAKE FLUID
Grade: SAE J 1703 or DOT 3

GREASE ON LITHIUM BASE with EP-additive and consistency NLG I No. 2

K **CHECK**

B REPLACE

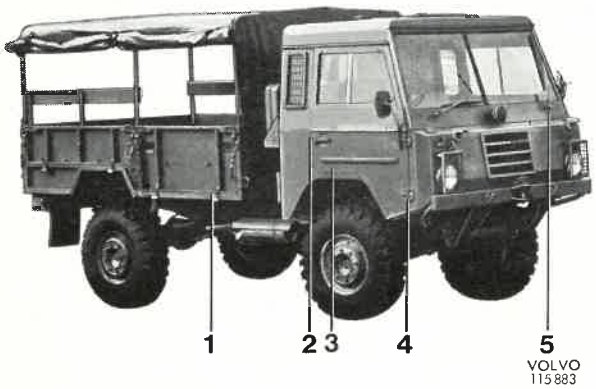
SPECIALLY ACTION

OIL CAPACITIES

Engine, incl. oil filter	5.7 litres	(10 pints)
excl. oil filter	5.2 litres	(9 pints)
Gearbox	1.2 litres	(2 pints)
Auxiliary gearbox	1.3 litres	(2.3 pints)
Front differential carrier	1.5 litres	(2.6 pints)
Rear differential carrier	1.5 litres	(2.6 pints)
Front wheel carrier	0.3 litre	(0.5 pints)
Rear wheel carrier	0.4 litre	(0.7 pint)
Steering gear	0.5 litre	(1 pint)
Power take-off	0.2 litre	(0.4 pint)
Winsch housing	1.2 litres	(2 pints)
Planetary gear	0.6 litre	(1 pint)

NOTES

Note 1 Check the oil level daily before starting.
Note 2 Check the oil level in the centre spindles.
Note 3 Change the paper insert.
Note 4. Replace the cleaner at every other oil change.
Note 5 Drain the clutch casing at every other oil change.



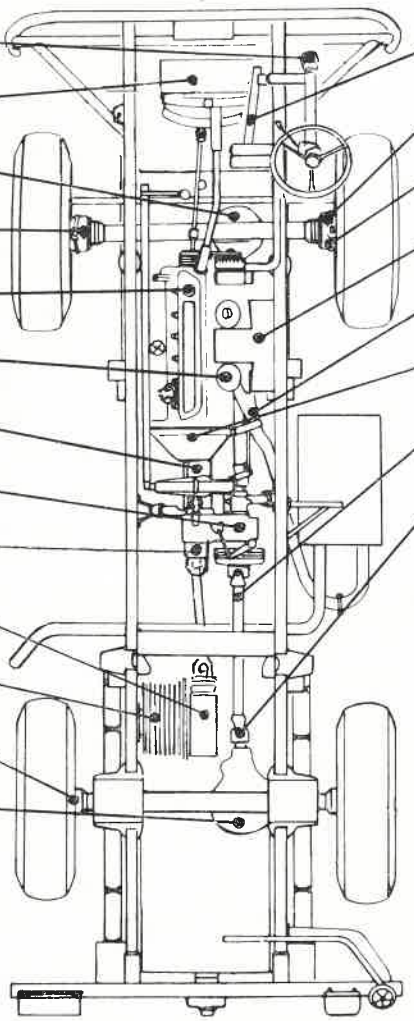
22. Joints, links, hinges, locks

Lubricating points	Number
1. Hinges	
2. Striker plates	2
3. Seat rails	4
4. Door hinges	4
5. Windscreen wipers, shafts	2

LUBRICATING CHART C 3-SERIES

*) 3 000 miles or at least every 6 months
**) 18 000 miles or at least once a year

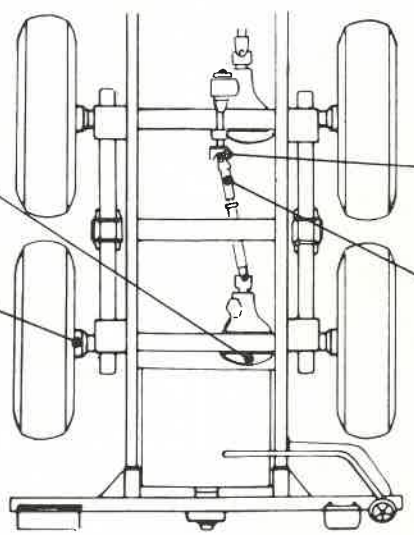
Nr	Lubricating point	Number	Every 5 000 km*	Every 30 000 km**
1	Steering gear	1	K	
2	Brake fluid container	2	(K)	
3	Front differential carrier	1	K	B
4	Front wheel carrier	2	K	B
5	Engine. Note 1	1	B	
6	Carburettors. Note 2	2	K	
7	Gearbox	1	K	B
8	Auxiliary gearbox	1	K	B
9	Power take-off	1	K	B
10	Winsch housing	1	K	B
11	Planetary gear (in winding drum)	1	K	B
12	Rear wheel carrier	2	K	B
13	Rear differential carrier	1	K	B



Every 30 000 km**	Every 5 000 km*	Number	Lubricating point	Nr
		1	Intermediate lever	14
		2	Lower steering knuckle joint	15
		2	Upper steering knuckle joint	16
		1	Air cleaner Note 3	17
	B	1	Oil filter Note 4	18
		1	Clutch casing. Note 5	19
		3	Slip joint	20
		6	Universal joint	21
	F		Joints, links, hinges, locks	22

Additional for the 3-axle vehicle

Nr	Lubricating point	Number	Every 5 000 km*	Every 30 000 km**
13	Rear differential carrier	2	K	B
12	Rear wheel carrier	1	K	B



Every 30 000 km**	Every 5 000 km*	Number	Lubricating point	Nr
		2	Slip joint	21
		1	Universal joint	20

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GROUP 14 RUSTPROOFING

CLOSED SECTION

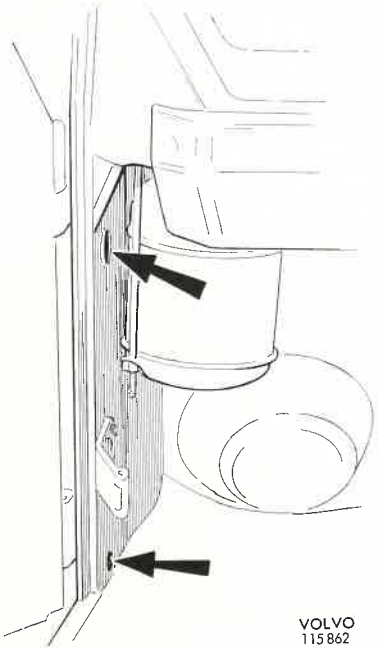
General

Before rustproofing the vehicle, clean it very thoroughly. Clean all drain holes from dirt. Allow the vehicle to dry or blow it dry with compressed air before applying the rustproofing. The body temperature may not be less tran +10°C (50°F).

Rustproofing should be applied with a spray machine which sprays on an air-free fluid jet at a pressure of at least 10 MPa (100 kp/cm²=1422 lbf/in²). The spray nozzle is inserted in the various holes and openings in the enclosed sections and used so that all inside walls, etc., are treated with the rustproofing. Spray until the rustproofing **runs out of** the adjacent holes or it is clearly seen in some other way that the entire enclosed section has been thoroughly treated.

For this internal spraying, use a rustproofing which meets the requirements according to the Volvo Group Standards, Class 11. Makes which meet this requirement are such as: Tikamin Dinitrol 33 B, Valvoline Tectyl 140 and Valvoline Tectyl 894.

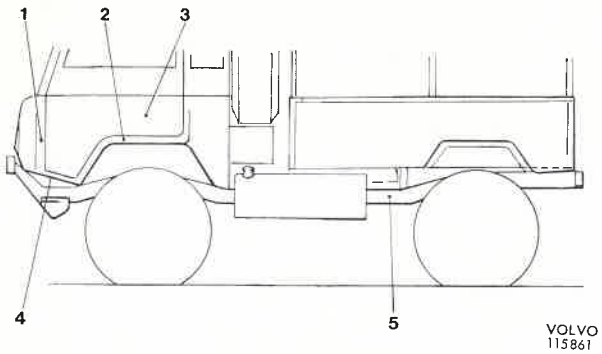
Remove any rustproofing spots or splash with alcohol. Use the alcohol sparingly to ensure that the rustproofing is not diluted in the joints.

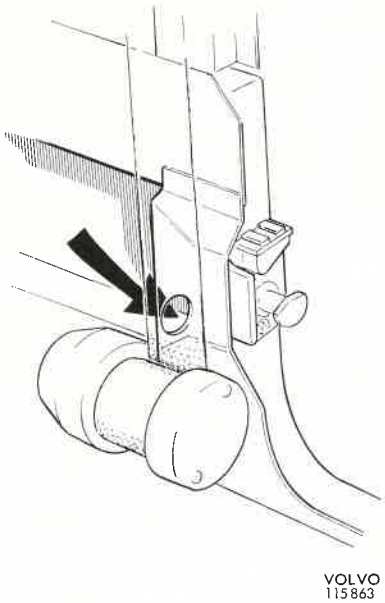


1. Front door pillars.
   2 holes on each side.

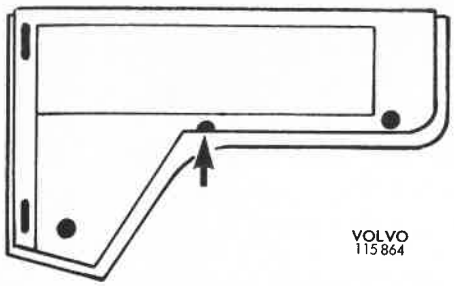
Procedure

The rustproofing work has been divided into 5 stages. The adjacent picture and the following pictures show what is to be done.

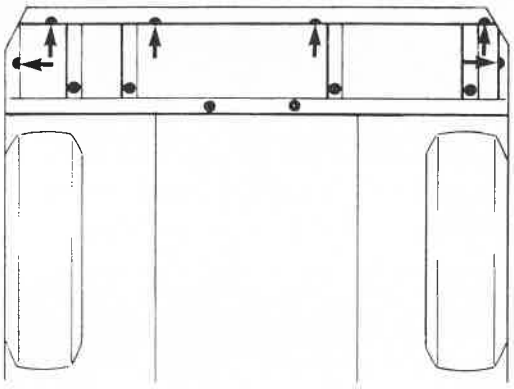




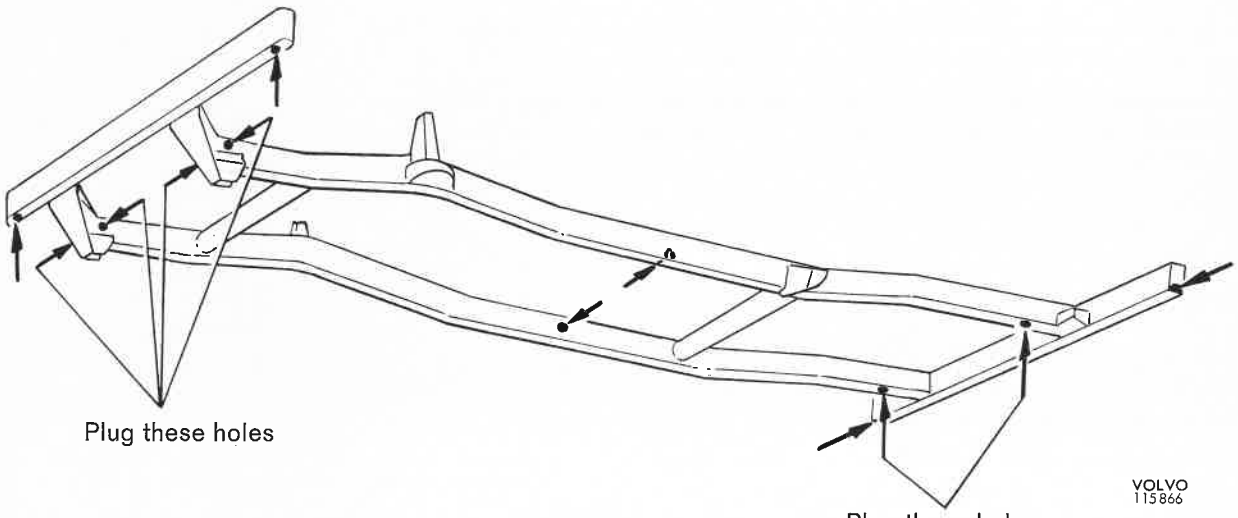
2. Rear door pillars and sill profile at door.
   1 hole on each side.
   Spray upwards (door pillar) and forwards (sill profile).



3. Doors
   5 holes in each door.
   Carefully spray in the rustproofing in the oval holes so as not to dirty the insulation.



4. Floor profiles on underside.
   12 holes.
   In the holes marked with a dot in Fig. the nozzle is inserted from underneath. In the arrow.



5. Frame and bumpers.
   12 holes.
   Plug 6 holes.

ENGINE COMPARTMENT AND UNDERBODY

Rustproofing the engine compartment

The engine and the components in the engine compartment can be suitably rustproofed with a suitable gun or similar. In this case the right type of rustproofing would be Class 1, that is, Valvoline Tectyl 810, Valvoline Tectyl 511 or corresponding.

Rustproofing the underbody

The entire underbody should be rustproofed, that is, frame, shafts, springs, fuel tank and underneath the engine, gearbox and auxiliary gearbox. A suitable rustproofing in this case is Class 3 or 4, that is, Valvoline Tectyl 400 c, Valvoline 506 or corresponding.

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