



Technical Handbook DCD90-180

DCD70-32E3 - 70-40E5

This Handbook deals with the design and maintenance of Kalmar forklift trucks, type DCD.

In addition, it gives details of troubleshooting and the most common corrective maintenance.

Operation and other matters that are primarily of interest to the operator are included in the Instruction Manual.

Kalmar Industries AB

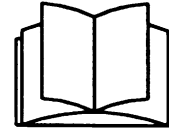
We reserve the right to modify our design and material specifications without prior notice.

00	General
10	Chassis and cab
20	Electrical system
30	Engine
40	Transmission, drive axle, brakes
50	
60	Steered axle
70	Hydraulic system
80	Lifting mast and fork carriage
90	Periodic supervision

Group 00

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It is important that you read the instruction manual

Incorrect handling can lead to personal injury or damage to products and/or property. Therefore, read the instruction book very carefully before operating the truck. The instruction manual contains important information about your Kalmar truck, about the operation of the truck, about safety during operation and about the truck's daily maintenance. In addition, you will find useful information that will make operations easier for you in your daily work.

Ask your foreman/group leader if there is anything in the manual that you do not understand or if you feel that information is missing in any area.

The symbol  is used on our products in certain cases and then refers to important information contained in the instruction manual. Make sure that warning and information symbols are always clearly visible and legible. Replace symbols that have been damaged or painted over.

Safety regulations

In this handbook warnings are inserted that apply to your own safety. Warnings point out the risk of accident that can cause personal injury.



WARNING!

Warns of the risk of serious personal injury, possible death and/or serious damage to product or property if the regulations are not followed.

For technical warnings, that point out the risk of break down, the word IMPORTANT is used:

IMPORTANT!

Is used to draw attention to such occurrences that can cause damage to the product or property.

For information that facilitates the working process or handling, N.B. is used:

N.B. Draws attention to useful information that helps the working process.



Safety regulations aimed at reducing the risk of personal injury and damage to loads or other property.

Intended of use

- The truck may only be used for the purpose for which it was intended, namely, to lift and transport goods, the weight of which does not exceed the maximum permitted load capacity of the truck.
- The truck may not, without specific permission from Kalmar, be modified or re-built so that its function or performance is altered.
- The truck may not be driven on public highways if it has not been adapted to comply with national road safety regulations.

Operator requirements

- The truck may only be driven by operators who have been specially trained and who have the company's authority to do so.
- Laws and other regulations relating to driving licence, operator ID, log book, etc., must be followed at all times.
- The operator must be aware of and follow all local safety regulations.

Operation of the truck is prohibited:

- If any of the fitted safety equipment, such as rear view mirrors, headlights, reversing alarm (optional) does not function correctly.
- If there is a fault with the brakes, steering or lift equipment.
- If the truck is fitted with tyres not approved by Kalmar.

Operating regulations

- Before starting, always check to ensure that nobody is in the way of the truck or its equipment.
- Make sure that nobody walks or stands underneath raised forks or other equipment, whether they are loaded or not.
- The operator must always face the direction of operation and take particular care in areas where persons or other vehicles are likely to appear in the vicinity. If visibility is limited by the load, the operator should operate the truck in reverse.
- It is prohibited to transport passengers on the truck outside the cab or on the load. Passengers may be transported inside the cab only on condition that it is equipped with a fixed passenger seat.
- It is prohibited to lift people if the truck is not equipped with an approved lift cage.
- It is prohibited to exceed the load capacity of the truck. See capacity plate and loading diagram.
- It is prohibited to transport loads in the raised position as this entails a risk of the truck tipping. All transportation shall take place with the load in the lowered position and with the mast tilted backwards to the maximum.
- The operator must adapt the speed of the truck to the character of the load, conditions of visibility, the character of the roadway/surface, etc.
- The operator shall avoid powerful acceleration and braking when turning. In addition, the operator shall always moderate the speed of the truck when turning so as to avoid the risk of lateral skidding or tipping.

- The operator shall take particular care when operating in the vicinity of electrical power lines, viaducts, quay-sides, ramps, gates/doors etc.
- Safety belts must always be worn, if fitted. In the event of the truck tipping, always remain in the cab and grip the steering wheel securely. Never try to jump out of the cab.
- The parking brake can also be used as an EMERGENCY BRAKE. **However**, having been used for emergency braking, the brake linings must be inspected and replaced if needed. If the parking brake has been mechanically released, **it must always be reset** in order for the truck to regain the parking brake function.

Interrupted operation, parking

- Always check that the gear lever is in the neutral position before turning the ignition key to restart or to reset an emergency stop.
- Never leave the operator's cab without applying the parking brake (ON position).
- Always remove the ignition key if the truck is to be left unattended.

Other important points to remember

- The truck's hydraulic system includes high pressure hydraulic accumulators. Always be extremely careful when working with the hydraulic system and avoid being unnecessarily close to the hydraulic equipment, lines and hoses. Before working on the hydraulic system, the accumulators must be emptied into the tank, with the help of the special accumulator evacuation valve.
- Handle batteries and junction boxes with great care. The batteries must always be protected over the poles and connections.
- Always rectify any damage or wear and tear that can risk personal safety or that can affect the functions of the truck or its service life.
- Trucks with tippable cabs: The cab must always be tipped over the point of balance. If there is insufficient lateral space the cab must always be secured against accidental lowering with a brace or similar.
- Avoid touching oils and greases. Avoid inhaling exhaust and oil fumes.
- Welding painted steel produces poisonous gases. Paint should therefore be stripped before welding, good ventilation ensured and/or face mask with filter used.

Operating with attachments

- The operator must always take the effect of the wind into account when handling containers. Avoid lifting with a wind strength in excess of 12 m/s (27 mph/40 feet per second).
- Always drive carefully so as to avoid attachments colliding with pillars, cables, etc.
- Carefully study the "Lift methods" section of the instruction manual.



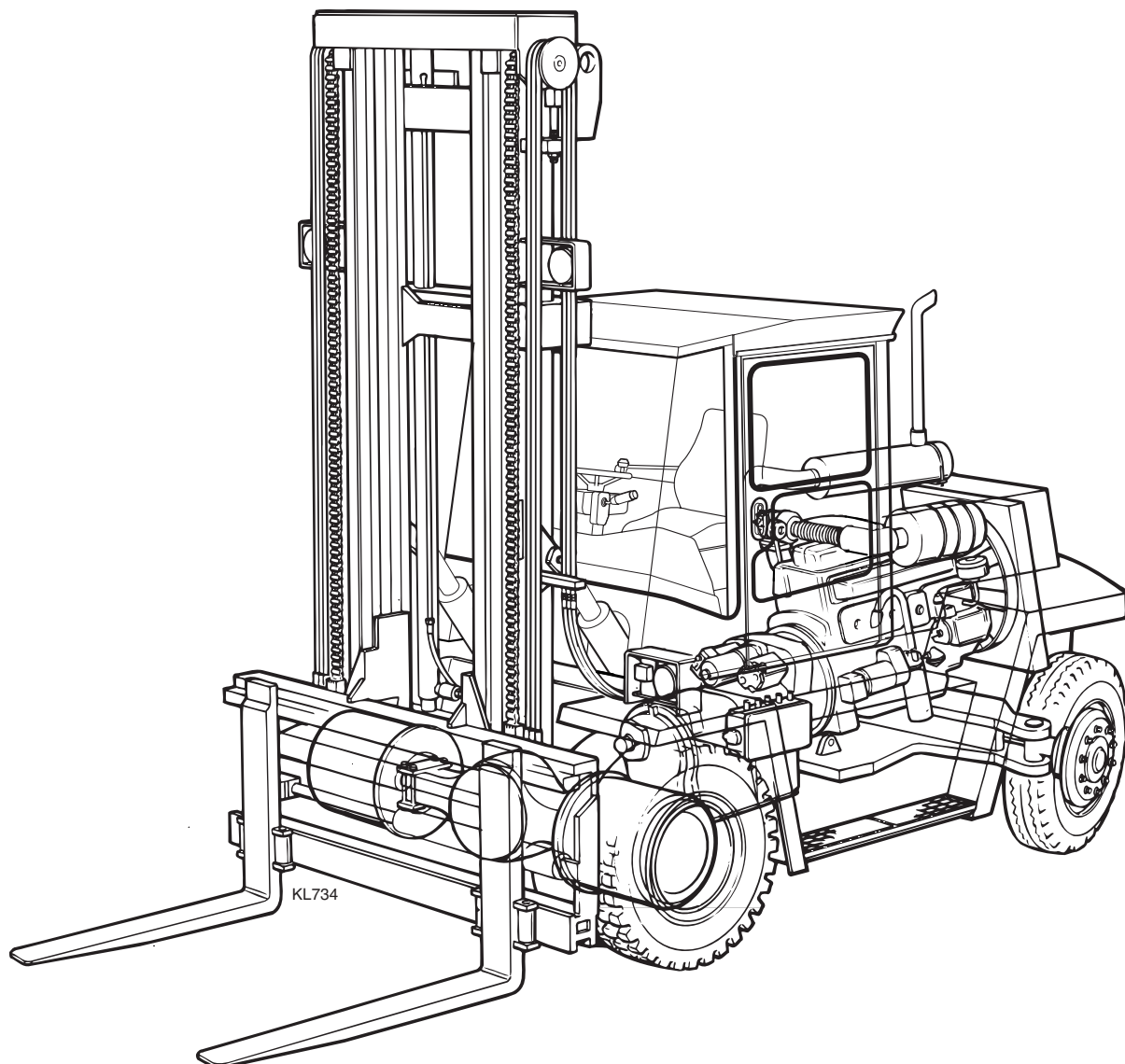
Safety instructions for working with tyres

- Tyre changing can be dangerous and should only be carried out by specially trained personnel using proper tools and procedures. Failure to comply with these procedures may result in faulty positioning of the tyre and/or rim and cause the assembly to burst with explosive force sufficient to cause physical injury or death. Never fit or use damaged tyres or rims.
- Never attempt to weld on an inflated tyre/rim assembly.
- Never let anyone assemble or disassemble tyres without proper training.
- Never run the truck on one tyre of a dual assembly. The load capacity of a single tyre is then dangerously exceeded and operation in this manner may damage the rim.
- **Deflation and dismantling**
 - Always block the tyre and wheel on the opposite side of the vehicle before you place the jack in position. Always crib up the blocks to prevent the jack from slipping.
 - Always check the tyre/rim assembly for proper component seating prior to removal from the truck.
 - Always deflate the tyre by removing the valve core prior to removing the complete assembly from the truck or dismantling any of the component. Before loosening mounting bolts, run a wire through the valve stem to ensure that it is not blocked. Ice or dirt can prevent all the air from escaping. Deflate and remove valve cores from both tyres of a dual assembly.
 - Never position body in front of the rim during deflation.
 - Always follow assembly and dismantling procedures outlined in the manufacturer's instruction manual, or other recognized industry instruction manuals. Use proper rubber lubricant.
 - Never use a steel hammer to assembling or dismantling rim components – use a lead, brass or plastic type mallets. The correct tools are available through rim/wheel distributors.
 - remove bead seat band slowly to prevent accidents. support the band with your thigh and roll it slowly to the ground in order to protect back and toes.
 - Disassembly tools apply pressure to rim flanges to unseat tyre beads. Keep your fingers clear. Slant disassembly tool about 10 degrees to keep it firmly in place. Always stand to one side when applying hydraulic pressure. Should the tool slip off, it may cause fatal injury.
- **Rim inspection**
 - Check rim components periodically for fatigue cracks. Replace all cracked, badly worn, damaged and severely rusted components.
 - Always select the correct tyre size and construction matching the manufacturer's rim or wheel rating and size.
- Do not use over-size tyres, too large for the rims, e.g. 14.5 inch tyres with 14 inch rims or 16.5 inch tyres with 16 inch rims.
- Never use damaged, worn or corroded rims/wheels or fitting hardware. Always verify that the rim is in a serviceable conditioning.
- Always clean and repaint lightly rusted rims.
- Never use a rim/wheel component that can not be identified. Check rim parts against multi-piece rim/wheel matching charts.
- **Assembly and inflation**
 - It is important that the inflation equipment is equipped with a water separator to remove moisture from the air line in order to prevent corrosion. Check the separator periodically to ensure that it is working properly.
 - Make sure that the locking is in its right position.
 - Never mix different manufacturer's parts since this is potentially dangerous. Always check manufacturer for approval.
 - Never seat rings with hammering while the tyre is inflated. Do not hammer on an inflated or partially inflated tyre/rim assembly.
 - Always double check to ensure that the rim assemblies have been correctly assembled and that securing studs and nuts are tightened to the correct torque setting.
 - Never inflate tyres before all side and lockrings are in place. Check components for proper assembly after pumping to approximately 5 psi (=34 kPa, =0.34 bar)
 - When adding air to a tyre on an industrial truck, use a clip-on chuck and stay out of the danger area. If the tyres has been run flat then the rim must be dismantled and all parts inspected for damage.
 - Under-inflated tyres have a serious effect on the stability of the truck and reduces the safe load handling capacity. Always maintain tyres at the correct inflation pressures. Check inflation pressure daily. Do not over-inflate.
 - Inspect tyres regularly – every day if possible. Look for and remove broken glass, torn pieces of tread, embedded metal chips etc. Inspect for uneven or rapid tread wear, usually caused by mechanical irregularities, such as brakes out of adjustment or excessive toe-in and toe-out. If discovered, correct the irregularity immediately.
- When installing and tightening trail wheel bolts, observe the following:
 - Ensure that trail wheel or hub mounting surfaces and trail wheel fastener mounting surfaces are clean and free from paint and grease.
 - Tighten bolts to specified torque settings. use staggered sequence; i.e. top bolt, bottom bolt etc.

Applications

The Kalmar DCD90-180 range of trucks is based on an entirely new approach to the design and production of medium-heavy, diesel-powered forklift trucks. The trucks are durable and safe and their accessibility for service and maintenance is unexcelled. Due to their versatility, the trucks can be used in a number of applications, such as:

- Steelworks and heavy engineering industry, where the trucks handle individual tasks in the handling of medium-heavy goods.
- The forest industry for handling logs by means of a log grapple attachment, sorting of logs at sawmills and handling of sawn timber in units loads.
- Ports and container terminals for handling medium-heavy goods and handling empty containers.
- Factories producing houses – lifting of house sections.



Design – general survey

Kalmar DCD90-180 diesel trucks are of sturdy design for heavy duty. They are built around a chassis which has high strength and torsional stiffness and an extremely low centre of gravity.

The operator's cab is provided with vibration isolation and sound insulation and offers excellent all-round visibility.

The operator is provided with many facilities for adjusting his seating attitude. The seat, backrest and springing of the operator's seat can be adjusted in a wide variety of ways.

The cab is tiltable and offers excellent accessibility to the transmission and pumps. The engine is easily accessible through a casing, divided in two halves.

The Volvo or Perkins six-cylinder turbocharged engine TD640VE or TD730VE/TWD731VE, combined with a three-speed gearbox with torque converter, provides smooth power whenever needed.

The drive axle with hub reductions, the oil-cooled hydraulic brake system and the pendulum-mounted steered axle with double-acting steering cylinder satisfy very strict demands on strength and mobility when travelling on irregular surfaces.

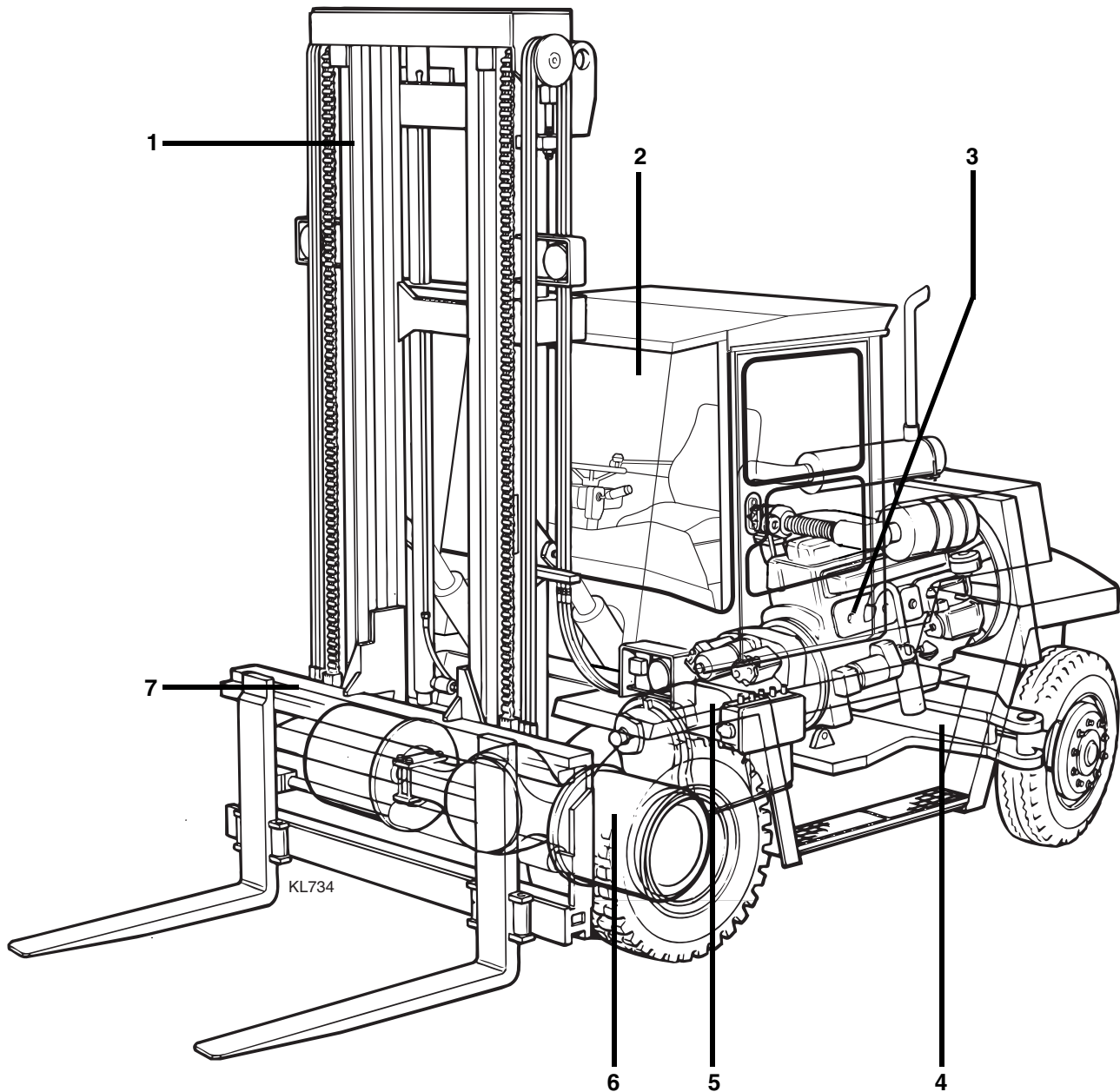
The hydraulic system is reliable and has high performance charged by two or three hydraulic pumps.

For further details, see group 70.

Component units

- Sound-insulated and safety-tested operator's cab with excellent all-round visibility. The non-slip, substantial steps provide convenient access to the cab. All models in the series can be equipped with a rotatable operator's seat.
- Clearly arranged instrument panel.
- Engine – Volvo TD640VE or TD730VE/TWD731VE six-cylinder, four-stroke, turbocharged diesel engine with direct injection and thermostatically controlled water cooling.
The engine is equipped with:
 - Injection pump with centrifugal governor that compensate for load variations.
 - Alternator.
 - For alternatives, see separate table.

- Gearbox with torque converter
 - Constant-mesh gearbox in which hydraulically actuated clutches for the different gears. The clutches are electrically operated.
 - Torque converter, which is a hydraulic coupling that amplifies the output torque on an increase in load. Torque conversion takes place smoothly and steplessly throughout the engine speed range.
 - Oil cooler connected to the engine cooling system for cooling the oil in the gearbox and torque converter.
 - Oil pump which supplies oil under pressure to the gearbox and torque converter.
 - Full-flow oil filter for effective cleaning of the gearbox oil.
- Drive axle with two-stage reduction - in the differential and the hub reductions.
 - Oil cooled hydraulic brakes for the foot brake, e.g. Wet disc brakes.
 - Disc type parking brake applied by a sturdy spring and released by hydraulic oil pressure.
- Hydraulic system with
 - Gear type hydraulic pumps connected to take-offs on the torque converter. One pump for working hydraulics and one for steering and accumulator charging, which in turn serves the brake circuits.
 - Main valve for controlling the main hydraulics. The valve is controlled hydraulically from the cab. An electro-hydraulic servo system is available as an option.
 - A high pressure filter after each pump for effective cleaning of the hydraulic fluid before it is fed to the system.
 - Steering valve (Orbitrol) - flow-control valve which supplies hydraulic fluid to the steering cylinder.
- Steered axle with pendulum mounting and double-acting steering cylinder.
- Sturdy clear-vision mast. Of duplex or triplex design, with or without free lift.
 - Outer mast with hydraulically controlled 5° forward and 10° backward tilting.
 - Tilting cylinders with back-pressure valves to prevent the load from tilting the mast forward.
 - Inner mast with support rollers that carry the forces on the mast. Yoke with guide rollers for the hydraulic hoses and guide sprockets for the lifting chains.
 - Lifting cylinders - two cylinders mounted on the outer mast.
- Fork carriage designed for optimum visibility and equipped hydraulic with fork positioning and sideshifting (optional).



- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Free -visibility mast, with two lifting cylinders 2. Operator's cab, rubber suspended cab 3. Engine, six-cylinder diesel engine with turbo-compressor 4. Steering axle, with pendulum suspension and double acting steering cylinder | <ol style="list-style-type: none"> 5. Gearbox, combined with torque converter 6. Drive axle, with hub gearing and oil-cooled hydraulic brake 7. Fork carriage, hydraulically controlled fork positioning and sideshift |
|--|---|

Main components

Alternative drive lines ● = Standard ○ = Optional		90-6	100-6	100-12	120-6	136-6	120-12	150-12	160-6	160-9	160-12	180-6
Engine	*Turbo **Turbo, intercooler											
Volvo TD640VE*	129 kW/690 Nm	●	●	●	●	●	●	●	●	●	●	●
Perkins 1006-60T1*	85 kW/465 Nm	○	○	○	○	○						
Volvo TD730VE*	150 kW/800 Nm		○	○	○	○	○	○	○	○	○	○
Volvo TWD731VE**	167 kW/893 Nm		○	○	○	○	○	○	○	○	○	○
Perkins 1006-60T2*	114 kW/620 Nm	○	○	○	○	○	○	○	○	○	○	○
Scania DI9**	167 kW/930 Nm			○		○	○	○	○	○	○	○
Cummins 6BTA5.9-C200**	162 kW/814 Nm	○	○	○	○	○	○	○	○	○	○	○
Gearbox with powershift, 3+3 gears												
Clark 13.7HR 28000 (Volvo TD640VE, TD730VE, Perkins 1006-60T2, Cummins 6BTA)		●	●	●	●	●	●	●	●	●	●	●
Clark 1207 FT 20302 (Perkins 1006-60T1)		○	○	○	○	○						
Clark 13.7HR 32000 (Volvo TD640VE, TD730VE, Volvo TWD731VE, Scania DI9, Cummins 6BTA)		○	○	○	○	○	○	○	○	○	○	○
Drive axle with Wet Disc Brakes		●	●	●	●	●	●	●	●	●	●	●
Pneumatic tyres	10.00x20/Æ/16PR 11.00x20/Æ/16PR 12.00x20/Æ/20PR	●	●		●							
Optional: Semi-solid tyres (Super-Elastic)		○	○	○	○	○	○	○	○	○	○	○

Supplementary books

In addition to the Instruction Manual and the Technical Handbook, the following books are delivered with every truck.

Spare parts catalogue

Instruction Manual for Volvo Industrial engines

Workshop Manual for Industrial engines

Workshop Manual for the Perkins engine

Replacement system - Spare parts

Kalmar operates a system of replacement parts, repair kits and gasket sets covering most of the vital components of the truck.

For the contents of these kits, see the Spare parts catalogue.

Tools

Kalmar offers a wide range of tools for truck maintenance work.

For further information, please contact Kalmar's service department.

Tightening torques

The tightening torques are applicable to steel bolts and nuts tightened with a torque wrench under the following conditions:

Condition	Surface treatment		Lubriation
	Bolt	Nut	
1	untreated	untreated	oiled
2	bright galvanised	untreated	dry or oiled
	bright galvanised	bright galvanised	
	bright galvanised	bright galvanised	
3	hot-dip galvanised	bright galvanised	dry or oiled

The values specified in Table 1 are applicable to nut-and-bolt joints, but can also be used for bolts fitted into tapped holes. However, in the latter case, the preloading force will be somewhat lower, depending on its depth of engagement.

When tightening by machine, the torque specified in Table 1 should be reduced by approx. 5%, due to the increased scatter and to prevent the bolt from being tightened beyond its yield point.

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread M fin	1	2	3	1	1
M8×1	27	24	30	39	46
M10×1,25	54	48	61	76	91
M12×1,25	96	85	108	135	162
M16×1,5	230	205	260	323	388
M18×1,5	330	294	373	466	559
M20×1,5	460	409	520	647	777
M24×2	786	700	888	1100	1330
M30×2	2660	1388	1763	2200	2640
M36×3	1560	2367	3005	3730	4480

To reduce the risk of settlement of the material and the associated reduction in the preloading force if the hardness of the surface supporting the bolt head or nut is lower than 200 HB, a washer should be fitted under the bolt head and nut. This is not applicable if flanged bolts or flanged nuts are used.

When tightening is carried out, the specified torque should be applied without pause, to ensure that the torque wrench will not be tripped by the static friction before the joint has been tightened to the specified torque.

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread M	1	2	3	1	1
4	3,2	2,9	3,6	4,6	5,5
5	6,4	5,7	7,2	9,1	11
6	11	9,8	12,5	16	19
8	26	24	30	38	45
10	52	47	59	74	89
12	91	81	103	128	154
16	220	198	250	313	375
20	430	386	49	620	732
24	750	668	848	1050	1270
30	1480	1317	1672	2080	2500

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread UNC	1	2	3	1	1
1/4	12,5	11,1	14,1	17,6	20
5/16	25	22,3	28,3	35	42
3/8	44	39	50	62	73
7/16	70	62	79	100	118
1/2	107	95	121	151	178
9/16	153	136	173	216	255
5/8	210	187	237	298	353
3/4	370	390	418	524	619
7/8	594	528	671	839	990
1	889	791	1005	1260	1480
1 1/8	1260	1120	1424	1780	2100
1 1/4	1760	1565	1990	2490	2940
1 3/8	2320	2065	2620	3280	3870
1 1/2	3060	2720	3455	4320	5100

Quality	8,8			10,9	12,9
	Tightening torque, Nm Condition				
Thread UNF	1	2	3	1	1
1/4	13	11	14	19	22
5/16	26	23	29	37	44
3/8	47	42	53	67	79
7/16	75	66	85	107	126
1/2	114	101	128	162	191
9/16	164	145	185	231	273
5/8	227	202	256	321	379
3/4	396	352	447	559	661
7/8	629	560	710	889	1050
1	937	834	1058	1320	1560
1 1/8	1350	1200	1525	1900	2250
1 1/4	1860	1655	2100	2630	3110
1 3/8	2500	2225	2825	3530	4170
1 1/2	3260	2900	3680	4610	5450

System of units

The SI system of units is employed in this handbook:
The conversion factors are as follows:

Pressure

megapascal	bar	Kilogram-force per square centimetre, kpf/cm ² Atmosphere, at	Pound-force per square inch, psi
1	10	10,2	145
0,1	1	1,02	14.5
0,098	0,98	1	14.2

Torque

Newton- meter Nm	Kilogram force-metre kgf m	Pound-force foot lbf ft
1	0,102	0.74
9,81	1	7.23

Power

Kilowatt kW	Horsepower (metric) hp	Horsepower hp
1	1,36	1.34
0,735	1	0.986

Group 10

Chassis and cab

Specifications	2
Chassis	3
Description	3
Operator's cab	4
Description	4
Steering column	7
Pump and cylinder for cab tilting	8
Accelerator pedal with change-over switches for forward and reverse	9
Gear selector type RMH	10
Hydraulic weight indicator	11
Service	12
Changing the fresh air filter	12
Check and lubrication of brake pedal	12
Windscreen wipers	13
Air conditioning unit	14
Description	14
Service	17
Checking the air conditioning unit	17

Air conditioner

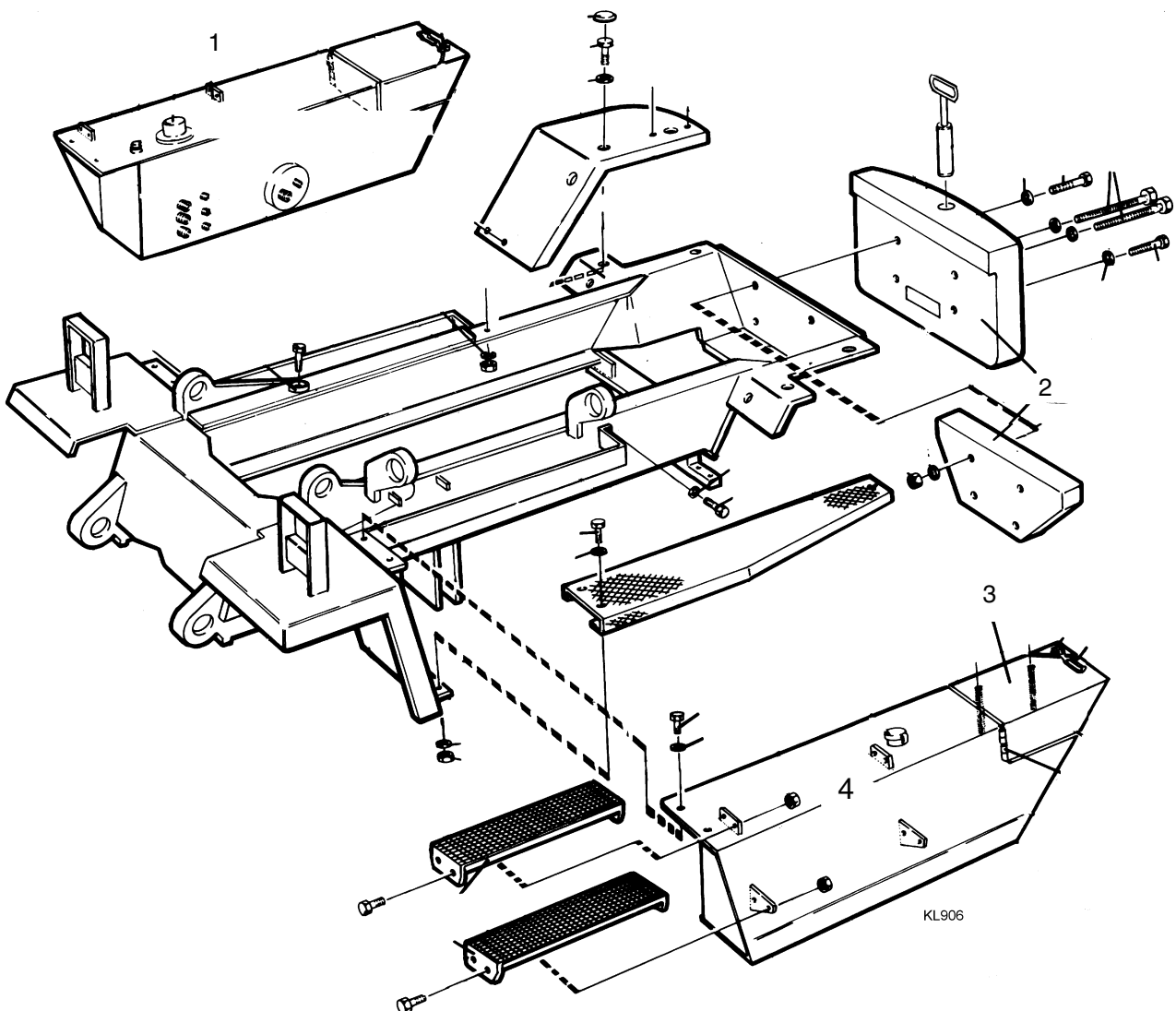
- Cab unit
 - Circulated air flow 500-600 m³/h
 - Electric power consumption approx 350 W
- Compressor
 - Max. speed 4000 r/min
 - Refrigerant R134a *)
 - Electric power consumption approx 50 W
 - Oil capacity Zexel PAG SP-20 1.5 dl
- Condenser
 - Electric power consumption 250 W
- Cooling effect 6-8,5 kW
- Heating effect approx 11 kW

*) Refrigerant R12 is no longer in production due to legislation

Chassis

The chassis consists of:

- A unit construction frame built up around two beams with a minimum of welds for best possible strength.
- Mountings for the drive axle, steered axle, mast, lifting cylinders and transmission.
- The necessary counterweights to provide a very low centre of gravity. Moreover, the steered axle is designed to serve as an additional counterweight.
- The hydraulic oil tank and the fuel tank are produced as separate units and are bolted to the side of the chassis. The tanks have a low profile, which contributes to the good visibility.

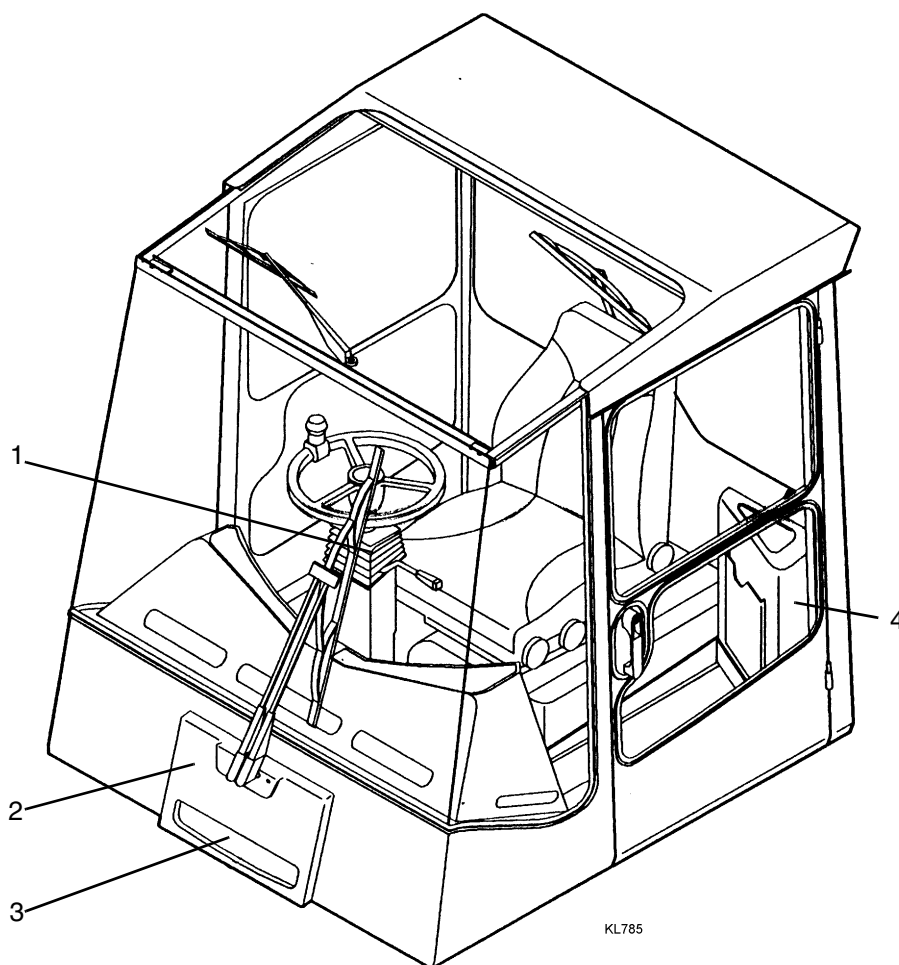


1. Hydraulic tank
2. Counterweights
3. Service hatch for the battery
4. Fuel tank

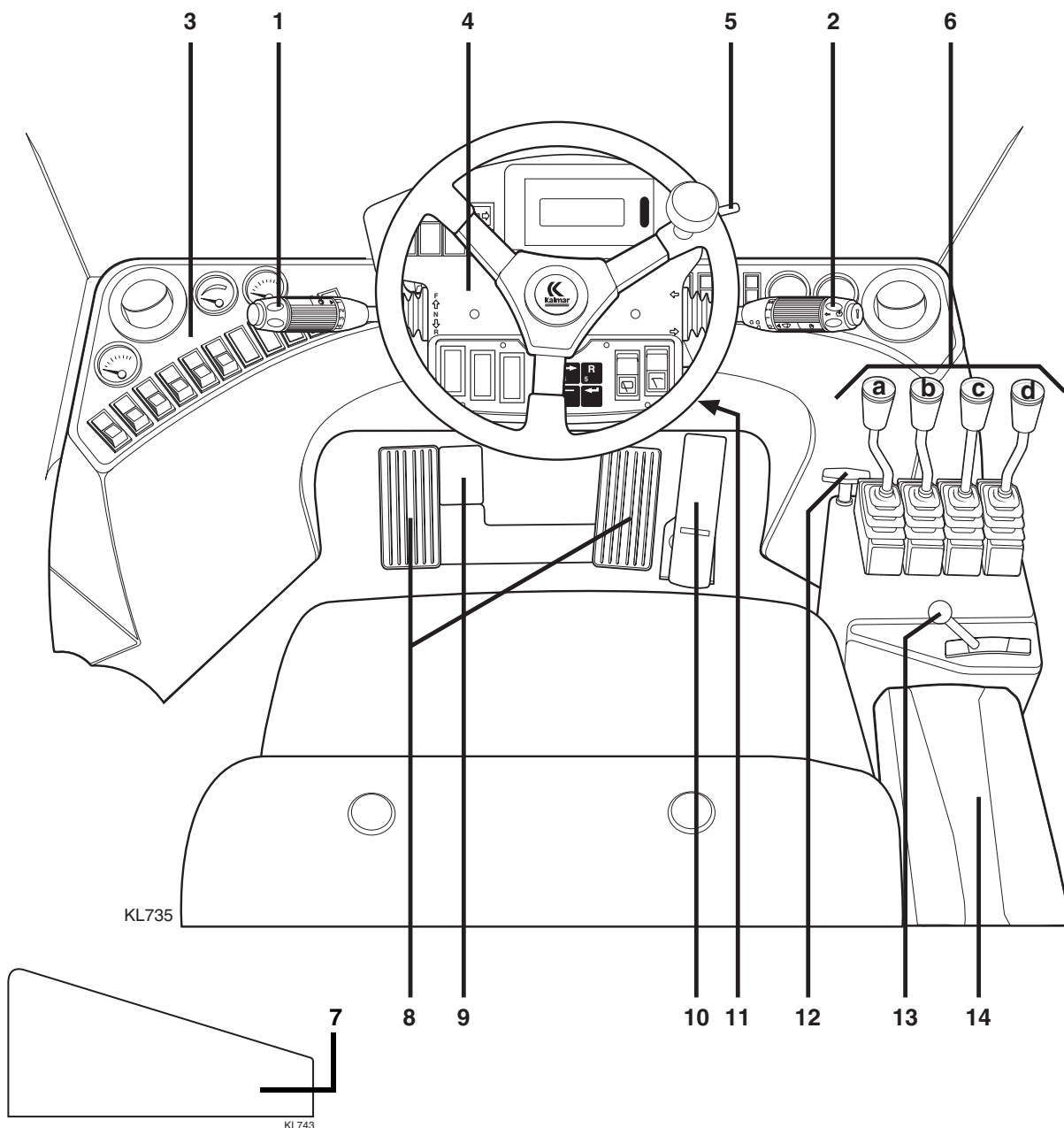
Operator's cab

The operator's cab is a separate structure and rests on the chassis on rubber dampers. The operator's seat, steering wheel and hydraulic control levers can be adjusted for best possible operator comfort. Effective insulation minimises the vibrations and sound level in the cab.

The standard heating system consists of a fan and heater for heating the air in the cab by recirculation. Fresh air is drawn in through a ventilation air filter. Full air conditioning, with cooling, heating and dehumidification, is available to special order.

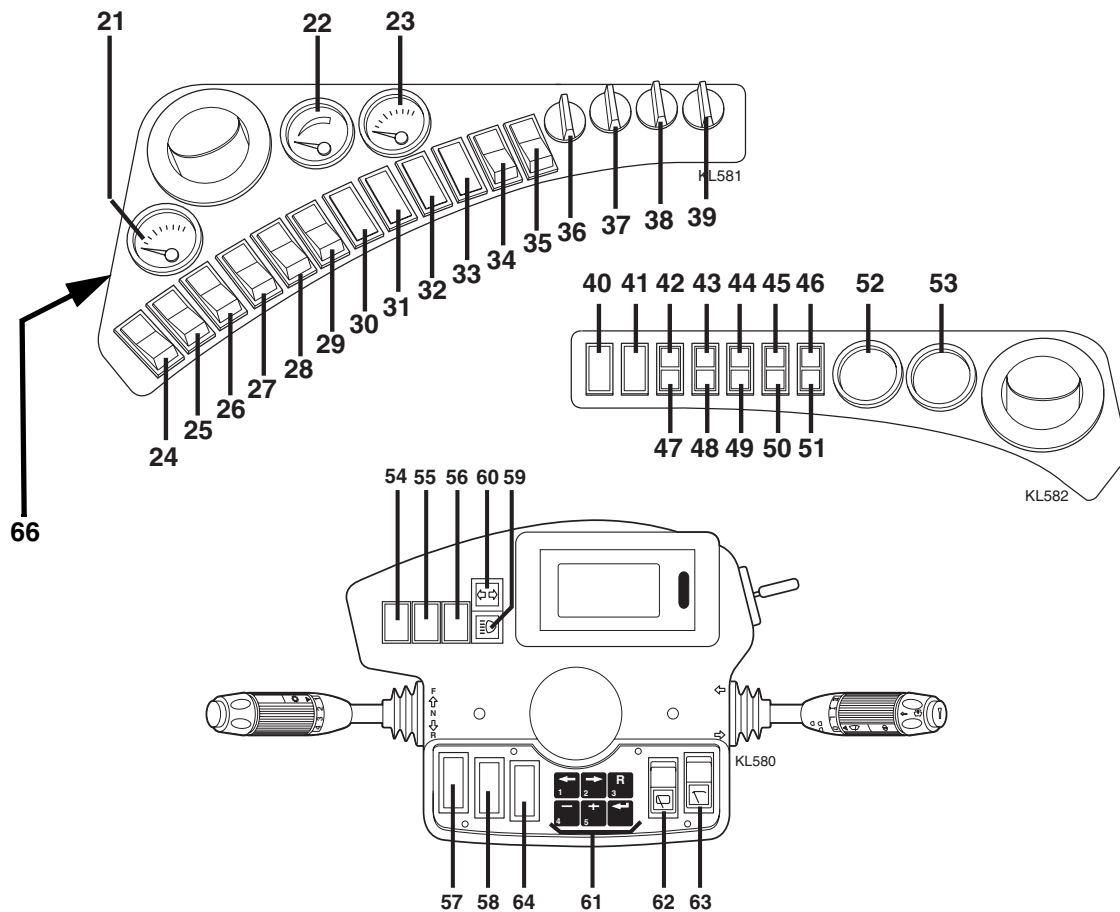


1. Steering column with instrument panel and switches, ECS-terminal (option)
2. Air filter
3. Heating system
4. Electrical central unit



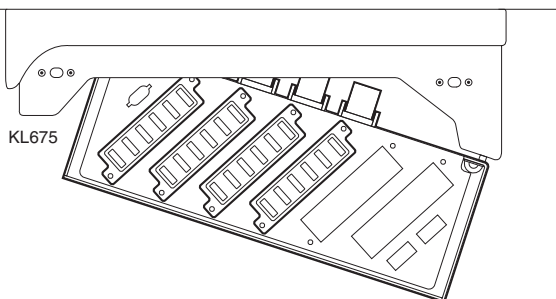
1. Gear selector
FORWARD/NEUTRAL/REVERSE 1/2/3
2. Lever DIRECTION INDICATORS/HORN
FRONT WINDSCREEN WASHER/
FRONT WIPERS/MAIN BEAM
3. Instrument panel
4. Steering wheel panel
5. Starting switch
6. Control lever, hydraulic functions
a. Lift, b. Tilt, c. Sideshift, d. Fork positioning

7. Electrical central unit with fuses and relays
8. Brake pedals, normal driving brake
9. Release clutch
10. Accelerator pedal
11. Steering wheel adjustment
12. Stop control
13. Parking brake
14. Operator's seat



- 21. Pressure gauge, gearbox oil pressure
- 22. Fuel gauge
- 23. Temperature gauge, engine coolant temperature
- 24. Switch, working lights
- 25. Switch, working lights
- 26. Switch, working lights
- 27. Switch, flashing beacon
- 28. Switch, hazard warning lights
- 29. Switch, driving lights
- 30. Spare
- 31. Spare
- 32. Spare
- 33. Spare
- 34. Switch, compressor air conditioning ¹⁾
- 35. Control, recirculation/fresh air
- 36. Control, defrost/cab
- 37. Switch, fan
- 38. Control, heat
- 39. Control, cold ¹⁾

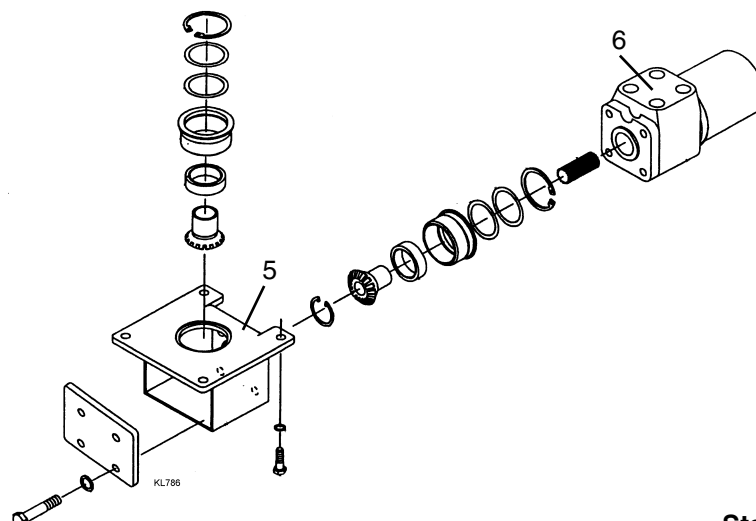
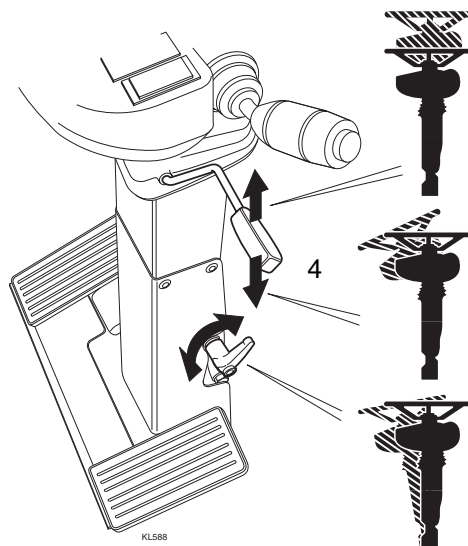
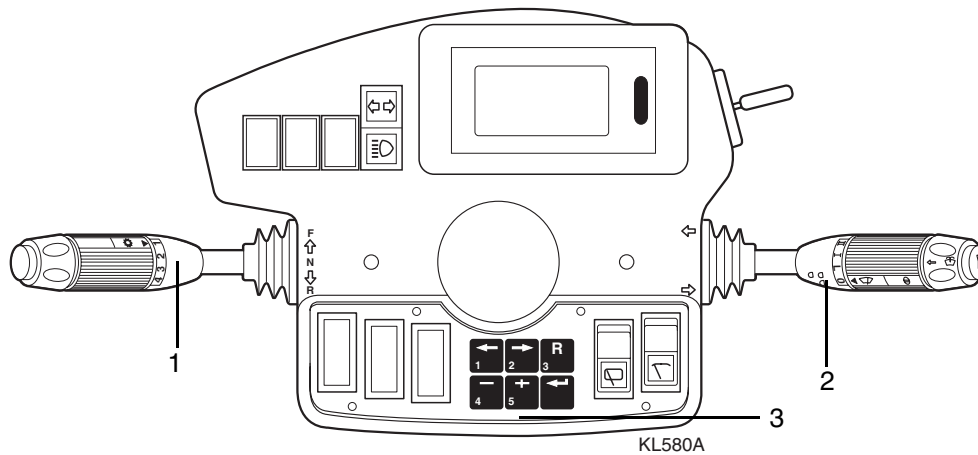
- 40. Spare
- 41. Spare
- 42. Warning lamp, battery charging
- 43. Warning lamp, low engine oil pressure
- 44. Warning lamp, low gearbox oil pressure
- 45. Warning lamp, low brake pressure (accumulator pressure)
- 46. Warning lamp, low engine coolant level
- 47. Indicating lamp, preheating
- 48. Warning lamp, high engine coolant temperature
- 49. Warning lamp, high gearbox oil temperature
- 50. Spare
- 51. Warning lamp, parking brake ON
- 52. Spare
- 53. Spare
- 54. Spare (Green lamp TWIST-LOCKS LOCKED) ¹⁾
- 55. Spare (Orange lamp ALIGNMENT) ¹⁾
- 56. Spare (Red lamp TWIST-LOCKS UNLOCKED) ¹⁾
- 57. Spare (LOCK/UNLOCK TWIST-LOCKS) ¹⁾
- 58. Spare (LENGT ADJUSTMENT 20-40") ¹⁾
- 59. Indicating lamp, headlights
- 60. Indicating lamp, direction indicators
- 61. ECS terminal ¹⁾
- 62. Switch, windscreen wiper, rear
- 63. Switch, windscreen wiper, roof
- 64. Spare
- 65. Fuses
- 66. Hour meter



¹⁾ Optional

Steering column

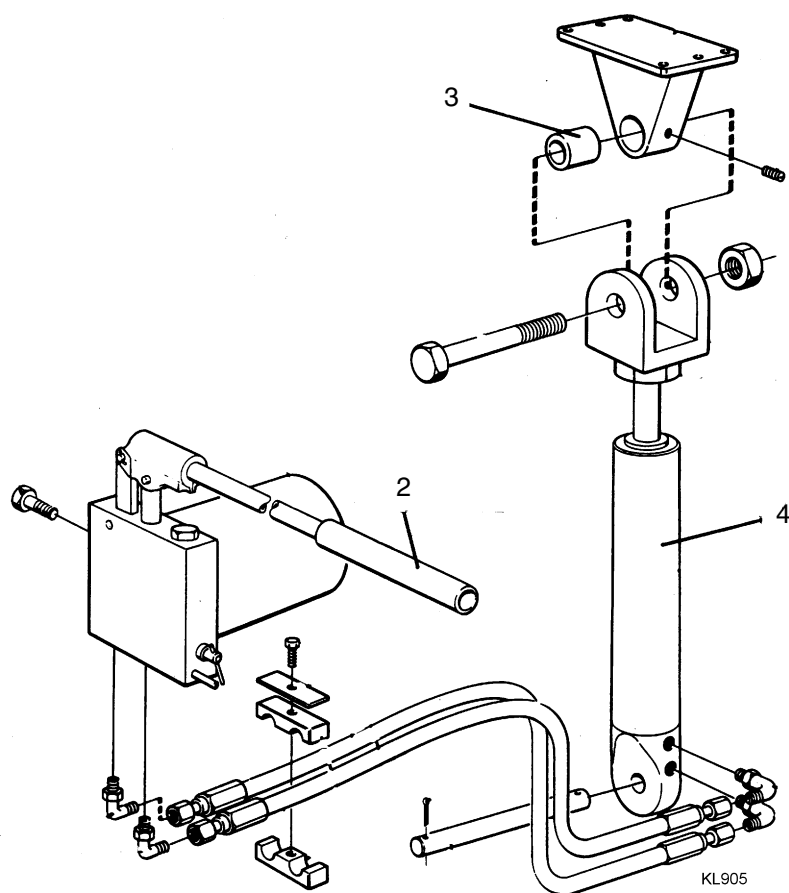
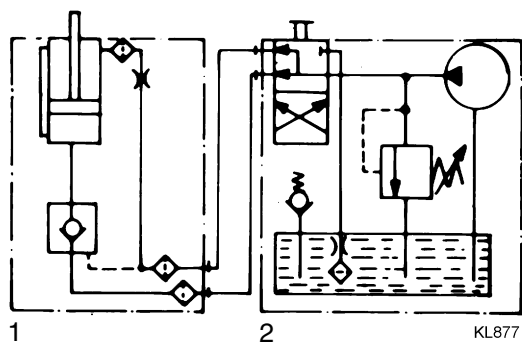
Surrounding the steering column are multi-function levers for gear changing, indicators, windshield wipers, etc., as well as the instrument panel with the ECS terminal. At the very foot of the steering column is the steering valve (Orbitrol), activated by the steering wheel via an angled gear. The steering column is equipped with an adjustment handles for the alteration of steering wheel height and rake.



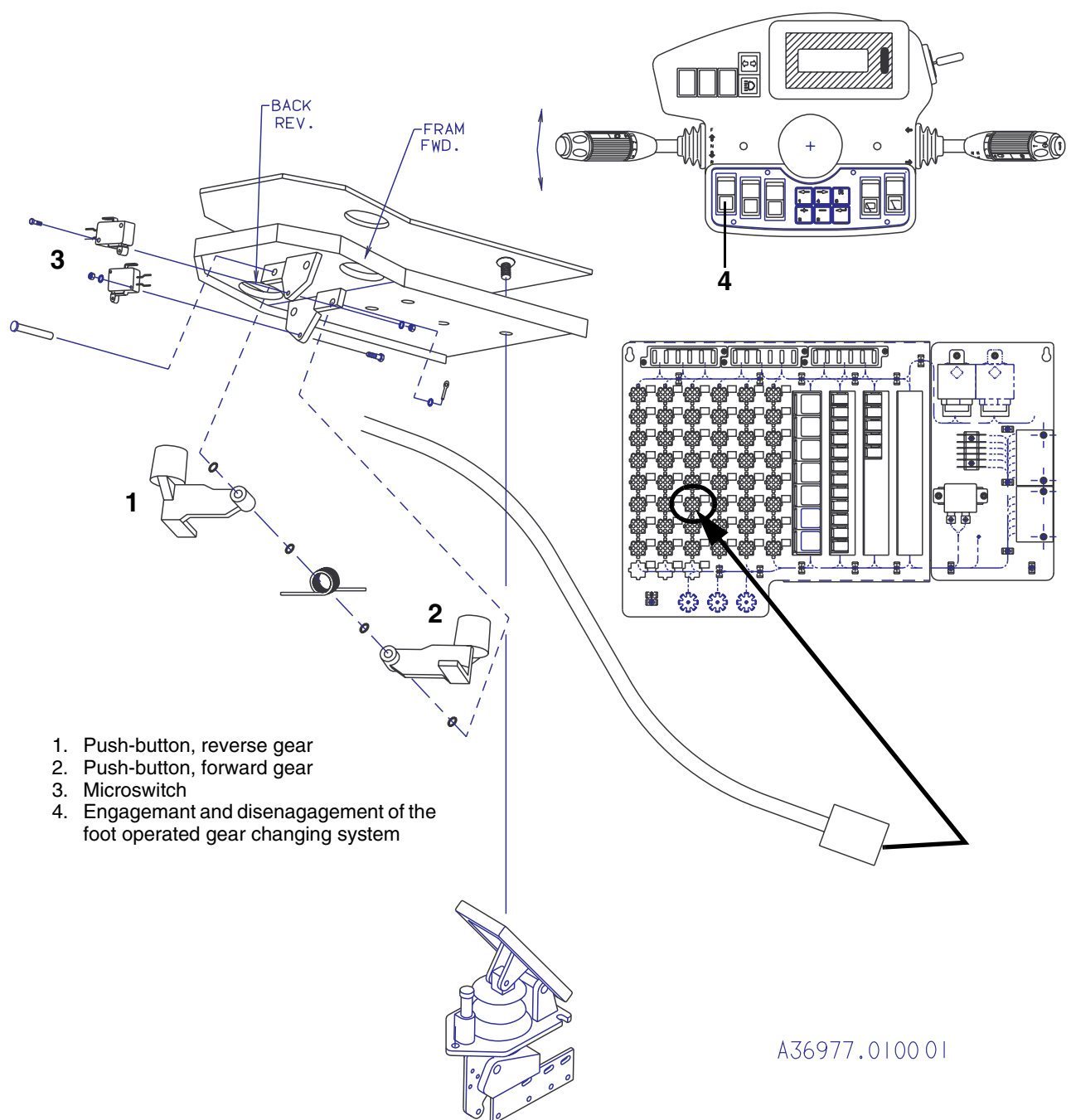
1. Gear lever
2. Multi-function lever
3. ECS terminal
4. Steering wheel adjustment handles
5. Angled gear
6. Orbitrol steering valve

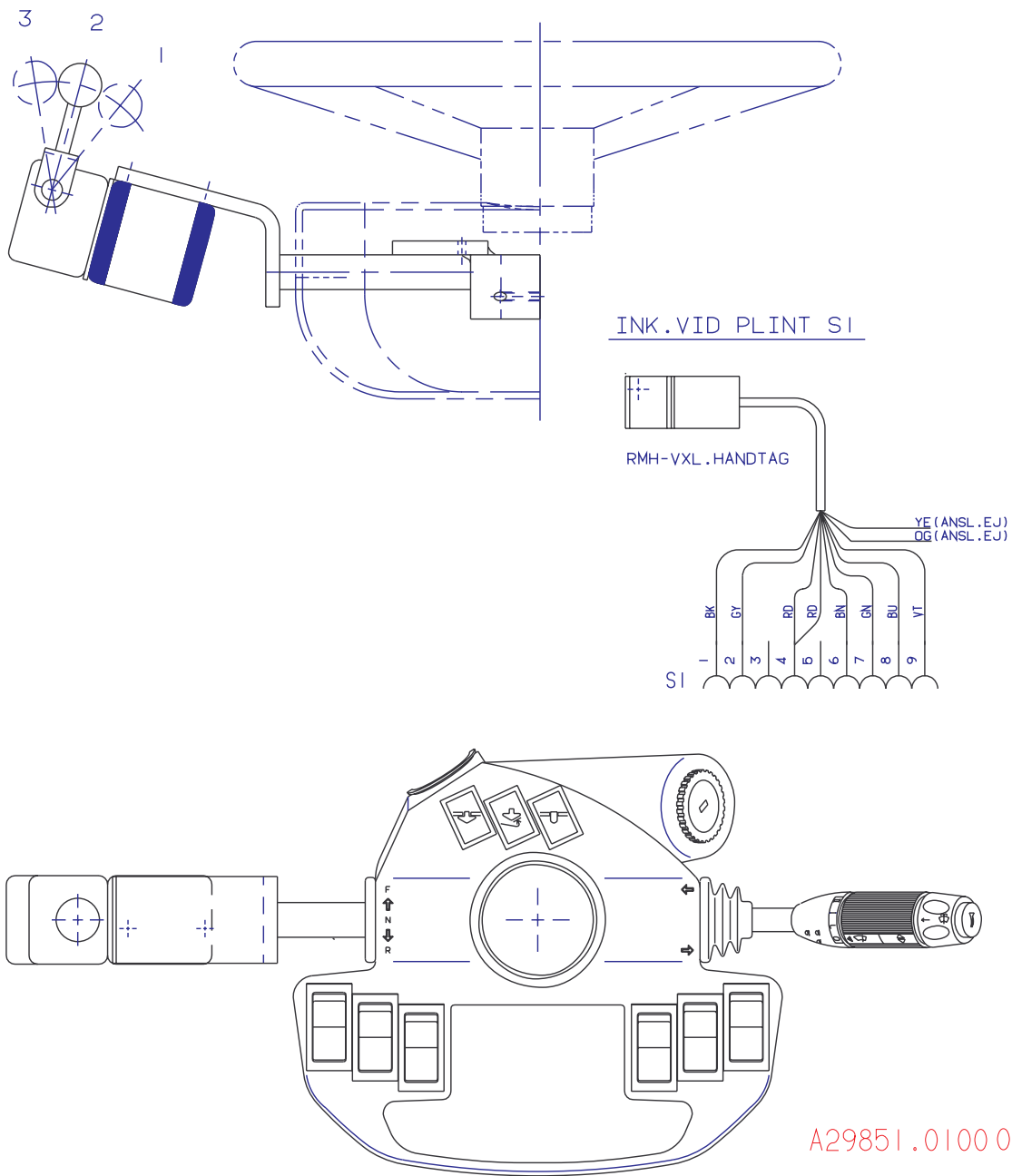
Pump and cylinder for cab tilting

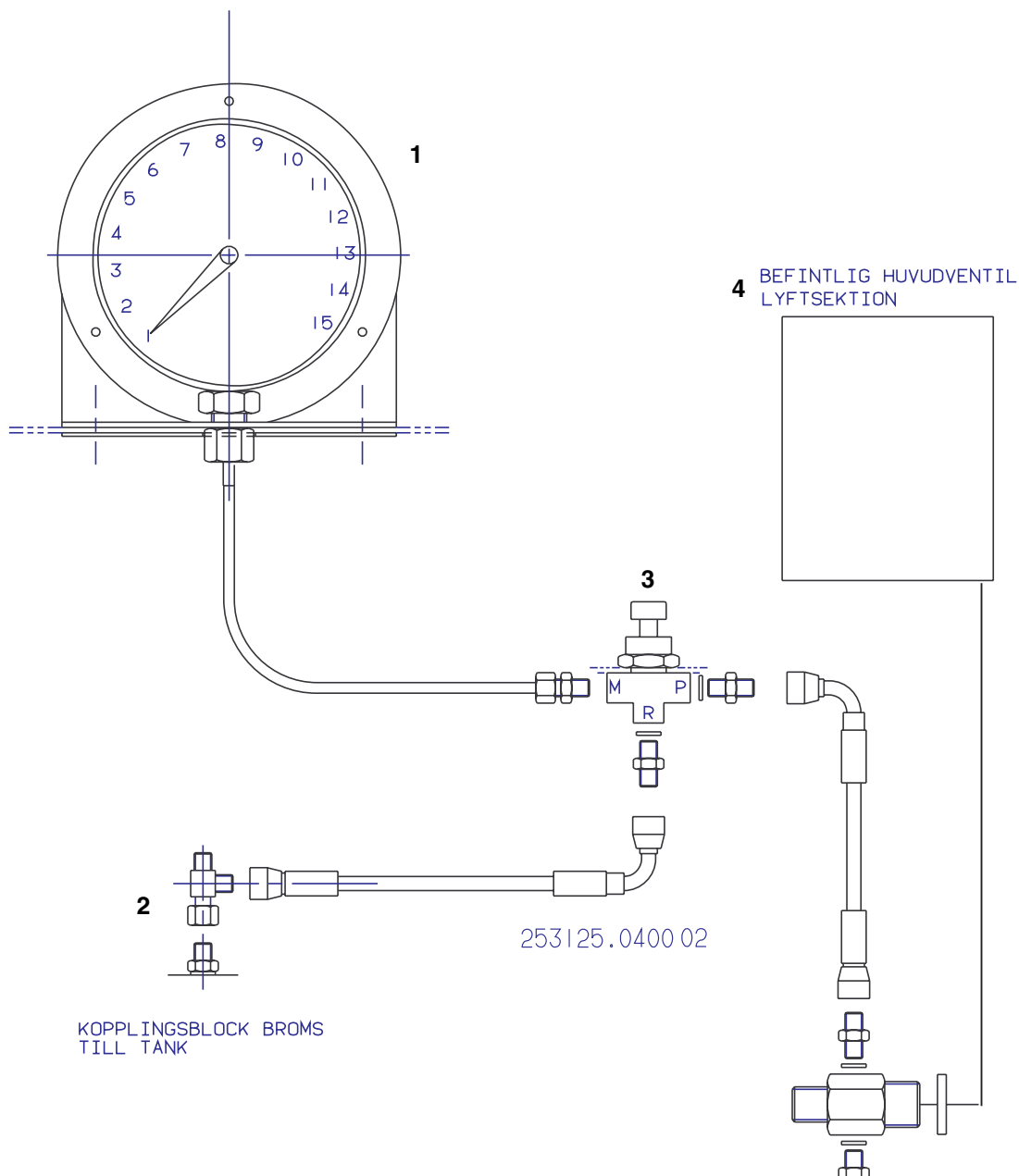
A hydraulic cylinder is provided for tilting the cab. The hydraulic fluid pressure for this purpose is generated by a manually operated pump. The pump is fitted with a reversing valve for upward or downward tilting.



1. Cab tilting cylinder
2. Manual pump
3. Vibration damper
4. Cab tilting cylinder

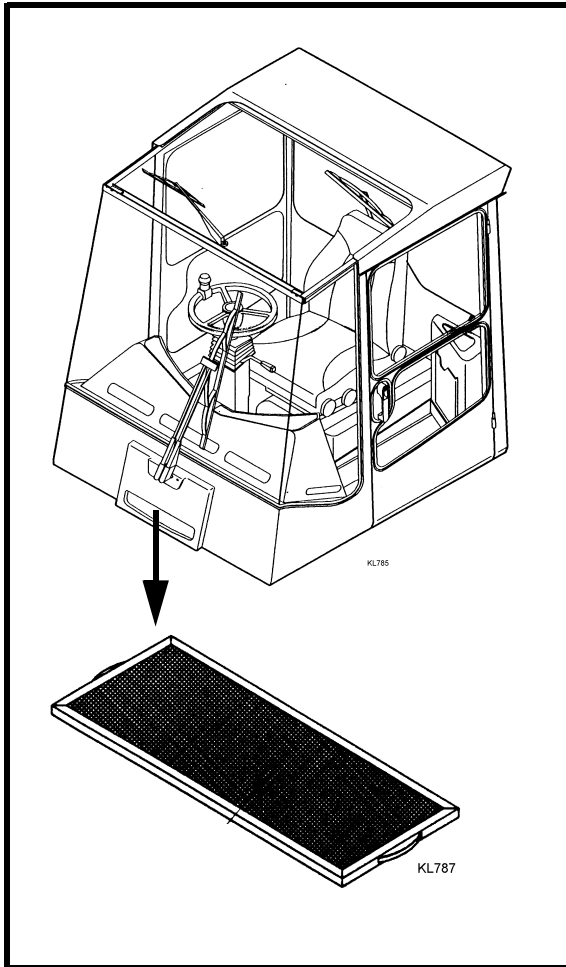






KOPPLINGSBLOCK BROMS
TILL TANK

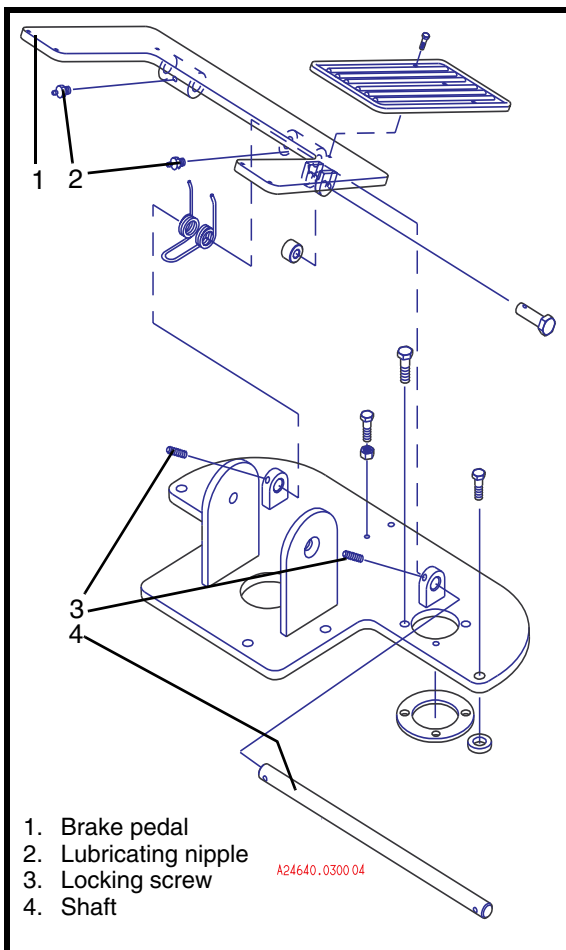
1. Indicator scale in the cab
2. Tank connection to the brake valve connecting block
3. Foot switch for weighing
4. Connection to the main valve LIFT section



Changing the fresh air filter

(every 200 hours or when needed)

1. Remove the filter casing retaining bolts and remove the filter element.
2. Wash the filter insert with water and detergent or by using a high pressure washer. Replace the insert if necessary.
3. Reinstall the filter insert.



Check and lubrication of brake pedal

(every 1000 hours)

1. Check and tighten the locking screws 3, so that the brake pedal is securely fitted in the console.
2. Lubricate the brake pedal shaft through the nipples 2.

1. Brake pedal
2. Lubricating nipple
3. Locking screw
4. Shaft

A24640..0300.04

Windscreen wipers

The wiper arms are fixed to the wiper motor shafts via conical splines. The shafts are manufactured of hardened steel and the wiper arm mounting of soft, pressed metal. When fitting, the nuts must be tightened so hard that the splines are pressed well into the mounting and function as a carrier.

Removal

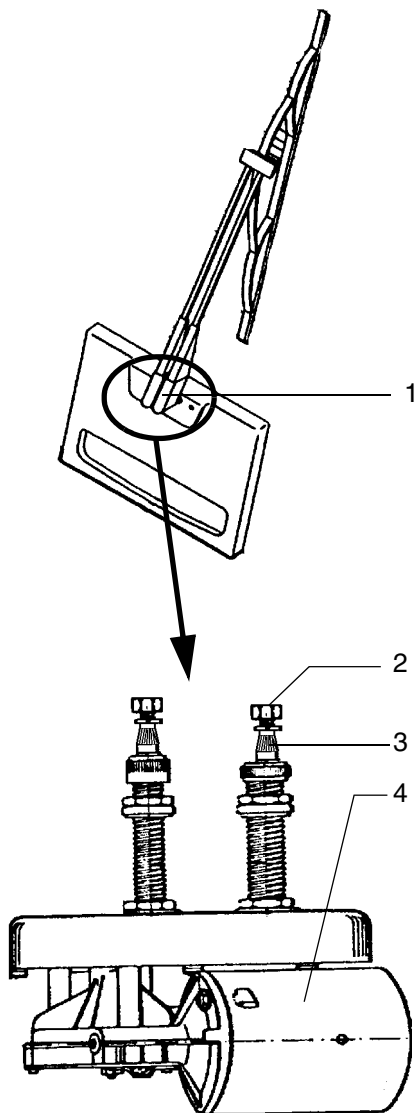
1. Remove the wiper arms by loosening the nuts and thereafter tapping and carefully rocking the arms to and fro.

Fitting

1. Check to ensure that the splines on the motor shaft are free from the softer material from the wiper arm mounting. If this is not the case, clean the splines so that they can be pressed fully into the wiper arm mounting.
2. Fit the wiper arms onto the motor shafts and tighten the nuts to a torque of 16-20 Nm. Hold the wiper arm to take up the torque pressure so that it is not transferred to the motor, which could result in damage

IMPORTANT!

The nuts must be tightened sufficiently hard, otherwise the shafts may start to slip inside the wiper arm mounting, resulting in damage.



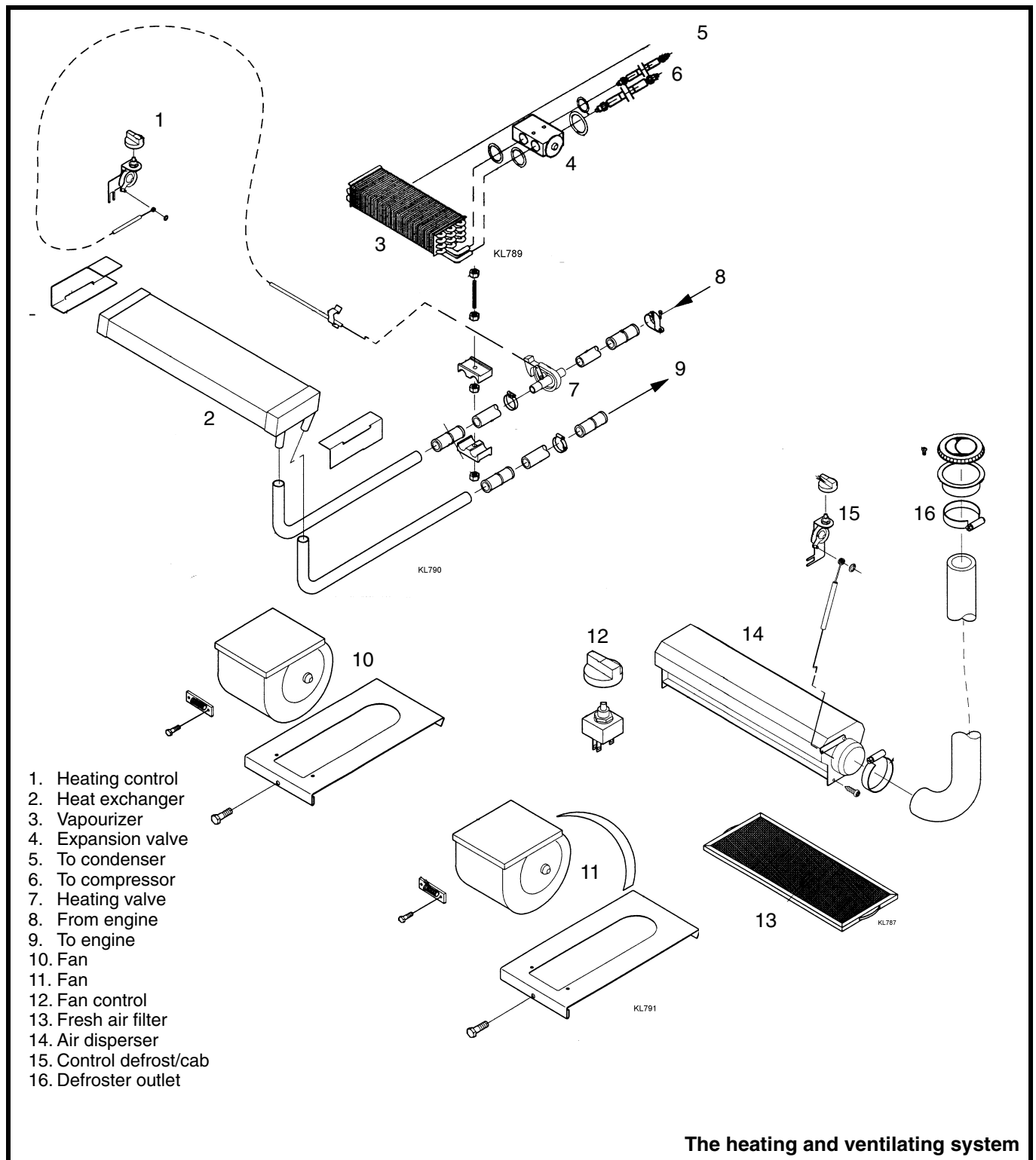
1. Wiper arm fitting
2. Securing nut, wiper arm
3. Grooved cone on motor shaft
4. Wiper motor

Air conditioning unit

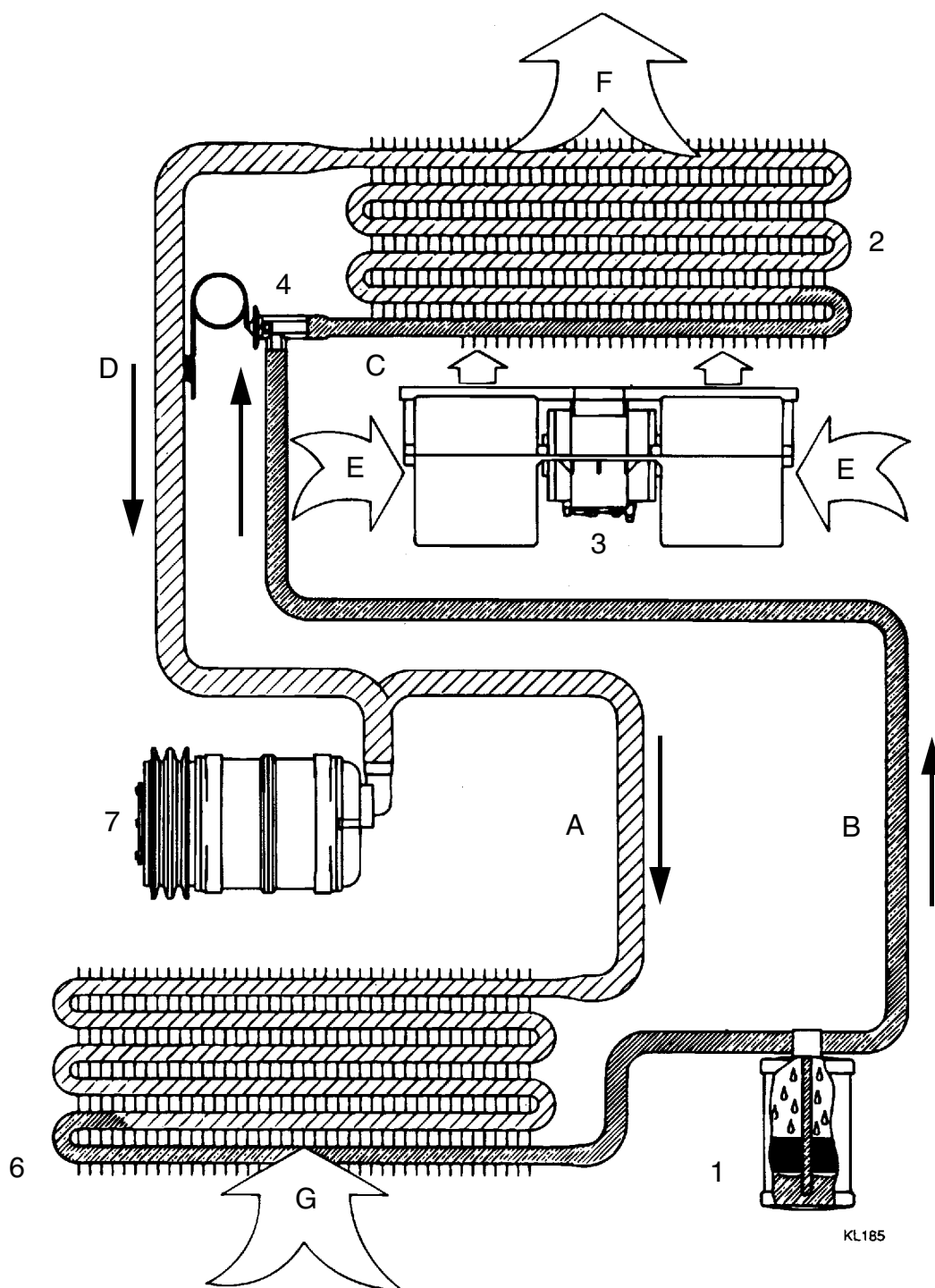
The air conditioning unit consists of the parts shown in the illustration and its function is to maintain the climate in the operator's cab as comfortable as possible. The air conditioning unit:

- heats the air when it is cold
- dehumidifies the air when it is humid
- removes impurities from the air
- cools the air when it is warm

The equipment is steered by switches and controls on the instrument panel.



The heating and ventilating system



1. Liquid receiver/filter dryer
2. Evaporator
3. Fan
4. Expansion valve
6. Condenser
7. Compressor

- A High-pressure gas
- B High-pressure liquid
- C Low-pressure liquid
- D Low-pressure gas
- E Warm air in cab
- F Cooled air to the cab
- G Outside air for removing heat

Compressor

The air conditioning system is driven by the compressor. This performs as a pump, drawing cold, low-pressure gas from the evaporator, compressing it and thereby raising its temperature, and discharging it at high pressure to the condenser.

The compressor is driven by V-belts directly from the diesel engine. Switching between operation and idling is controlled by an electro-magnetic clutch which, in turn, is controlled by a thermostat whose sensor is located between the fins of the evaporator coil. The thermostat switches off the compressor at low temperatures, to prevent icing of the evaporator.

Condenser

The function of the condenser is to convert the hot high-pressure gas from the compressor into liquid form. The tubes and fins of the condenser coil absorb heat, which is then removed by the air delivered by the fan.

The temperature of the refrigerant in the condenser varies from about +50°C to +70°C. The pressure varies between 12 and 20 bar, depending on the ambient temperature and the flow of air through the condenser. When the refrigerant is condensed into liquid form, it is transferred under pressure to the liquid receiver/filter dryer.

Liquid receiver with filter-dryer

The function of the liquid receiver with integrated filter dryer is to collect the liquid coolant, bind the moisture, and to filter and remove impurities. The receiver, which is located in the condenser housing, also serves as the expansion vessel in the refrigeration circuit.

After flowing through the dryer in the bottom of the liquid receiver, the refrigerant flows through a riser tube. A sight glass enables the operator to check that the liquid flows without the presence of any bubbles, and that the system is filled with a sufficient amount of refrigerant.

Expansion valve

The expansion valve throttles the flow and passes an optimised quantity of refrigerant that the evaporator is capable of evaporating.

The expansion valve is also the part of the circuit which separates the high- pressure side from the low-pressure side. The refrigerant flows to the expansion valve under high pressure and leaves it under low pressure.

The amount of refrigerant which passes the evaporator varies, depending on the thermal load. The valve operates from 'fully open' to 'fully closed' and in-between searches for a point to give optimum evaporation.

Evaporator

The heat necessary for evaporating the refrigerant is extracted from the cab air which is circulated by a fan through the evaporator coil. The cab air is thus cooled, and is distributed and returned to the cab.

In the evaporator, the refrigerant reverts to the gaseous state and returns to the compressor suction, thereby completing the cycle.



WARNING!

- If the refrigerant hose should fail or if other refrigerant leakage should occur, switch off the air conditioner immediately.
- Refrigerant is injurious to the skin and eyes.
- Never release refrigerant in an enclosed space. If released into a service pit, for instance, the gas may cause asphyxia.
- It is forbidden by law to discharge refrigerants into the air intentionally.
- Never carry out welding on a charged refrigeration system or in its vicinity.
- Only authorised service mechanics are allowed to drain off and fill refrigerant in the air conditioning system.

Only the prescribed refrigerant may be used when refilling.

The liquid refrigerant should be completely evaporated before it is allowed to flow from the evaporator. The refrigerant is still cold even when it has completely evaporated. The cold vapour which flows through what remains of the evaporator continues to absorb heat, and then becomes overheated. This means that the temperature of the refrigerant has risen to above the point where it evaporates without changing the pressure.

In an evaporator which operates at a suction pressure of 2 bar, the liquid refrigerant will have a temperature of -1.1°C . When the refrigerant is subsequently evaporated through heat absorption in the evaporator, the temperature of the gas will rise at the evaporator outlet to $+1.6^{\circ}\text{C}$. This represents a difference of 2.7°C between the evaporation temperature and the temperature at the outlet. This is called overheating.

All expansion valves should be adjusted at the plant in such a way that maximum evaporation with overheating is performed in the air conditioning system.

Checking the air conditioning unit

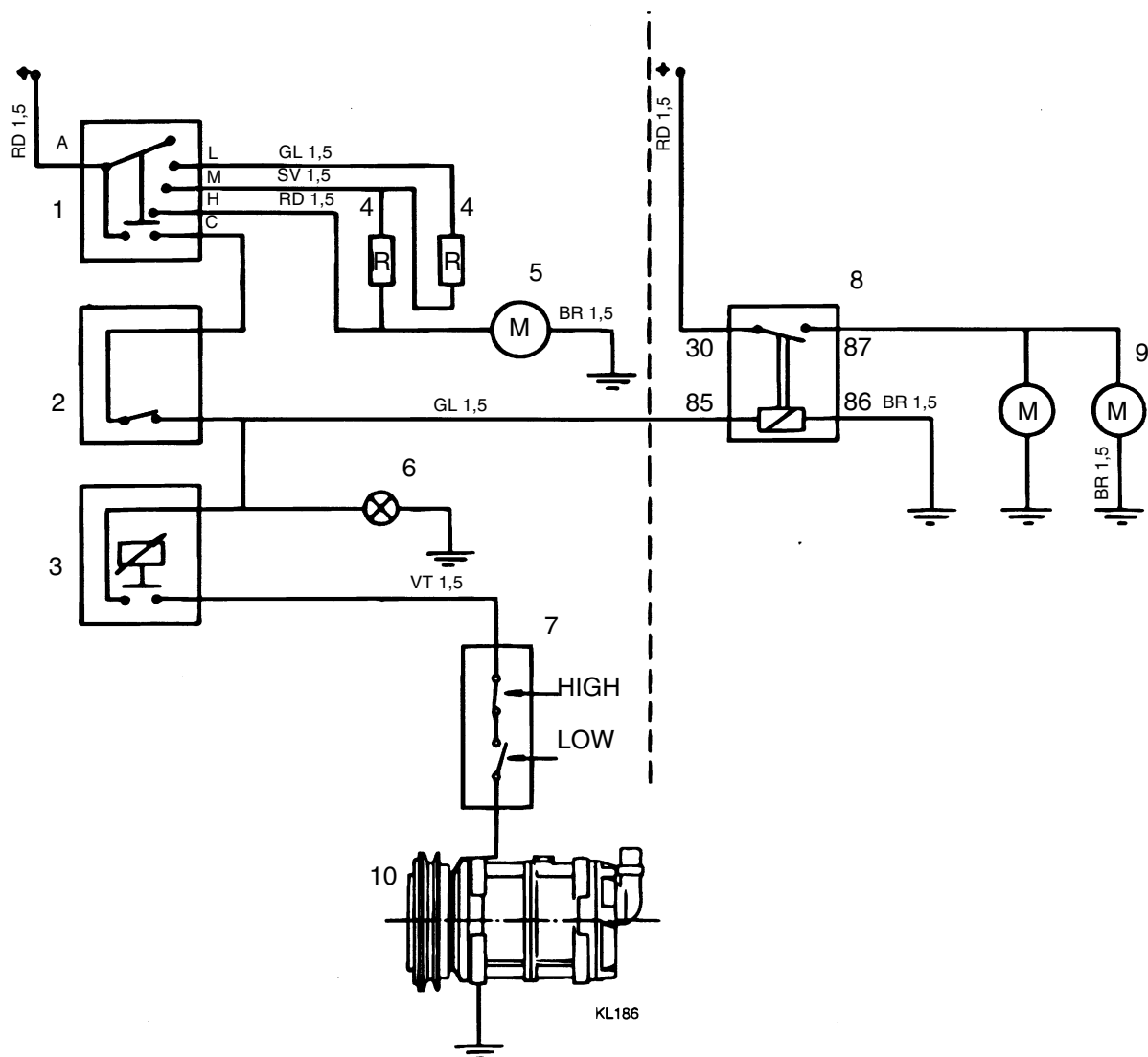
If the unit is in continuous operation, this check should be carried out every week from early spring to late autumn and during extended periods of high humidity during the winter.

If the unit is used very little during cold and dry winter periods, the compressor should be run for a few minutes every week, to lubricate the rubber hoses, couplings, seals and shaft seal.

1. Start the engine and start the air conditioner.
At an outdoor temperature below 0°C , the system cannot start since the low-pressure relay breaks contact.
2. After 10 minutes of operation, check that no bubbles are visible in the sight glass of the filter-dryer. (Bubbles should occur only when the compressor is started and stopped.)
If there are any air bubbles, subsequent filling should be performed by an authorised service mechanic.
3. Check that the condenser is not clogged. If necessary, clean the condenser fins with compressed air.
4. Change the fresh air filter as necessary.
5. Check the V-belt tension and the compressor mounting.
6. Check that the magnetic coupling engages and disengages satisfactorily.
7. Check that the condensate drain from the cooling element is not clogged. Check for leakage.

IN CAB CLIMATE UNIT

CONDENSER UNIT



1. Fan switch
2. Cooler on/off
3. Anti-freeze thermostat
4. Resistor
5. Fan motor
6. Indicator lamp – cold (in push button)
7. High-/low-pressure monitor
8. Relay
9. Condenser fan
10. Compressor

Group 20

Electrical system

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Component list DCD90-450	
Wiring diagram, truck body	A08334.1000
Wiring diagram, inner, standard	A08333.1000
Wiring diagram, inner, rotatable operator's seat	A08333.1100
Safety interlock system, empty container attachment, Volvo	A28047.0600
Safety interlock system, empty container attachment, Perkins	A28047.0700

Alternator rating

Perkins: 1260 W

Volvo: 1540 W

Starting battery, voltage
capacity
earthing

2 x 12 V

140 Ah

negative

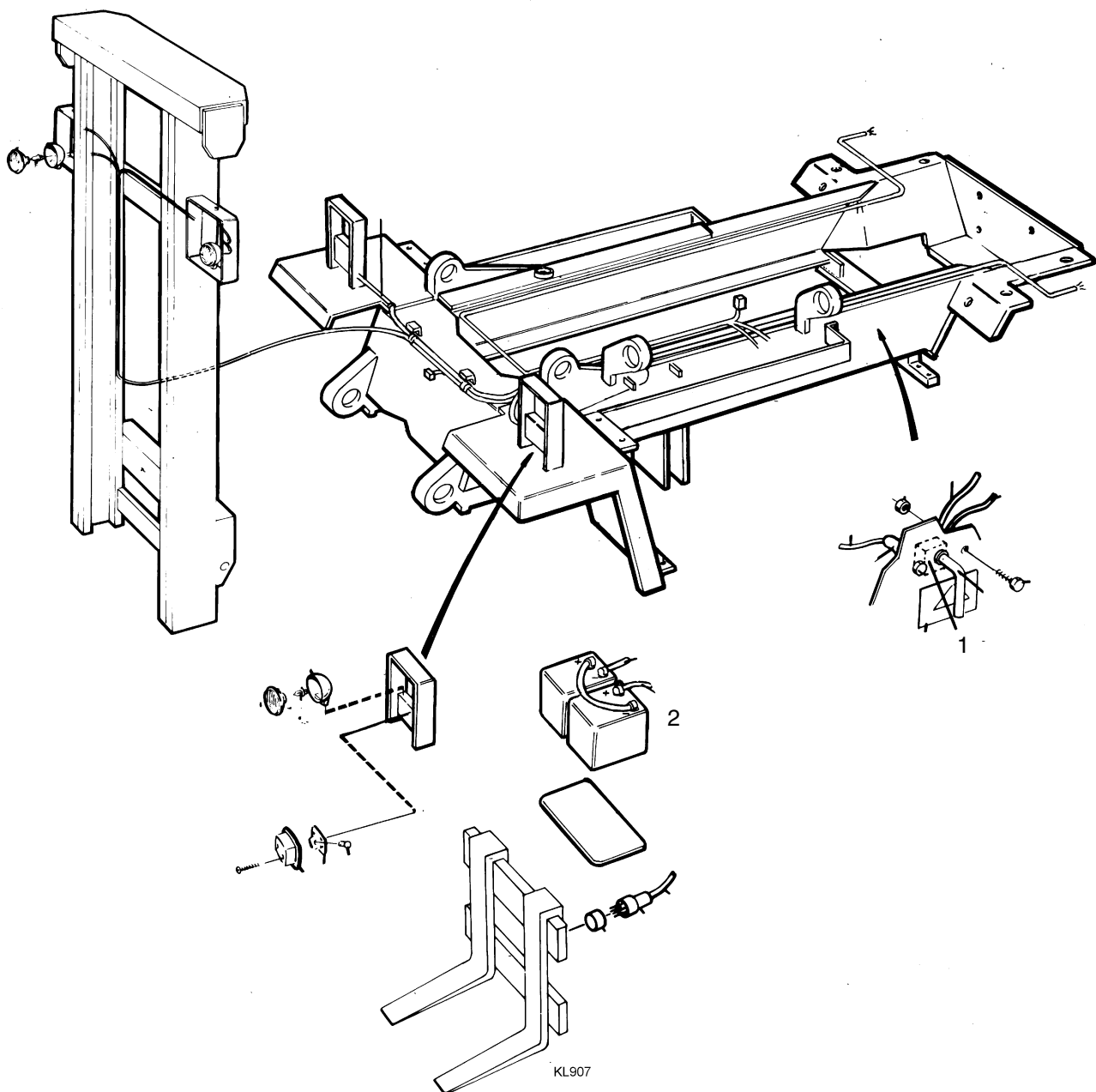
IMPORTANT!

Always open the main switch whenever work is to be carried out on the electrical system, if the truck is to remain idle for some time and whenever welding work is to be carried out on the truck.

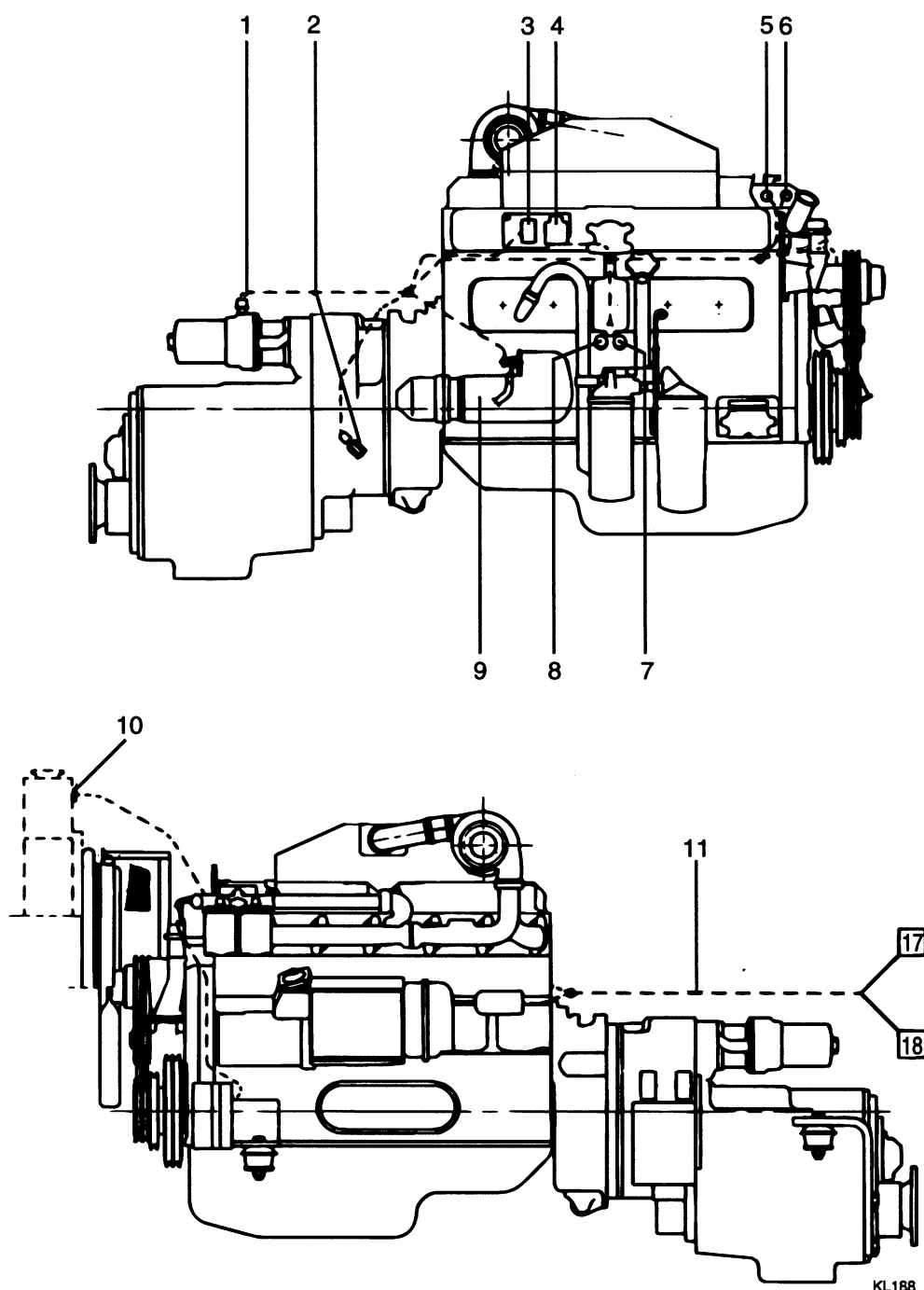
The system voltage is 24V and the supply is taken from two 12V batteries connected in series and charged by an alternator across electronic rectifying and voltage stabilisation circuits.

The positive pole is connected across a main switch. The negative pole is then connected to the chassis.

Warning lamps and instruments are clearly arranged on the instrument panel. The central electrical unit with fuses and relays is located on the lower section of the cab's rear wall.

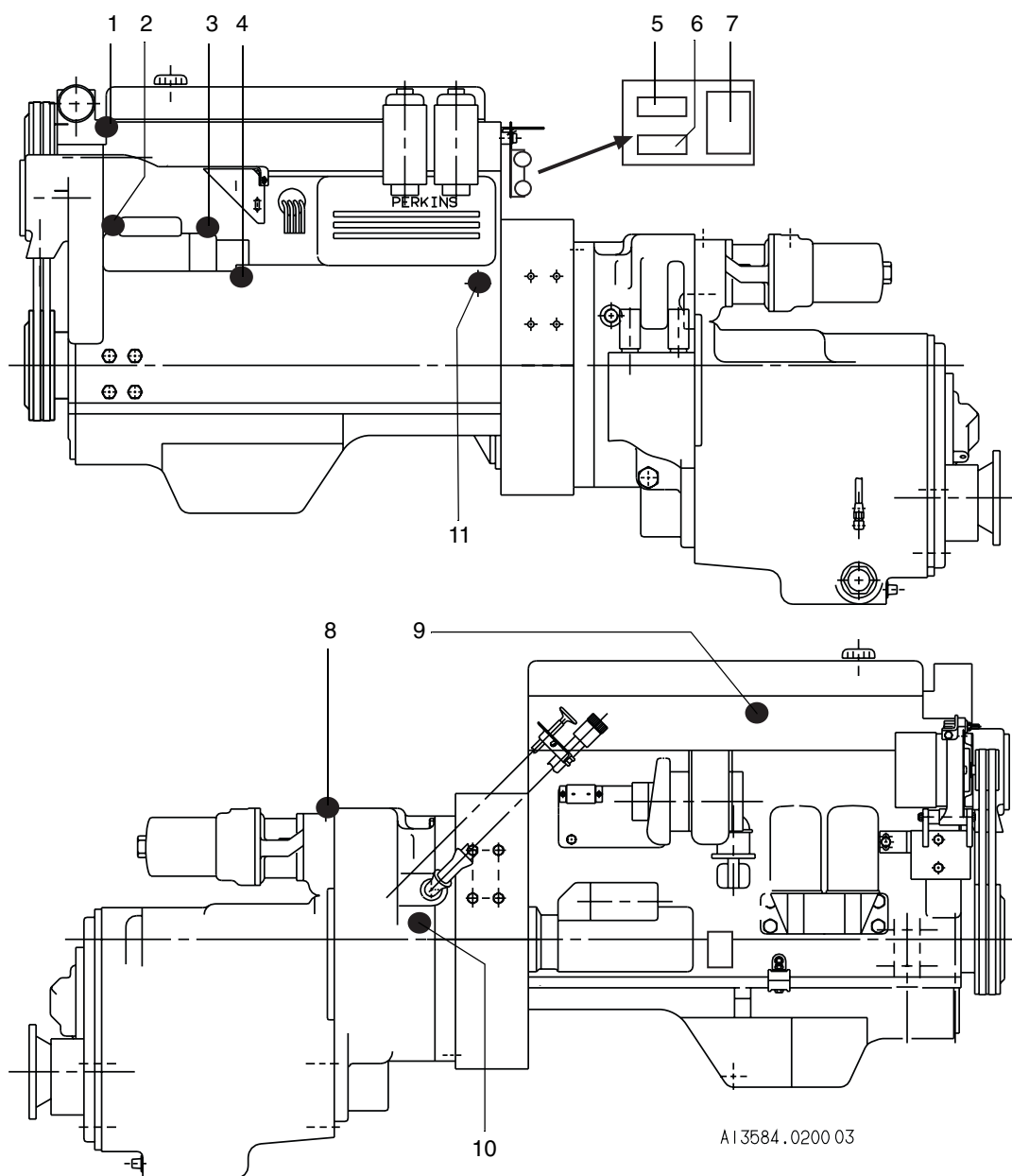


1. Main switch
2. Battery



KL188

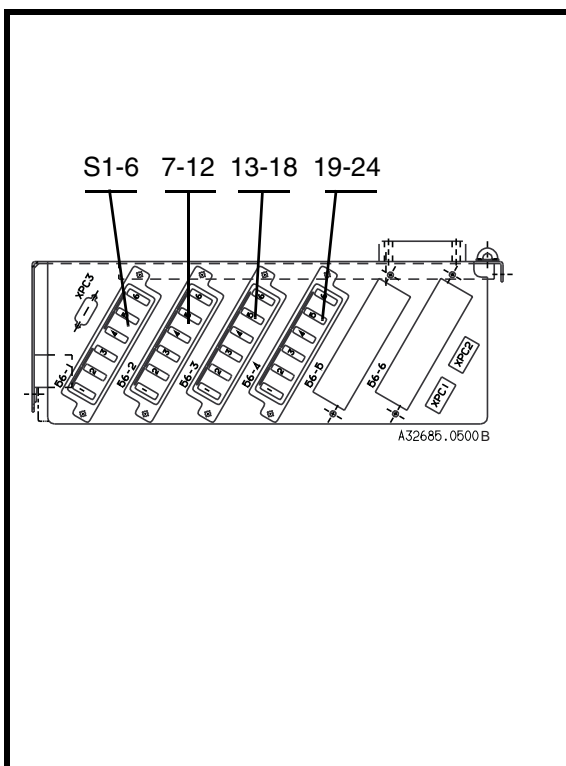
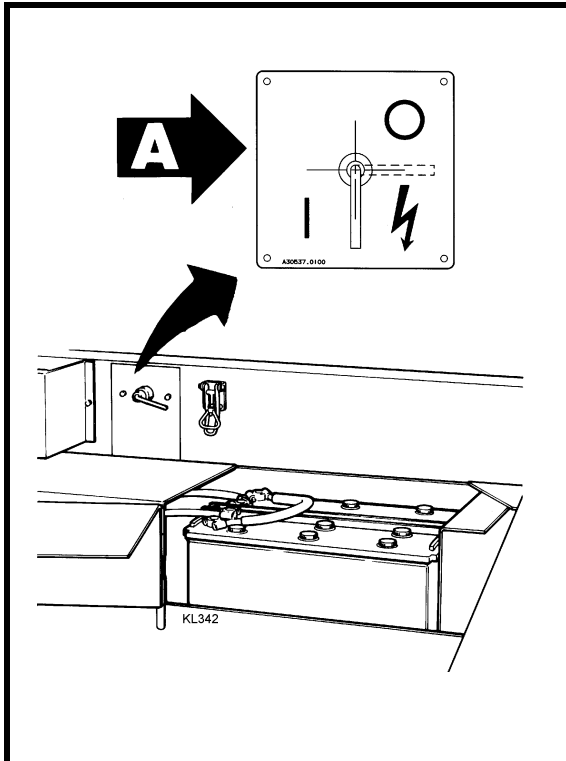
1. Transmitter, warning lamp low oil pressure and gearbox oil pressure instrument
2. Transmitter, warning lamp low oil temperatur and gearbox oil temperatur instrument
3. Fuse
4. Relay preheater element
5. Transmitter, coolant temp instrument
6. Transmitter, high coolant temp instrument
7. Transmitter, engine oil pressure instrument
8. Transmitter, low engine oil pressure warning lamp
9. Starter motor
10. Transmitter, low coolant level warning lamp
11. Engine wiring



1. Sensor, coolant temperature
2. Sensor, engine temperature (cold start)
3. Stop solenoid valve
4. Solenoid valve, disconnection cold start
5. Resistor for stop solenoid valve
6. Resistor for pre-heating glowplug
7. Main fuse electrical system 2 x 50 A
8. Sensor, warning lamp low gearbox oil pressure
9. Glowplug, inlet air pre-heating
10. Sensor, instrument gearbox oil temperature
11. Sensor, warning lamp low engine oil pressure

N.B.

The starting batteries accompanying the truck are of the maintenance-free type, which implies that it should not be necessary to top-up with electrolyte during the life of the batteries. However, the level of the electrolyte should preferably be checked once or twice a year. Fill as required by adding de-ionized water.



Electrical system

The electrical system operates at 24 V. The source of power supply are two 12 V batteries which are charged by an alternator. The negative pole is connected to the chassis.

The positive pole is connected to a main switch **A**.

IMPORTANT!

When working with the electrical system, when carrying out welding on the truck or at long time parking, always isolate the batteries.

A Main switch

Checking the electrolyte level of the batteries

The batteries are fitted behind a cover on the left-hand side of the truck. The electrolyte level should be about 10 mm above the cells. Top up with de-ionized water as necessary.

Relay box in cab – fuses

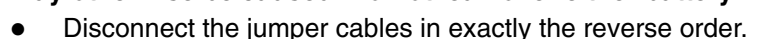
Fuse No.	Circuit protected	Rating A
S1	Wiper motor front, direction indicators, seat buzzer, parking brake sensor	10
S2	Ignition key, pre-heater, starter motor, cab lighting (Air conditioner 25 A ¹⁾)	15
S3	Container attachment, safety interlock	15
S4	Electric gear-changing	5
S5	Warning lamps, instrument illumination, relay, coolant level	5
S6	Brake lights, reversing lights, reversing alarm	15
S7	Fan (Air conditioner ¹⁾)	25
S8	Spare (Working lights, container ¹⁾)	15
S9	Working lights (15 A for 4 lamps ¹⁾)	15
S10	Hazard beacon	10
S11	Working lights, standard (15 A for 4 lamps)	10
S12	Horn, screenwash motor, wiper rear and roof, wiper front, intermittent relay	10
S13	Driving lights (main fuse), rear lights (main fuse), position lights	15
S14	Main beam, right-hand (Main beam, front 10A ²⁾)	5
S15	Main beam, left-hand (Main beam, rear 10A ²⁾)	5
S16	Dipped beam, right-hand (Dipped beam, front ²⁾)	5
S17	Dipped beam, left-hand (Dipped beam, rear ²⁾)	5
S18	Rear light, left-hand (Rear light, front ²⁾)	5
S19	Rear light, right-hand (Rear light, rear ²⁾)	5
S20	ECU 1 ¹⁾	10
S21	ECU 4 ¹⁾	10
S22	Voltage converter 24/12	5
S22-24	Spare	-

¹⁾ Optional equipment

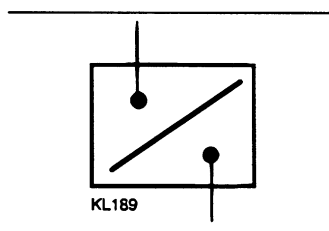
²⁾ Rotatable operator's seat

Bulbs

Description	Rating Watts	Base
Instruments	3	BA7s
Indicating lamps	1,2	W2x4,6d
Cab lighting	10	S8,5
Rear lights, red	5	BA15s
Brake lights	21	BA15s
Direction indicators	21	BA15s
Position lights	5	SV8,5
Driving lights (full/dipped beam)	75/70	P43t-38
Reversing lights, white	70	PK22s
Working lights	70	PK22s
Hazard beacon	70	PK22s



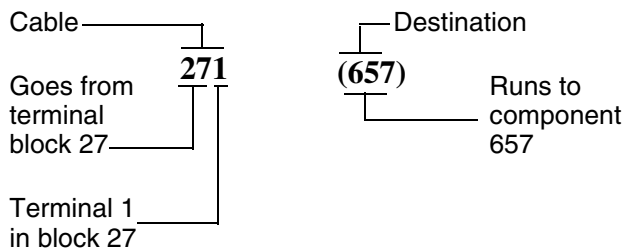
P = Pressure
T = Temperature
η = Coolant level
o = Fuel level



V = ON/OFF
G = Variable sensor

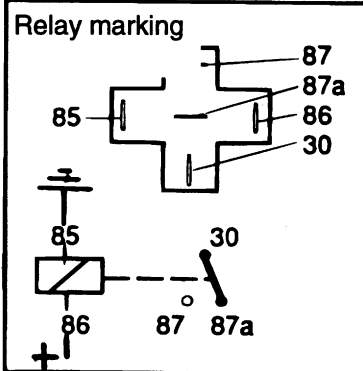
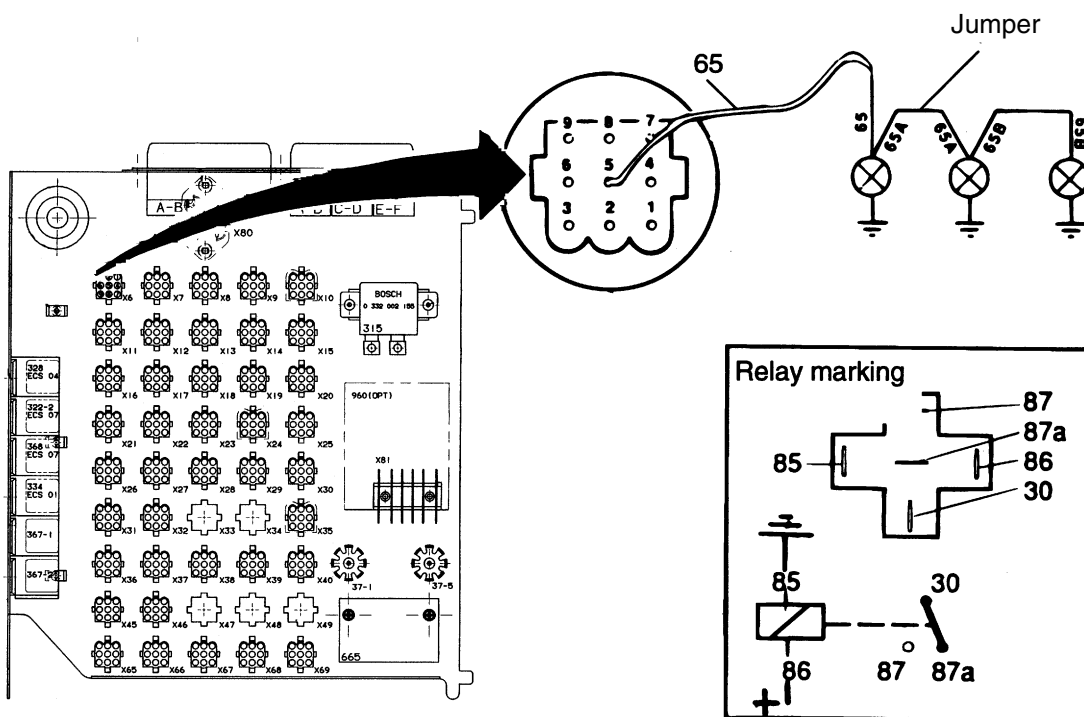
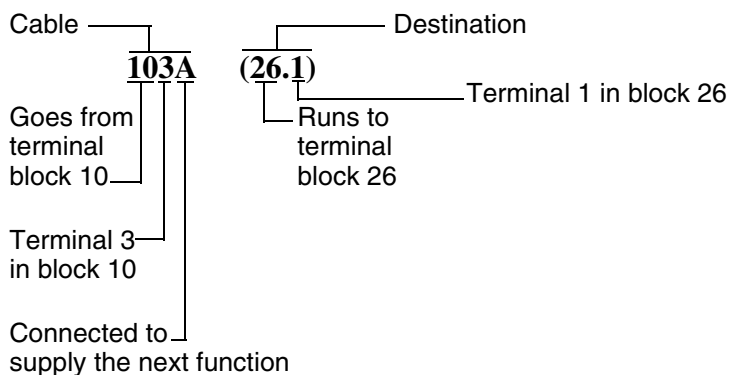
Cable markings

All cables are marked with a number for identifying the terminal points as follows:



If there is a dot in the destination number it describes a terminal block.

If the cable has a jumper, e.g. a common cable for supplying several functions, a capital letter is added to the cable number.



KL1020

Manual electrical gear-changing system

The manual electric gear-changing system is electro-hydraulic and controls the transmission by means of solenoid valves. Oil under pressure is supplied to the solenoid valves from the oil pump built into the transmission.

An inductive sensor senses the speed of the propeller shaft and applies a signal to a speed monitor which prevent gear-changing at speeds above 3 km/h.

See the circuit diagrams on the following pages.

Manual electric gear-changing system
Clark 18000/20000 Fixed operator's seat

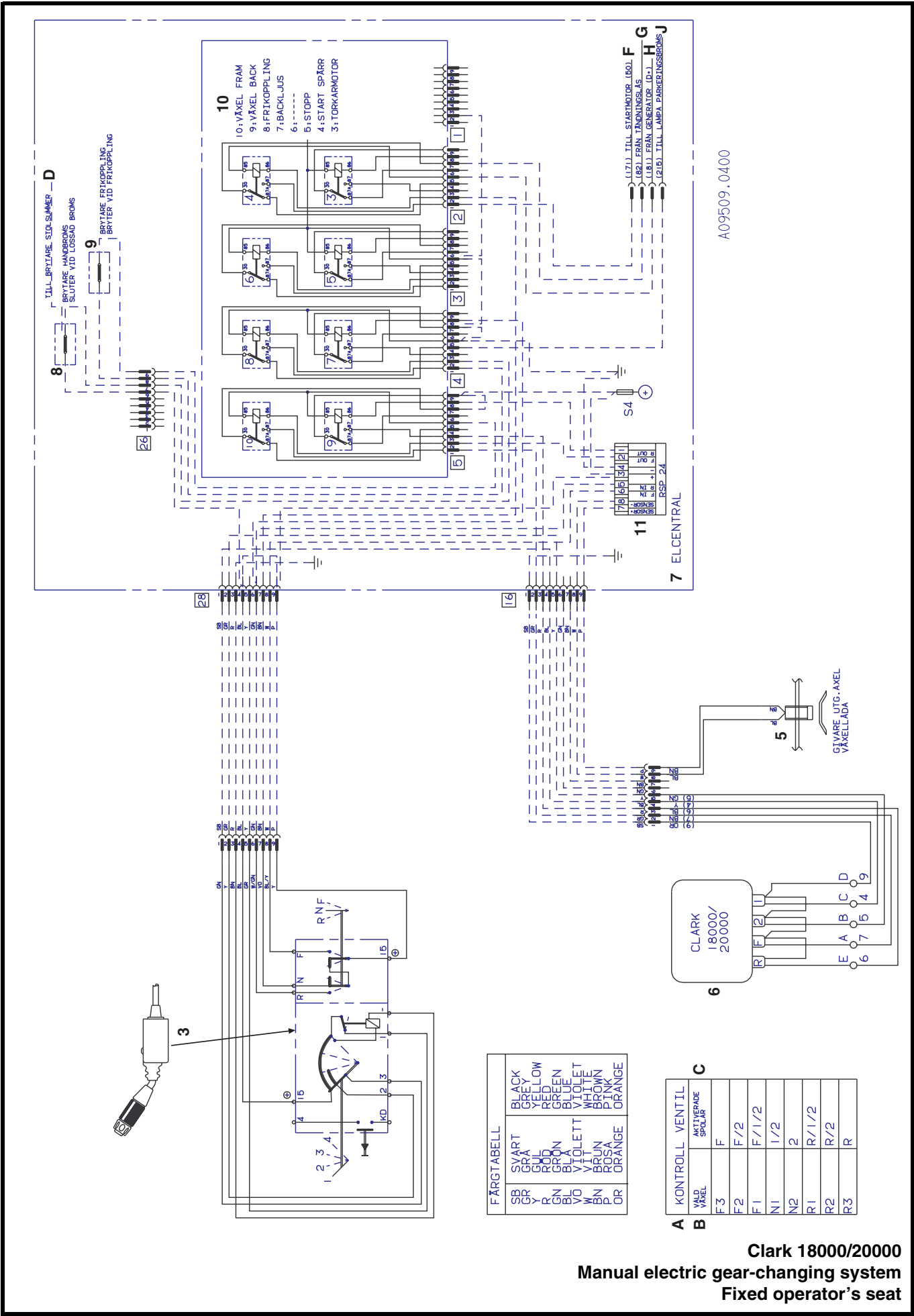
A09509.0400

This diagram can also be found integrated in the general electric diagrams DCD90-450 in this Handbook.

- A. Gearbox control valve
 - B. Employed gear
 - C. Activated solenoids
 - D. To seat buzzer switch
 - F. To starter motor (50)
 - G. From start switch
 - H. From alternator (D+)
 - J. To parking brake warning lamp
-
- 3. Gear selector
 - 5. Speed sensor on gearbox output shaft (output speed)
 - 6. Valve cover with solenoid valves
 - 7. Electrical central unit
 - 8. Switch at parking brake – ON when brake is released
 - 9. Switch at inching – OFF when inching
 - 10. Relays
 - 3. Wiper motor
 - 4. Starting interlock
 - 5. Stop
 - 6. –
 - 7. Reversing lights
 - 8. Inching
 - 9. Reverse gear
 - 10. Forward gear
 - 11. Reversing interlock

Cable colours

- Svart = Black
- Grå = Grey
- Röd = Red
- Blå = Blue
- Gul = Yellow
- Grön = Green
- Brun = Brown
- Vit = White
- Rosa = Pink



A09509.0400

Manual electrical gear-changing system
Clark 18000/20000 Rotatable operator's seat

A09510.0400

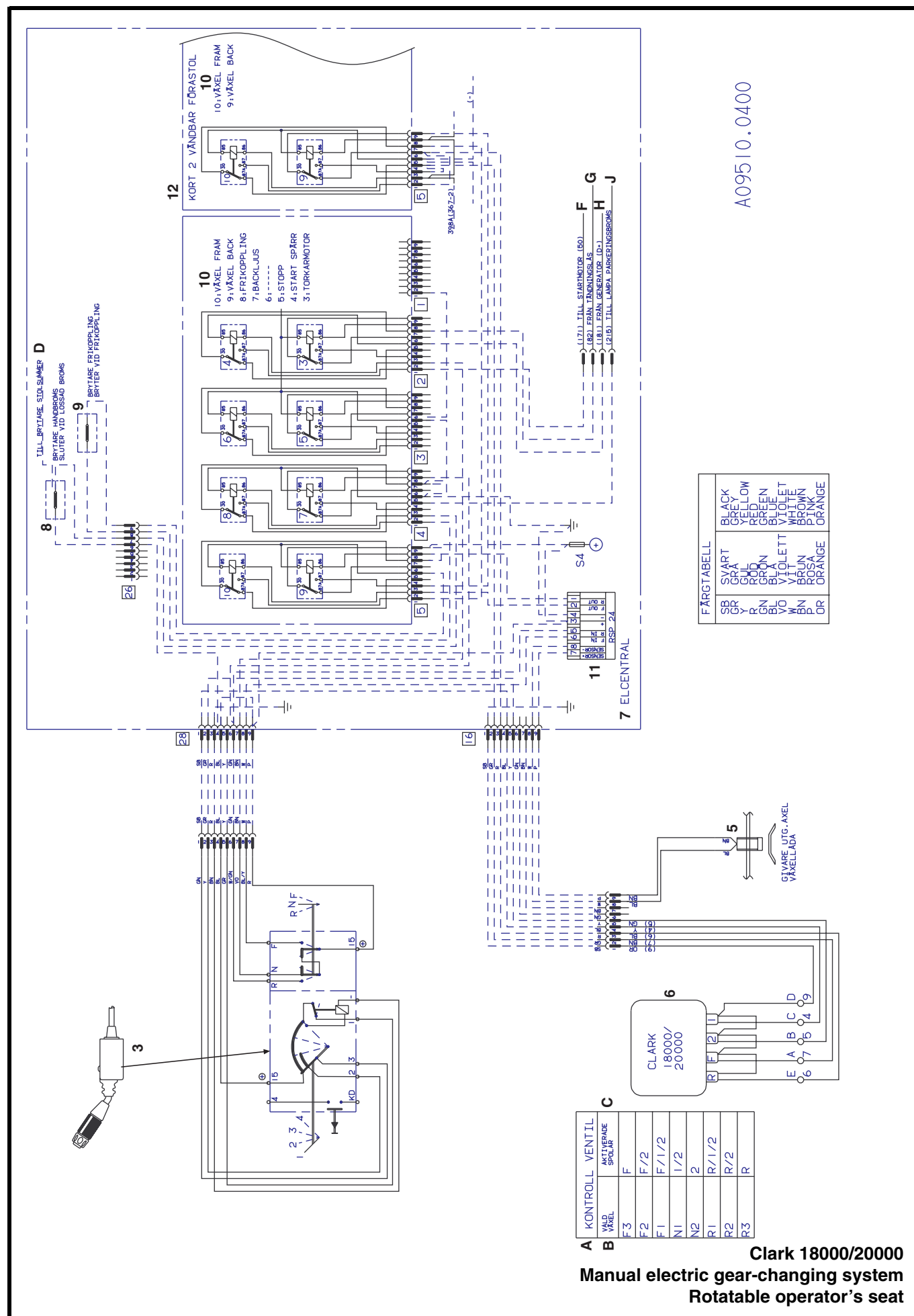
This diagram can also be found integrated in the general electric diagrams DCD90-450 in this Handbook.

- A. Gearbox control valve
- B. Employed gear
- C. Activated solenoids
- D. To seat buzzer switch
- F. To starter motor (50)
- G. From start switch
- H. From alternator (D+)
- J. To parking brake warning lamp

- 3. Gear selector
- 5. Speed sensor on gearbox output shaft (output speed)
- 6. Valve cover with solenoid valves
- 7. Electrical central unit
- 8. Switch at parking brake – ON when brake is released
- 9. Switch at inching – OFF when inching
- 10. Relays
 - 3. Wiper motor
 - 4. Starting interlock
 - 5. Stop
 - 6. –
 - 7. Reversing lights
 - 8. Inching
 - 9. Reverse gear
 - 10. Forward gear
- 11. Reversing interlock
- 12. PCB 2 – rotatable operator's seat

Cable colours

- Svart = Black
- Grå = Grey
- Röd = Red
- Blå = Blue
- Gul = Yellow
- Grön = Green
- Brun = Brown
- Vit = White
- Rosa = Pink



Manual electrical gear-changing system
Clark 28000/32000 Fixed operator's seat

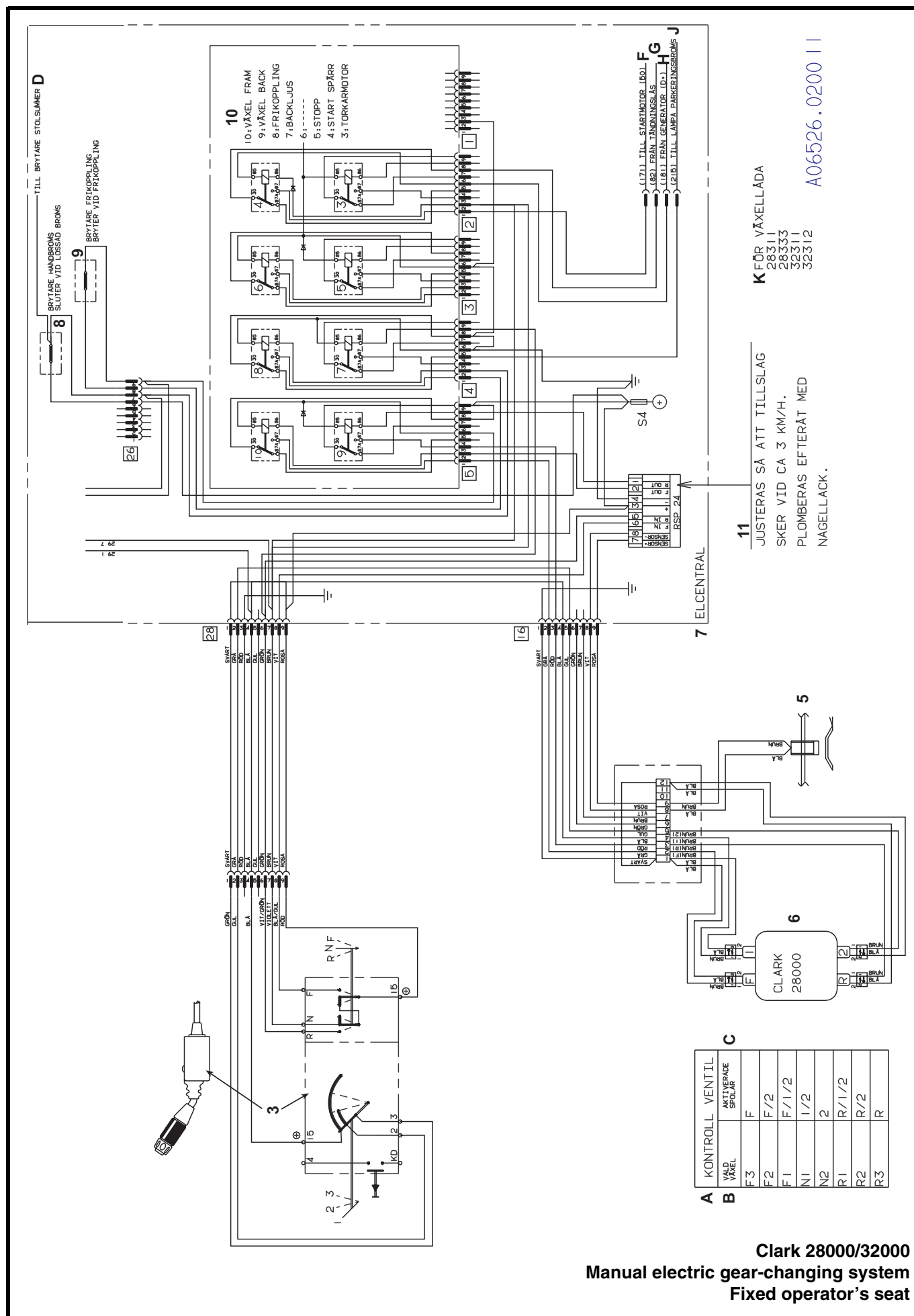
A06526.0200

This diagram can also be found integrated in the general electric diagrams DCD90-450 in this Handbook.

- A. Gearbox control valve
 - B. Employed gear
 - C. Activated solenoids
 - D. To seat buzzer switch
 - F. To starter motor (50)
 - G. From start switch
 - H. From alternator (D+)
 - J. To parking brake warning lamp
-
- 3. Gear selector
 - 5. Speed sensor on gearbox output shaft
 - 6. Valve cover with solenoid valves
 - 7. Electrical central unit
 - 8. Switch at parking brake – ON when brake is released
 - 9. Switch at inching – OFF when inching
 - 10. Relays
 - 3. Wiper motor
 - 4. Starting interlock
 - 5. Stop
 - 6. –
 - 7. Reversing lights
 - 8. Inching
 - 9. Reverse gear
 - 10. Forward gear
 - 11. Reversing interlock

Cable colours

- Svart = Black
- Grå = Grey
- Röd = Red
- Blå = Blue
- Gul = Yellow
- Grön = Green
- Brun = Brown
- Vit = White
- Rosa = Pink



Clark 28000/32000
Manual electric gear-changing system
Fixed operator's seat

Manual electrical gear-changing system
Clark 28000/32000 Rotatable operator's seat

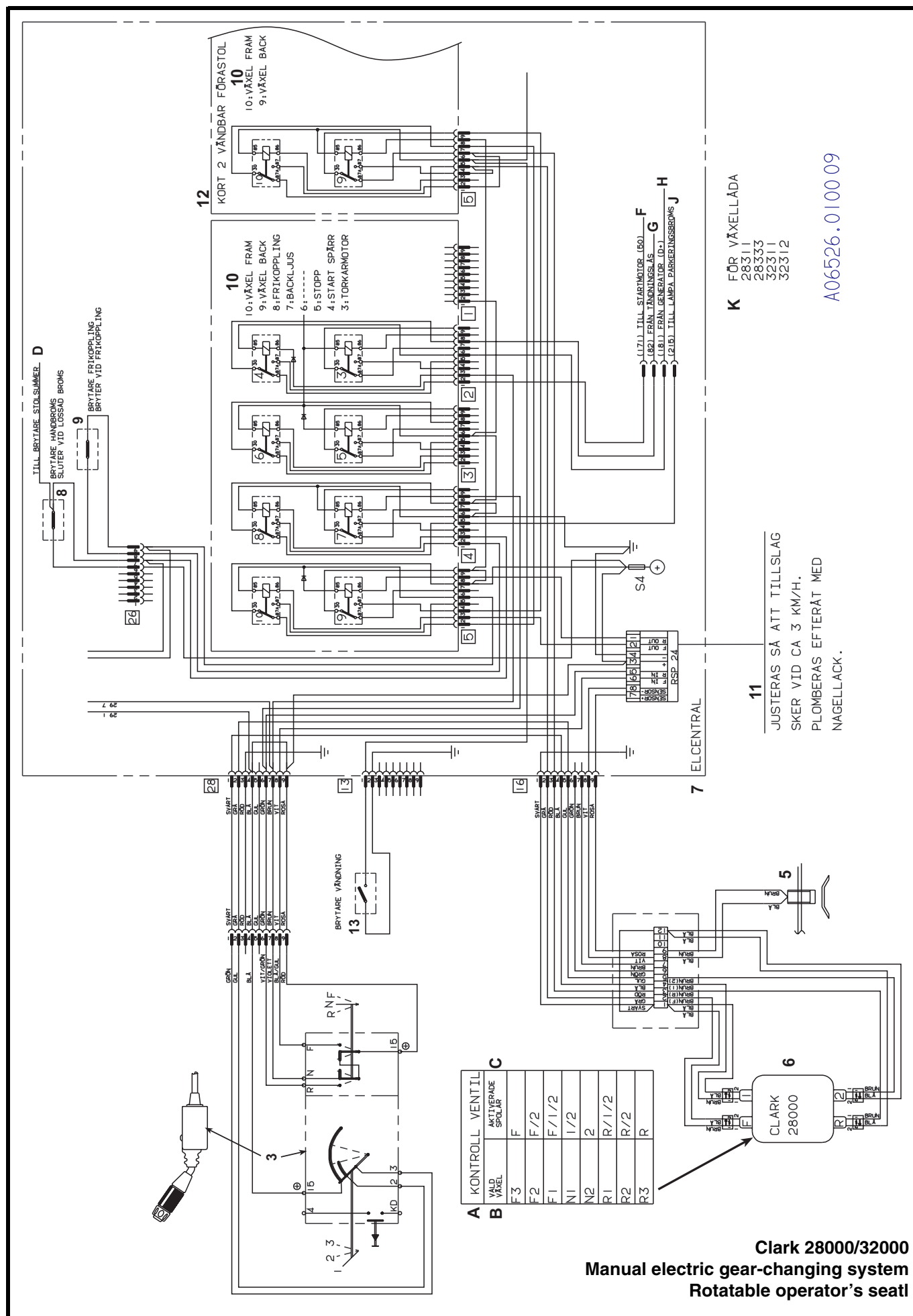
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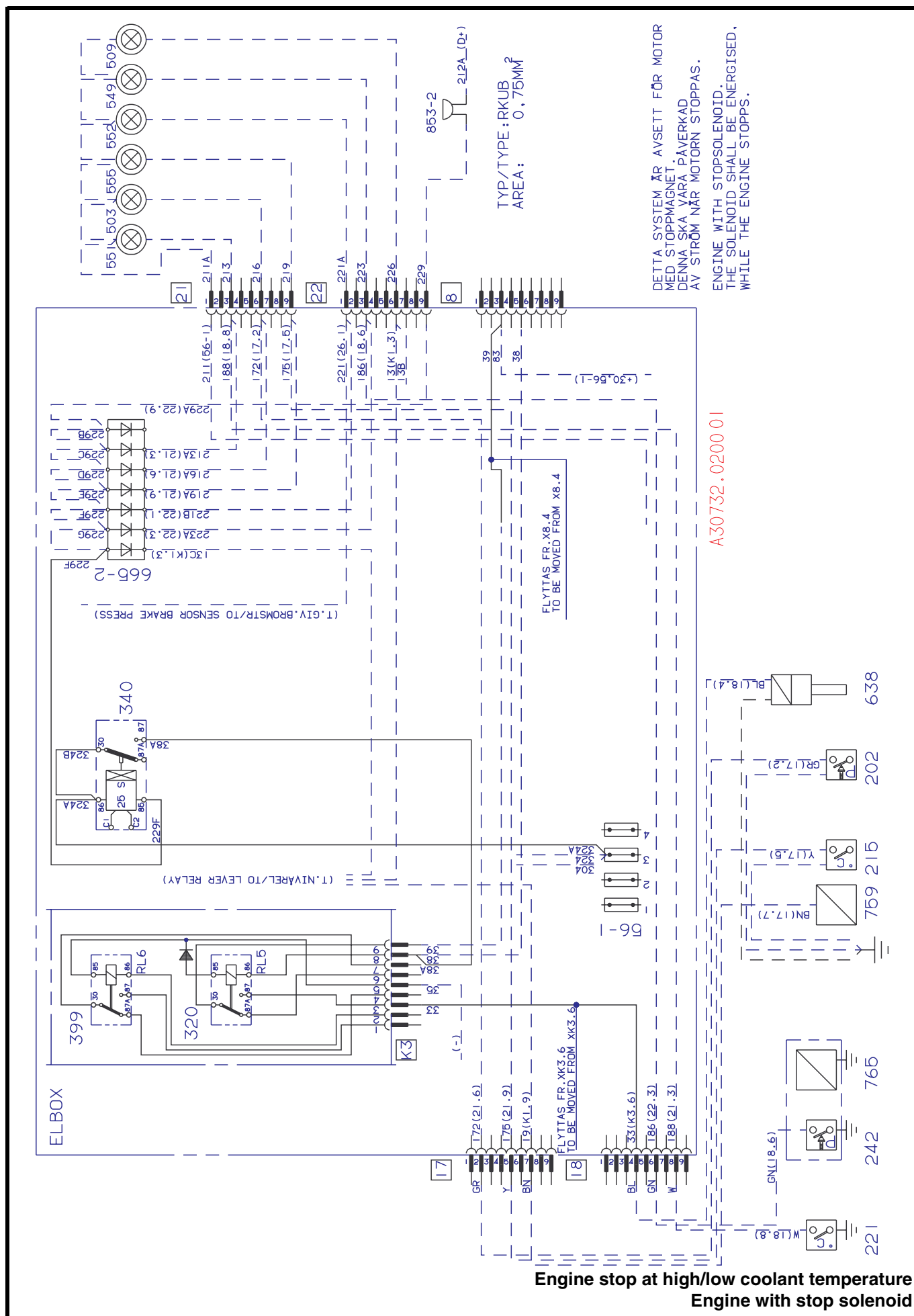
This diagram can also be found integrated in the general electric diagrams DCD90-450 in this Handbook.

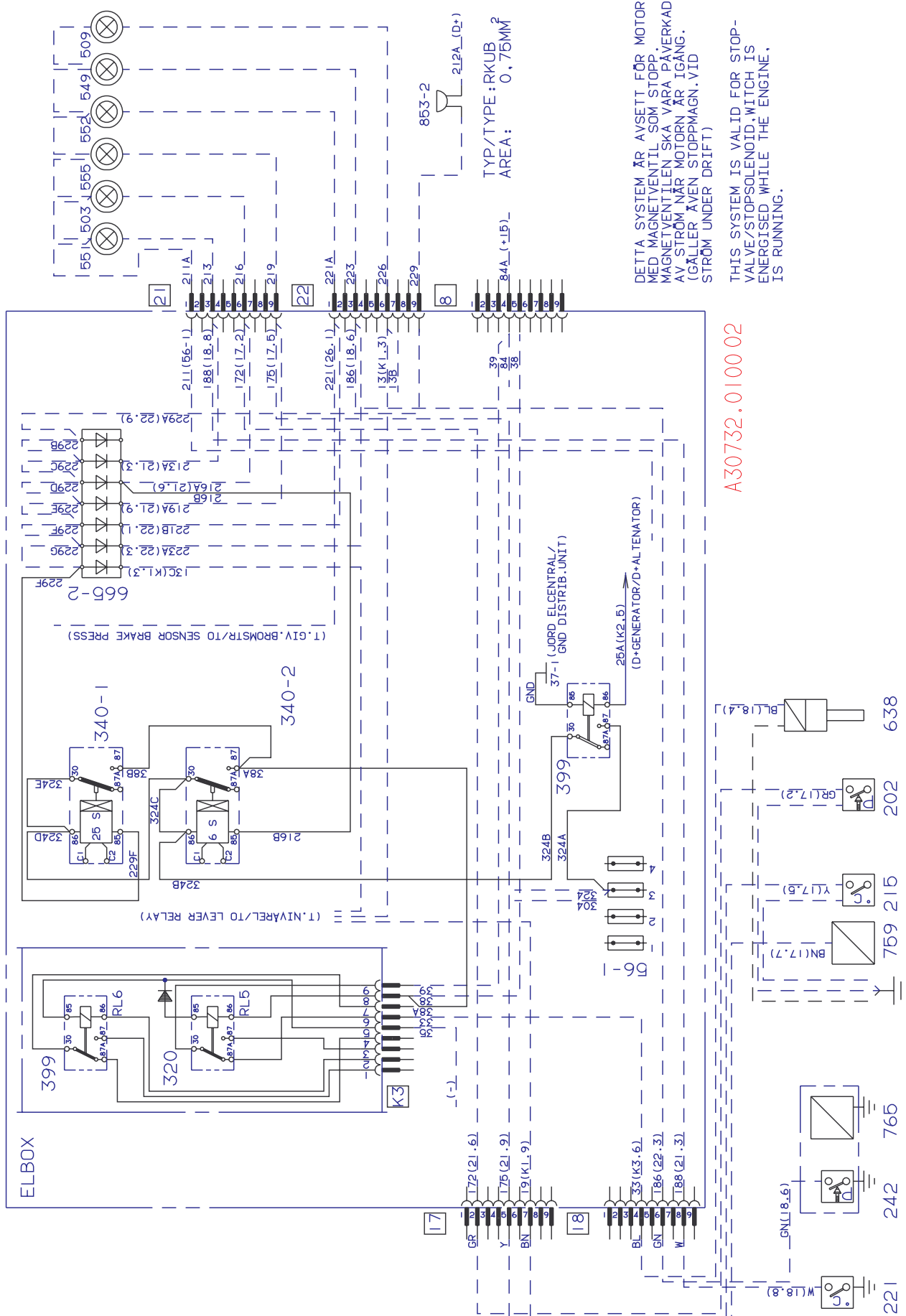
- A. Gearbox control valve
 - B. Employed gear
 - C. Activated solenoids
 - D. To seat buzzer switch
 - F. To starter motor (50)
 - G. From start switch
 - H. From alternator (D+)
 - J. To parking brake warning lamp
-
- 3. Gear selector
 - 5. Speed sensor on gearbox output shaft (output speed)
 - 6. Valve cover with solenoid valves
 - 7. Electrical central unit
 - 8. Switch at parking brake – ON when brake is released
 - 9. Switch at inching – OFF when inching
 - 10. Relays
 - 3. Wiper motor
 - 4. Starting interlock
 - 5. Stop
 - 6. –
 - 7. Reversing lights
 - 8. Inching
 - 9. Reverse gear
 - 10. Forward gear
 - 11. Reversing interlock
 - 12. PCB 2 – rotatable operator's seat

Cable colours

- Svart = Black
- Grå = Grey
- Röd = Red
- Blå = Blue
- Gul = Yellow
- Grön = Green
- Brun = Brown
- Vit = White
- Rosa = Pink



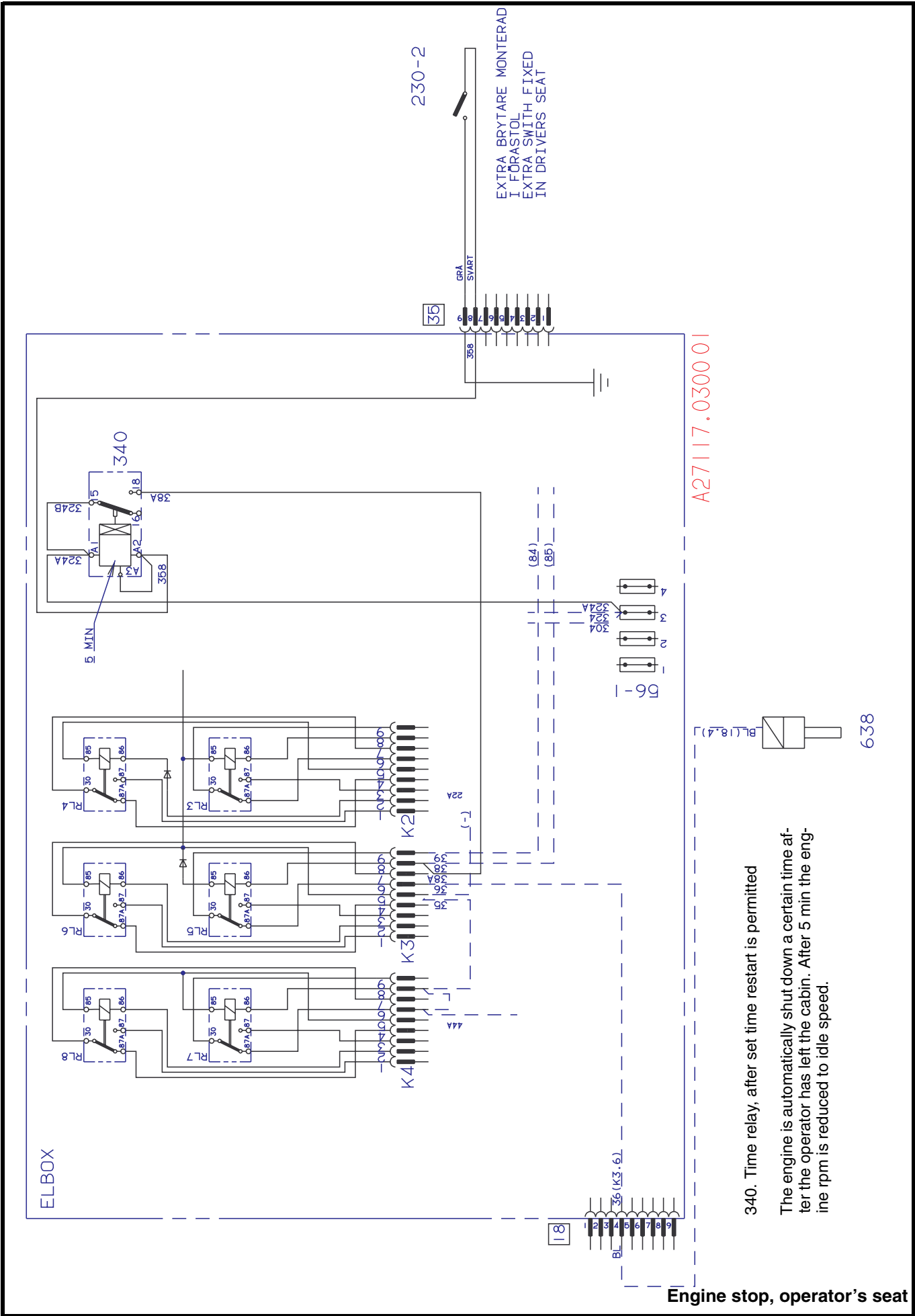


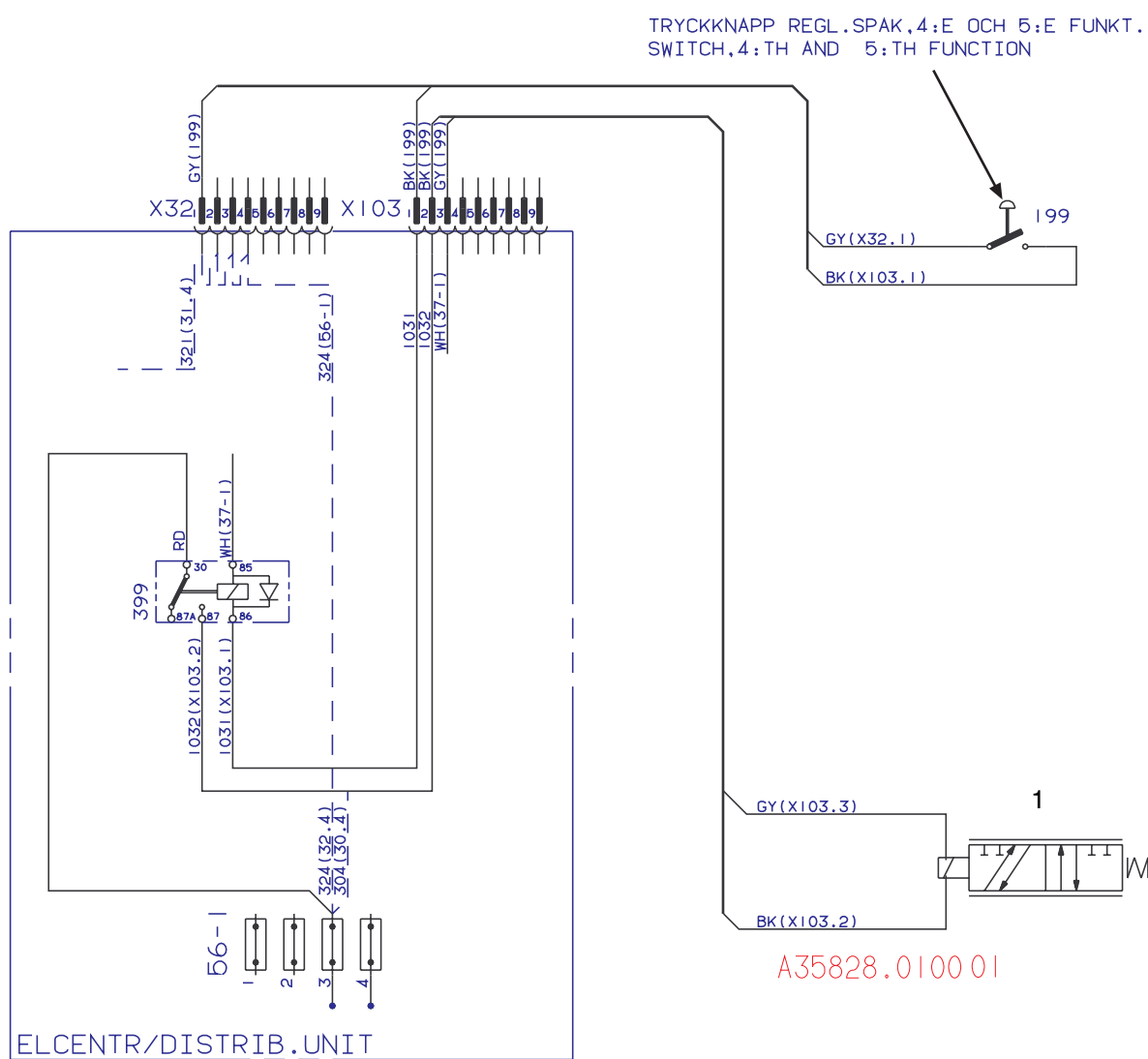


DETTA SYSTEM ÄR AVSETT FÖR MOTOR MED MAGNETVENTIL SOM STÖPP. MAGNETVENTILEN SKA PÅVERKAD AV STRÖM NÄR MOTORN ÄR IGÅNG. (GÄLLER ÄVEN STÖPPMAGN. VID STRÖM UNDER DRIFT)

THIS SYSTEM IS VALID FOR STOP-VALVE/STOPSOLENOID, WHICH IS ENERGISED WHILE THE ENGINE, IS RUNNING.

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1. Control section in the main valve, extra function
199. Push-button for extra function in the 4th or 5th control lever



WARNING!

The truck must not be operated with by-passed safety interlock system!

Safety interlock for container handling

The safety interlock comprises three solenoid valves which are activated by switches or sensors on the container attachment. The valves interrupt the servo supply from control levers to main valve in two cases:

1. Interrupt LIFT if not every twist-locks is either open or locked. This prevents lifting of a container if accidentally only one side of the container has been properly locked with the twist-locks.
2. Interrupt locking of the twist-locks if the attachment is not fully aligned onto the container, i.e. all corners are not close up to the container.

In case of emergency, the safety interlock system is possible to by-pass with a key operated switch.

N.B. The operator is responsible for by-passing with the key. When the key is turned to ON-position, the safety interlock system is out of function!

Safety interlock system

Volvo engine: A28047.0600

Perkins engine: A28047.0700

1. Switch, twist-locks
2. Switch, length adjustment 20–40'
3. Indicating lamp TWIST-LOCKS LOCKED
4. Indicating lamp ALIGNMENT
5. Indicating lamp TWIST-LOCKS OPEN
6. Terminal in chassis
7. Terminal in fork carriage
8. Sockets in the electrical central unit
9. Key operated by-pass switch
10. Solenoid valves, cut off servo pressure for twist-locks if there is no alignment signal
11. Solenoid valve cuts off servo pressure for lift if twist-locks are neither unlocked nor locked
12. Attachment electrical system
13. Sensor TWIST-LOCKS LOCKED
14. Sensor TWIST-LOCKS OPEN
15. Sensor ALIGNMENT
16. Indicating lamp, lights up when the system is by-passed with key switch 9



Komponentförteckning/List of Components/Komponentenverzeichnis/ Liste de composants

Nr/No/	Svenska	English	Deutsch	Francaise	Anm.
30	Batteri	Battery	Batterie	Batterie	
32	Kretskort elcentral	Printed circuit board, Junction box	Leiterplatte, Elektrozentrale	Circuit imprimé, centrale électrique	
37	Terminal stomanslutning	Earthing terminal on chassis	Terminal, masseanschluss	Borne, mis à la masse	
39	Terminal minusanslutning	Terminal, negative terminal	Terminal, Minus-Anschluss	Borne, connexion moins	
51	Säkringshållare 1-polig	Fuse holder, 1-pole	Sicherungshalter, 1polig	Porte-fusible, 1 pôle	
52	Säkringshållare 2-polig	Fuse holder, 2-pole	Sicherungshalter, 2polig	Porte-fusible, 2 pôles	
56	Säkringshållare 6-polig	Fuse holder, 6-pole	Sicherungshalter, 6polig	Porte-fusible, 6 pôles	
58	Säkringshållare 8-polig	Fuse holder, 8-pole	Sicherungshalter, 8polig	Porte-fusible, 8 pôles	
59	Säkringshållare 12-polig	Fuse holder, 12-pole	Sicherungshalter, 12polig	Porte-fusible, 12 pôles	
62	Batterihandske 2-polig	Battery connector, 2-pole	Batteriestecker, 2polig	Connecteur de charge de batterie, 2 pôles	
64	Batterihandske 4-polig	Battery connector, 4-pole	Batteriestecker, 4polig	Connecteur de charge de batterie, 4 pôles	
72	Stickuttag 2-polig	Outlet, 2-pole	Buchse 2polig	Prise, 2 pôles	
77	Stickuttag 7-polig	Outlet, 7-pole	Buchse 7polig	Prise, 7 pôles	
78	Stickuttag extra 7-polig	Outlet, extra, 7-pole	Buchse Extra, 7-polig	Prise supplémentaire, 7 pôles	
100	Strömställare ljus	Switch, light	Schalter, Beleuchtung	Interrupteur, feux	
101	Strömställare omk hel/halvjus	Switch, main/dipped beam	Schalter, Umschalter Fern-/Abblendlicht	Interrupteur, commutation route-croisement	
102	Strömställare dimljus	Switch, fog light	Schalter, Nebelscheinwerfer	Interrupteur, feux de brouillard	
103	Strömställare fjärrljus	Switch, distance light	Schalter, Fernscheinwerfer	Interrupteur, feux longue portée	
104	Strömställare lastljus	Switch, mast lights	Schalter, Ladescheinwerfer	Interrupteur, feux de travail	
105	Strömställare arbetsljus	Switch, working lights	Schalter, Arbeitsbeleuchtung	Interrupteur, feux de travail	
106	Strömställare containerljus	Switch, container light	Schalter, Containerbeleuchtung	Interrupteur, éclairage conteneur	
107	Strömställare park broms	Switch, parking brake	Schalter, Feststellbremse	Interrupteur, frein de stationnement	
108	Strömställare centr smörjning	Switch, central lubricator	Schalter, Zentralschmierung	Interrupteur, graissage centralisé	
109	Strömställare varningsljus	Switch, hazard lights	Schalter, Warnblinkanlage	Interrupteur, feux de détresse	
110	Strömställare rot varningsljus	Switch, rotating hazard beacon	Schalter, Rundum-Kennleuchte	Interrupteur, gyrophares	
111	Strömställare fönsterhiss	Switch, window regulator	Schalter, Fensterheber	Interrupteur, leve-glace	
112	Strömställare kylanläggning (AC)	Switch, air conditioner (AC)	Schalter, Klimaanlage (AC)	Interrupteur, groupe de refroidissement climatisation, (AC)	
113	Strömställare styrning alt	Switch, alternative steering	Schalter, Lenkung Alt.	Interrupteur, type commande de direction	
114	Strömställare läsbelysning	Switch, reading light	Schalter, Leselampe	Interrupteur, éclairage lecture	
115	Strömställare instr belysning	Switch, instrument illumination	Schalter, Instrumentenbeleuchtung	Interrupteur, éclairage des instruments	
116	Strömställare innerbelysning	Switch, interior lighting	Schalter, Innenbeleuchtung	Interrupteur, éclairage intérieur	
117	Strömställare värme	Switch, heating	Schalter, Heizung	Interrupteur, chauffage	
118	Strömställare fläktm värme	Switch, heater fan	Schalter, Lüftermotor Heizung	Interrupteur, motoventilateur chauffage	
119	Strömställare vindrutetorkare	Switch, wiper	Schalter, Scheibenwischer	Interrupteur, essuie-glace	
120	Strömställare spolare	Switch, washer	Schalter, Waschanlage	Interrupteur, lave-glace	
121	Strömställare blackout	Switch, blackout	Schalter, Ausfall	Interrupteur, blackout	
122	Strömställare nöd hydraulpump	Switch, emergency hydraulic pump	Notschalter, hydraulikpumpe	Interrupteur, urgence pour la pompe	

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Nr/No/	Svenska	English	Deutsch	Francaise	Anm.
123	Strömställare backspegel	Switch, observation mirror	Schalter, Rückspiegel	Interrupteur, rétroviseur	
124	Strömställare kallstart	Switch, cold start	Schalter, kaltstart	Interrupteur, démarrage à froid	
125	Strömställare avgasbroms	Switch, exhaust brake	Schalter, Motorbremse	Interrupteur, ralentisseur sur échappement	
126	Strömställare diff spärr/broms	Switch, diff. Block	Schalter, Differentialsperre/Bremse	Interrupteur, blocage de différentiel/frein	
127	Strömställare värmesystem diesel	Switch, heating system diesel	Schalter, Heizsystem Diesel	Interrupteur pour circuit de chauffage diesel	
128	Strömställare kraftuttag sida	Switch, power take off side	Schalter, Nebenantrieb Seite	Interrupteur, prise de puissance latérale	
129	Strömställare kraftuttag bak	Switch, power take off rear	Schalter, Nebenantrieb hinten	Interrupteur, prise de puissance arrière	
130	Strömställare hög/lågväxel	Switch, high/low gear	Schalter, Rangegetriebe Hoch/Niedrig	Interrupteur, petite/grande vitesse	
131	Strömställare färdväljare fram	Switch, gear selector forward	Schalter, Fahrtrichtungswähler vorwärts	Interrupteur, marche avant	
132	Strömställare färdväljare bak	Switch, gear selector rear	Schalter, Fahrtrichtungswähler rückwärts	Interrupteur, marche arrière	
135	Strömställare växelväljare	Switch, gear shift	Schalter, Schalthebel	Interrupteur, sélecteur de vitesse	
136	Strömställare framhjul's styrning	Switch, forward wheel steering	Schalter, Vorderrad Lenkung	Interrupteur, roues avant directrices	
137	Strömställare 4-hjuls styrning	Switch, 4-wheel steering	Schalter, Vierradlenkung	Interrupteur, 4 roues directrices	
138	Strömställare crab styrning	Switch, crab steering	Schalter, Diagonal Lenkung	Interrupteur, déplacement en diagonale	
142	Strömställare fot	Switch, foot	Fußschalter	Interrupteur, pédale	
143	Strömställare sitsvärme	Switch, seat heater	Schalter, Sitzheizung	Interrupteur, chauffage d'assise	
144	Batterifrånsläpplare	Battery disconnecting switch	Batterietrennschalter	Interrupteur, général	
145	Strömställare AT-regulator	Switch, AT-regulator	Schalter, Abgasdruckregler	Interrupteur, régulateur AT	
147	Strömställare körvisare	Switch, direction indicators	Schalter, Fahrtrichtungsanzeiger	Interrupteur, clignotants	
149	Strömställare signalhorn	Switch, horn	Schalter, Signalhorn	Interrupteur, avertisseur sonore	
150	Strömställare startlås/ellas	Switch, main key switch	Schalter, Startschloß/E-Sperre	Interrupteur, contacteur antivol/verrou électrique	
152	Strömställare intervalltorkare	Switch, intermittent wiper	Schalter, Intervallwischer	Interrupteur, balayage intermittent	
156	Strömställare kupevärmare	Switch, cab heating	Schalter, Kabinenheizung	Interrupteur, chauffage habitacle	
157	Strömställare stoltit	Switch, seat tilt	Schalter, Kippen des Sitzes	Interrupteur, basculement du siège	
158	Strömställare dimbakljus	Switch, rear fog light	Schalter, Nebelschlußleuchte	Interrupteur, feux de brouillard arrière	
159	Strömställare extra fram/back väljare	Switch, extra direction selector	Schalter,	Interrupteur,	
160	Strömställare komb fram/back	Switch, combi-forward/reverse	Schalter, Kombi - vorn/rückwärts	Interrupteur, sélecteur marche avant/marche arrière	
161	Strömställare komb signal, ljus hel/halv spol,torkare m intervall körvisare	Schalter, combi-horn, light main/dipped beam, washer, wiper (intermittent), direction indicator	Schalter, Kombi-Signal, Beleuchtung Fern-/Abblendlicht, Waschanlage, Intervallwischer, Fahrtrichtungsanzeiger	Interrupteur, avertisseur, feux de route et de croisement, lave-glace, essuie-glace a balayage intermittent, clignotants	
162	Strömställare komb signal ljus hel/halv, spol, torkare m 2 int, fram/back	Switch, combi horn, light main/dipped beam, washer, wiper w 2int., forward/revers	Schalter, Kombi-Signal, Beleuchtung Fern-/Abblendlicht, Waschanlage, 2 Intervallwischer, vor/rückwärts	Interrupteur, avertisseur, feux de route et de croisement, essuie glace à balayage intermittent	
163	Strömställare start på 2-an	Switch, start 2nd gear	Schalter, Start 2-gang	Interrupteur, démarrage 2-trans.	
165	Strömställare stolvärme	Switch, seat heater	Schalter, Sitzheizung	Interrupteur, chauffage du siège	
166	Strömställare låsning vändskiva	Switch, interlocking of turntable	Schalter, Sperren Sattelkupplung	Interrupteur, verrouillage de la sellette	

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167	Strömställare luftfjädring	Switch, pneumatic springing	Schalter, Luftfederung	Interrupteur, suspension pneumatique	
168	Strömställare låsn stol	Switch, interlocking of seat	Schalter, Sitzverriegelung	Interrupteur, verrouillage du siège	
169	Strömställare stolsvändning	Switch, reversible seat	Schalter, Drehen des Sitzes	Interrupteur, pivotement du siège	
170	Strömställare förångare (LPG)	Switch, evaporator (LPG)	Schalter, Verdampfer (LPG)	Interrupteur, évaporateur (GPL)	
171	Strömställare v-skiva upp/ner	Switch, fifth wheel up/down	Schalter, Sattelkupplung, aufwärts/abwärts	Interrupteur, sellette montée/descente	
172	Strömställare v-skiva fr/back	Switch, fifth wheel forward/reverse	Schalter, Sattelkupplung, vorn/hinten	Interrupteur, sellette marche avant/marche arrière	
173	Strömställare v-skiva skვნning	Switch, fifth wheel, levelling	Schalter, Sattelkupplung, Niveausausgleich	Interrupteur, sellette marché, corr-niveau	
174	Strömställare, utskjut	Switch, projecting	Schalter, Längengeber	Interrupteur, pour le réglage du déploiement	
175	Strömställare hyttlyft upp	Switch, cab hoist up	Schalter, Kabinenhub, aufwärts	Interrupteur, élévation de cabine, montée	
176	Strömställare hyttlyft ner	Switch, cab hoist down	Schalter, Kabinenhub, abwärts	Interrupteur, élévation de cabine, descente	
177	Strömställare hyttskjutning	Switch, cab movement	Schalter, Kabinenversetzung	Interrupteur, mouvement cabine	
178	Strömställare nollställning	Switch, reset	Schalter, Nullstellung	Interrupteur "reset"	
180	Strömställare fyrhjulsdrift	Switch, 4-WD	Schalter, Vierradantrieb (4WD)	Interrupteur, 4 roues motrices	
190	Strömställare klimatanläggning	Switch, air conditioner	Schalter, Frischluftheizung	Interrupteur, climatisation	
191	Strömställare recirkulation	Switch, re-circulation	Schalter, Re-zirkulation	Interrupteur, re-circulation	
192	Strömställare vattenavskiljare	Switch, waterseparator	Schalter, Wasserabscheider	Interrupteur, séparateur d'eau	
195	Strömställare joy-stick X	Switch, joy-stick X	Schalter, Joy-stick X	Interrupteur, Joy-stick X	
196	Strömställare joy-stick X+Y	Switch, joy-stick X+Y	Schalter, Joy-stick X+Y	Interrupteur, Joy-stick X+Y	
197	Strömställare längs/tvårskörning	Switch, length/sideways driving	Schalter, Längs-/Querfahren	Interrupteur, sens longitudinal/transversal	
198	Strömställare flytläge skვნning	Switch, equalizing fifth wheel	Schalter, Ausgleich der Sattelkupplung	Interrupteur, équilibré de la selette	
199	Strömställare option	Switch, option	Schalter, Option	Interrupteur, option	
1001	Strömställare, TW	Switch, TW	Schalter, TW	Interrupteur, TW	
1002	Strömställare, lossa TW	Switch, unlocking of TW	Schalter, Lösen der TW	Interrupteur, verrouillage TW	
1003	Strömställare, låsa TW	Switch, locking of TW	Schalter, Verriegelung der TW	Interrupteur, verrouillage TW	
1004	Strömställare, stopp vid 30'-35'	Switch, stop at 30'-35'	Schalter, Stopp bei 30'-35'	Interrupteur, arrêt à 30'-35'	
1005	Strömställare, förbikoppling av säkerhetssystem	Switch, overriding of the safety system	Schalter, überbrückung des sicherheitssystem	Interrupteur, Dérivation du système de sécurité	
1006	Strömställare, fällning främre ben	Switch, front legs down	Schalter, vorderes Bein ab	Interrupteur, béquille avant baisse	
1007	Strömställare, fällning bakre ben	Switch, rear legs down	Schalter, hinteres Bein ab	Interrupteur, béquille arrière baisse	
1008	Strömställare, klämma/lossa ben	Switch, clamping/-releasing legs	Schalter, Klemmen/Lösen der Beine	Interrupteur, serrage/-deserrage béquilles	
1009	Strömställare, Motor information	Switch, Engine information	Schalter, Motor Information	Interrupteur, information moteur	
1010	Strömställare, tilt av hytt	Switch, tilt of cab	Schalter, Kabinenneigung	Interrupteur, arêt inclinaison de la cabine	
1011	Strömställare IR ljus	Switch IR light	Schalter, IR Licht	Interrupteur, lampe IR	
1012	Strömställare aut. utskjut 20'-40'	Switch, Aut. Extension 20'-40'	Schalter, Automatische Teleskopiere 20'-40'	Interrupteur, extension automatique 20'40'	
1013	Strömställare stödben	Switch, Support jacks	Schalter, Stützbein	Interrupteur, bequilles	
1014	Strömställare förbikoppling rotationstopp	Switch, over ride rotation stop	Schalter, überbrückung Rotation stopp	Interrupteur pour shunt "stop rotation"	
1015	Strömställare förbikoppling höjdbeg/tp-beg	Switch, over ride height limit/tp-limit	Schalter, überbrückung Höhenbegrenzung/ LSP-Begrenzung	Interrupteur shunt pour hauteur et CDG maxi	

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Nr/No/	Svenska	English	Deutsch	Francaise	Anm.
239	Brytkontakt termisk	Contact, breaking, thermic	Unterbrecherkontakt, thermisch	Contact à ouverture, thermique	
240	Slutkontakt termisk	Contact, making, thermic	Schließkontakt, thermisch	Contact à fermeture, thermique	
241	Brytkontakt lampa luftmatning släp	Contact, breaking, warning lamp air supply to trailer	Unterbrecherkontakt, Warnlampe Förderluft Anhänger	Contact à ouverture, témoin air d'alimentation remorque	
242	Slutkontakt lampa oljetryck v-låda	Contact, making, warning lamp, oil pressure gear box	Schließkontakt, Warnlampe, Öldruck Getriebe	Contact à fermeture, voyant, pression d'huile boîte de vitesses	
243	Brytkontakt tryck kylmedia AC	Contact, breaking, coolant pressure (air condition)	Unterbrecherkontakt, Druck Kühlmittel (Klimaanlage)	Contact à ouverture, pression frigorigène (climatisation)	
244	Slutkontakt hydraulik aktiverad	Contact, making, hydraulics	Schließkontakt, Hydraulik aktiviert	Contact à fermeture, hydraulique actionnée	
245	Slutkontakt hydraultryck styrning	Contact, making, hydraulic pressure control	Schließkontakt Hydraultryck Lenkung	Contacteur pression hydraulique de la direction	
246	Slutkontakt tryck kylmedia	Contact, pressure refrigerant	Schließkontakt, Druck Kühlmittel	Contact à ouverture, pression liquide de refroidissement	
250	Brytkontakt nödstopp	Contact, breaking, emergency stop	Unterbrecherkontakt, Notaus	Contact à ouverture, arrêt d'urgence	
251	Slutkontakt vänderbar förarsät	Contact, making, VBS	Schließkontakt, drehbarer Fahrersitz	Contact à fermeture, siège pivotant	
260	Slutkontakt lyft steg 1	Contact, making, hoist step 1	Schließkontakt, Hub Stufe 1	Contact à fermeture, élévation e'tape 1	
261	Slutkontakt lyft steg 2	Contact, making, hoist step 2	Schließkontakt, Hub Stufe 2	Contact à fermeture, élévation e'tape 2	
262	Slutkontakt tilt	Contact, making, tilting	Schließkontakt, Neigung	Contact à fermeture, inclinaison	
263	Slutkontakt gaffelspridning	Contact, making, fork positioning	Schließkontakt, Gabelverstellung	Contact à fermeture, écartement des bras de fourche	
264	Slutkontakt sidoföring	Contact, making, sideshift	Schließkontakt, Seitenverschiebung	Contact à fermeture, déplacement latéral	
265	Slutkontakt stativ in/ut	Contact, making, lifting mast in-out	Schließkontakt, Hubgerüst ein-aus	Contact à fermeture, mat de lev. ext-ret.	
266	Brytkontakt hyttddör	Contact, breaking cab door	Unterbrecherkontakt, Kabinetur	Contact à ouverture, portière de cabine	
267	Slutkontakt bromstryck	Contact, making, brake pressure	Schließkontakt, Bremsdruck	Contact à fermeture, pression de frein	
268	Slutkontakt kompressor	Contact, making, Compressor	Schließkontakt, Compresseur	Contact à fermeture, Pou le compresseur	
299	Slut/brytkontakt option	Contact, making/braking option	Schließ-/Unterbrecherkontakt, (option)	Contact à fermeture/ouverture, (option)	
300	Relä hel/halvljus	Relay, main/dipped beam	Relais, Fern-/Abblendlicht	Relais, route-croisement	
301	Relä dimljus	Relay, fog light	Relais, Nebelscheinwerfer	Relais, feux antibrouillard	
302	Relä fjärrljus	Relay, distance light	Relais, Fernscheinwerfer	Relais, feux longue portée	
303	Relä lastljus	Relay, mast light	Relais, Fernscheinwerfer	Relais, projecteur de chargement	
304	Relä arbetsljus	Relay, working light	Relais, Ladescheinwerfer	Relais, projecteur de travail	
305	Relä backljus	Relay, reversing light	Relais, Arbeitsbeleuchtung	Relais, feux de recul	
306	Relä halvljus	Relay, main beam	Relais, Rückfahrscheinwerfer	Relais, feux de route	
307	Relä lastljus	Relay, dipped beam	Relais, Fernlicht	Relais, feux de croisement	
308	Relä bromsljus	Relay, brake light	Relais, Abblendlicht	Relais, feux stop	
309	Relä parkeringsbroms	Relay, parking light	Relais, Standlicht	Relais, feux de stationnement	
310	Relä körvisare vä	Relay, direction indicator left	Relais, Fahrtrichtungsanzeiger, L	Relais, clignotant supplémentaire, ga.	
311	Relä körvisare hö	Relay, direction indicator right	Relais, Fahrtrichtungsanzeiger, R	Relais, clignotant supplémentaire, dr.	
312	Relä startelement	Relay,element preheater	Relais, Startelement	Relais, élément de démarrage	

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313	Relä vändbar förarstol	Relay, rotating driver's seat (VBFS)	Relais, drehbarer Fahrersitz	Relais, siège pivotant	
314	Relä parkeringsbroms	Relay, parking brake	Relais, Feststellbremse	Relais, frein de stationnement	
315	Relä startlås	Relay, starting key	Relais, Startschloß	Relais, démarreur antivol	
316	Relä torkare	Relay, wiper	Relais, Wischer	Relais, essuie-glace	
317	Relä strålkastartorkare	Relay, wiper	Relais, Scheinwerferwischer	Relais, essuie-phare	
318	Relä AT-regulator	Relay, AT-regulator	Relais, Abgasdruckregler	Relais, régulateur AT	
319	Relä varningsblinkers	Relay, hazard blinkers	Relais, Warmlinker	Relais, feux de détresse	
320	Relä elektrisk stopp	Relay, electrical stop	Relais, elektrischer Stopp	Relais, arrêt électrique	
321	Relä intervalltorkare	Relay, intermittent wiper	Relais, Intervallwischer	Relais, balayage intermittent	
322	Relä kylvätskenivå	Relay, coolant level	Relais, Kühlfülligkeitsstand	Relais, niveau radiateur	
323	Relä blinkers	Relay, blinkers	Relais, Blinker	Relais, clignotants	
324	Relä rangespärr	Relay, range interlock	Relais, Rangesperre	Relais, blocage doubleur	
325	Relä blinkande bromsljus (back)	Relay, flashing brake lights (reversing)	Relais, blinkendes Bremslicht (beim Zurücksetzen)	Relais, feux stop clignotants (en marche arrière)	
326	Relä blinkande bromsljus (runt)	Relay, flashing hazard brake lights	Relais, blinkendes Bremslicht (Rund-um)	Relais, feux stop clignotants (gyrophare)	
327	Relä växel neutral	Relay, gear neutral	Relais, Wechselschaltung	Relais, changement neutre	
328	Relä växelskifte	Relay, gear shift	Relais, Wechselschaltung	Relais, changement de rapports	
329	Relä växel hög/låg	Relay, high/low gear	Relais, Wechsel hoch/niedrig	Relais, petite/grande vitesse	
330	Relä startspärr	Relay, start interlock	Relais, Startsperr	Relais, blocage démarrage	
331	Relä drivning fram	Relay, forward driving	Relais, Antrieb vorn (LPG, Diesel)	Relais, marche avant	
332	Relä drivning bak	Relay, reversing driving	Relais, Antrieb hinten (LPG, Diesel)	Relais, marche arrière	
333	Tidrelä förvärmning	Time relay, automatically preheating	Zeitrelais, Vorwärmautomatik	Relais, temporise, préchauffage automatique	
334	Relä frikoppling/drivbrytning	Relay, free wheel/drive disconnection	Relais, Auskuppeln/Antriebsabschaltung	Relais, débrayage/arrêt d'entraînement	
335	Relä växelventil 1:a (diesel, gas)	Relay, gear change valve 1-gear (diesel, LPG)	Relais, Schaltventil 1 Getriebe (Diesel, LPG)	Relais, distributeur de changement, boîte à 1 rapport (gazole, GPL)	
336	Relä växelventil 2:a (diesel, gas)	Relay, gear change valve 2-gear (diesel, LPG)	Relais, Schaltventil 2 Getriebe (Diesel, LPG)	Relais, distributeur de changement, boîte à 2 rapports (gazole, GPL)	
337	Relä drivriktning motor	Relay, motor drive direction	Relais, Antriebsrichtung Motor	Relais, sens de marche moteur	
338	Relä kylfläkt drivmotor	Relay, cooling fan drive motor	Relais, Lüfter Antriebsmotor	Relais, moteur du ventilateur	
339	Relä kylfläkt elskåp	Relay, cooling fan electrical box	Relais, Lüfter Schaltschrank	Relais, boîtier électrique du ventilateur	
340	Tidrelä fördröjt tillslag	Time relay, start delay	Zeitrelais, verzögerte Einschaltung	Relais, temporise, mise en marche temporisée	
341	Tidrelä fördröjt fränslag	Time relay, stop delay	Zeitrelais, verzögerte Ausschaltung	Relais, temporise, arrêt temporisée	
342	Relä drivning 2/4 hjul	Relay, switching 2/4 WD	Relais, 2-Rad/4-Rad-Antrieb	Relais, commutation 2/4 roues motrices	
343	Relä dimbakljus	Relay, fog light rear	Relais, Nebelschlussleuchte	Relais, feux de brouillard arrière	
344	Relä momentförstärkare	Relay, torque amplifier	Relais, Drehmomentwandler	Relais, convertisseur de couple	
345	Relä låsning vändskiva	Relay, interlocking of turntable	Relais, Sperren der Sattelkupplung	Relais, verrouillage de la sellette	
346	Relä frikoppling stollåsning	Relay, releasing of seat interlocking	Relais, Freigabe Sitzverriegelung	Relais, déverrouillage du siège	
347	Relä stolvändning/ljussignal	Relay, multifunction, seat rotation/light signal	Relais, Multifunktion, Sitzdrehen/Lichtsignal	Relais, multifonction siège/appel de phare	

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348	Relä fläktmotor värmare	Relay, fan heating	Relais, Gebläsemotor Heizung	Relais, chauffage du moteur de ventilateur	
349	Relä fartreglage	Relay, speed control	Relais, Geschwindigkeitsregelung	Relais, commande de vitesse	
350	Relä pumpkontaktor/pumpkontroll	Relay, pump contactor/pump control	Relais, Pumpenkontrolle	Relais, commande de pompe	
351	Relä hyttlyft upp	Relay, cab hoist up	Relais, Kabinenhub, aufwärts	Relais, élévation de cabine, montée	
352	Relä hyttlyft ner	Relay, cab hoist down	Relais, Kabinenhub, abwärts	Relais, élévation de cabine, descente	
353	Relä säkerhetsslinga	Relay, safety loop	Relais, Sicherheitsschleife	Relais, boucle de sécurité	
354	Relä styrsystem	Relay, signal control system	Relais, Signal Lenkung	Relais, signal système de commande	
355	Relä sensorstyrning	Relay, sensor control	Relais, Sensorsteuerung	Relais, commande capteurs	
356	Skiftrelä långskörning/tvårskörning	Shift relay, length/sideways driving	Schaltrelais, Längs-/Querfahren	Relais, de commutation, sens longitudinal/transversal	
357	Relä roterande varningsljus	Relay, hazard beacon	Relais, rotierende Rund-um-Kennleuchte	Relais, gyrophare	
358	Relä kompressor luft	Relay, compressor air	Relais, kompressor luft	Relais, compresseur du air	
359	Relä Hydraulikölkylare	Relay hydraulic oil cooler	Relais, Hydraulik Ölkühler	Relais, radiateur huile hydraulique	
360	Relä startsolenoid	Relay, starting solenoid	Relais, Anlaßmagnet	Relais, solénoïde démarreur	
361	Relä kompressor AC	Relay, compressor air conditioner	Relais, kompressor klimaanlage	Relais, compresseur climatisation	
362	Relä vattenventil AC	Relay, water valve air conditioner	Relais, Wasser Ventil für Klimaanlage	Relais, soupape pour l'eau du climatiseur	
363	Relä kondensor AC	Relay, condenser air conditioner	Relais, kondensor klimaanlage	Relais, condenseur climatisation	
365	Relä fönsterhiss upp	Relay, electrical screen elevator up	Relais, elektrischer Fensterheber aufwärts	Relais, montée du lève-glace électrique	
366	Relä fönsterhiss ner	Relay, electrical screen elevator down	Relais, elektrischer Fensterheber abwärts	Relais, descente du lève-glace électrique	
367	Relä styrning	Relay, steering	Relais, Lenkung	Relais, direction	
368	Relä lågt bromstryck	Relay, low brake pressure	Relais, niedriger Bremsdruck	Relais, pression de frein petite	
369	Relä centralsmörjning	Relay, central lubrication	Relais, zentralschmierung	Relais, graissage centralisé	
370	Relä centralsmörjning, aggregat	Relay, central lubrication, attachment	Relais, zentralschmierung, Aggregat	Relais, graissage centralisé et accessoires	
371	Relä lyfthöjd	Relay, lift height	Relais, hubhöhe	Relais, élévation	
372	Relä blinkande varn.ljus, höjdbegränsn.	Relay, flashing beacon, lifting height limiter	Relais, blinkende Rundumleuchte, Höhebegrenzung	Relais lampe clignotante, limiteur de hauteur	
375	Huvudkontaktor reglersystem	Main contactor, operating control	Hauptschütz, Regelsystem	Contacteur principal, système de régulation	
376	Kontaktor fram reglersystem	Contact, forward operating control	Schütz, vom Regelsystem	Contacteur, régulation avant	
377	Kontaktor bak reglersystem	Contact, reversing operating control	Schütz, hinten Reglersystem	Contacteur, régulation arrière	
378	Kontaktor by-pass reglersystem/Fältförsvagning	Contact, "by-pass" operating control/Field weakening	Schütz, Bypass Reglersystem/ Feldschwächung	Contacteur, système de régulation by-pass/ Affaiblissement de champ	
379	Kontaktor pumpmotor	Contact, pump motor	Schütz, Pumpenmotor	Contacteur, moteur de la pompe	
380	Kontaktor	Contact	Schütz	Contacteur	
381	Kontaktor återladdning	Contact, recharging	Schütz, Aufladung	Contacteur, recharge	
382	Relä förbikoppling säkerhetssystem	Relay, by-pass safety system	Relais, überbrückung des Sicherheitssystems	Relais, shunt sécurité	
383	Relä Stolsvärme	Relay, heated seat	Relais, Sitzheizung	Relais, siège chauffant	
384	Relä vattenseparator	Relay, waterseparator	Relais, Wasserabscheider	Relais, séparateur d'eau	
399	Relä option	Relay, option	Relais, Option	Relais, option	
3001	Relä rotation	Relay, rotation	Relais, rotation	Relais, rotation	



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3002	Relä tift	Relay, tilt	Relais, neigung	Relais, inclinaison	
3003	Relä sidoföring	Relay, side shifting	Relais, seitenverstellung	Relais, translation laterale	
3004	Relä längdinställning	Relay, length adjustment	Relais, längeneinstellung	Relais, dispersion	
3005	Relä twist lock	Relay, twist lock	Relais, twist lock	Relais, twist lock	
3006	Relä spridning	Relay, spreading	Relais, verstellung	Relais, dispersion	
3007	Relä lyft/sänk	Relay, lifting/lowering	Relais, heben/senken	Relais, élévation/descente	
3008	Relä hydraulfunktion extra	Relay, extra hydraulic function	Relais, extra hydraulisch funktion	Relais,	
3009	Relä nödstopp	Relay, emergency stop	Relais, Nothalt	Relais, arrêt d'urgence	
3010	Relä bromsjust vxl std/blackout	Relay, brake light shift std/blackout	Relais, Bremslicht, Schaltung std/Ausfall	Relais, normal/blackout pour les feux de stop	
3011	Relä backjust vxl std/blackout	Relay, reversing light shift std/blackout	Relais, Rueckfahrleuchte, Schaltung std/ Ausfall	Relais, normal/blackout pour les feux de recul	
3012	Relä arb.bel hytt vxl std/blackout	Relay, working light cab, shift std/blackout	Relais, Arbeitsbeleuchtung, schaltung std/ Ausfall	Relais, normal/blackout pour l'éclair age de la cabine	
3013	Relä arb.bel. bom 20' vxl std/blackout	Relay, working light boom20' shift std/b out	Relais, Arbeitsbeleuchtung, Ausleger 20', Schaltung std/ Ausfall	Relais, normal/blackout pour les feux de travail sur la poutre pour les 20'	
3014	Relä arb.bel. bom 40' vxl std/blackout	Relay, working light boom40' shift std/b out	Relais, Arbeitsbeleuchtung, Ausleger 40' Schaltung std/Ausfall	Relais, normal/blackout pour les feux de travail sur la poutre pour les 40'	
3015L	Relä vxl bromsjust/blinkers vxl	Relay, shift brake light/direction indicator left	Relais, Bremslicht/ Blinker links	Relais, feux de stop clignotant gauche	
3015R	Relä vxl bromsjust/blinkers hö	Relay, shift brake light/direction indicator right	Relais, Bremslicht/ Blinker rechts	Relais, feux de stop clignotant droit	
3016	Relä signalhorn	Relay, horn	Relais, Hube	Relais, avertisseur	
3017	Relä containerbelysning	Relay, Container light	Relais, Container Beleuchtung	Relais, eclairge des conteneurs	
3018	Relä containerbelysning IR	Relay, Container light IR	Relais, Container Beleuchtung IR	Relais, eclairge des conteneurs infra rouge	
3305	Relä VBFS, backjust	Relay, rotating driver's seat, reversing light	Relais, drehbarer Fahrersitz, Rückfahrerscheinwerfer	Relais, siège pivotant, feux de recul	
3306	Relä VBFS, helijus	Relay, rotating driver's seat, main beam	Relais, drehbarer Fahrersitz, Fernlicht	Relais, siège pivotant, feux de route	
3307	Relä VBFS, halvjust	Relay, rotating driver's seat, dipped beam	Relais, drehbarer Fahrersitz, Abblendlicht	Relais, siège pivotant, feux de croisement	
3308	Relä VBFS, bromsjust	Relay, rotating driver's seat, brake light	Relais, drehbarer Fahrersitz, Bremslicht	Relais, siège pivotant, feux stop	
3310	Relä VBFS, körvisare vxl	Relay, rotating driver's seat, direction indicator left	Relais, drehbarer Fahrersitz, Fahrtrichtungsanzeiger, L	Relais, siège pivotant, clignotant supplémentaire, ga.	
3311	Relä VBFS, körvisare hö	Relay, rotating driver's seat, direction indicator right	Relais, drehbarer Fahrersitz, Fahrtrichtungsanzeiger, R	Relais, siège pivotant, clignotant supplémentaire, dr.	
3330	Relä säkerhetsbälte	Relay, seat belt	Relais, sicherheitsgurt	Relais, ceinture de sécurité	
3331	Relä VBFS, drivning fram	Relay, rotating driver's seat, forward driving	Relais, drehbarer Fahrersitz, Antrieb vorn (LPG, Diesel)	Relais, siège pivotant, marche avant	
3332	Relä VBFS, drivning bak	Relay, rotating driver's seat, reversing driving	Relais, drehbarer Fahrersitz, Antrieb hinten (LPG, Diesel)	Relais, siège pivotant, marche arrière	
3349	Relä VBFS, fartreglage	Relay, rotating driver's seat, speed control	Relais, drehbarer Fahrersitz, Geschwindigkeitsregelung	Relais, siège pivotant, commande de vitesse	
3404	Relä VBFS, mastjust	Relay, rotating driver's seat, mast light	Relais, drehbarer Fahrersitz, Ladescheinwerfer	Relais, siège pivotant, feux de travail	

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3412	Relä bak ljus	Relay, rotating driver's seat, rear light	Relais, drehbarer Fahrersitz, Rücklicht	Relais, siège pivotant, feu arrière	
3768	Relä oljetryck hydraulik	Relay, hydraulic pressure	Relais, Öldruck, Hydraulik	Relais, pression d'huile hydraulique	
3769	Relä, blockering av hyttit	Relay, blocking of cab tilt	Relais, Kabinenneigung stop	Relais, blocage inclinaison de la cabine	
400L	G-lampa vä fram	Light bulb, roading light left hand front	Güßlampe, Scheinwerfer links vorn	Ampoule, projecteur avant gauche	
400R	G-lampa hö fram	Light bulb, roading light right hand rear	Güßlampe, Scheinwerfer rechts vorn	Ampoule, projecteur avant droite	
401L	G-lampa vä bak	Light bulb, roading light left hand front	Güßlampe, Scheinwerfer links hinten	Ampoule, projecteur arrière gauche	
401R	G-lampa hö bak	Light bulb, roading light right hand rear	Güßlampe, Scheinwerfer rechts hinten	Ampoule, projecteur arrière droite	
402	G-lampa fjärrljus	Light bulb, distance light	Güßlampe, Fernscheinwerfer	Ampoule, feux longue portée	
403	G-lampa lastljus	Light bulb, mast light	Güßlampe, Ladescheinwerfer	Ampoule, projecteur de chargement	
404	G-lampa arbetsljus	Light bulb, working light	Güßlampe, Arbeitsbeleuchtung	Ampoule, projecteur de travail	
405	G-lampa backljus	Light bulb, rear light	Güßlampe, Rückfahrcheinwerfer	Ampoule, feux de recul	
406L	G-lampa cont belysning vänster	Container light left-hand	Containerbeleuchtung links	Eclairage conteneur gauche	
406R	G-lampa cont belysning höger	Container light right-hand	Containerbeleuchtung rechts	Eclairage conteneur droite	
408L	G-lampa park ljus vä fram	Light bulb, parking light, left-hand forward	Güßlampe, Standlicht, links vorn	Ampoule, feux de stationnement, avant gauche	
408R	G-lampa park ljus hö fram	Light bulb, parking light, right-hand forward	Güßlampe, Standlicht, rechts vorn	Ampoule, feux de stationnement, avant droite	
410L	G-lampa broms ljus vä fram	Light bulb, brake light, left-hand forward	Güßlampe, Bremslicht, links vorn	Ampoule, feu stop, avant gauche	
410R	G-lampa broms ljus hö fram	Light bulb, brake light, right-hand forward	Güßlampe, Bremslicht, rechts vorn	Ampoule, feu stop, avant droite	
411L	G-lampa broms ljus vä bak	Light bulb, brake light, left-hand rear	Güßlampe, Bremslicht, links hinten	Ampoule, feu stop, arrière gauche	
411R	G-lampa broms ljus hö bak	Light bulb, brake light, right-hand rear	Güßlampe, Bremslicht, rechts hinten	Ampoule, feu stop, arrière droite	
412L	G-lampa bak ljus vä bak	Light bulb, rear light, left-hand rear	Güßlampe, Rücklicht, links hinten	Ampoule, feu arrière gauche	
412R	G-lampa bak ljus hö bak	Light bulb, rear light, right-hand rear	Güßlampe, Rücklicht, rechts hinten	Ampoule, feu arrière droite	
413L	G-lampa bak ljus vä fram (VBFS)	Light bulb, rear light, left-hand forward (VBFS)	Güßlampe, Rücklicht, links vorn (drehbarer Fahrersitz)	Ampoule, feu arrière, avant gauche	
413R	G-lampa bak ljus hö fram (VBFS)	Light bulb, rear light, right-hand forward (VBFS)	Güßlampe, Rücklicht, rechts vorn (drehbarer Fahrersitz)	Ampoule, feu arrière, avant droite	
416-1	G-lampa sidomarkering vä fram	Light bulb, side position light, left-hand forward	Güßlampe, seitliche Begrenzungsleuchte, links vorn	Ampoule, feu de position latérale avant gauche	
416-2	G-lampa sidomarkering vä bak	Light bulb, side position light, left-hand rear	Güßlampe, seitliche Begrenzungsleuchte, links hinten	Ampoule, feu de position latérale arrière gauche	
417-1	G-lampa sidomarkering hö fram	Light bulb, side position light, right-hand forward	Güßlampe, seitliche Begrenzungsleuchte, rechts vorn	Ampoule, feu de position latérale avant droite	
417-2	G-lampa sidomarkering hö bak	Light bulb, side position light, right-hand rear	Güßlampe, seitliche Begrenzungsleuchte, rechts hinten	Ampoule, feu de position latérale arrière droite	
420	G-lampa positionsljus vänster	Light bulb, position light, left-hand	Güßlampe, Positionsleuchte links	Ampoule, feu de position gauche	
421	G-lampa positionsljus höger	Light bulb, position light, right-hand	Güßlampe, Positionsleuchte rechts	Ampoule, feu de position droite	
422	G-lampa körvisare vä fram	Light bulb, direction indicator left-hand forward	Güßlampe, Fahrtrichtungsanzeiger links	Ampoule, clignotant avant gauche	
423	G-lampa körvisare hö fram	Light bulb, direction indicator right-hand forward	Güßlampe, Fahrtrichtungsanzeiger rechts vorn	Ampoule, clignotant avant droite	
426	G-lampa körvisare vä bak	Light bulb, direction indicator left-hand rear	Güßlampe, Fahrtrichtungsanzeiger links hinten	Ampoule, clignotant arrière gauche	



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427	G-lampa körvisare hö bak	Light bulb, direction indicator right-hand rear	Glühlampe, Fahrtrichtungsanzeiger rechts hinten	Ampoule, clignotant arrière droite	
428	G-lampa roterande varningsljus	Light bulb, flashing beacon lamp	Glühlampe, Rundum-Kennleuchte	Ampoule, gyrophare	
429	G-lampa cigarettändare belysning	Light bulb, cigarette lighter illumination	Glühlampe, Zigarettenanzünder-Beleuchtung	Ampoule, éclairage allume-cigares	
431	G-lampa instrument belysning	Light bulb, instrument illumination	Glühlampe, Instrumentenbeleuchtung	Ampoule, éclairage des instruments	
432	G-lampa handsfack belysning	Light bulb, glove pocket light	Glühlampe, Handschuhfachbeleuchtung	Ampoule, éclairage de la boîte à gants	
433	G-lampa instegs belysning	Light bulb, step-in lighting	Glühlampe, Einstiegbeleuchtung	Ampoule, éclairage de l'embarquement	
434	G-lampa innerbelysning	Light bulb, interior lighting	Glühlampe, Innenbeleuchtung	Ampoule, éclairage intérieur	
435	G-lampa läsbelysning	Light bulb, reading lighting	Glühlampe, Leselampe	Ampoule, éclairage de lecture	
436	G-lampa identifikationsljus	Light bulb, identification light	Glühlampe, Identifikationsleuchte	Ampoule, éclairage de plaque	
437	G-lampa identifikationsljus/takskylt	Light bulb, identification light/roof sign	Glühlampe, ID-Beleuchtung/Dachschild	Ampoule, signalisation toit intérieur cabine	
438	G-lampa motorrumsbelysning	Light bulb, engine compartment light	Glühlampe, Motorraumbeleuchtung	Ampoule, éclairage compartiment moteur	
440	G-lampa värmeregler belysning	Light bulb, heating control light	Glühlampe, Beleuchtung für Heizungsbedieung	Ampoule, éclairage commande chauffage	
445	G-lampa körvisare vä (extra)	Light bulb, extra direction indicator left	Glühlampe, Fahrtrichtungsanzeiger links, Extra	Ampoule, clignotant supplémentaire gauche	
446	G-lampa körvisare hö (extra)	Light bulb, extra direction indicator right	Glühlampe, Fahrtrichtungsanzeiger, rechts, Extra	Ampoule, clignotant supplémentaire droite	
451	G-lampa dimbakljus vänster	Light bulb, fog light rear left	Glühlampe, Nebelschlussleuchte links	Ampoule, feu de brouillard arrière gauche	
452	G-lampa dimbakljus höger	Light bulb, fog light rear right	Glühlampe, Nebelschlussleuchte rechts	Ampoule, feu de brouillard arrière droite	
453L	G-lampa bromsljus/körvisare vänster	Light bulb, brake light/dir. indicator left-hand	Glühlampe, Bremslicht/ Fahrtrichtung links	Ampoule, feu stop/ clignotant gauche	
453R	G-lampa bromsljus/körvisare höger	Light bulb, brake light/dir. indicator right-hand	Glühlampe, Bremslicht/ Fahrtrichtung rechts	Ampoule, feu stop/ clignotant droit	
454L	G-lampa bromsljus blackout vänster	Light bulb, brake light blackout left-hand	Glühlampe, Bremslicht/ Ausfall links	Ampoule, feu stop/ clignotant gauche blackout	
454R	G-lampa bromsljus blackout höger	Light bulb, brake light blackout right-hand	Glühlampe, Bremslicht/ Ausfall rechts	Ampoule, feu stop/ clignotant droit blackout	
456L	G-lampa backljus blackout IR vänster	Light bulb, rear light blackout IR left-hand	Glühlampe, Rueckfahrleuchte Ausfall IR links	Ampoule, feu de recul blackout infra rouge gauche	
456R	G-lampa backljus blackout IR höger	Light bulb, rear light blackout IR right-hand	Glühlampe, Rueckfahrleuchte Ausfall IR rechts	Ampoule, feu de recul blackout infra rouge droit	
457L	G-lampa positionsljus blackout vänster	Light bulb, position light blackout left-hand	Glühlampe, Positionslampe Ausfall links	Ampoule, feu de position blackout gauche	
457R	G-lampa positionsljus blackout höger	Light bulb, position light blackout right-hand	Glühlampe, Positionslampe Ausfall rechts	Ampoule, feu de position blackout droit	
458L	G-lampa fram blackout vänster	Light bulb, roading light blackout left-hand	Glühlampe, Abblendlicht Ausfall links	Ampoule, feu de route blackout gauche	
458R	G-lampa fram blackout höger	Light bulb, roading light blackout right-hand	Glühlampe, Abblendlicht Ausfall rechts	Ampoule, feu de route blackout droit	
459L	G-lampa fram blackout IR vänster	Light bulb, roading light blackout IR left-hand	Glühlampe, Abblendlicht Ausfall IR links	Ampoule, feu de route blackout infra rouge gauche	
459R	G-lampa fram blackout IR höger	Light bulb, roading light blackout IR right-hand	Glühlampe, Abblendlicht Ausfall IR rechts	Ampoule, feu de route blackout infra rouge droit	
460L	G-lampa arb.belysning hytt blackout IR vä	Light bulb, working light cab blackout IR left	Glühlampe, Arbeitsbeleuchtung kabine Ausfall links	Ampoule, éclairage cbine blackout infra rouge gauche	
460R	G-lampa arb.belysning hytt blackout IR hö	Light bulb, working light cab blackout IR right	Glühlampe, Arbeitsbeleuchtung kabine Ausfall rechts	Ampoule, éclairage cbine blackout infra rouge droit	
461L	G-lampa arb.bel. bom 20' blackout IR vä	Light bulb, working light boom20' b.out IR left	Glühlampe, Arbeitsbeleuchtung Ausleger 20' Ausfall IR links	Ampoule, feu de travail gauche sur la poutre pour les 20' blackout infra rouge	

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461R	G-lampa arb.bel. bom 20' blackout IR hö	Light bulb, working light boom20' b.out IR right	Glühlampe, Arbeitsbeleuchtung Ausleger 20' Ausfall IR rechts	Ampoule, feux de travail droit sur la poutre pour les 20' blackout infra rouge	
462L	G-lampa arb.bel. bom 40' blackout IR vä	Light bulb, working light boom40' b.out IR left	Glühlampe, Arbeitsbeleuchtung Ausleger 40' Ausfall IR links	Ampoule, feux de travail gauche sur la poutre pour les 40' blackout infra rouge	
462R	G-lampa arb.bel. bom 40' blackout IR hö	Light bulb, working light boom40' b.out IR right	Glühlampe, Arbeitsbeleuchtung Ausleger 40' Ausfall IR rechts	Ampoule, feux de travail droit sur la poutre pour les 40' blackout infra rouge	
463L	G-lampa bak ljus vänster bak, blackout	Light bulb, rear light left-hand rear, blackout	Glühlampe, Rueckfahrleuchte links hinten,Ausfall	Ampoule, feux de recul gauche blackout	
463R	G-lampa bak ljus höger bak, blackout	Light bulb, rear light right-hand rear, blackout	Glühlampe, Rueckfahrleuchte rechts hinten,Ausfall	Ampoule, feux de recul droit blackout	
464L	G-lampa cont belysning IR vänster	Light bulb, Container light IR left-hand	Glühlampe, Container Beleuchtung IR links	Ampoule, eclairage conteneurs infra rouge gauche	
464R	G-lampa cont belysning IR höger	Light bulb, Container light IR right-hand	Glühlampe, Contanier Beleuchtung IR rechts	Ampoule, eclairage conteneurs infra rouge droit	
500	Kont lampa körvisare	Indicating lamp, direction indicator	Kontrollampe, Fahrtrichtungsanzeiger	Témoin, clignotants	
501	Kont lampa körvisare (extra)	Indicating lamp, direction indicator extra	Kontrollampe, Fahrtrichtungsanzeiger, Extra	Témoin, clignotant supplémentaire	
503	Varn lampa oljetryck motor	Warning lamp, oil pressure engine	Warnlampe, Öldruck Motor	Voyant, pression d'huile moteur	
504	Kont lampa helijus	Indicating lamp, main beam	Kontrollampe, Fernlicht	Témoin, feux de route	
505	Varn lampa laddning	Warning lamp, loading	Warnlampe, Ladestrom	Voyant, charge	
506	Varn lampa laddning (extra)	Warning lamp, loading extra	Warnlampe, Ladestrom Extra	Voyant, charge supplémentaire	
507	Varn lampa färbroms	Warning lamp, brake	Warnlampe, Betriebsbremse	Voyant, frein de service	
508	Varn lampa parkerings broms	Warning lamp, parking brake	Warnlampe, Feststellbremse	Voyant, frein de stationnement	
509	Varn lampa nivå kylvatten	Warning lamp, coolant level	Warnlampe, Kühlflüssigkeitsstand	Voyant, niveau liquide de refroidissement	
510	Kont lampa diff spärr	Indicating lamp, diff. interlock	Kontrollampe, Differentialsperre	Témoin, blocage du différentiel	
512	Varn lampa temp momentförst	Warning lamp, temperature converter	Warnlampe, Temperatur Drehmomentwandler	Voyant, température du convertisseur	
514	Kont lampa överväxel	Indicating lamp, overdrive clutch	Kontrollampe, Overdrive	Témoin, overdrive	
519	Kont lampa halvljus	Indicating lamp, dipped lights	Kontrollampe, Abblendlicht	Témoin, feu de croisement	
524	Kont lampa luftfilter	Indicating lamp, air filter	Kontrollampe, Luftfilter	Témoin, filtre à air	
525	Kont lampa UNIKAT	Indicating lamp, UNIKAT	Kontrollampe, UNIKAT	Témoin, UNIKAT	
528	Kont lampa förvärmning	Indicating lamp, preheating	Kontrollampe, Vorwärmung	Témoin, préchauffage	
530	Kont lampa framhjul's styrning	Indicating lamp, forward wheel steering	Kontrollampe, Vorderrad lenkung	Témoin, roue avant directrice	
531	Kont lampa 4-hjul's styrning	Indicating lamp, 4-wheel steering	Kontrollampe, Vierradlenkung	Témoin, 4 roues directrices	
532	Kont lampa crab styrning	Indicating lamp, crab steering	Kontrollampe, Diagonal lenkung	Témoin, déplacement en diagonal	
533	Kont lampa hyd.pump	Indicating lamp, emergency hyd. pump	Kontrollampe, Akkumulatorladepumpe	Témoin, pompe hydraulique d'urgence	
547	Varn lampa centralvarning	Warning lamp, central warning	Warnleuchte, Zentrales Warnsystem	Voyant, signalisation centralisée	
549	Varn lampa oljetryck v-låda	Warning lamp, oil pressure gear box	Warnlampe, Öldruck Getriebe	Voyant, pression d'huile de la boîte	
550	Varn lampa hyttlåsning	Warning lamp, cab lock	Warnlampe, Kabinenverriegelung	Voyant, verrouillage de la cabine	
551	Varn lampa temp v-låda	Warning lamp, temperature gear box	Warnlampe, Temperatur Getriebe	Voyant, température de la boîte de vitesses	
552	Varn lampa bromstryck	Warning lamp, brake pressure	Warnlampe, Bremsdruck	Voyant, pression de freinage	
554	Varn lampa temp spolkrets bromsar	Warning lamp, temp. cooling system brakes	Warnlampe, Temperatur Spülkreis Bremsen	Voyant, température circuit de freins	



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555	Varn lamp temp kylvatten mot	Warning lamp, temperature coolant engine	Warnlampe, Temperatur Kühlwasser Motor	Voyant, température refroidissement moteur	
556	Varn lamp temp låsning vändskiva	Warning lamp, interlocking of turntable	Warnleuchte, Sperren der Sattelkupplung	Voyant, verrouillage de la sellette	
560	Varn lamp temp drivmotor el	Warning lamp, temperature, drive motor	Warnleuchte, Temperatur Antriebsmotor, el.	Voyant, temp.moteur propulsion, élect.	
561	Varn lamp temp pumphmotor el	Warning lamp, temperature, pump motor	Warnleuchte, Temperatur Pumpenmotor el.	Voyant, temp.moteur pompe, élect.	
562	Varn lamp temp öppen twistlock	Warning lamp, unlocked twist lock	Warnleuchte, Twistlock offen	Voyant, verrous non verrouillés	
563	Varn lamp temp låst twistlock	Warning lamp, locked twist lock	Warnleuchte, Twistlock geschlossen	Voyant, verrous verrouillés	
564	Varn lamp temp anliggning	Warning lamp, alignment	Warnleuchte, Auflage	Voyant, d'alignement	
569	Kont lamp temp elvärme	Indicating lamp, electric heater	Kontrollleuchte, Elektroheizung	Témoin, chauffage électrique	
569	Kont lamp temp elvärme	Indicating lamp, electric heater	Kontrollleuchte, Elektroheizung	Témoin, chauffage électrique	
570	Varn lamp temp överkoppling säkerhetssystem	Warning lamp, by-pass safety system	Warnleuchte, Sicherheitssystem umgeschaltet	Voyant, surconnection du système de sécurité	
571	Kont lamp temp bränslenivå	Indicating lamp, fuel level	Kontrolllampe, Kraftstoff	Témoin, niveau de carburant	
572	Varningslampe temp lyfthöjd	Warning lamp, lifting height	Warnlampe Hubhöhe	Lampe alarme, hauteur de levée	
573	Kontroll lamp temp motor information	Indicator lamp engine information	Kontrolllampe Motor-Information	Lampe de contrôle, information moteur	
574	Kontroll lamp temp stödben nere	Indicator lamp support jacks down	Kontrolllampe Stuetzbein unten	Lampe de contrôle, bequilles abaissées	
575	Kontroll lamp temp stödben ur arb.läge	Indicator lamp support jacks out of working position	Kontrolllampe Stuetzbein außerhalb Arbeitsposition	Lampe de contrôle, béquille relevées	
576	Kontroll lamp temp anliggning främre ben	Indicator lamp, alignment front legs	Kontrolllampe Auflage vorderes Bein	Lampe de contrôle, alignement jambes avant	
577	Kontroll lamp temp anliggning bakre ben	Indicator lamp, alignment rear legs	Kontrolllampe Auflage hinteres Bein	Lampe de contrôle, alignement jambes arrières	
578	Kontroll lamp temp klämläge främre ben	Indicator lamp, clamp position front legs	Kontrolllampe Klemmposition vordere Beine	Lampe de contrôle, position de verrouillage jambes avant	
579	Kontroll lamp temp klämläge bakre ben	Indicator lamp, clamp position rear legs	Kontrolllampe Klemmposition hintere Beine	Lampe de contrôle, position de verrouillage jambes arrières	
580	Kontroll lamp temp främre ben uppe	Indicator lamp, front legs upper position	Kontrolllampe vorderes Bein oben	Lampe de contrôle, position haute jambes avant	
581	Kontroll lamp temp främre ben nere	Indicator lamp, front legs lower position	Kontrolllampe vorderes Bein unten	Lampe de contrôle, position basse jambes arrières	
599	Kont lamp temp option	Indicating lamp, option	Kontrolllampe, Option	Témoin, option	
600	M-ventil avgasbroms	Solenoid valve, exhaust brake	Magnetventil, Motorbremse	Electrovanne, ralentisseur sur échappement	
601	M-ventil diff spärr	Solenoid valve, diff. interlock	Magnetventil, Differentialsperre	Electrovanne, blocage du différentiel	
602	M-ventil broms	Solenoid valve, brake	Magnetventil, Bremse	Electrovanne, frein	
603	M-ventil värme	Solenoid valve, heater	Magnetventil, Heizung	Electrovanne, chaleur	
604	M-ventil kraftfutttag sida	Solenoid valve, power take off, side	Magnetventil, Nebenantrieb Seite	Electrovanne, prise de force latérale	
605	M-ventil kraftfutttag bak	Solenoid valve, power take off, rear	Magnetventil, Nebenantrieb hinten	Electrovanne, prise de force arrière	
606	M-ventil 2/4 hjulsdrift	Solenoid valve, 2/4WD	Magnetventil, 2-Rad/4-Rad-Antriebe	Electrovanne, 2/4 roues motrices	
607	M-ventil höglåg växel	Solenoid valve, high/low gear	Magnetventil, Wechsel hoch/niedrig	Electrovanne, petite/grande vitesse	
608	Pumpaggregat temp hyttlyft	Pump unit, cab hoist	Pumpenanlage, Kabinenhub	Groupe pompe-moteur, élévation de cabine	

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609	Stålmotor gaspådrag	Regulating motor, throttle	Stellmotor, Gasgeben	Moteur de commande de gaz	
610	M-ventil hydraulsystem allm	Solenoid valve, hydraulics, general	Magnetventil, hydraulische Anlage allgemein	Electrovanne, système hydraulique, général	
611	M-ventil flödesbegränsning	Solenoid valve, flow restriction	Magnetventil, Fließbegrenzung	Electrovanne, limiteur de débit	
612	Stålmotor recirkulation	Regulating motor, re-circulation	Stellmotor, Re-zirkulation	Moteur de commande, re-circulation	
613	M-ventil momentförstärkare	Solenoid valve, torque amplifier	Magnetventil, Drehmomentwandler	Electrovanne, convertisseur de couple	
614	M-ventil rangespärr	Solenoid valve, ranging interlock	Magnetventil, Rangesperre	Electrovanne, blocage du doubleur	
615	M-ventil hjulvridning	Solenoid valve, wheel turning	Magnetventil, Radeinschlag	Electrovanne, pivotement roues	
616	M-ventil kallstart	Solenoid valve, cold start aid	Magnetventil, Kaltstarthilfe	Electrovanne, pour le démarrage a froid	
617	M-ventil AT-regulator by-pass	Solenoid valve, AT-regulator "by-pass"	Magnetventil, Abgasdruckregler "Bypass"	Electrovanne, by-pass du régulateur AT	
618	M-ventil vatten klimatanläggning	Solenoid valve, water air conditioner	Magnetventil, wasser klimaanlage	Electrovanne, pour l'eau du climatiseur	
620	M-ventil vändskiva upp	Solenoid valve, fifth wheel up	Magnetventil, Sattelkupplung, aufwärts	Electrovanne, sellette, montée	
621	M-ventil vändskiva ner	Solenoid valve, fifth wheel down	Magnetventil, Sattelkupplung, abwärts	Electrovanne, sellette, descente	
622	M-ventil vändskiva fram	Solenoid valve, fifth wheel forward	Magnetventil, Sattelkupplung, vorn	Electrovanne, sellette, marche avant	
623	M-ventil vändskiva bak	Solenoid valve, fifth wheel rear	Magnetventil, Sattelkupplung, hinten	Electrovanne, sellette, marche arrière	
624	M-ventil skevning hö	Solenoid valve, levelling right hand	Magnetventil, Niveausausgleich rechts	Electrovanne, corr.-niveau droits	
625	M-ventil skevning vä	Solenoid valve, levelling left hand	Magnetventil, Niveausausgleich links	Electrovanne, corr.-niveau gauche	
626	M-ventil AT-regulator	Solenoid valve, AT-regulator	Magnetventil, Abgasdruckregler	Electrovanne, régulateur AT	
630	M-ventil v-låda fram	Solenoid valve, gear box, forward gear	Magnetventil, Getriebe Vorwärtsgang	Electrovanne, boîte de vitesses marche avant	
631	M-ventil v-låda bak	Solenoid valve, gear box, rear gear	Magnetventil, Getriebe Rückwärtsgang	Electrovanne, boîte de vitesses marche arrière	
632	M-ventil v-låda spole 1	Solenoid valve, gear box, 1 gear	Magnetventil, Getriebe Schaltstufe I	Electrovanne, boîte vitesses rapport I	
633	M-ventil v-låda spole 2	Solenoid valve, gear box, 2 gear	Magnetventil, Getriebe Schaltstufe II	Electrovanne, boîte de vitesses rapport II	
634	M-ventil v-låda spole 3	Solenoid valve, gear box, 3 gear	Magnetventil, Getriebe Schaltstufe III	Electrovanne, boîte de vitesses rapport III	
635	M-ventil klämtryck	Solenoid valve, clamping pressure	Magnetventil, Anliegedruck	Electrovanne, pression de serrage	
636	M-ventil styrning	Solenoid valve, steering	Magnetventil, Lenkung	Electrovanne, direction	
637	M-ventil flytläge skevning	Solenoid valve, equalizing fifth wheel	Magnetventil, Ausgleich der Sattelkupplung	Electrovanne, équilibré de la selette	
638	M-ventil stopp insprut pump	Solenoid valve, stop injection pump	Magnetventil, Abstellung Einspritzpumpe	Electrovanne, arrêt de la pompe d'injection	
639	M-ventil låsning orbitrol ls	Solenoid valve, locking LS orbitrol	Magnetventil, Sperren LS Orbitrol	Electrovanne, verrouillage de LS Orbitrol	
640	M-ventil gasol	Solenoid valve, LPG	Magnetventil, LPG	Electrovanne, GPL	
641	M-ventil förångare (LPG)	Solenoid valve, evaporator (LPG)	Magnetventil, Verdampfer (LPG)	Electrovanne, évaporateur (GPL)	
642	M-ventil park broms	Solenoid valve, parking brake	Magnetventil, Feststellbremse	Electrovanne, frein de stationnement	
643	M-ventil låsning stol (VBFS)	Solenoid valve, seat locking (VBFS)	Magnetventil, Sitzsperre (VBFS)	Electrovanne, verrouillage du siège (VBFS)	
644	M-ventil låsning vändskiva	Solenoid valve, fifth wheel locking	Magnetventil, Sperren Sattelkupplung	Electrovanne, verrouillage de la sellette	
645	Magnetkoppling komp AC	Magnetic clutch, compressor AC	Magnetkupplung, Kompressor Klimaanlage	Coupleur magnétique, compresseur climatisation	
646	M-ventil stolsvändning	Solenoid valve, seat rotation	Magnetventil, Drehen des Sitzes	Electrovanne, pivotement du siège	
647	M-ventil stolstilt	Solenoid valve, seat tilt	Magnetventil, Kippen des Sitzes	Electrovanne, basculement du siège	
648	M-ventil luftfjädring	Solenoid valve, pneumatic springing	Magnetventil, Luftfederung	Electrovanne, suspension pneumatique	
649	Termostat klimatanläggning	Thermostat, air condition	Thermostat, Klimaanlage	Thermostat, climatisation	

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650-1	Torkarmotor fram	Wiper motor forward	Scheibenwischermotor vorn	Moteur essuie-glace avant	
650-2	Torkarmotor bak	Wiper motor rear	Scheibenwischermotor hinten	Moteur essuie-glace arrière	
650-3	Torkarmotor tak	Wiper motor roof	Scheibenwischermotor Dach	Moteur essuie-glace pavillon	
650-4	Torkarmotor tak (option)	Wiper motor roof (option)	Scheibenwischermotor Dach (Option)	Moteur essuie-glace pavillon (option)	
651	Vindrutespolarmotor	Washer motor	Motor für Scheibenwaschanlage	Moteur lave-glace	
652	Strålkastarmotor	Light motor	Motor för Scheinwerfer	Moteur projecteurs	
653	Strålkastarspolarmotor	Light washer motor	Motor für Scheinwerferreinigungsanlage	Moteur lave-phares	
654	Startmotor	Starter motor	Anlasser	Démarrreur	
655	Kylfläkt drivmotor (EC)	Cooling fan, main motor (EC)	Lüfter Antriebsmotor (EC)	Moteur du ventilateur (EC)	
656	Kylfläkt elskåp (EC)	Cooling fan, electrical box (EC)	Lüfter Schaltschrank (EC)	Boîtier électrique du ventilateur (EC)	
657	Fläktmotor värme	Heating fan	Gebläsemotor (Heizung)	Moteur du ventilateur (chauffage)	
658	Generator (extra)	Alternator extra	Generator, Extra	Alternateur supplémentaire	
659	Generator utan laddregulator	Alternator without loading regulator	Generator ohne angebaute Reglerschalter	Alternateur sans régulateur de charge	
660	Generator med laddregulator	Alternator with loading regulator	Generator mit angebaute Reglerschalter	Alternateur avec régulateur de charge	
661	Fönsterhissmotor	Screen elevator motor	Fensterhebermotor	Moteur lève-glaces	
662	Laddregulator	Loading regulator	Reglerschalter	Régulateur de charge	
663	Doseringspump klimatanläggning	Dosage pump, air condition	Dosierpumpe, Klimaanlage	Pompe de dosage, climatisation	
664	Cirk pump klimatanläggning	Circulating pump, air condition	Umwälzpumpe, Klimaanlage	Pompe de circulation, climatisation	
665	Diod	Diode	Diode	Diode	
666	Fläktmotor cirkulation	Circulation fan	Umluftgebläse	Moteur du ventilateur (circulation)	
667	Cirkulationspump värmesystem	Circulation pump heating system	Wärmetauscher Heizsystem	Pompe de circulation circuit de chauffage	
668	Kylfläkt hydraulolja	Cooling fan, hydraulic oil	Gebläse, Hydrauliköl	Ventilateur, radiateur huile hydraulique	
669	Värmare kupe/ motor diesel	Heater compartment/engine diesel	Innenheizung/ Dieselmotor	Réchauffeur pour habitacle et moteur	
670	Kompressor	Compressor	Kompressor	Compresseur	
671	Doseringspump diesel	Dosage pump diesel	Einspritzpumpe Diesel	Pompe de dosage pour diesel	
672	Spjäll motor, ECC	Draught valve motor, ECC	Drosselventil Motor, ECC	Valve de traction pour moteur, ECC	
673	Vatten ventil motor, ECC	Water valve motor, ECC	Wasserventil Motor, ECC	Soupape pour refroidissement moteur, ECC	
674	Kylfläkt bromsolja	Cooling fan, brake fluid	Gebläse, Bremsöl	Refroidisseur, huile de frein	
685	Reglerenhet termostat AC	Control unit, thermostat AC	Reglereinheit, Thermostat AC	Unité de régulation, Thermostat AC	
690	Fartreglage (EC)	Speed control (EC)	Geschwindigkeitsregler (EC)	Régulation de la vitesse (EC)	
693	Pump centralsmörjning	Pump, central lubrication	Pumpe, Zentralschmierung	Pompe, graissage centralisé	
694	Styrmotor	Steering motor	Steuermotor	Moteur de direction	
695	Drivmotor (EC)	Drive motor (EC)	Antriebsmotor (EC)	Moteur d'entraînement (EC)	
696	Pumpaggregate nödstyrning	Pump, emergency steering	Pumpe, Notlenkung	Pompe, direction de secours	
697	Elbroms	Electric brake	E-Bremse	Frein électrique	
698	Pumpmotor (EC)	Pump motor (EC)	Pumpenmotor (EC)	Moteur de la pompe (EC)	
699	M-ventil option	Solenoid valve, option	Magnetventil (option)	Electrovanne, (option)	
6001	M-ventil blockering höger	Solenoid valve, blocking right	Magnetventil, Blockierung rechts	Electrovanne, blocage droit	
6002	M-ventil blockering vänster	Solenoid valve, blocking left	Magnetventil, Blockierung links	Electrovanne, blocage gauche	

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6003	M-ventil inkoppling av hydraulik till topplyft	Solenoid valve, activation of toplift hydraulics	Magnetventil, Aktivierung von Oberhubhydraulik	Electrovanne, alimentation hydraulique du levage supérieur	
6004	M-ventil sänk	Solenoid valve, lower	Magnetventil, Senken	Electrovanne, descente	
6005	M-ventil lyft	Solenoid valve, lift	Magnetventil, Heben	Electrovanne, levage	
6006	M-ventil bom ut	Solenoid valve, boom out	Magnetventil, Ausleger aus	Electrovanne, flèche sortie	
6007	M-ventil bom in	Solenoid valve, boom in	Magnetventil, Ausleger ein	Electrovanne, flèche rentrée	
6008	M-ventil vridning medsols	Solenoid valve, rotation clockwise	Magnetventil, Rotation im Uhrzeigersinn	Electrovanne, rotation horaire	
6009	M-ventil vridning motsols	Solenoid valve, rotation counter-clockwise	Magnetventil, Rotation entgenen Uhrzeigersinn	Electrovanne, rotation anti-horaire	
6010	M-ventil tilt ut	Solenoid valve, tilt out	Magnetventil, Neigung aus	Electrovanne, inclinaison sortie	
6011	M-ventil tilt in	Solenoid valve, tilt in	Magnetventil, Neigung ein	Electrovanne, inclinaison rentrée	
6012	M-ventil tilt	Solenoid valve, tilt	Magnetventil, Neigung	Electrovanne, inclinaison	
6013	M-ventil fällning främre ben	Solenoid valve, lowering front legs	Magnetventil, vorderes Bein ab	Electrovanne, béquille avant baisse	
6014	M-ventil fällning bakre ben	Solenoid valve, lowering rear legs	Magnetventil, hinteres Bein ab	Electrovanne, béquille arrière baisse	
6015	M-ventil klämma/lossa ben	Solenoid valve, clamping/releasing legs	Magnetventil, Klemmen/-Lösen der Beine	Electrovanne, serrage/desserrage béquilles	
6016	M-ventil Hyttskjutning fram	Solenoid valve, cab movement forward	Elektro-Magnetventil, Kabinenversetzung vorwärts	Electrovanne, mouvement avant de la cabine	
6017	M-ventil Hyttskjutning bak	Solenoid valve, cab movement reverse	Elektro-Magnetventil, Kabinenversetzung hinten	Electrovanne, mouvement arrière de la cabine	
6018	M-ventil spridning ut	Solenoid valve, spreading out	Elektro-Magnetventil, verstellung auswärts	Electrovanne, dispersion en dehors	
6019	M-ventil spridning in	Solenoid valve, spreading in	Elektro-Magnetventil, verstellung einwärts	Electrovanne, dispersion en dedans	
6020	M-ventil sidoföring vänster	Solenoid valve, side shift left	Elektro-Magnetventil schiebeträger links	Electrovanne, translation laterale à gauche	
6021	M-ventil sidoföring höger	Solenoid valve, side shift right	Elektro-Magnetventil schiebeträger rechts	Electrovanne, translation laterale à droite	
6022	M-ventil extra hydraulfunktion ut	Solenoid valve, extra hydraulic function out	Elektro-Magnetventil extra auswärts	Electrovanne, supplémentaire en dehors	
6023	M-ventil extra hydraulfunktion in	Solenoid valve, extra hydraulic function in	Elektro-Magnetventil extra einwärts	Electrovanne, supplémentaire en dedans	
6024	M-ventil stativ ut	Solenoid valve, mast out	Elektro-Magnetventil hubgerüst aus	Electrovanne mat de lev. ret.	
6025	M-ventil stativ in	Solenoid valve, mast in	Elektro-Magnetventil hubgerüst ein	Electrovanne mat de lev. ext.	
6026	M-ventil höger framhjul styrning vänster	Solenoid valve, right front wheel, steering left	Magnetventil, Vorderrad rechts, Lenkung links	Electrovanne, roue avant droite/ direction gauche	
6027	M-ventil höger framhjul styrning höger	Solenoid valve, right front wheel, steering right	Magnetventil, Vorderrad rechts, Lenkung rechts	Electrovanne, roue avant droite/ direction droite	
6028	M-ventil vänster framhjul styrning vänster	Solenoid valve, left front wheel, steering left	Magnetventil, Vorderrad links, Lenkung links	Electrovanne, roue avant gauche/direction gauche	
6029	M-ventil vänster framhjul styrning höger	Solenoid valve, left front wheel, steering right	Magnetventil, Vorderrad links, Lenkung rechts	Electrovanne, roue avant gauche/direction droite	
6030	M-ventil höger bakhjul styrning vänster	Solenoid valve, right rear wheel, steering left	Magnetventil, Hinterrad rechts, Lenkung links	Electrovanne, roue arrière droite/ direction gauche	
6031	M-ventil höger bakhjul styrning höger	Solenoid valve, right rear wheel, steering right	Magnetventil, Hinterrad rechts, Lenkung rechts	Electrovanne, roue arrière droite/ direction droite	
6032	M-ventil vänster bakhjul styrning vänster	Solenoid valve, left rear wheel, steering left	Magnetventil, Hinterrad links, Lenkung links	Electrovanne, roue arrière gauche/ direction -	



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6033	M-ventil vänster bakhjul styrning höger	Solenoid valve, left rear wheel, steering right	Magnetventil, Hinterrad links, Lenkung rechts	gauche Electrovanne, roue arrière gauche/ direction droite	
6034	M-ventil skevning	Solenoid valve, levelling	Magnetventil, Niveausgleich	Electrovanne, levage	
6035	M-ventil skevning höger	Solenoid valve, levelling right	Magnetventil, Niveausgleich rechts	Electrovanne, levage droit	
6036	M-ventil skevning vänster	Solenoid valve, levelling left	Magnetventil, Niveausgleich links	Electrovanne, levage gauche	
6037	M-ventil kylfläkt	Solenoid valve, Cooling fan	Magnetventil, Gebläse	Electrovanne, ventilateur de refroidissement	
6038	M-ventil frikoppling koppling	Solenoid valve, lockup clutch	Magnetventil, Auskuppeln	Electrovanne, embrayage 'point mort'	
6039	M-ventil öppna twistlock	Solenoid valve, unlocked twist lock	Magnetventil, Twistlock öffnen	Electrovanne, verrous non verrouillés	
6040	M-ventil låsa twistlock	Solenoid valve, locked twist lock	Magnetventil, Twistlock schließen	Electrovanne, verrous verrouillés	
6041	M-ventil nöd, twistlock	Solenoid valve, emergency, twistlock	Magnetventil, Twistlock ueberbrueck	Electrovanne, ungence verrous	
6042	M-ventil mellan bom	Solenoid valve, middle boom	Magnetventil, Mast mittlerer	Electrovanne, milieu de la poutre	
6043	Magnetventil, fällning torn (RTCH)	Solenoid valve, boom lowering (RTCH)	Magnetventil, Ausleger senken (RTCH)	Electrovanne, abaissement du support AR de la poutre télescopique (RTCH)	
6044	M-ventil blockering twistlock	Solenoid valve, blocking twistlock	Magnetventil, Twistlock überbrücken	Electrovanne, blocage des twistlocks	
6045	M-ventil blockering lyft	Solenoid valve, blocking lift	Magnetventil, Heben überbrücken	Electrovanne, blocage de la levée	
6046	M-ventil utskjut	Solenoid valve, projecting	Magnetventil, Längengeber	Electrovanne, blocage du déploiement	
6047	M-ventil, hyttit upp	Solenoid valve, cab tilt up	Magnetventil, Kabinenneigung oben	Electrovanne, inclinaison cab position haute	
6048	M-ventil, hyttit ner	Solenoid valve, cab tilt down	Magnetventil, Kabinenneigung unten	Electrovanne, inclinaison cab position basse	
6049	M-ventil, kylkrets broms	Solenoid valve, cooling circuit brake	Magnetventil, Kühlkreislauf Bremse	Electrovanne, refroidissement des freins	
6050	M-ventil blockering utskjut	Solenoid valve, blocking projecting	Magnetventil, Blockierung teleskopieren	Electrovanne pour blocage extension	
6051	M-ventil, regenerering höger	Solenoid valve, regeneration right	Magnetventil, regeneration rechts	Electrovanne regeneration droite	
6052	M-ventil, regenerering vänster	Solenoid valve, regeneration left	Magnetventil, regeneration links	Electrovanne, regeneration gauche	
6053	M-ventil, körläge	Solenoid valve, driving position	Magnetventil, Fahrposition	Electrovanne, en position de conduite	
6054	M-ventil, klämma ihop	Solenoid valve, clamping in	Magnetventil, zuklammern	Electrovanne, serrage	
6055	M-ventil, klämma isär	Solenoid valve, clamping out	Magnetventil, aufklammern	Electrovanne, déserrage	
6056	M-ventil, främre knä ut	Solenoid valve, front knee out	Magnetventil, vorderes Knie ausklappen	Electrovanne, sortie d'articulation avant	
6057	M-ventil, främre knä in	Solenoid valve, front knee in	Magnetventil, vorderes Knie einklappen	Electrovanne, rentrée d'articulation avant	
6058	M-ventil, bakre knä ut	Solenoid valve, rear knee out	Magnetventil, hinteres Knie ausklappen	Electrovanne, sortie d'articulation arrière	
6059	M-ventil, bakre knä in	Solenoid valve, rear knee in	Magnetventil, hinteres Knie einklappen	Electrovanne, rentrée d'articulation arrière	
6060	M-ventil, främre ben upp	Solenoid valve, front legs up	Magnetventil, vorderes Bein hoch	Electrovanne, position haute jambes avant	
6061	M-ventil, bakre ben upp	Solenoid valve, rear legs up	Magnetventil, hinteres Bein hoch	Electrovanne, position haute jambes arrières	
6062	M-ventil, urkoppling hydraulpump	Solenoid valve interruption hydraulic pump	Magnetventil, auskuppeln Pumpe	Electrovanne, coupure de pompe	
6063	M-ventil, stödben upp	Solenoid valve, brace up	Magnetventil, Stuetzbein oben	Electrovanne béquille levée	
6064	M-ventil, stödben ner	Solenoid valve, brace down	Magnetventil, Stuetzbein unten	Electrovanne béquille baissée	
700	Hastighetsmätare	Speedometer	Tachometer	Compteur de vitesse	
701	Mätare oljetemp v-låda	Gear box oil temperature gauge	Meßinstrument, Öltemperatur Getriebe	Thermomètre, huile de la boîte	
702	Klocka	Clock	Uhr	Montre	

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703	Varvtalsmätare	Engine rev meter	Drehzahlmesser	Compte-tours	
704	Tryckluftsmätare	Air pressure gauge	Druckluftmesser	Manomètre, air	
705	Mätare oljetryck v-låda	Gear box oil pressure gauge	Meßinstrument, Öldruck Getriebe	Manomètre, huile de la boîte	
706	Termometer temp kylvätska motor	Temperature gauge, engine coolant	Thermometer, Temperatur Kühlfüssigkeit Motor	Thermomètre, temp. liquide refroidissement moteur	
707	Bränslemätare	Fuel gauge	Kraftstoffanzeiger	Jauge de carburant	
708	Timräknare	Hour meter	Betriebsstundenzähler	Compteur horaire	
709	Kapacitetsmätare batteri	Capacity gauge, battery	Kapazitätsmesser	Indicateur de capacité, batterie	
710	Tidur motor/kupevärmare	Timer, engine- and cab heater	Schaltuhr, motor- und Kabinenheizung	Minuterie, chauffage moteur et habitacle	
711	Räknare, impuls	Counter, impulse	Zähler, impuls	Compteur d'impulsion	
712	Mätare oljetryck motor	Motor oil pressure gauge	Maßinstrument, Öldruck Motor	Minuterie, pression d'huile moteur	
714	Mätare, temp. Hydraulolja	Hydraulic fluid temperature, gauge	Maßinstrument, temperatur hydrauliköl	Minuterie, température huile hydraulique	
715	Extra instrument allm	Extra instrument, general	Zusatzinstrument, allgemein	Instruments supplémentaires, général	
720	Givare vändbar förarsstol	Transmitter, revolving driver's seat (VBFS)	Geber, drehbarer Fahrersitz (VBFS)	Capteur, siège de conduite pivotant (VBFS)	
751	Givare varvtal turbin	Transmitter, speed turbin	Geber, Drehzahl Turbine	Capteur, nombre de tour turbine	
752	Givare varvtal inre växellåda	Transmitter, speed internal gear chain	Geber, Getriebe Schaltpunkt	Capteur, nombre de tour à l'intérieur de la boîte de vitesse	
753	Varvtalsgivare motor	Transmitter, engine revolution	Drehzahlgeber Motor	Capteur de régime moteur	
754	Givare lufttryck	Transmitter, air pressure	Geber, Luftdruck	Capteur, pression d'air	
755	Givare hydraulfilter indikering	Transmitter, hydraulics filter indication	Geber, Hydraulikfilter Anzeige	Capteur, indication filtre à l'huile	
756	Temperatur kylvätska motor	Transmitter, engine coolant temperature	Temperaturgeber, Kühlfüssigkeit Motor	Capteur de température, liquide de refroidissement	
757	Bränslenivågivare	Transmitter, fuel level	Kraftstoffstandgeber	Capteur de niveau de carburant	
758	Varvtalsgivare v-låda	Transmitter, gear box revolution	Drehzahlgeber Getriebe	Capteur de régime boîte de vitesses	
759	Nivåindikator kylvätska	Transmitter, coolant level	Flüssigkeitsstandanzeiger, Kühlfüssigkeit	Indicateur de niveau, liquide de refroidissement	
760	Givare rev-spärr/aut-vxl trans	Transmitter, reversing interlock / automatic gear change system (on gearbox output shaft)	Geber Umkehrsperr/automatische Schaltung	Capteur blocage marche arrière/ changement automatique transmission	
761	Givare rev-spärr/aut-vxl motor	Transmitter, reversing interlock / automatic gear changing system (engine speed)	Geber Umkehrsperr/automatische Schaltung Motor	Capteur blocage marche arrière/ changement automatique moteur	
762	Givare temp spolkreets bromsar	Transmitter, brake flushing circuit	Geber, Temperatur Spülkreis Bremsen	Capteur, temp. circuit refroidiss. freins	
763	Givare nivå hydraulolja	Transmitter, hydraulic fluid level	Geber, Hydraulikölstand	Capteur, niveau huile hydraulique	
764	Givare servotryck växellåda	Transmitter, gear box servo pressure	Geber, Servodruck, Getriebe	Capteur, pression servo de la boîte	
765	Givare oljetryck v-låda	Transmitter, oil pressure gear box	Geber, Öldruck Getriebe	Capteur, pression d'huile de la boîte	
766	Givare oljetemp. v-låda	Transmitter, oil temperature gear box	Geber, Öltemperatur Getriebe	Capteur, température d'huile de la boîte	
767	Givare oljetryck motor	Transmitter, oil pressure engine	Geber, Öldruck Motor	Capteur, pression d'huile moteur	
768	Givare oljetryck hydraulik	Transmitter, hydraulic pressure	Geber, Öldruck, Hydraulik	Capteur, pression d'huile hydraulique	
769	Givare ändläge	Transmitter, end position	Geber, Anschlag	Capteur fin de course	
770	Givare rattutslag	Transmitter, steering wheel angle	Geber, lenkradeinschlag	Capteur, braquage	

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771	Givare vinkel	Transmitter, angle	Geber, Winkel	Capteur, angle	
772	Givare temp bromsolja	Transmitter, temperature brake fluid	Geber, Temperatur Bremskuehlöl	Capteur, température liquide de frein	
773	Givare närvaro	Transmitter, presence	Geber, Präsenz	Capteur, présence	
774	Givare utomhustemp	Transmitter, ambient temperature	Geber, Außentemperatur	Capteur, température extérieure	
775	Givare temp klimatanläggning	Transmitter, temperature air condition	Geber, Temperatur, Klimaanlage	Capteur, de température, climatisation	
776	Givare temp hydraulolja	Transmitter, hydraulic temperature	Geber, Temperatur, Hydrauliköl	Capteur, température huile hydraulique	
777	Givare läge	Transmitter, position	Geber, Position	Capteur, position	
778	Givare drivbrytning	Transmitter, drive break	Geber, Antriebsabschaltung	Capteur, arrêt d'entraînement	
779	Reglersystem återladdning (EC)	Control system, recharging (EC)	Steuersystem, Aufladung (EC)	Système de régulation de recharge (EC)	
780	Reglersystem åkmotor (EC)	Control system main motor (EC)	Regelsystem, Fahrmotor (EC)	Système de régulation moteur d'avancement (EC)	
781	Reglersystem pumpmotor (EC)	Control system pump motor (EC)	Regelsystem Pumpenmotor (EC)	Système de régulation moteur de la pompe (EC)	
782	Logik interface 2 drivmotorer	Logic (interface) two main motors (EC)	Logik (Schnittstelle) zwei Antriebsmotoren	Interface deux moteurs de propulsion	
783	Logik interface gaspådrag	Logic (interface) throttle	Logik (Interface) Gasgeben	Interface d'accélérateur	
784	Logik interface bromsregl	Logic (interface) brake control	Logik (Interface) Bremssteuerung	Interface de commande de frein	
785	Logik interface styrsystem	Logic (interface) control system	Logik (Interface) Lenkung	Interface de système de commande	
786	Servoförstärkare styrsystem	Servo amplifier steering system	Servoverstärker, Steuerungssystem	Amplificateur pour le servo commande du système de direction	
789	Givare allmän	Transmitter, common	Geber, allgemein	Capteur, général	
790	Elektronisk kontrollenhet ECU, hytt	Electronic Control Unit ECU, cab	Elektronische Kontrolleinheit ECU, Kabine	Unité de control électronique ECU, cabine	
791	Elektronisk kontrollenhet aggregat	Electronic Control Unit, attachment	Elektronische Kontrolleinheit, Aggregat	Unité électronique de control accessoire	
792	Elektronisk kontrollenhet styrning	Electronic Control Unit, steering system	Elektronische Kontrolleinheit, Lenkung	Unité électronique de control système de direction	
793	Elektronisk kontrollenhet växellåda	Electronic Control Unit, gearbox	Elektronische Kontrolleinheit, Getriebe	Unité électronique de control boîte de vitesse	
794	Elektronisk kontrollenhet motor	Electronic Control Unit, engine	Elektronische Kontrolleinheit, Motor	Unité électronique de control boîte moteur	
795	Display	Display	Display	Afficheur	
796	Elektronisk kontrollenhet, lasthantering	Electronic Control Unit, Loadhandling	Elektronische Kontrolleinheit, Ladengerät	Unité électronique de control pour la manutention de la charge	
797	Elektronisk kontrollenhet, ram	Electronic Control Unit, frame	Elektronische Kontrolleinheit, Rahmen	Unité de control électronique ECU, chassis	
799	Logik allm (option)	Logic, general (option)	Logik, allgemein (option)	Circuit logique, général (option)	
7200	Givare, axeltryck höger	Sensor, axle pressure right	Drucksensor, Achsdruck rechts	Capteur de pression, arbre du vérin du levage droit	
7201	Givare, axeltryck vänster	Sensor, axle pressure left	Drucksensor, Achsdruck links	Capteur de pression, arbre du vérin du levage gauche	
7202L	Givare, anliggning vänster fram	Sensor, alignment left front	Geber, Auflage links vorne	Capteur de pression, alignement avant gauche	
7202R	Givare, anliggning höger fram	Sensor, alignment right front	Geber, Auflage rechts vorne	Capteur de pression, alignement avant droit	
7203L	Givare, anliggning vänster bak	Sensor, alignment left rear	Geber, Auflage links hinten	Capteur de pression, alignement arrière	

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				gauche	
7203R	Givare, anliggning höger bak	Sensor, alignment right rear	Geber,Auflage rechts hinten	Capteur de pression, alignement arrière droit	
7204L	Givare, öppen vänster twistlock	Sensor, unlocked twistlock left	Geber, Twistlock links offen	Capteur de position, verrous non verrouillés gauche	
7204R	Givare, öppen höger twistlock	Sensor, unlocked twistlock right	Geber, Twistlock rechts offen	Capteur de position, verrous non verrouillés droit	
7205L	Givare, låst vänster twistlock	Sensor, locked twistlock left	Geber, Twistlock links geschlossen	Capteur de position,verrous verrouillés gauche	
7205R	Givare, låst höger twistlock	Sensor, locked twistlock right	Geber, Twistlock rechts geschlossen	Capteur de position, verrous verrouillés droit	
7206	Givare, gaffel aggregat	Sensor, fork attachment	Geber, Gabel Aggregat	Capteur de position, accessoire fourches	
7207	Givare, 2WD/4WD	Sensor, 2WD/4WD	Geber, 2WD/4WD	Capteur de position, 2 ou 4 roues motrices	
7208	Givare, hytt i köräge	Sensor, Cab in drive position	Geber, kabinverstellung	Capteur, Cabine eu position de conduite	
7209	Givare, oljefilter indikering	Sensor, Oil filter indication	Geber, Oilfilter indication	Capteur, indication filtre à huile	
7210	Givare, hytt i transportläge	Sensor, Cab in transportation position	Geber, Kabine im Position	Capteur, cabine en position de transport	
7211	Givare, lyfthöjd	Sensor, lifting height	Geber, Hubhöhe	Capteur, hauteur de levée	
7212	Givare, köräge	Sensor, driving position	Geber, Fahrposition	Capteur, position de conduite	
7213	Givare, Anliggning främre ben	Sensor, Alignment front legs	Geber, Anliegen vordere Beine	Capteur, alignement jambes avants	
7214	Givare, Anliggning bakre ben	Sensor, Alignment rear legs	Geber, Anliegen hinten Beine	Capteur, alignement jambes arrières	
7215	Givare, kläm främre ben	Sensor, Clamp front legs	Geber, Anliegen Beine vorne	Capteur, position de verrouillage jambes avants	
7216	Givare, kläm bakre ben	Sensor, Clamp rear legs	Geber, Anliegen Beine hinten	Capteur, position verrouillage jambes arrières	
7217	Givare, främre knä	Sensor, front knee	Geber, vorderes Knie	Capteur, articulation avant	
7218	Givare, bakre knä	Sensor, rear knee	Geber, hinteres Knie	Capteur articulation arriere	
7219	Givare, främre ben	Sensor, front legs	Geber, vorderes Bein	Capteur jambes avants	
7220	Givare, bakre ben	Sensor, rear legs	Geber, hinteres Bein	Capteur, jambes arrières	
7221	Givare, styraxel	Sensor, steering axle	Geber, Lenkachse	Capteur, essieu directeur	
7222	Givare, stödben uppe	Sensor, brace up	Geber, Stuetzbein oben	Capteur béquille levée	
7223	Givare, stödben nere	Sensor, brace down	Geber, Stuetzbein unten	Capteur béquille baissée	
800	Startelement	Start element	Startelement	Réchauffeur de démarrage	
802	Eluppvärmd backspegel	Electrical heated observation mirror	Elektrisch beheizter Rückspiegel	Rétroviseur à chauffage électrique	
803	Eluppvärmd stol	Electrical heated seat	Elektrisch beheizter Sitz	Siège à chauffage électrique	
804	Cigaretändare	Cigaret lighter	Zigarettenanzünder	Allume-cigares	
805	Elvärme hytt	Electrical heating cab	Elektrische Heizung Kabine	Chauffage électrique cabine	
806	Aggregat klimatanläggning	Aggregate, air conditioner	Aggregat, Klimaanlage	Groupe climatisation	
807	Potentiometer	Potentiometer	Potentiometer	Potentiomètre	
808	Eluppvärmd lufttorkare	Electrical heater air dryer	Elektrisch beheizter Lufttrockner	Séchage à l'air, à chauffage électrique	
810	Kondensor AC, fläkt	Condensor AC, fan	Kondensor Klimaanlage, Gebläse	Condenseur climatisation, ventilateur	
815	Manöverspak	Control lever	Bedienungshebel	Levier de commande	
820	Motstånd	Resistor	Widerstand	Résistance	

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822	Signalfilter	Signal filter	Signalfilter	Filter de signal	
823	Signalomvandlare höger	Signal amplifier, right	Signalverstärker, rechts	Amplificateur de signaux, droit	
824	Signalomvandlare vänster	Signal amplifier, left	Signalverstärker, links	Amplificateur de signaux, gauche	
825	Reglage spakstyrning	Controls, (steering with control levers)	Regler, Hebelsteuerung	Commande, leviers	
826	Ventil spakstyrning	Valve, (steering with control levers)	Ventil, Hebelsteuerung	Distributeur, leviers	
827	Växellåda	Gearbox	Getriebe	Bolt de vitesse	
830	Tändspole	Ignition coil	Zündspule	Bobine d'allumage	
835	Tändstift	Ignition plug	Zündkerze	Bougie	
840	Strömfördelare	Distributor	Stromverteiler	Distributeur	
850	Signalhorn	Horn	Signalhorn	Avertisseur sonore	
853	Summer	Buzzer	Summer	Signal sonore	
8071	Potentiometer lyft/sänk	Potentiometer lift/lower	Potentiometer heben/senken	Potentiomètre levage/descente	
8072	Potentiometer tilt	Potentiometer tilt	Potentiometer neigen	Potentiomètre inclinaison	
8073	Potentiometer sidoföring	Potentiometer side shifting	Potentiometer schiebeträger	Potentiomètre translation laterale	
8074	Potentiometer spridning	Potentiometer spreading	Potentiometer verstellung	Potentiomètre dispersion	
8075	Potentiometer extra	Potentiometer extra	Potentiometer extra	Potentiomètre supplémentaire	
8076	Potentiometer mast in/out	Potentiometer reach in/out	Potentiometer ein/aus-fahren	Potentiomètre, mat de lev ext-ret.	
8077	Potentiometer höger framhjul	Potentiometer right front wheel	Potentiometer vorderrad rechts	Potentiomètre, roue avant droite	
8078	Potentiometer vänster framhjul	Potentiometer left front wheel	Potentiometer vorderrad links	Potentiomètre, roue avant gauche	
8079	Potentiometer höger bakhjul	Potentiometer right rear wheel	Potentiometer hinterrad rechts	Potentiomètre, roue arrière droite	
8080	Potentiometer vänster bakhjul	Potentiometer left rear wheel	Potentiometer hinterrad links	Potentiomètre, roue arrière gauche	
8081	Potentiometer tiltvinkel	Potentiometer tilt angle	Potentiometer niegungswinkel	Potentiomètre, inclinaison	
8082	Potentiometer fläkthastighet, ECC	Potentiometer fan speed, ECC	Potentiometer Gebläsesgeschwindigkeit, ECC	Potentiomètre, vitesse ventilateur, ECC	
8083	Potentiometer temperatur, ECC	Potentiometer temperature, ECC	Potentiometer Temperatur, ECC	Potentiomètre, température, ECC	
8084	Potentiometer spjäll, ECC	Potentiometer draught valve, ECC	Potentiometer Drossel, ECC	Potentiomètre pour valve de traction ECC	
900	Radio/bandspelare	Radio/tape recorder	Radio/Kassettengerät	Radio/lecteur	
901	Spänningsomvandlare	Voltage converter	Spannungsumwandler	Convertisseur de tension	
902	Högtalare	Loud speaker	Lautsprecher	Haut-parleur	
903	Antenn radio	Aerial, radio	Antenne, Radio	Antenne radio	
905	Kommunikationsradio	Communication radio	CB-Funk	Radiotéléphone	
906	Antenn kommunikationsradio	Aerial, communication radio	Antenne, CB-Funk	Antenne radiotéléphone	
910	Spänningsomvandlare 80V/24V	Voltage converter 80 V / 24 V	Spannungsumwandler 80 V/24 V	Convertisseur de tension 80 V/24 V	
940	Logik batterivakt	Logic switch, battery watch	Logik Batteriewächter	Circuit logique de surveillance batterie	
950	Logik transistorfordning	Logic transistor ignition	Logik Transistorzündung	Circuit logique allumage transistorisé	
955	Logik övervarningsskydd (LPG)	Logic overspeed protection (LPG)	Logik Überdrehungsschutz (LPG)	Circuit logique protection de surrégime (GPL)	
960	Logik rev-spärr/aut-vxl	Logic unit, reversing interlock/automatic gear changing	Logikeinheit Umkehrsperre/automatische Schaltung	Unité logique blocage de marche arrière/ changement automatique	
961	Motor/kupevärmare	Engine- and cab heater	Motor- und Kabinenheizung	Chauffeur moteur et habitacle	
962	Logik slitageind kol elmotor	Logic indication of wear, brush electrical motor	Logik Verschleißanzeige Kohle, Elektromotor	Circuit logique indicateur d'usure des balais	

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Signature: POL

Change No: 020239



Komponentförteckning/List of Components/Komponentenverzeichnis/
Liste de composants

Nr/No/	Svenska	English	Deutsch	Francaise	Anm.
965	Backvarnare	Reversing alarm	Rückfahwarner	moteur électrique Avertisseur de recul	

Group 30

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Cummins 6BTA5.9

See Cummins Operation and Maintenance Manual and also Shop Manual

Volvo TD640VE

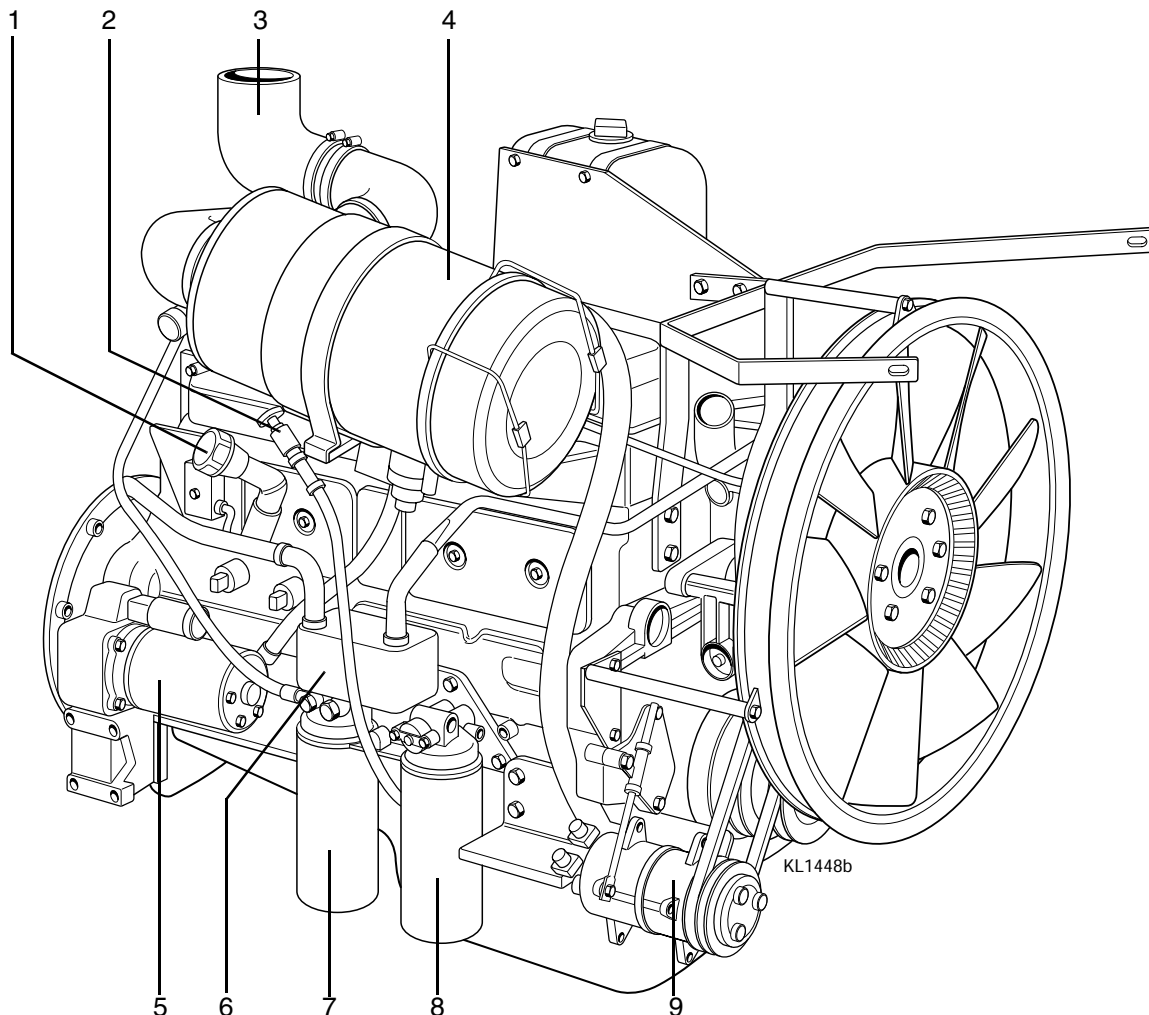
Manufacturer, type	TD640VE
Coolant volume, l	37
Rating ISO 3046 kW (Hp) at r/min	129 (175) 2400
Torque ISO 3046, Nm at r/min	690 1500
Number of cylinders	6
Swept volume, l	5.48
Valve clearance, engine cold inlet, mm exhaust, mm	0.40 0.55
Idle speed, r/min (adjust so that the engine runs smoothly)	650±50
Injection pump, timing	13°±0,5° BTDC
Thermostat, starts to open at °C fully open at °C	75 88
Lubricating oil filter	Full flow, disposable paper element with by-pass valve
Lubricating oil pressure, kPa running speed idling speed	300–500 min 150
Lubricating oil grade viscosity	See Group 90
Volume, incl filter, l	16

The TD640VE engine is a 6-cylinder, inline, 4-stroke diesel engine with overhead valves. The engine is turbocharged, i.e. combustion air is supplied under pressure. As a result, the quantity of fuel injected can be increased, which increases the engine output. The turbocharger is driven by the exhaust gases and uses energy that would otherwise be lost.

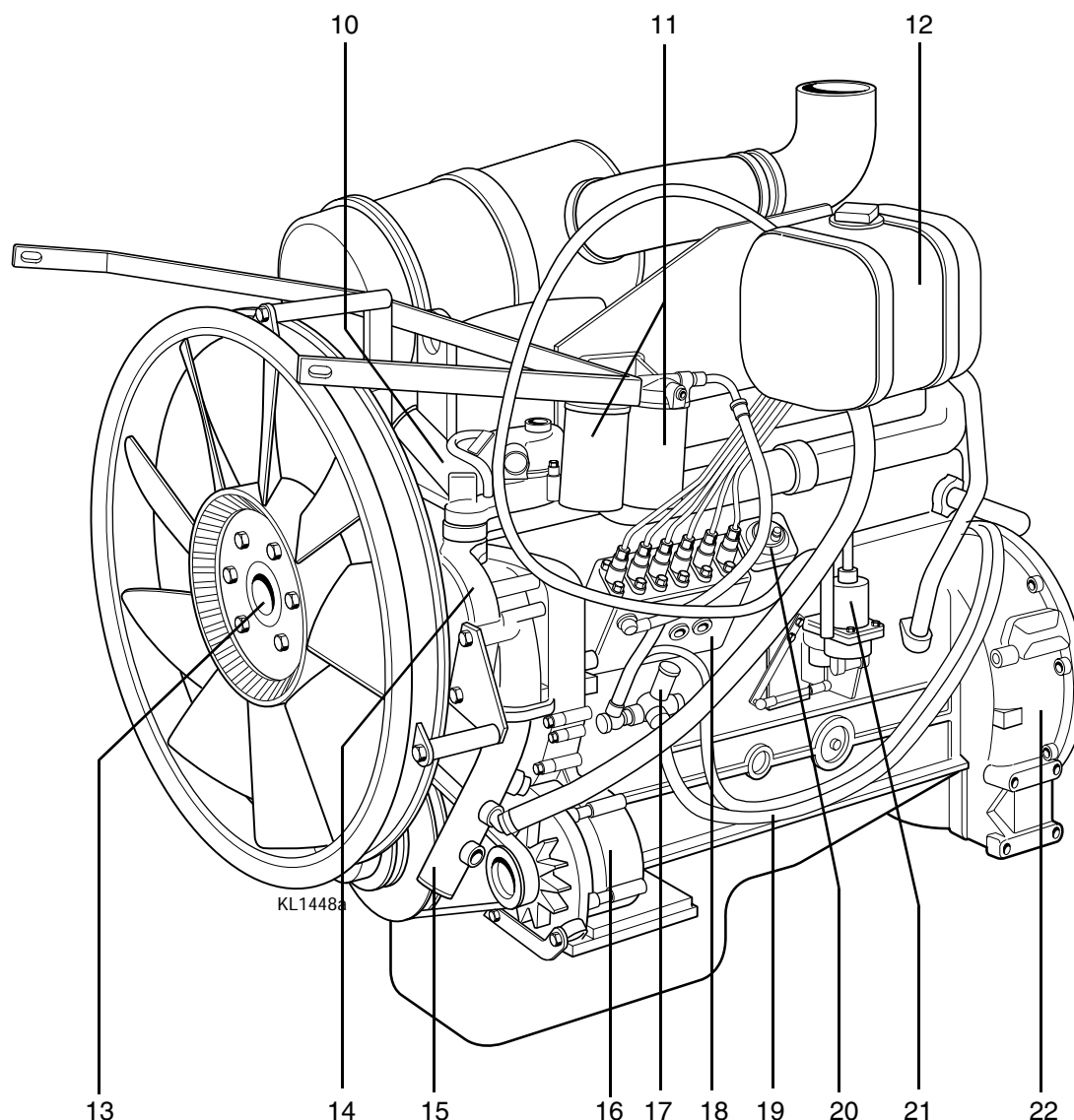
The engine is pressure-lubricated by an oil pump which delivers oil to all lubrication points. A full-flow oil filter effectively cleans the lubricating oil. The fuel system is protected against impurities by replaceable filters. The engine has replaceable wet cylinder liners and two cylinder heads, each covering three cylinders.

The low emission engine has a new design of combustion chamber, injection equipment and charge air cooler (intercooler) which satisfy future emission requirements from both the USA (California) and Europe. The new engines represent a considerable improvement, not only in terms of exhaust gas emissions, but also in terms of power and torque curves.

In addition, all Volvo engines comply with the EC OFF-ROAD and EPA 1/CARB 1 exhaust smoke requirements.



- | | |
|---------------------|--|
| 1. Oil filler cap | 6. Oil cooler |
| 2. Oil dipstick | 7. Oil filter, full flow |
| 3. Fresh air intake | 8. Oil filter, by-pass |
| 4. Air filter | 9. Compressor, air conditioning system |
| 5. Starter motor | |



- 10. Outlet coolant
- 11. Fuel filters
- 12. Expansion tank, cooling system
- 13. Fan hub
- 14. Gear wheel driven coolant pump
- 15. Coolant inlet
- 16. Alternator
- 17. Fuel feed pump
- 18. Injection pump
- 19. Fuel lines for tank connection
- 20. Smoke limiter
- 21. Control motor, electrically controlled
accelerator (Optional, ECS)
- 22. Flywheel housing SAE 2

Volvo TD730VE/TWD731VE

Manufacturer, type	Volvo TD730VE	Volvo TWD731VE
Coolant volume, l	40	41
Rating ISO 3046 kW (Hk) at r/min	150 (231) 2200	167 (231) 2200
Torque ISO 3046, Nm at r/minl	800 1400-1500	893 1300-1400
Number of cylinders	6	6
Swept volume, l	6.73	6.73
Valve clearance, engine cold inlet, mm exhaust, mm	0.40 0.55	0.40 0.55
Idle speed, r/min (adjust so that the engine runs smoothly)	650±50	650±50
Injection pump, timing	10°±0.5° BTDC	10°±0.5° BTDC
Thermostat, starts to open at °C fully open at °C	75 88	75 88
Lubricating oil filter	Full flow, disposable paper el- ement with by-pass valve	Full flow, disposable paper el- ement with by-pass valve
Lubricating oil pressure, kPa running speed idling speed	300–500 min 150	300–500 min 150
Lubricating oil grade viscosity	See Group 90	See Group 90
Volume, l	19	19

Overview

The TD730VE/TWD731VE engine is a 6-cylinder, inline, 4-stroke, low emission diesel engine with overhead valves. The engine is turbocharged, i.e. combustion air is supplied under pressure. As a result, the quantity of fuel injected can be increased, which increases the engine output. The turbocharger is driven by the exhaust gases and uses energy that would otherwise be lost.

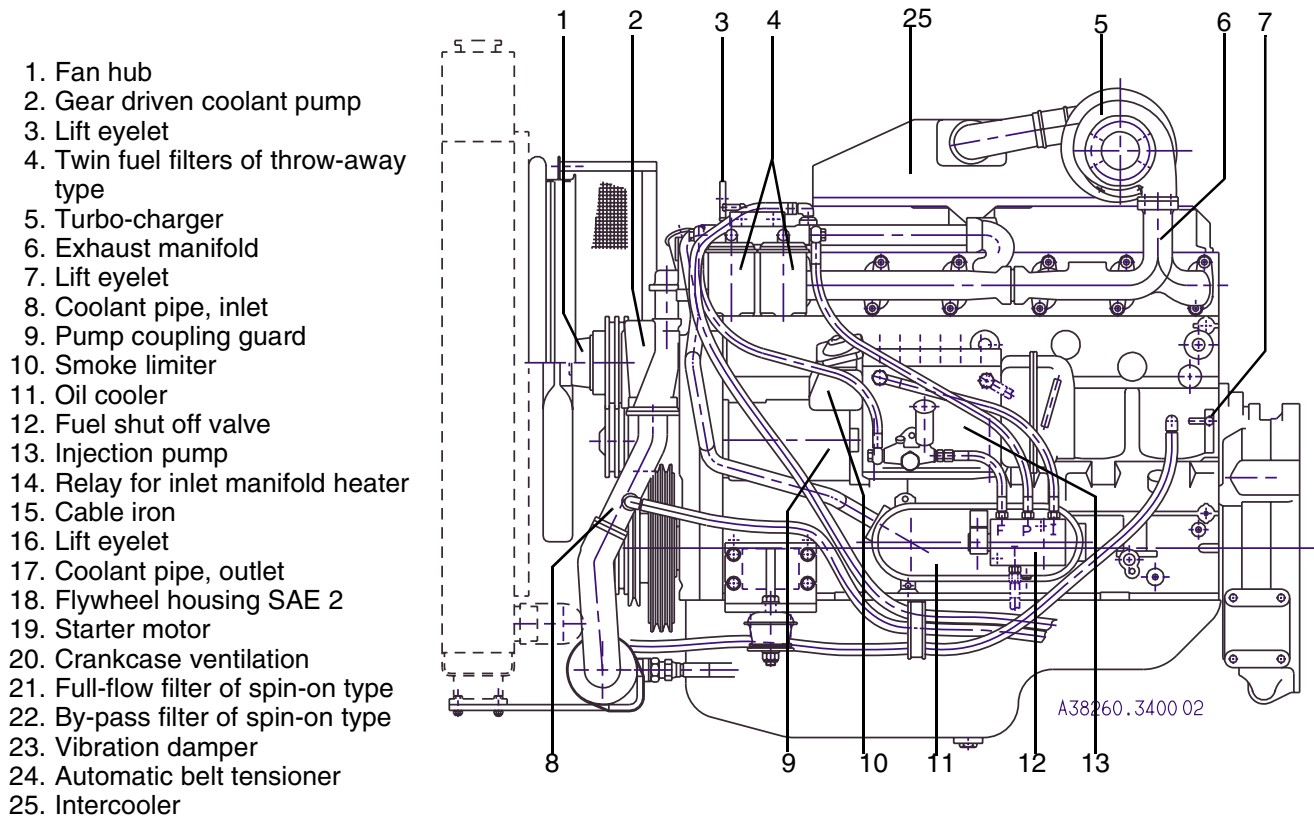
In order to further increase the engine efficiency, the engine is equipped with a water to air intercooler. (Only TWD731VE)

The engine is pressure-lubricated by an oil pump which delivers oil to all lubrication points. A full-flow oil filter effectively cleans the lubricating oil. The fuel system is protected against impurities by replaceable filters. The engine has replaceable wet cylinder liners and two cylinder heads, each covering three cylinders.

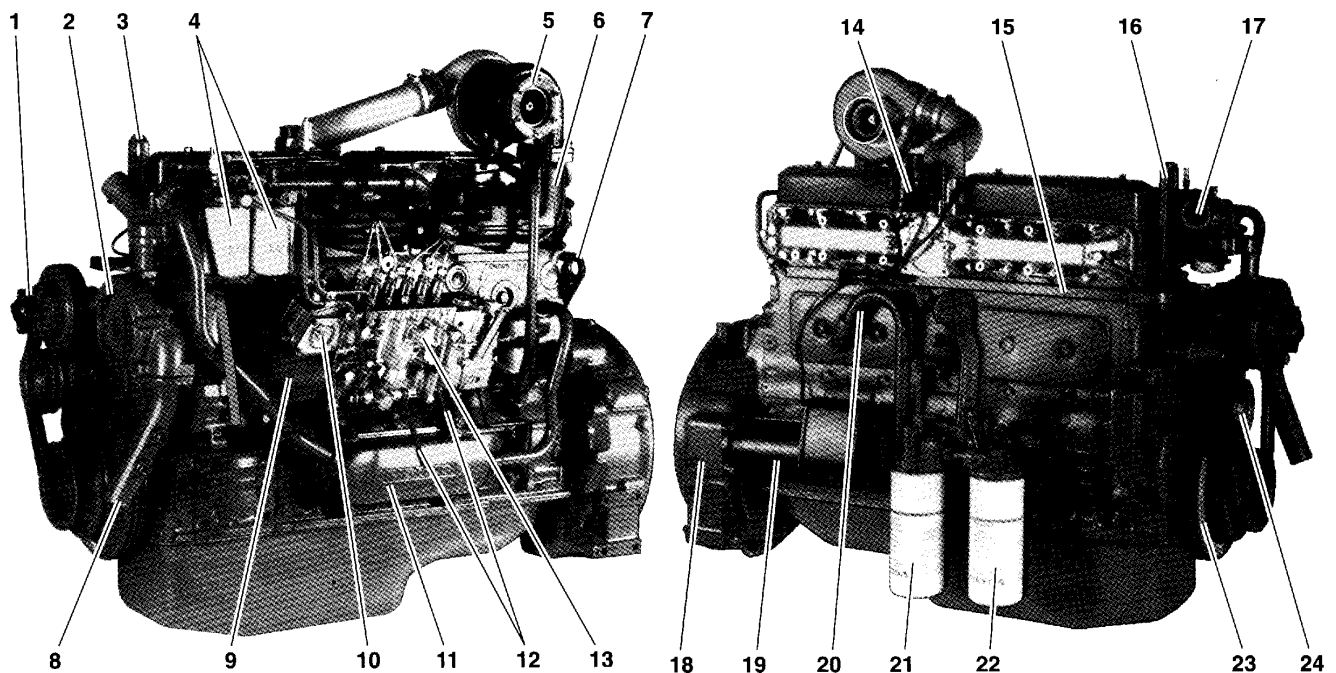
The low emission engine has a new design of combustion chamber, injection equipment and charge air cooler (intercooler) which satisfy future emission requirements from both the USA (California) and Europe. The new engines represent a considerable improvement, not only in terms of exhaust gas emissions, but also in terms of power and torque curves.

In addition, all Volvo engines comply with the R24 exhaust smoke requirements.

TWD731VE



TD730VE



Cooling system

The engine is liquid-cooled and equipped with a closed cooling system consisting of the following main components:

- Coolant pump
- Radiator
- Expansion tank
- Thermostat
- Radiator fan
- Coolant passages
- Engine oil cooler
- Gearbox oil cooler
- Intercooler (only TWD-engine)

The coolant flows through a longitudinal passage into the engine block. The opening into the cooling jacket of each cylinder is individually sized to ensure that each cylinder will be supplied with the same rate of coolant flow.

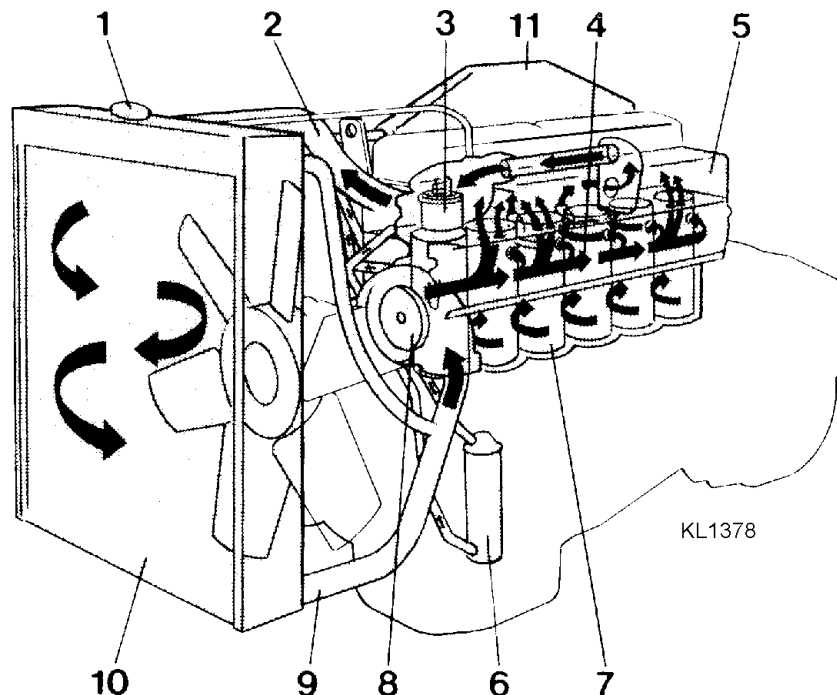
The coolant flows in the separate return lines converge into a common pipe in the thermostat housing. The coolant then flows to the coolant pump and then into the engine and to the oil cooler.

When the engine has reached its normal operating temperature, the thermostat will open the circuit to the radiator.

The piston-type thermostat is capable of passing a high coolant flow rate at a minimum of pressure drop, thus contributing to favourable coolant circulation in the engine.

The coolant pump is fitted on the transmission cover and is driven by a gear wheel from the transmission wheel.

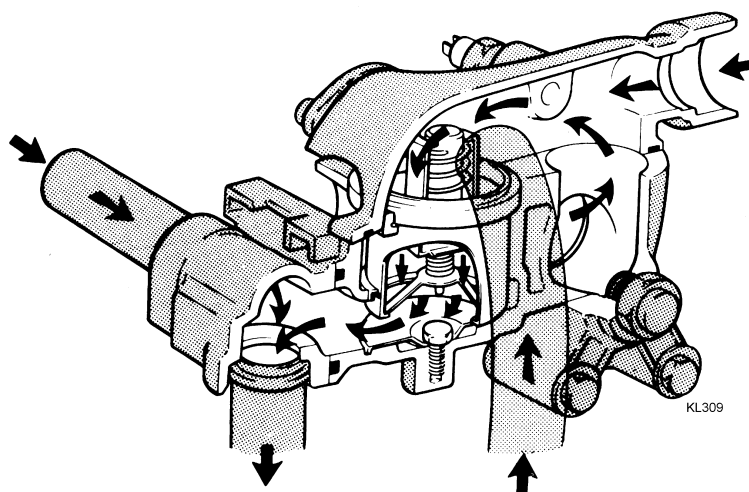
The intercooler (TWD engine) is connected to the cooling system by a pipe from the coolant pump. The outlet from the intercooler is connected to the oil cooler.



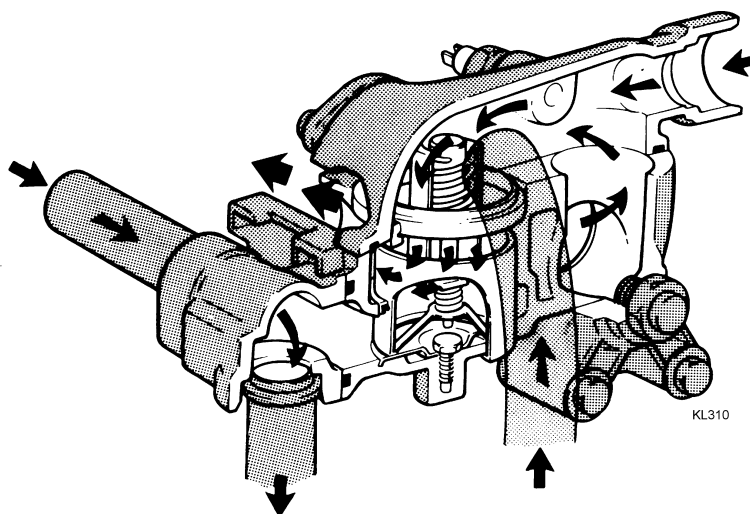
- | | |
|--|---|
| 1. Filler cap | 7. Cylinder lining |
| 2. Pipe thermostat housing- upper expansion tank | 8. Coolant pump |
| 3. Piston thermostat | 9. Pipe to the suction side of the pump |
| 4. Distribution channel | 10. Radiator |
| 5. Cylinder head | 11. Intercooler (only TWD-engine) |
| 6. Oil cooler | |

The cooling system is equipped with a sensor which activates the "Low coolant level" warning lamp on the instrument panel.

The engine lubricating oil is cooled efficiently and reliably in a plate oil cooler. The gearbox oil is also cooled by the engine coolant, but in a separate shell-and-tube cooler.



Thermostat function during heating-up period



Thermostat function, full coolant circulation

Fuel system

The fuel circulates in two circuits - the high-pressure circuit and the low-pressure circuit. When the engine is started, the feed pump draws fuel from the tank and delivers it at relatively low pressure through fine filters up to the injection pump. This then delivers fuel at high pressure to the injectors which supply the fuel in atomised form to the engine combustion chambers.

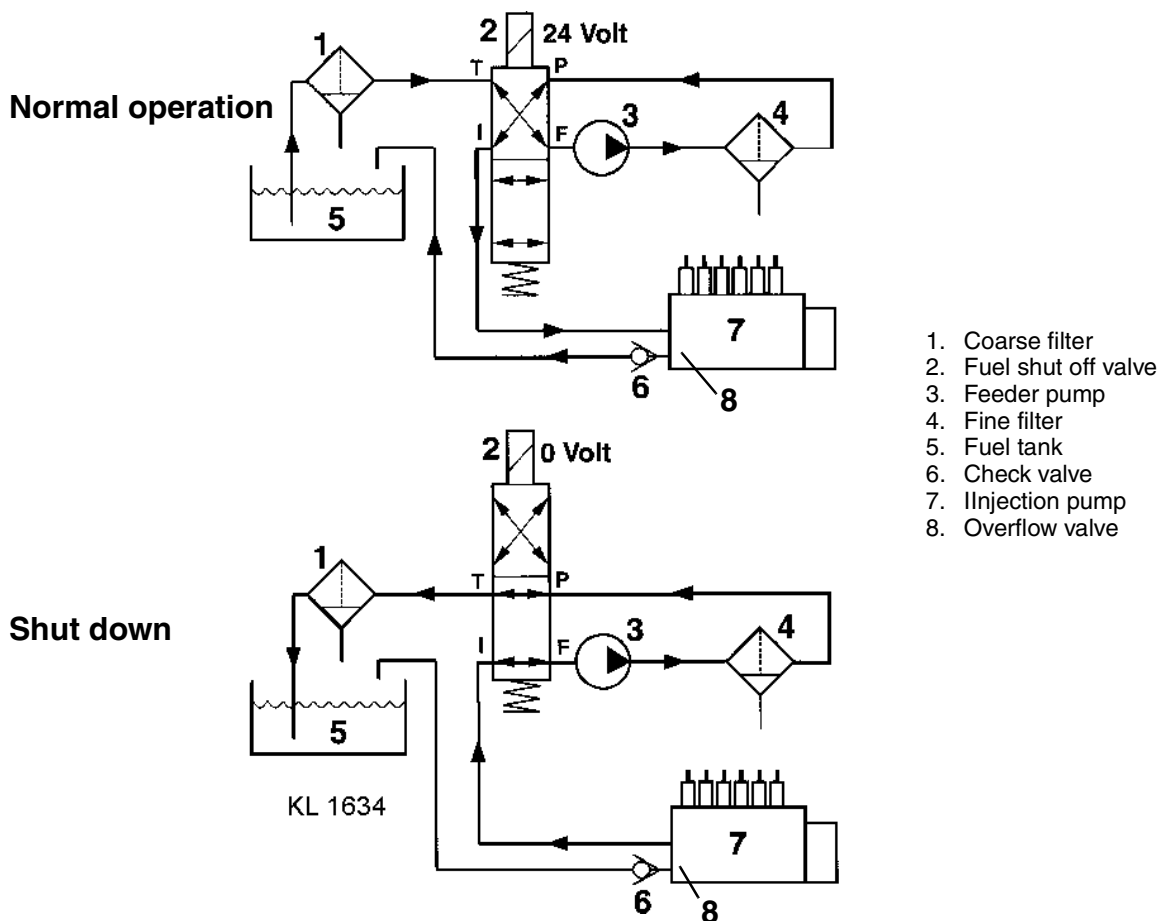
Excess fuel which is circulated in the low-pressure system is also cleaned in the fine filters and is returned through a spill valve back to the tank.

The fuel system includes the following components:

Fuel tank - a separate unit located on the left-hand side of the truck. The fuel volume in the tank can be read on a gauge on the instrument panel.

Feed pump - of piston type, supplies fuel at a certain pressure and flow rate to the injection pump.

Spill valve - which restricts the fuel feed pressure and provides continuous venting of the fuel system. Excess fuel flows through the injection pump before returning to the tank, thus cooling the fuel in the fuel chamber of the pump, which contributes to more uniform distribution of the fuel to the various cylinders.

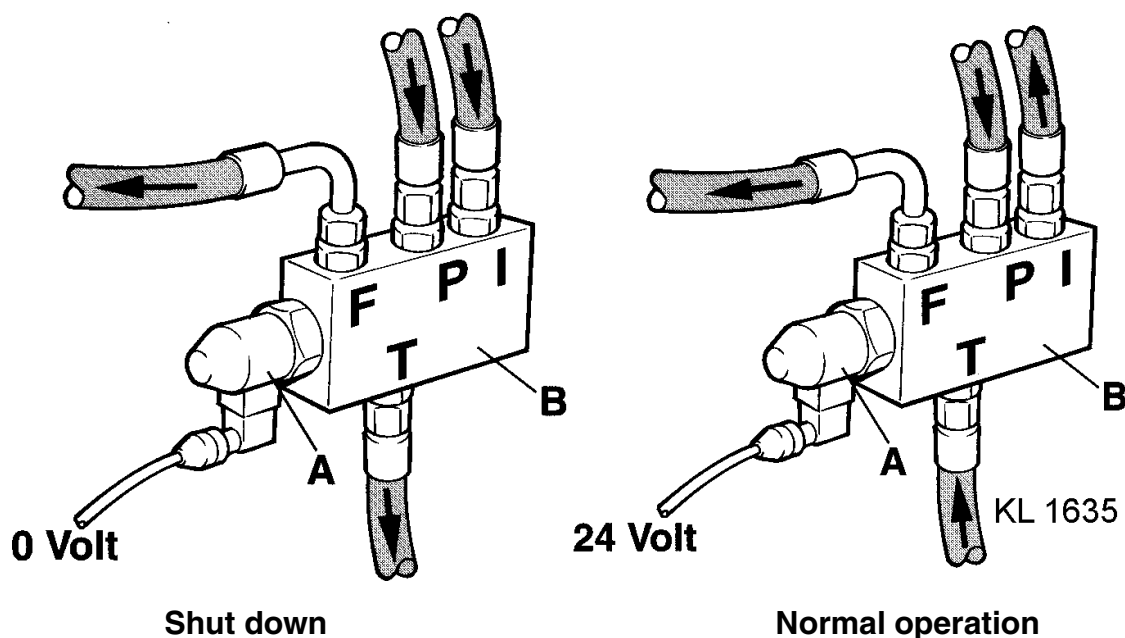


Bränslesystem, principschema

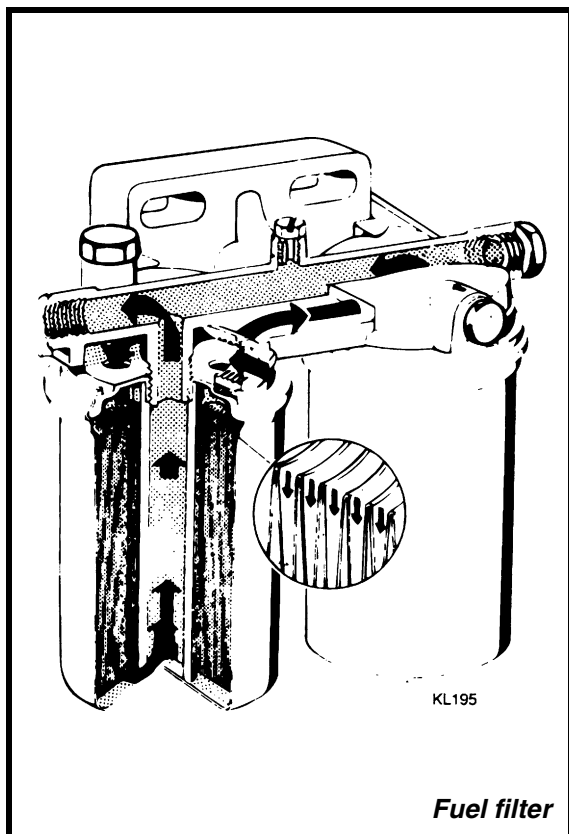
Fuel shut off valve

At normal operation, the solenoid in the shut off valve is activated and fuel is fed to the injection pump.

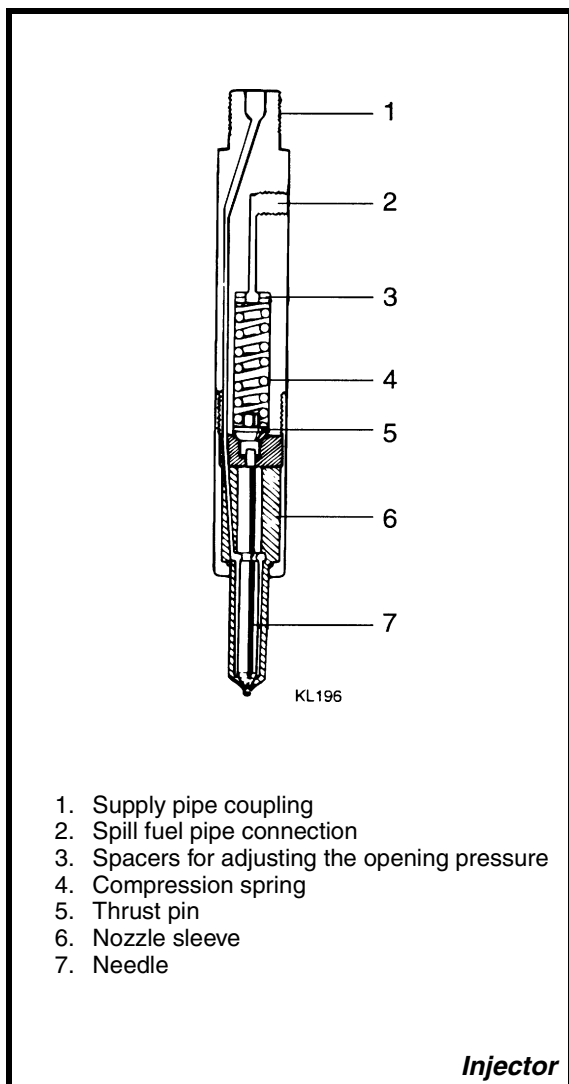
When the starting key is turned to 0, the solenoid valve is deactivated and the flow is reversed. Thereby the feeder pump drains the fuel from the injection pump resulting in engine shut down. The check valve prevents return fuel from flowing into the injection pump.



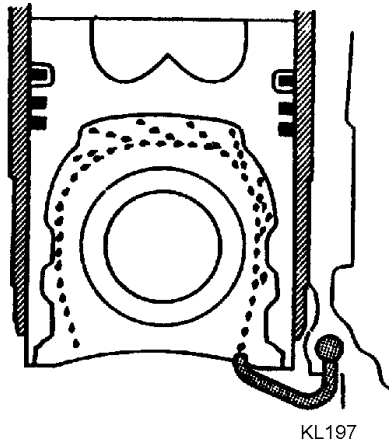
- T. Inlet from fuel tank
- F. Outlet to fuel pump
- P. Inlet from fuel filter
- I. Outlet to injection pump



Fuel filters - two filters connected in parallel and with a common cover. The filters are of disposable type, with the filter elements made of spirally wound paper.



Injectors - each with a nozzle holder and a nozzle. When the fuel pressure has risen to the preset value, the needle will lift and atomised fuel will be injected into the combustion chamber through accurately calibrated holes in the nozzle sleeve.



Lubricating system

The engine is pressure-lubricated, and the oil is supplied by a pump in the oil sump. All lubricating oil flows through a full-flow filter. One part of the oil flows through a by-pass filter for separation of extremely small particles.

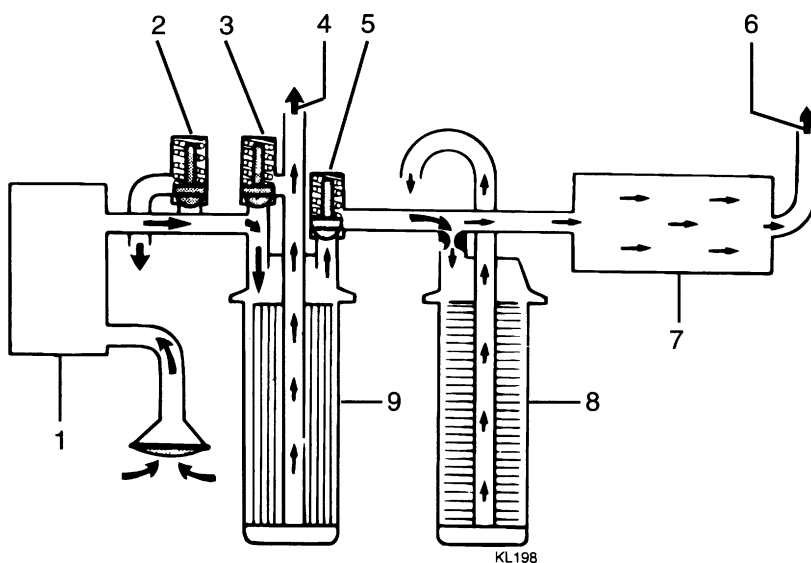
The lubricating oil is cooled in a plate oil cooler by the engine coolant.

The lubricating system includes the following main components:

Oil pump - of gear type, which draws oil through a coarse strainer that arrests larger particles. The pump delivers oil through the lubricating oil filters to the various passages of the lubricating system.

Piston cooling – reduces substantially the piston temperature which, in turn, contributes to a longer life of the piston rings, reduces the risk of carbon deposits and lowers the oil consumption. The pistons are cooled by oil which is sprayed by nozzles into the underside of each piston and into the cooling passages when the piston is at the bottom dead centre.

Cooling is controlled by a piston cooling valve which shuts off the cooling oil supply at low engine speeds. This ensures that the lubricating oil flow will be a maximum when the engine is started and when it is running at idling speed. The valve also restricts the pressure of the piston cooling oil at high engine speeds, to make more oil available for lubrication.



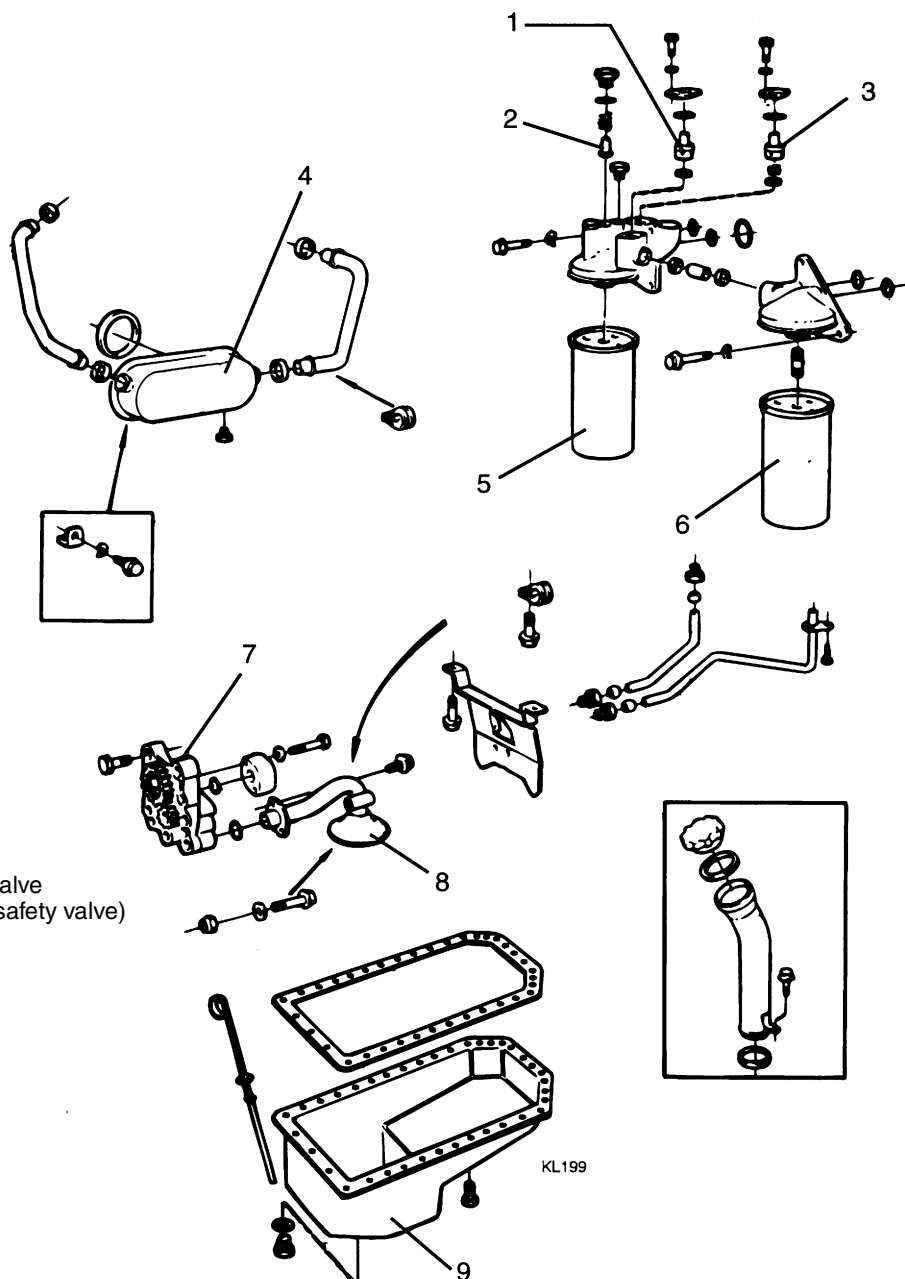
1. Oil pump
2. Reducing valve
3. By-pass valve
4. Oil under pressure to the lubrication system
5. Piston cooling valve
6. Oil under pressure for piston cooling
7. Oil cooler
8. By-pass filter
9. Oil filter

Reducing valve – located just before the filter. The valve will open if the lubricating oil pressure is too high and will return excess oil back to the sump.

Oil filter – of full-flow type, with a filter element of pleated filter paper. To protect the engine against insufficient lubricating oil, a by-pass valve is fitted in the oil filter bracket. The valve will open if the lubricating oil pressure should rise above a certain pressure due to clogging of the filter. When the valve is open, unfiltered oil will flow to the engine. The filter is of disposable type and should be scrapped after use.

By-pass filter – approx. 5% of the oil passes through the by-pass filter with very low speed. The low speed allows very small particles to be separated. The filter insert is of the disposable type.

Crankcase ventilation – prevents pressurising of the crank-case and collects fuel vapour, steam and other gaseous products of combustion. Crankcase ventilation is provided by a pipe connected to the crankcase inspection cover on the right-hand side of the engine, between the starter motor and the oil filter.



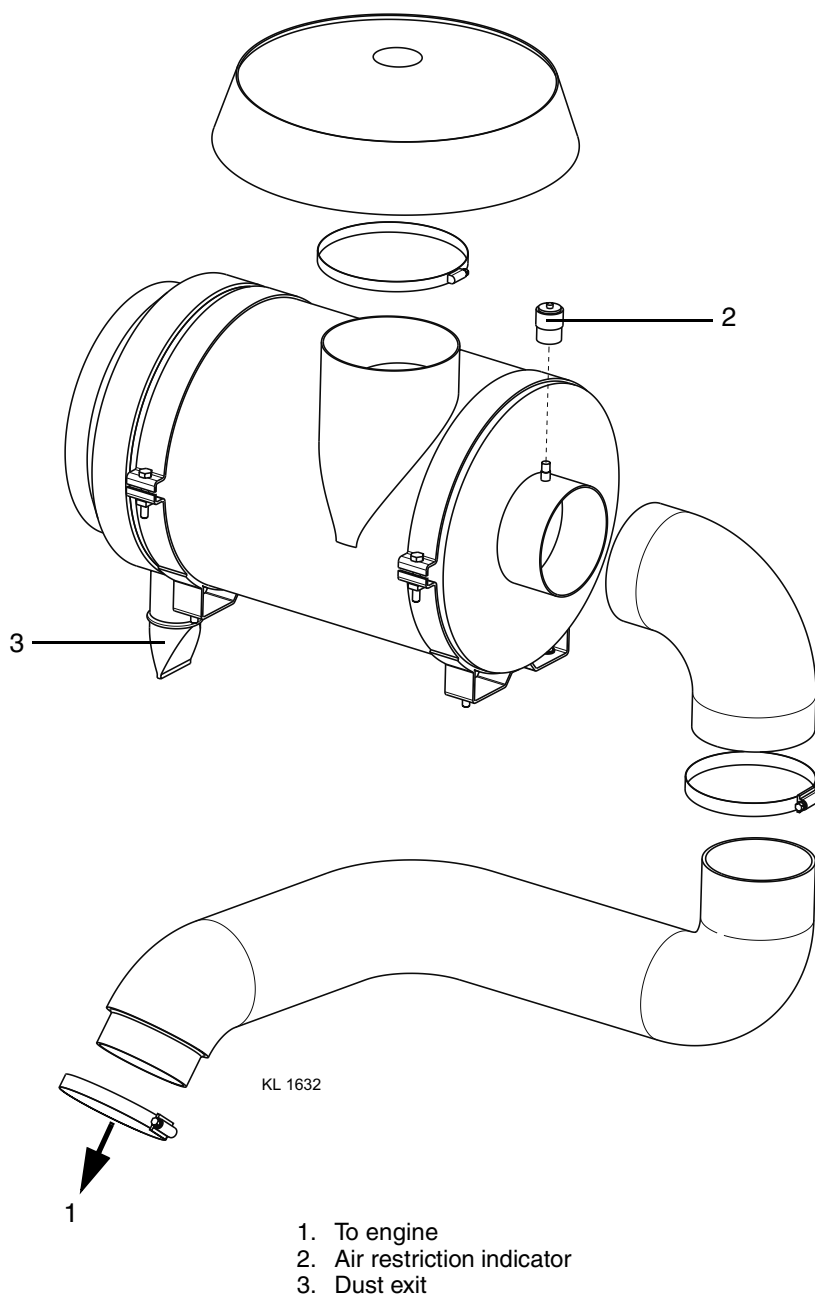
1. Piston cooling valve
2. By-pass valve (safety valve)
3. Reducer valve
4. Oil cooler
5. Full-flow filter
6. By-pass filter
7. Oil pump
8. Suction strainer
9. Oil sump

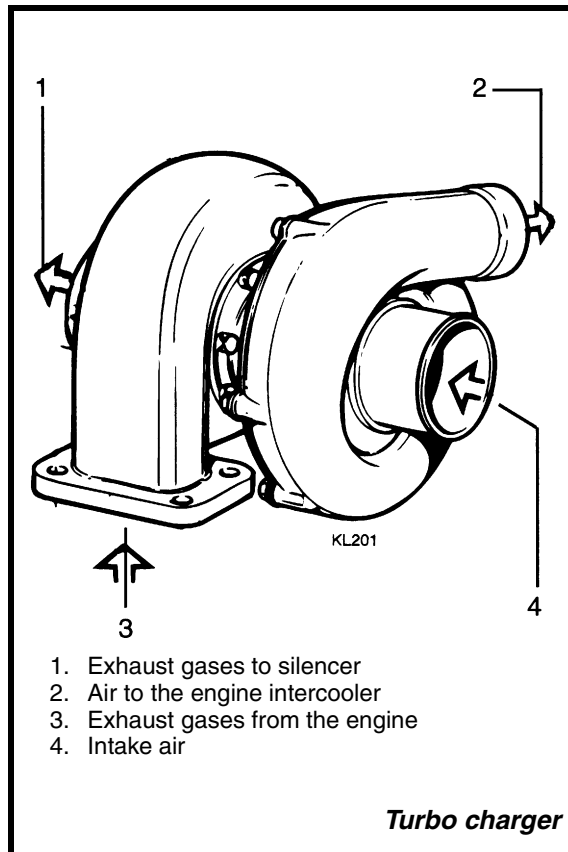
Combustion system

Large quantities of air are necessary for burning the fuel supplied to the engine. Free, unrestricted flow of fresh air and exhaust gases is therefore essential to allow the engine to run efficiently.

Air cleaner

The intake air is cleaned in a two-stage air cleaner, the first stage of which collects coarse particles by cyclone action, and the particles are then collected in a dust receiver. The second stage consists of a filter element - the main filter element. A safety filter element is located on the inside of the main element. The safety element prevents the ingress of impurities into the engine while the main element is being changed and if the main element should sustain damage while the engine is running, e.g. due to incorrect installation.





Turbocharger

The turbocharger supplies more air to the combustion chambers than the engine would be capable of drawing naturally. This enables the engine to burn more fuel which, in turn, increases the engine output.

The turbocharger consists of a turbine wheel and a centrifugal compressor impeller, each with a separate casing but mounted on a common shaft.

The exhaust gases provide the energy necessary for driving the turbine wheel which, in turn, drives the compressor.

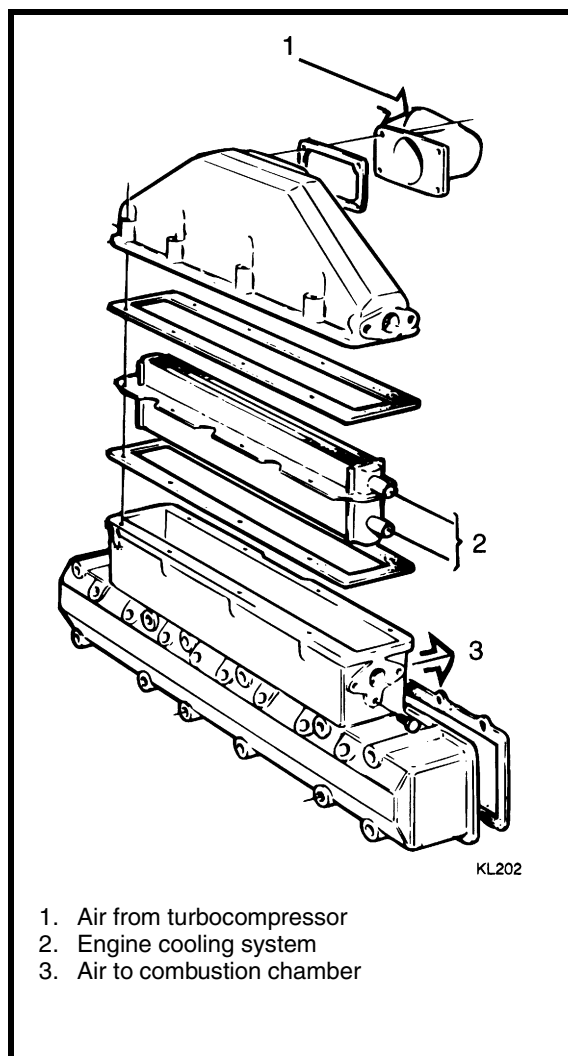
The turbocharger is lubricated and cooled by the lubricating oil from the engine.

Intercooler (Only TWD731VE)

In intercooling, the air that has been compressed and heated by the turbo is cooled in an intercooler.

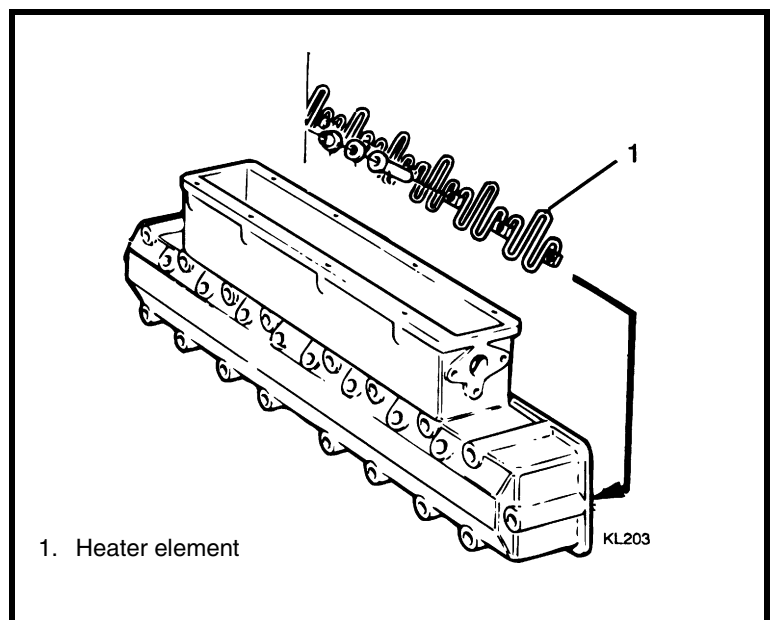
The intercooler increases the oxygen supply for combustion so allowing the injected fuel to be burnt more effectively whilst reducing fuel consumption as well as the level of exhaust emission.

Intercooling also reduces the thermal stressed on the engine, increasing durability and reducing oil consumption



Inlet manifold heater

Before the air is admitted into the combustion chamber, it flows across an electrically heated starting element. This has a high rating of 3 kW and heats the intake air sufficiently for the engine to start at low ambient temperatures. The heater element is energised when the starting key is turned. Suitable preheating time is about 50 seconds.



Coolant quality

Throughout the year, the coolant should consist of a mixture of 60% of water and 40% of ethylene glycol. The coolant should be changed and the cooling system should be flushed once a year.

Always add a corrosion inhibitor (Kalmar part No. 923.110.0003) to the coolant, if the above mixture is not used in the cooling system.

N.B. Never add a corrosion inhibitor if the cooling system contains glycol, since this would cause foaming which seriously impairs the cooling capacity.

Lubricating oil quality

See Group 90, Periodic supervision.

Draining the water from the fuel tank

Drain any water from the fuel tank by removing the drain plug. Immediately refit the drain plug as soon as the flow of fuel is free from water and other impurities.

Inspection of the air cleaner and changing the filter element

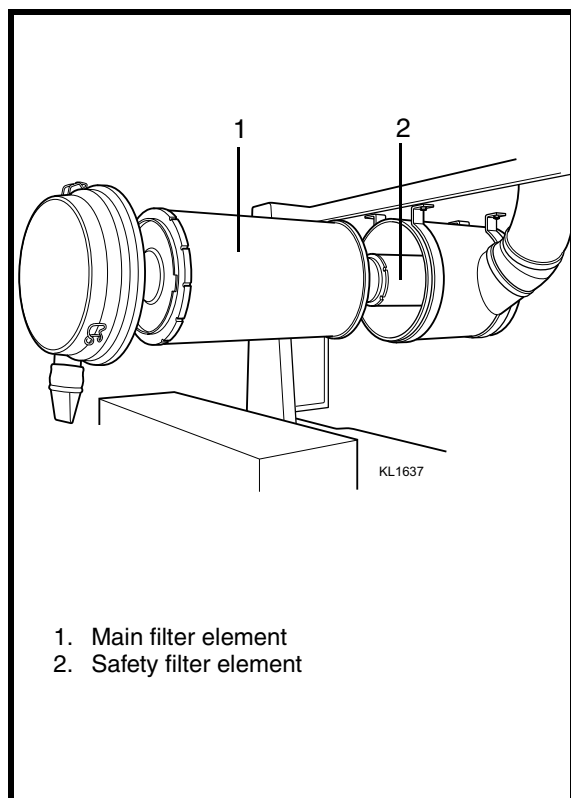
Check the indicator when the engine is running. If it shows red, the main filter element must be changed. The collecting efficiency of the filter element will not be improved if the element is changed too early. But if changing of the filter element is delayed, smoke emission from the engine will increase, the engine may lose power due to insufficient supply of combustion air, and engine damage may occur in certain cases.

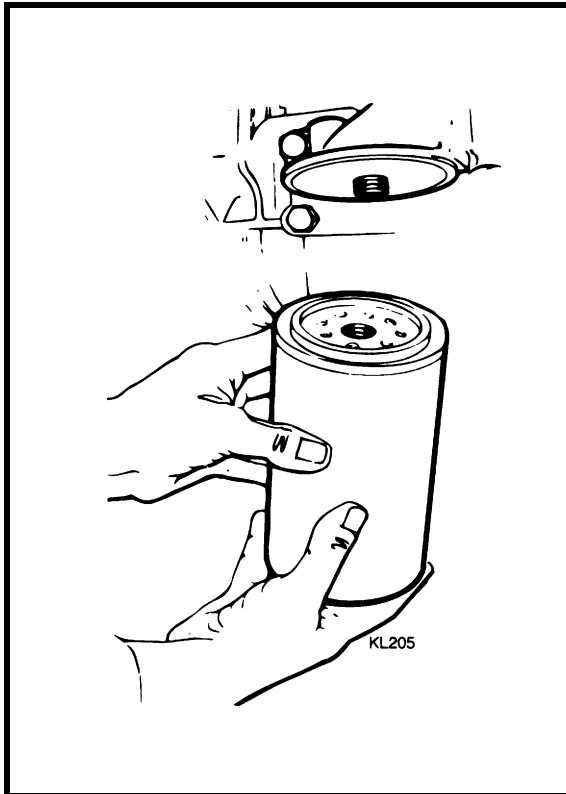
The air pipe from the air cleaner to the engine should be checked for tightness from time to time. Minor leakage, such as that caused by loose hose clips, and damaged or porous hoses may cause dust to be drawn into the engine, which will give rise to costly engine wear.

Change the filter element as follows:

1. The engine must not be running.
2. Clean the outside of the air cleaner.
3. Remove the cover.
4. Release and carefully remove the main filter element. Do not remove the safety filter element.
5. Fit a new main filter element. Carefully check that it is not damaged. Note on the safety filter element when the main element was replaced.
6. Change the safety filter element:
 - after the main filter element has been changed five times
 - at least every other year
 - if the indicator shows red after the main element has been changed
 - if the engine has been run with the main element damaged

The safety filter element must not be cleaned and reused. The engine must not be run without the main filter element. If the main element must be cleaned and refitted in emergency cases, don't use compressed air to clean it, since the filter element may be damaged. Before refitting it, carefully check that the main filter element is undamaged.



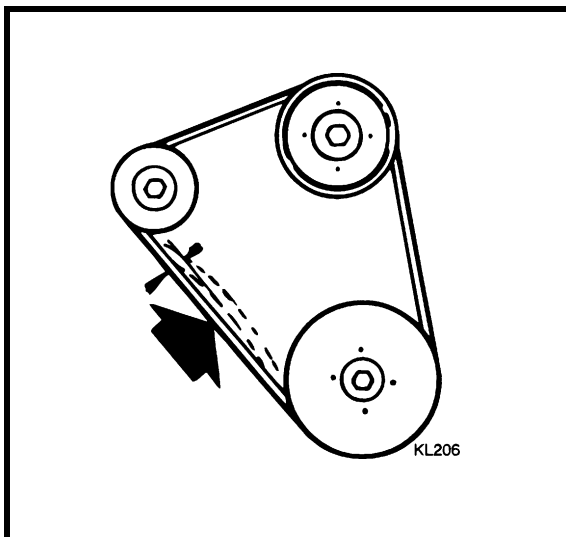


Changing the oil and oil filter

N.B. Before draining the oil, make sure that it is at normal working temperature.

1. Remove the drain plug from the underside of the sump and drain the oil.
2. Clean the area round the filters and place a tray under the filters to collect any spillage.
3. Remove and discard the filter canisters, which are of disposable type.
4. Pour clean oil into the centre of the new filters, wait until the oil has seeped through the filter paper and top up until the filters are full.
5. Lubricate the canister seals with oil.
6. Fit the new filters and tighten them - by hand only.
7. Fill the engine with oil (see Group 90, Lubrication chart).
8. Run the engine and check that no oil leaks at the filters.
9. Stop the engine and check the oil level after a few minutes. Top up as necessary to the MAX level on the dipstick.

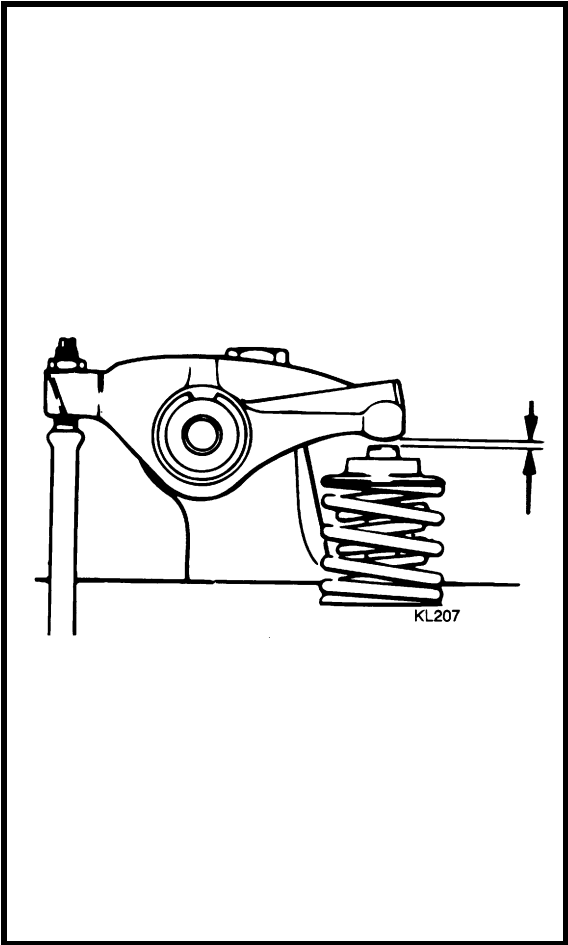
N.B. To avoid serious damage to the engine, use only genuine Kalmar filters.



Checking the V-belt tension

1. Check at regular intervals that the V-belts are correctly tensioned. It should not be possible to depress the V-belt more than 10 - 12 mm mid-way between the pulleys.
2. The engines are equipped with an automatic belt tensioner which maintains the belt tension constant.

N.B. If the belt drive consists of two belts, always change both belts.



Checking and adjusting the valve clearances

N.B. Never attempt to check the valve clearances when the engine is running. The engine must be stationary and cold.

- 1. Turn the crankshaft in its normal direction of rotation until the inlet valve of No. 6 cylinder has just opened and the exhaust valve of the same cylinder has not yet closed fully. Check the valve clearances on No. 1 cylinder and adjust as necessary.

Valve clearance

Engine	TD730VE/TWD731VE
Inlet	0.40 mm
Exhaust	0.55 mm

- 2. Check the oter valves in accordance with the table below.

Check the valve clear- ance of cylinders No...	1	5	3	6	2	4
...when the inlet and ex- haust valves of the fol- lowing cylinders are just changing over (are moving simultane- ously)	6	2	4	1	5	3

Changing the fuel filters

- 1. Clean the outsides of the filters.
- 2. Remove the filters and discard them.
- 3. Clean the filter head.
- 4. Check that the new filters are perfectly clean and that the seals are in good condition.
- 5. Fit the new filter canisters and tighten them by hand until the seal is in contact with the seating surface. Then tighten them a further half a turn.



WARNING!

Never run the engine with the air inlet or exhaust pipes disconnected from the turbocharger, since personnel could then sustain injuries.

IMPORTANT!

Adjustments on the injection pump are to be performed by authorized personnel only.

Preventive maintenance on the turbocharger

The turbocharger may be damaged and, in the worst case, may break down if the engine is not properly serviced.

1. Check that the engine air inlet system is in good condition, i.e. that the air cleaner is clean, that none of the hoses are worn and that hose connections are not defective, which would allow oil to seep past the seals on the compressor side and be entrained by the inlet air. The latter may lead to high exhaust gas temperatures and overheating of the turbine shaft bearing. If corrective action is then not taken, the turbocharger may break down.
2. Change the lubricating oil and filter at the specified intervals. Check at regular intervals that the lubricating oil lines to the turbocharger are in good condition and do not leak. Also check regularly that the oil pressure is not too low, since this could quickly lead to damage to the turbocharger.
3. Ensure that the fuel system is serviced at the specified intervals. Inadequate fuel supply caused by clogged fuel filters or incorrect setting of the injection pump reduces the turbocharger speed which, in turn, results in a lower engine output.
4. Check that there are no restrictions in the crankcase ventilation. If the vent is blocked, pressure may build up and may force oil into the inlet air system of the turbocharger and engine.

Volvo TAD720VE

Manufacturer, type	Volvo TAD720VE
Coolant volume, l	40
Rating ISO 3046 kW (Hk) at r/min	174 (237) 2300
Torque ISO 3046, Nm at r/minl	854 1400
Number of cylinders	6
Swept volume, l	7,15
Valve clearance, engine cold inlet, mm exhaust, mm	 0,35 0,55
Idle speed, r/min (adjust so that the engine runs smoothly)	700±50
Thermostat, starts to open at °C fully open at °C	87 102
Lubricating oil filter	Full flow, disposable paper el- ement with by-pass valve
Lubricating oil pressure, kPa running speed idling speed	350 min 80
Lubricating oil grade viscosity	Se Grupp 90
Volume, l	20

Overview

The TAD720VE engine is a 6-cylinder, inline, 4-stroke, low emission diesel engine with overhead valves. The engine is turbocharged, i.e. combustion air is supplied under pressure. As a result, the quantity of fuel injected can be increased, which increases the engine output. The turbocharger is driven by the exhaust gases and uses energy that would otherwise be lost.

In order to further increase the engine efficiency, the engine is equipped with a air-to air intercooler.

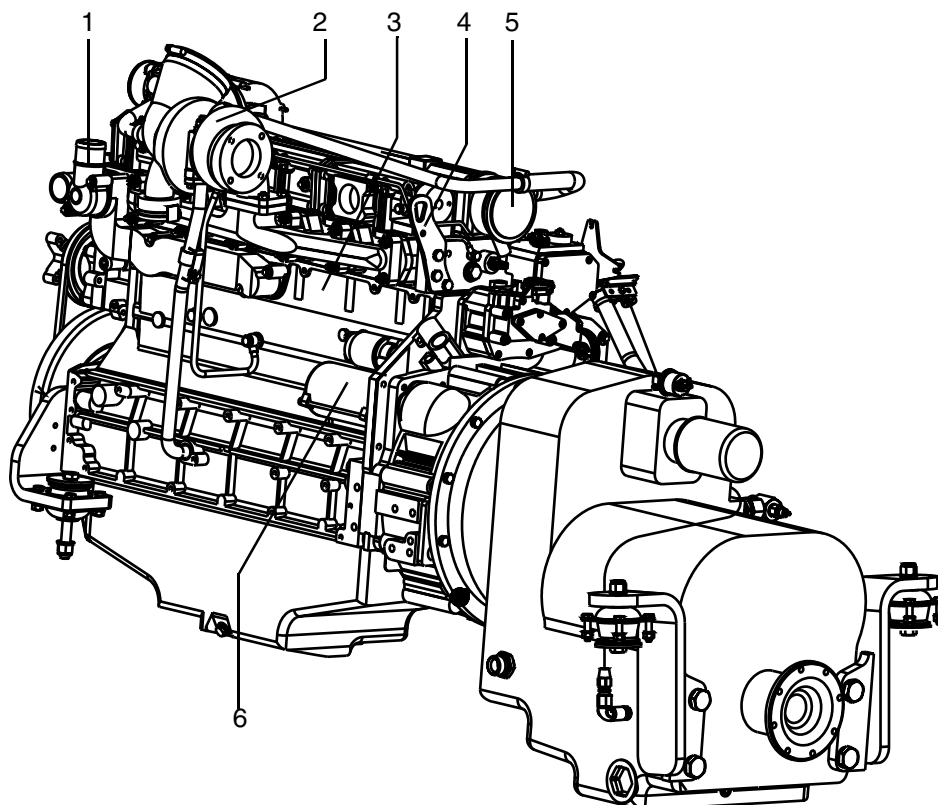
The engine is pressure-lubricated by an oil pump which delivers oil to all lubrication points. A full-flow oil filter effectively cleans the lubricating oil. An integrated, side mounted oil cooler is cooling the entire oil flow.

The fuel system is protected against impurities by replaceable filters.

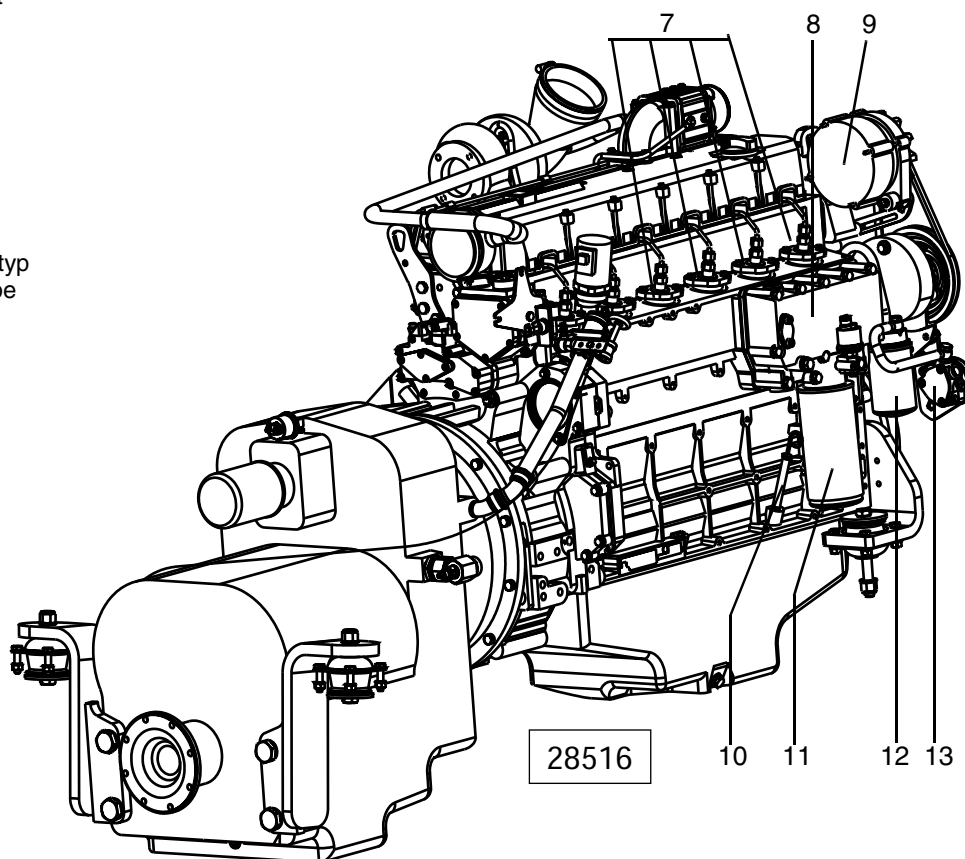
To maintain a controlled working temperature in cylinders and combustion chambers, the engine is provided with piston cooling.

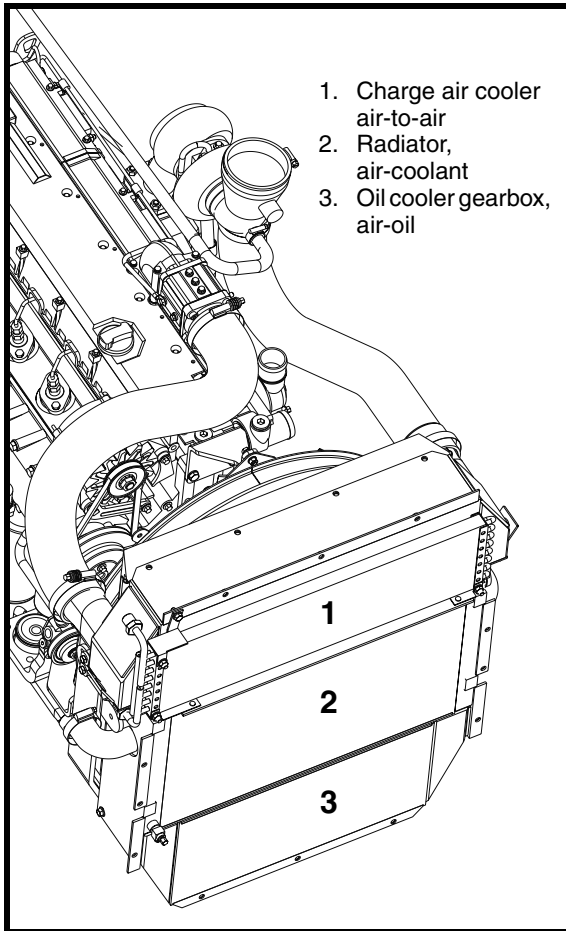
The low emission engine has a new design of combustion chamber, injection equipment and charge air cooler (intercooler) which satisfy future emission requirements from both the USA (California) and Europe. The new engines represent a considerable improvement, not only in terms of exhaust gas emissions, but also in terms of power and torque curves.

In addition, all Volvo engines comply with the R24 exhaust smoke requirements.



1. Coolant connection, outlet
2. Turbo-compressor
3. Manifold
4. Lifting eylet
5. Crankcase ventilation
6. Starter motor
7. Injection pump
8. Oil cooler
9. Generator
10. Oil dip stick
11. Full flow filter, of "spin-on" typ
12. Fuel filter of disposable type
13. Fuel pump





Cooling system

The engine is liquid-cooled and equipped with a closed cooling system consisting of the following main components:

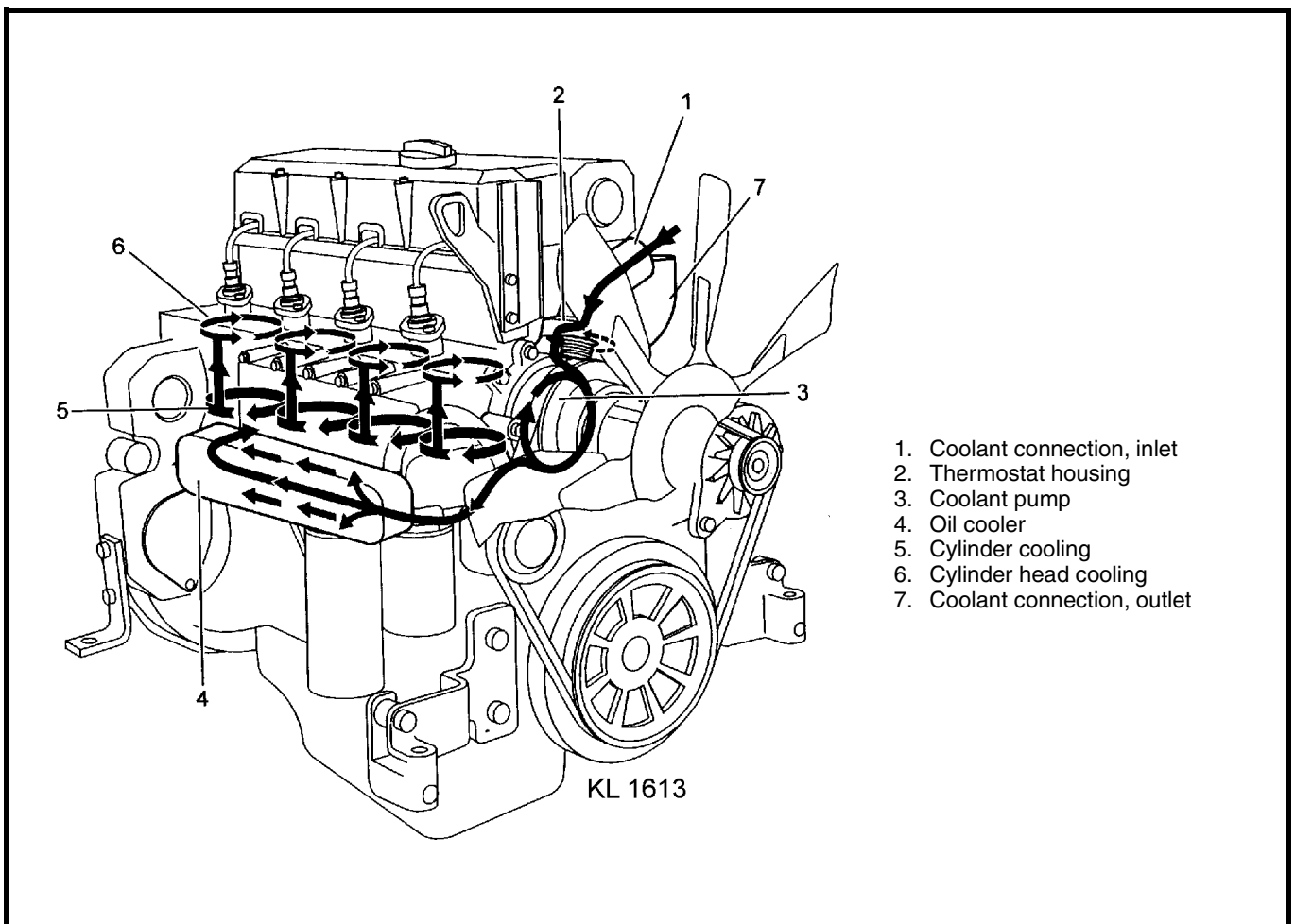
- Coolant pump
- Radiator
- Expansion tank
- Thermostat
- Radiator fan
- Coolant passages
- Engine oil cooler
- Gearbox oil cooler
- Intercooler

The coolant flows through a longitudinal passage into the engine block. The opening into the cooling jacket of each cylinder is individually sized to ensure that each cylinder will be supplied with the same rate of coolant flow.

The coolant flows in the separate return lines converge into a common pipe in the thermostat housing. The coolant then flows to the coolant pump and then into the engine and to the oil cooler.

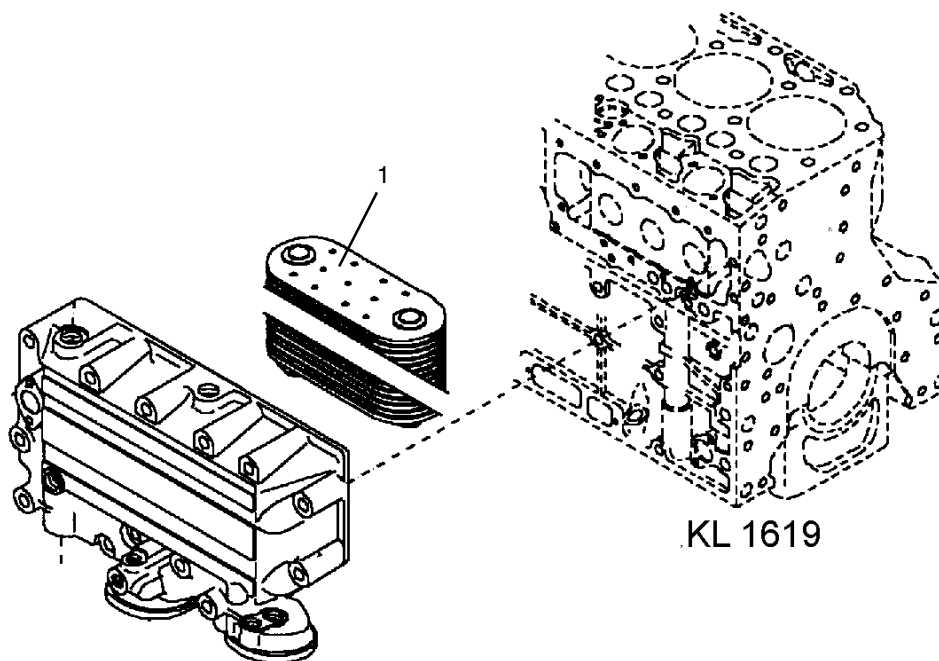
When the engine has reached its normal operating temperature, the thermostat will open the circuit to the radiator.

The piston-type thermostat is capable of passing a high coolant flow rate at a minimum of pressure drop, thus contributing to favourable coolant circulation in the engine.



The cooling system is equipped with a sensor which activates the "Low coolant level" warning lamp on the instrument panel.

The engine lubricating oil is cooled efficiently and reliably in a plate oil cooler. The gearbox oil is also cooled by the engine coolant, but in a separate shell-and-tube cooler.



1. Plate oil cooler

Fuel system

The fuel circulates in two circuits - the high-pressure circuit and the low-pressure circuit. When the engine is started, the feed pump draws fuel from the tank and delivers it at relatively low pressure through fine filters up to the injection pumps. These then deliver fuel at high pressure to the injectors which supply the fuel in atomised form to the engine combustion chambers.

Excess fuel which is circulated in the low-pressure system is also cleaned in the fine filters and is returned through a spill valve back to the tank.

The fuel system includes the following components:

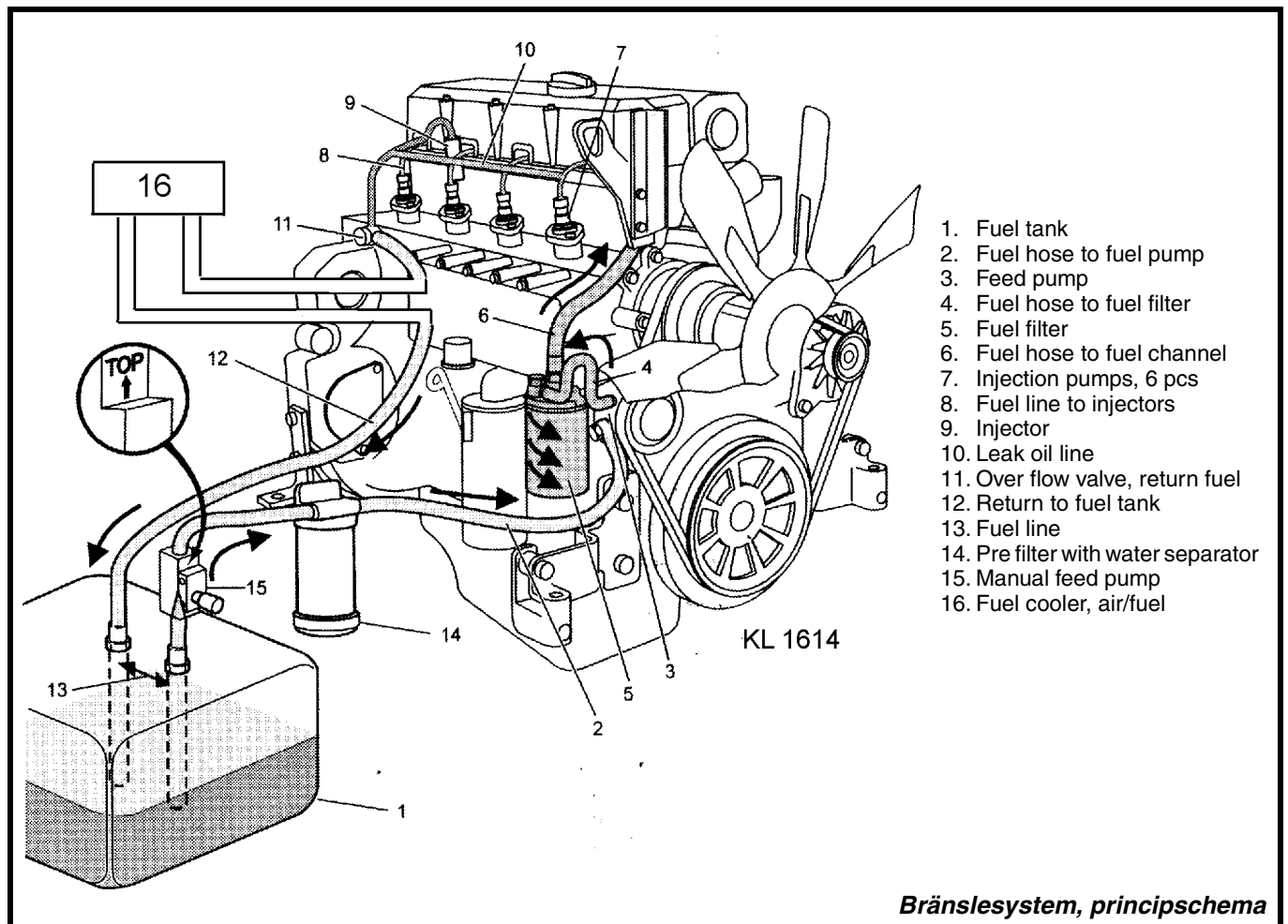
Fuel tank - a separate unit located on the left-hand side of the truck. The fuel volume in the tank can be read on a gauge on the instrument panel.

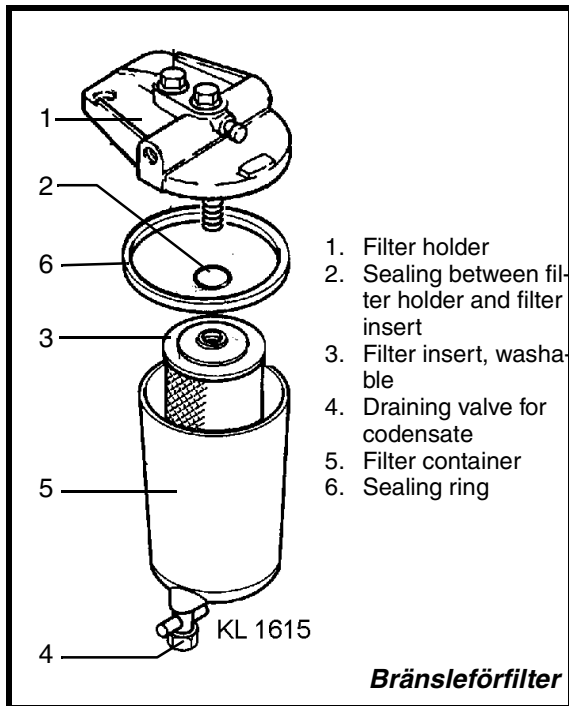
Feed pump - of piston type, supplies fuel at a certain pressure and flow rate to the injection pumps.

Spill valve - which restricts the fuel feed pressure and provides continuous venting of the fuel system. The excessive fuel is flowing through the injection pumps before it is fed through the return line to the fuel cooler and thereafter to the fuel tank.

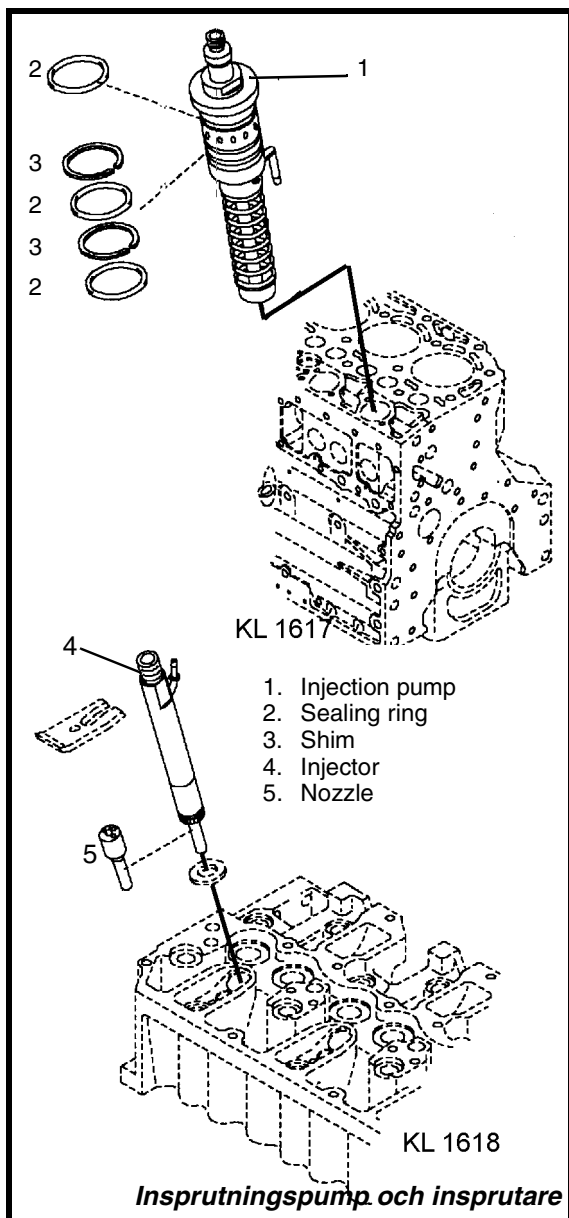
Fuel cooler

The fuel cooler is positioned on top of the charge air cooler. Its purpose is to lower the return fuel temperature and thereby also the temperature in the fuel tank. A lower fuel temperature gives higher combustion efficiency.





Fuel pre filter - with washable filter insert and draining valve for condensate .



Injection pumps and injectors

The injection pumps are of the single type, e.g. one for each cylinder and feed high pressure fuel to the injectors. These have an opening pressure of 27.5 MPa. When adjustment of the injectors is needed this has to be made separately with shims for every single pump.

Lubricating system

The engine is pressure-lubricated, and the oil is supplied by a pump in the oil sump. All lubricating oil flows through a full-flow filter. One part of the oil flows through a by-pass filter for separation of extremely small particles.

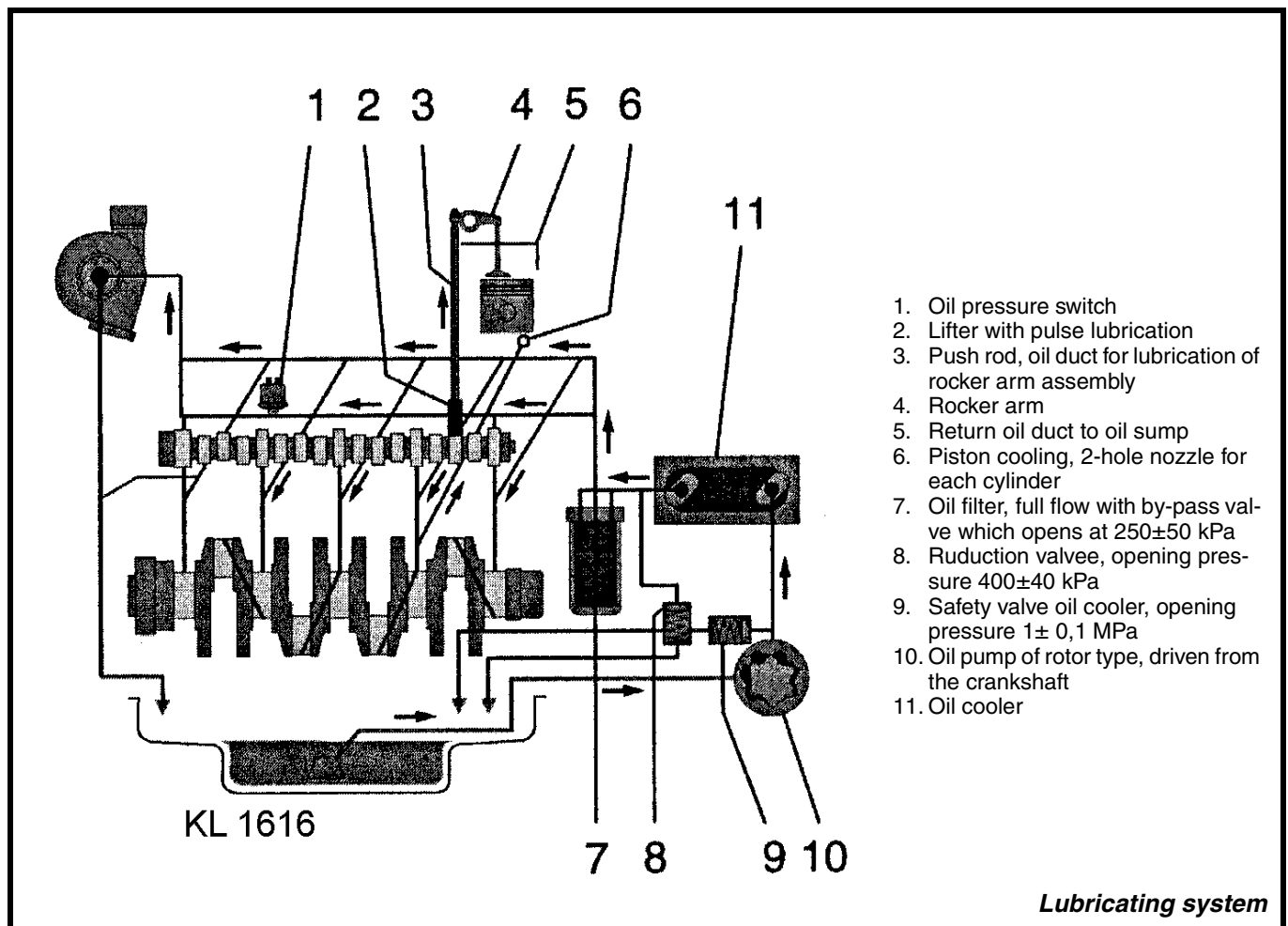
The lubricating oil is cooled in a plate oil cooler by the engine coolant.

The lubricating system includes the following main components:

Oil pump - of rotor type, draws oil through a strainer which separates coarse particles. The oil is fed from the pressure side of the pump through the oil filter and is then distributed to the different ducts of the lubricating system

Piston cooling – reduces substantially the piston temperature which, in turn, contributes to a longer life of the piston rings, reduces the risk of carbon deposits and lowers the oil consumption.

The pistons are cooled by oil which is sprayed by nozzles into the underside of each piston and into the cooling passages when the piston is at the bottom dead centre.

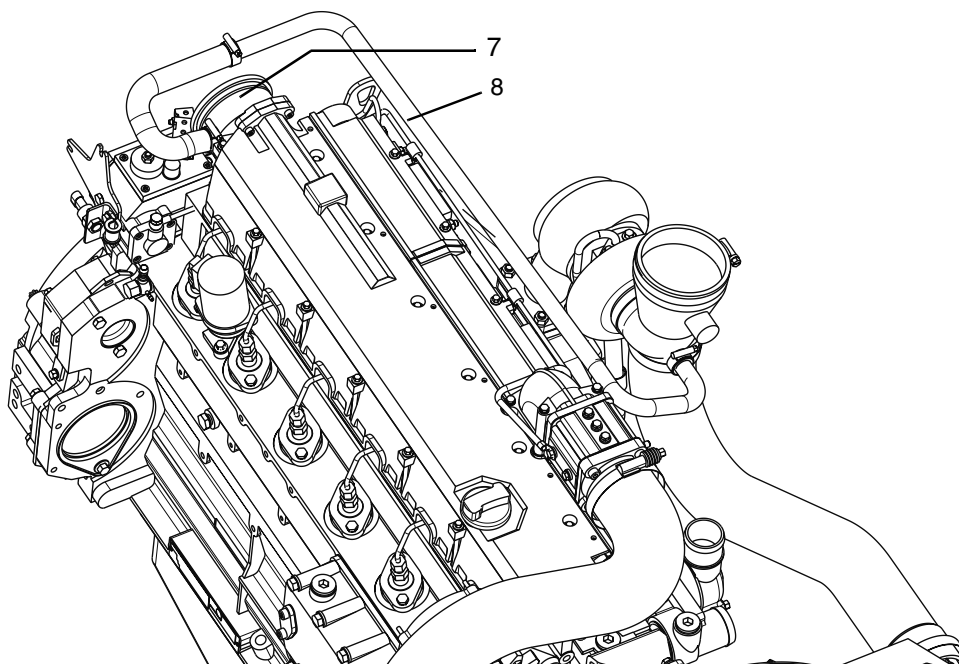
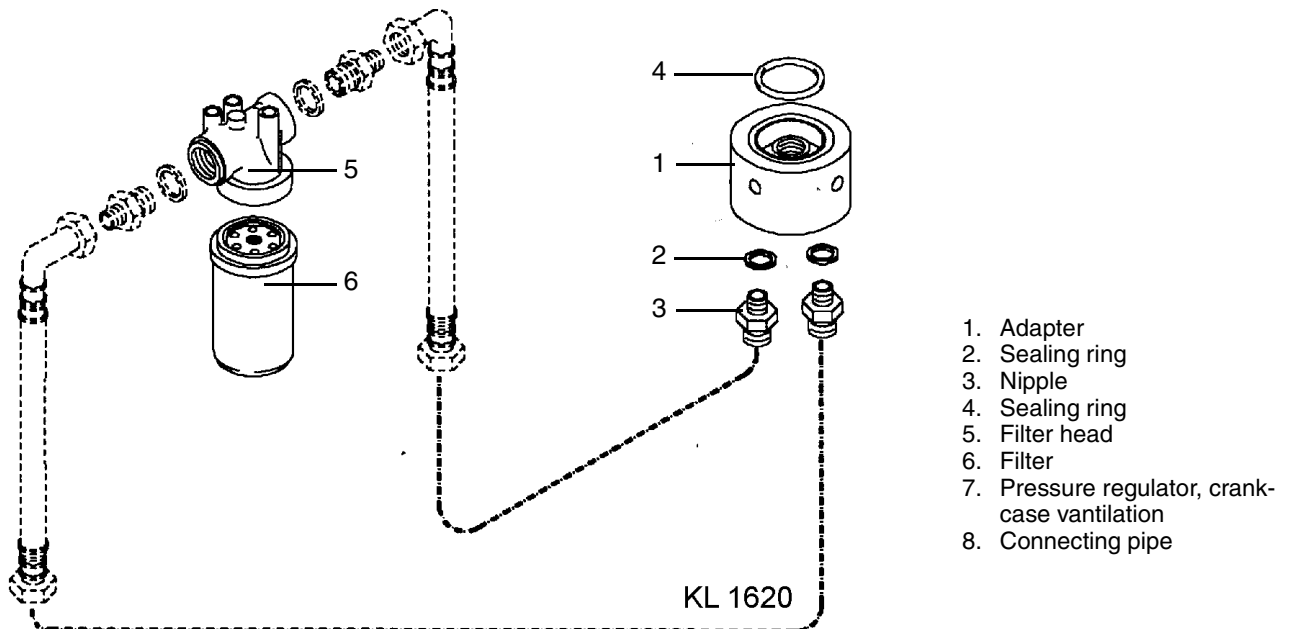


Reducing valve – located just before the filter. The valve will open if the lubricating oil pressure is too high and will return excess oil back to the sump.

Oil filter – of full-flow type, with a filter element of pleated filter paper. To protect the engine against insufficient lubricating oil, a by-pass valve is fitted in the oil filter bracket. The valve will open if the lubricating oil pressure should rise above a certain pressure due to clogging of the filter. When the valve is open, unfiltered oil will flow to the engine. The filter is of disposable type and should be scrapped after use.

By-pass filter – approx. 5% of the oil passes through the by-pass filter with very low speed. The low speed allows very small particles to be separated. The filter insert is of the disposable type.

Crankcase ventilation - prevents over-pressure in the crankcase and separates fuel mist, water mist and other gaseous combustion products. The crankcase ventilation is controlled by a pressure regulator which discharges excessive pressure from the crankcase through a pipe connected to the turbo-compressor suction line.



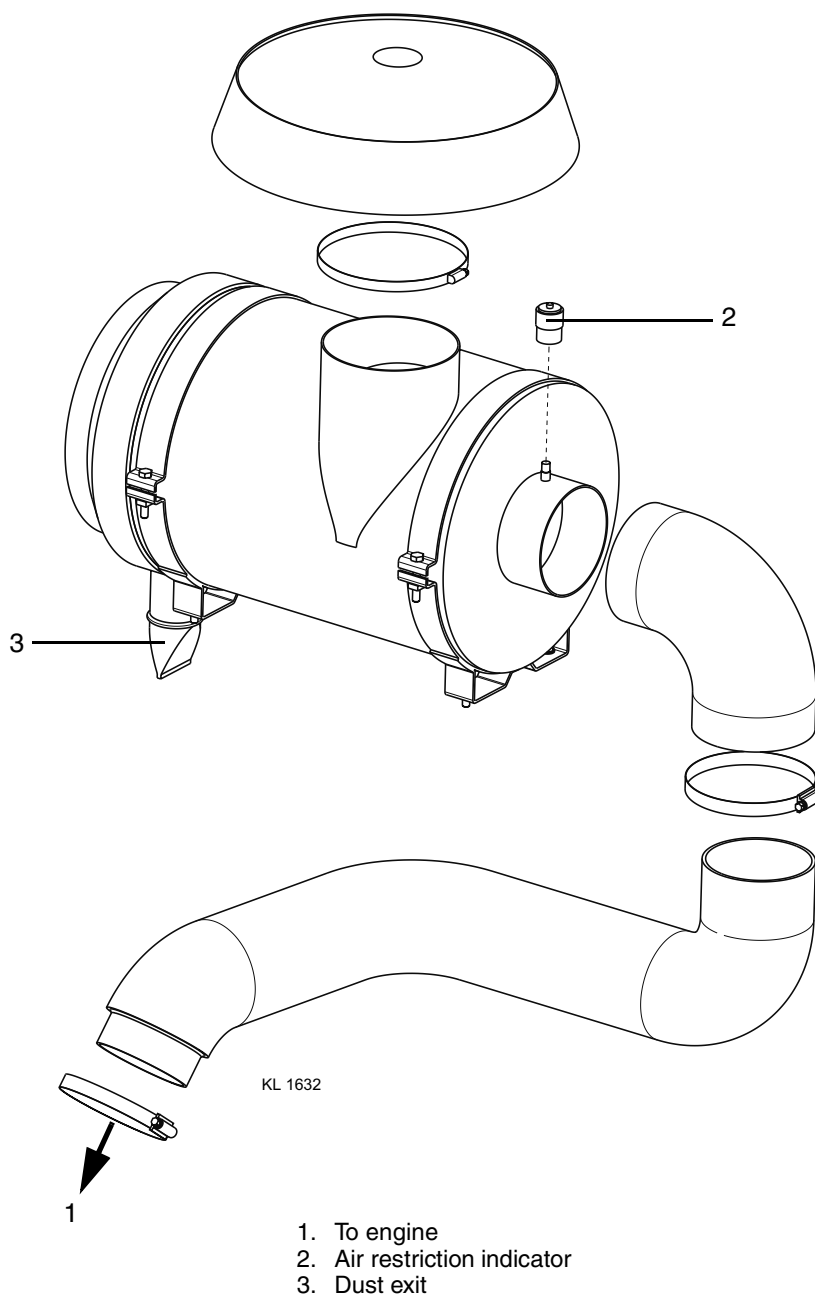
Lubricating system

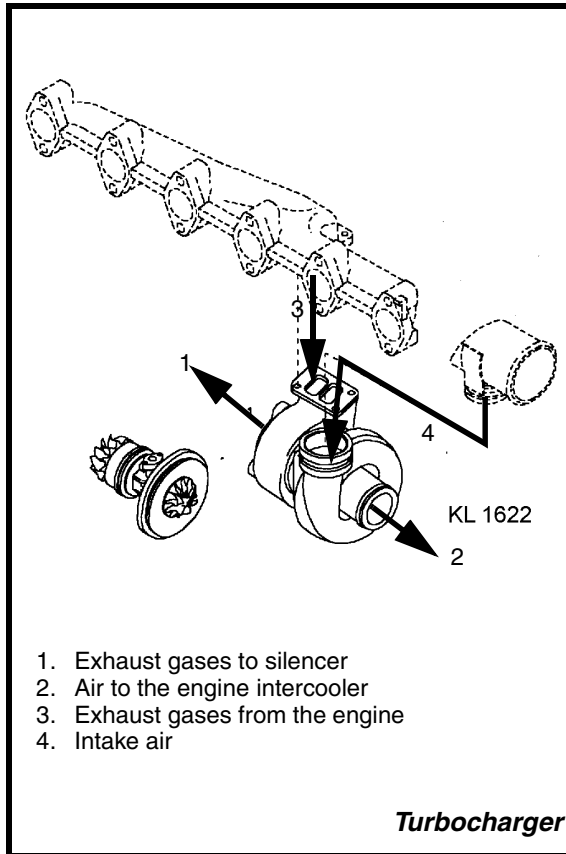
Combustion system

Large quantities of air are necessary for burning the fuel supplied to the engine. Free, unrestricted flow of fresh air and exhaust gases is therefore essential to allow the engine to run efficiently.

Air cleaner

The intake air is cleaned in a two-stage air cleaner, the first stage of which collects coarse particles by cyclone action, and the particles are then collected in a dust receiver. The second stage consists of a filter element - the main filter element. A safety filter element is located on the inside of the main element. The safety element prevents the ingress of impurities into the engine while the main element is being changed and if the main element should sustain damage while the engine is running, e.g. due to incorrect installation.





Turbocharger

The turbocharger supplies more air to the combustion chambers than the engine would be capable of drawing naturally. This enables the engine to burn more fuel which, in turn, increases the engine output.

The turbocharger consists of a turbine wheel and a centrifugal compressor impeller, each with a separate casing but mounted on a common shaft.

The exhaust gases provide the energy necessary for driving the turbine wheel which, in turn, drives the compressor.

The turbocharger is lubricated and cooled by the lubricating oil from the engine.

Intercooler

In intercooling, the air that has been compressed and heated by the turbo is cooled in an intercooler.

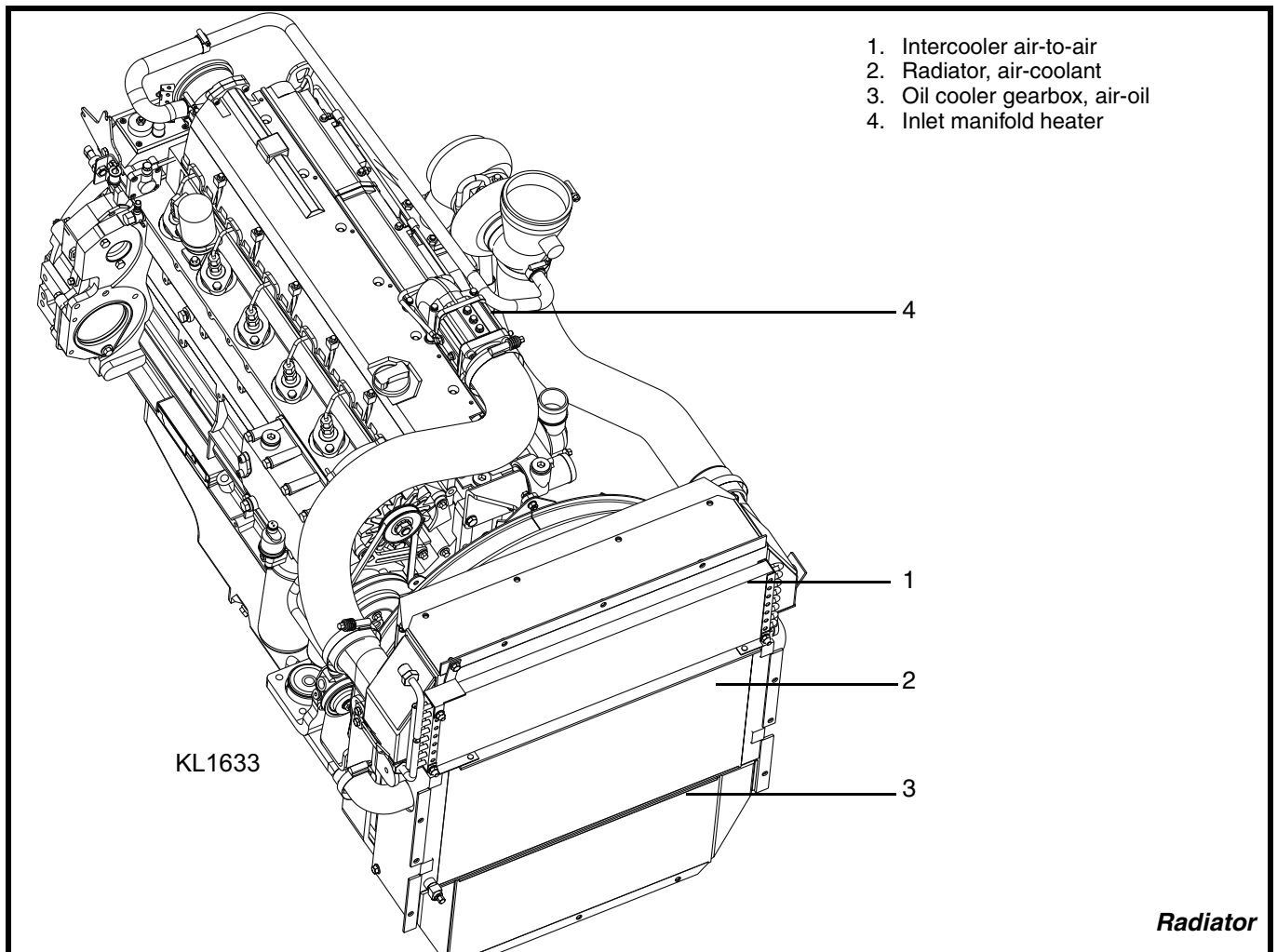
The intercooler increases the oxygen supply for combustion so allowing the injected fuel to be burnt more effectively whilst reducing fuel consumption as well as the level of exhaust emission.

Intercooling also reduces the thermal stressed on the engine, increasing durability and reducing oil consumption

The intercooler is of the air-to-air type and integrated with the radiator and the gearbox oil cooler.

Inlet manifold heater

Before the air is admitted into the combustion chamber, it flows across an electrically heated starting element. This has a high rating of 3 kW and heats the intake air sufficiently for the engine to start at low ambient temperatures. The starter heater is automatically controlled through separate electronic circuits.



Coolant quality

Throughout the year, the coolant should consist of a mixture of 60% of water and 40% of ethylene glycol. The coolant should be changed and the cooling system should be flushed once a year. Always add a corrosion inhibitor (Kalmar part No. 923.110.0003) to the coolant, if the above mixture is not used in the cooling system.

N.B. Never add a corrosion inhibitor if the cooling system contains glycol, since this would cause foaming which seriously impairs the cooling capacity.

Lubricating oil quality

See Group 90, Periodic supervision.

Draining the water from the fuel tank

Drain any water from the fuel tank by removing the drain plug. Immediately refit the drain plug as soon as the flow of fuel is free from water and other impurities.

Inspection of the air cleaner and changing the filter element

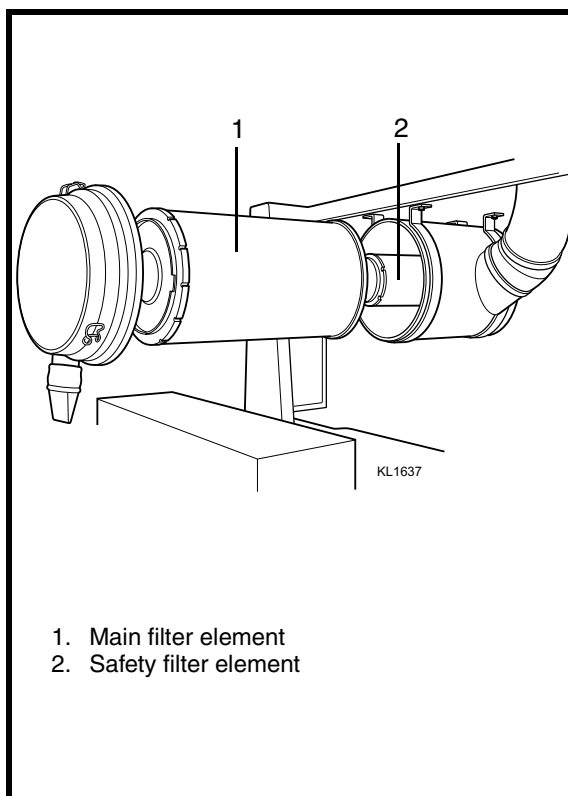
Check the indicator when the engine is running. If it shows red, the main filter element must be changed. The collecting efficiency of the filter element will not be improved if the element is changed too early. But if changing of the filter element is delayed, smoke emission from the engine will increase, the engine may lose power due to insufficient supply of combustion air, and engine damage may occur in certain cases.

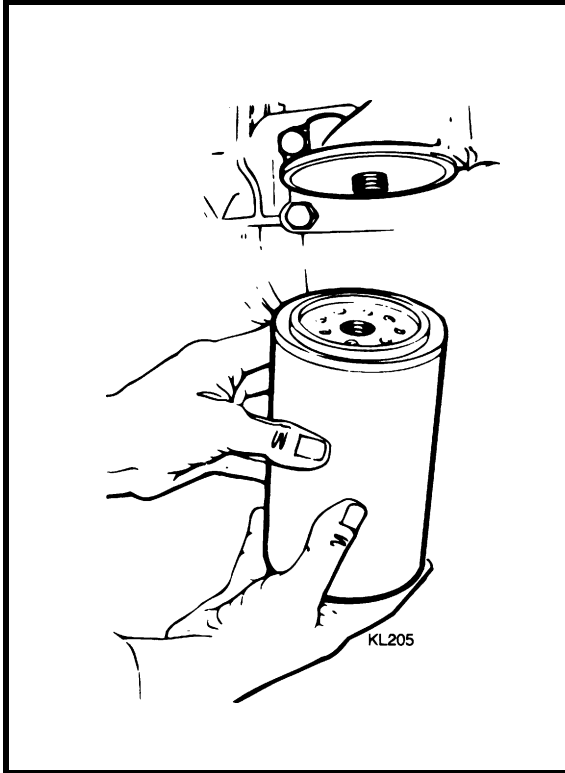
The air pipe from the air cleaner to the engine should be checked for tightness from time to time. Minor leakage, such as that caused by loose hose clips, and damaged or porous hoses may cause dust to be drawn into the engine, which will give rise to costly engine wear.

Change the filter element as follows:

1. The engine must not be running.
2. Clean the outside of the air cleaner.
3. Remove the cover.
4. Release and carefully remove the main filter element. Do not remove the safety filter element.
5. Fit a new main filter element. Carefully check that it is not damaged. Note on the safety filter element when the main element was replaced.
6. Change the safety filter element:
 - after the main filter element has been changed five times
 - at least every other year
 - if the indicator shows red after the main element has been changed
 - if the engine has been run with the main element damaged

The safety filter element must not be cleaned and reused. The engine must not be run without the main filter element. If the main element must be cleaned and refitted in emergency cases, don't use compressed air to clean it, since the filter element may be damaged. Before refitting it, carefully check that the main filter element is undamaged.



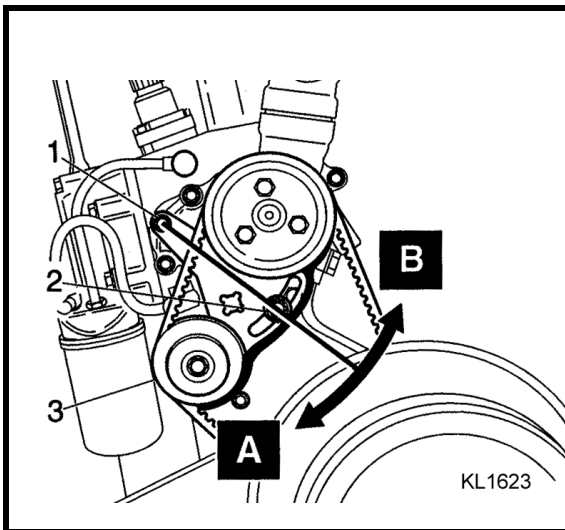


Changing the oil and oil filter

N.B. Before draining the oil, make sure that it is at normal working temperature.

1. Remove the drain plug from the underside of the sump and drain the oil. Fit the plug with a new gasket.
2. Clean the area round the filters and place a tray under the filters to collect any spillage.
3. Remove and discard the filter canisters, which are of disposable type.
4. Pour clean oil into the centre of the new filters, wait until the oil has seeped through the filter paper and top up until the filters are full.
5. Lubricate the canister seals with oil.
6. Fit the new filters and tighten them - by hand only.
7. Fill the engine with oil (see Group 90, Lubrication chart).
8. Run the engine and check that no oil leaks at the filters.
9. Stop the engine and check the oil level after a few minutes. Top up as necessary to the MAX level on the dipstick.

N.B. To avoid serious damage to the engine, use only genuine Kalmar filters.

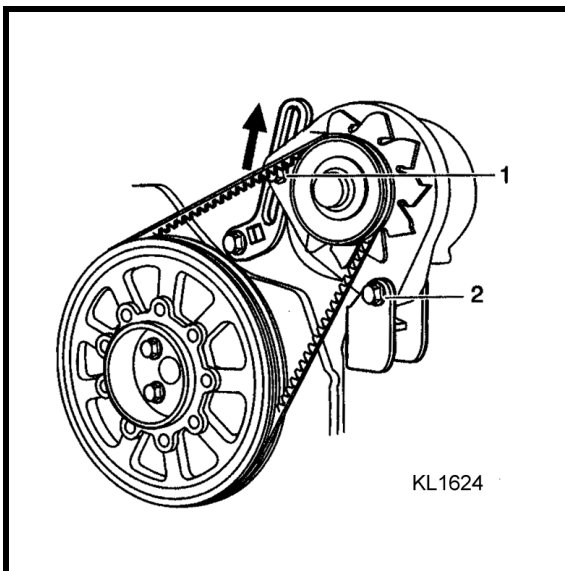


Checking the V-belt tension

1. Check at regular intervals that the V-belts are correctly tensioned. It should not be possible to depress the V-belt more than 10 - 12 mm mid-way between the pulleys.

Coolant-fuel pump

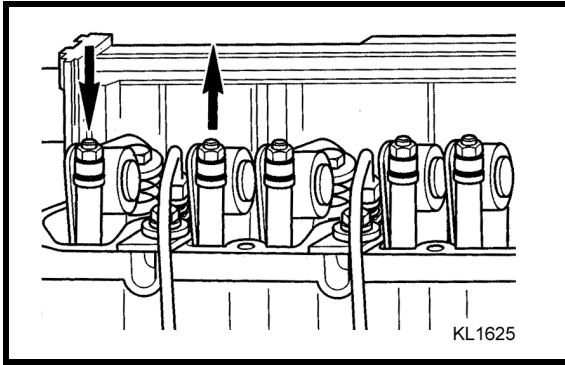
1. Loosen the screws 1 and 2
2. Push the fuel pump in the direction of the arrow 3 (A or B) until the correct belt tension is achieved.
3. Tighten the screws 1 and 2



Alternator

1. Loosen the screws 1 and 2.
2. Move the alternator until the right belt tension is achieved.
3. Tighten the screws 1 and 2

N.B. If the belt drive consists of two belts, always change both belts.



Checking and adjusting the valve clearances

N.B. Never attempt to check the valve clearances when the engine is running. The engine must be stationary and cold.

1. Remove valve cover and crankcase ventilation

Crankshaft position 1

2. Rotate the crankshaft until the valves of cylinder 1 overlap. See picture for valve adjustment

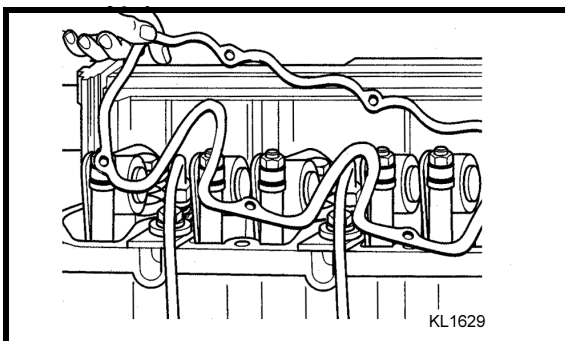
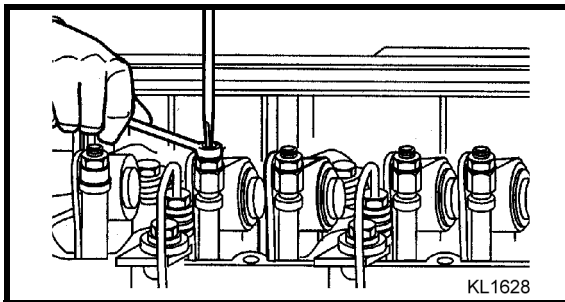
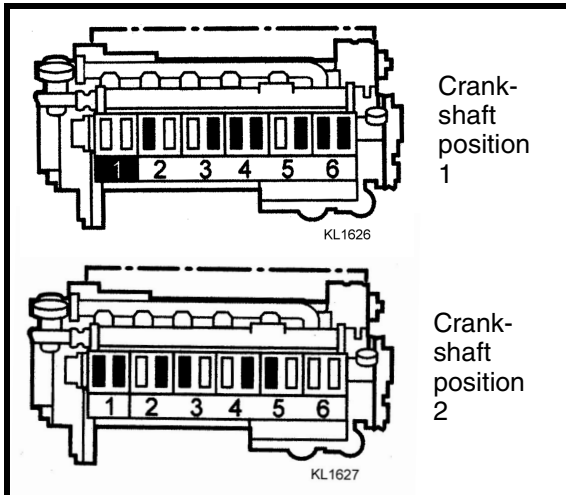
N.B. Overlapping of valves means

The exhaust valve is just closing and the inlet valve is just opening. Neither of the push-rods can be turned around in this position. Cylinder 1 is closest to the flywheel.

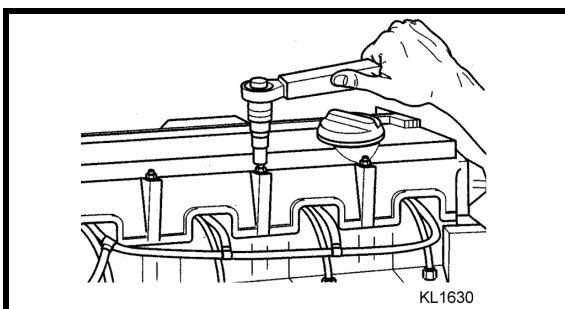
3. Adjust the valve clearances according to the black markings in the adjoining picture.
Inlet valve: 0,30 mm
Exhaust valve: 0,50 mm
4. Tighten the lock nut with 20 ± 2 Nm. Re-check the clearance with a feeler gage.
5. Make a chalk mark on every adjusted valve.

Crankshaft position 2

6. Rotate the crank shaft another turn (360°)
7. Adjust the valve clearances according to the black markings in the adjoining picture.



8. Fit a new gasket for the valve cover.



9. Fit the valve cover and tighten the cover screws with 9 ± 1 Nm.

Changing the fuel filters

1. Clean the outsides of the filters.
2. Remove the filters and discard them.
3. Clean the filter head.
4. Check that the new filters are perfectly clean and that the seals are in good condition.
5. Fit the new filter canisters and tighten them by hand until the seal is in contact with the seating surface. Then tighten them a further half a turn.



WARNING!

Never run the engine with the air inlet or exhaust pipes disconnected from the turbocharger, since personnel could then sustain injuries.

IMPORTANT!

Adjustments on the injection pump are to be performed by authorized personnel only.

Preventive maintenance on the turbocharger

The turbocharger may be damaged and, in the worst case, may break down if the engine is not properly serviced.

1. Check that the engine air inlet system is in good condition, i.e. that the air cleaner is clean, that none of the hoses are worn and that hose connections are not defective, which would allow oil to seep past the seals on the compressor side and be entrained by the inlet air. The latter may lead to high exhaust gas temperatures and overheating of the turbine shaft bearing. If corrective action is then not taken, the turbocharger may break down.
2. Change the lubricating oil and filter at the specified intervals. Check at regular intervals that the lubricating oil lines to the turbocharger are in good condition and do not leak. Also check regularly that the oil pressure is not too low, since this could quickly lead to damage to the turbocharger.
3. Ensure that the fuel system is serviced at the specified intervals. Inadequate fuel supply caused by clogged fuel filters or incorrect setting of the injection pump reduces the turbocharger speed which, in turn, results in a lower engine output.
4. Check that there are no restrictions in the crankcase ventilation. If the vent is blocked, pressure may build up and may force oil into the inlet air system of the turbocharger and engine.

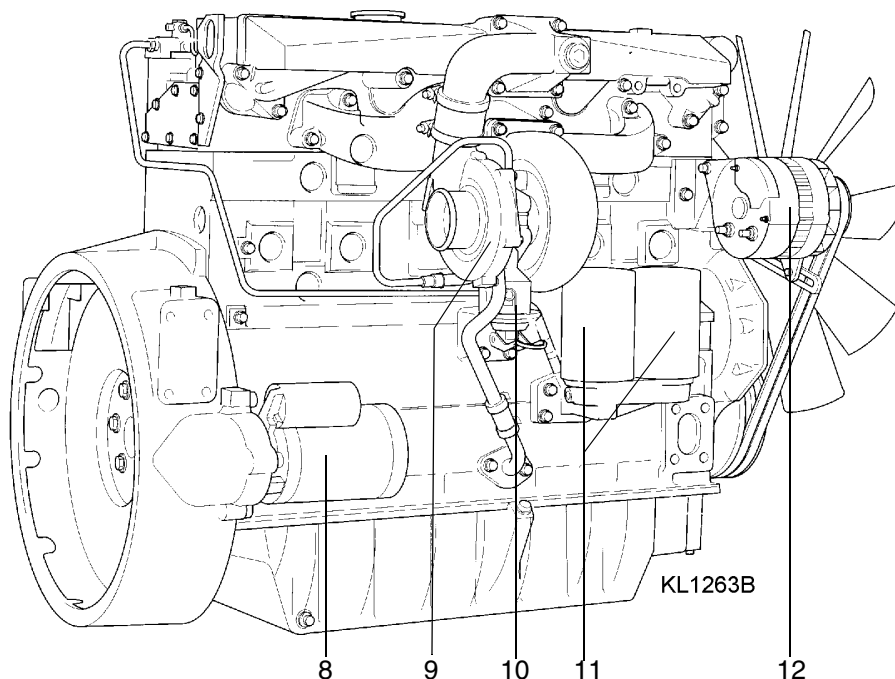
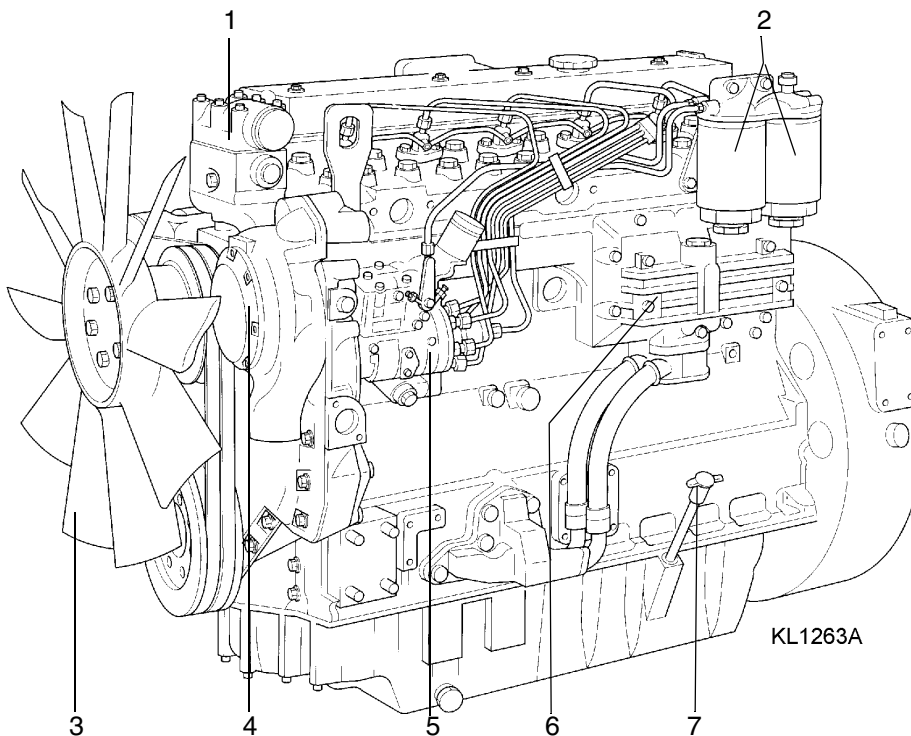
Perkins 1006-60T

Manufacturer, type	Perkins 1006-60T1	Perkins 1006-60T2
Coolant volume, l	35	35
Rating, DIN 6271, kW at r/min	85 2300	114 2300
Torque, DIN 6271, Nm at r/min	465 1400	620 1500
Number of cylinders	6	6
Swept volume, litres	6	6
Valve clearance, cold engine		
inlet, mm	0.20	0.20
exhaust, mm	0.45	0.45
Idling speed, r/min (adjust so that the engine runs smoothly)	675±25	675±25
Thermostat,		
starts to open at °C	77–85	77–85
fully open at °C	92–98	92–98
Lubricating oil filter	Full-flow, disposable paper el- ements with by-pass valve	Full-flow, disposable paper el- ements with by-pass valve
Lubricating oil pressure, kPa		
running speed	min 276	min 276
idling speed		
Lubricating oil grade viscosity	See Group 90	See Group 90
Volume incl filters, l	13	13

General

The engine is a 6-cylinder, inline, 4-stroke diesel engine with overhead valves. The engine is turbocharged, i.e. combustion air is supplied under pressure. As a result, the quantity of fuel injected can be increased, which increases the engine output. The turbocharger is driven by the exhaust gases and uses energy that would otherwise be lost.

The engine is pressure-lubricated and incorporates an oil pump which delivers oil to all lubrication points. A full-flow oil filter effectively cleans the lubricating oil. The fuel system is protected against impurities by replaceable filters. The engine has replaceable wet cylinder liners and two cylinder heads, each covering three cylinders.



1. Thermostat housing
2. Fuel filters
3. Cooling fan
4. Coolant pump
5. Injection pump
6. Oil cooler
7. Oil dipstick
8. Starter motor
9. Turbocompressor
10. Fuel feed pump
11. Oil filter
12. Alternator

Cooling system

The Perkins engine is liquid-cooled and has a closed cooling system consisting of the following main components:

- Coolant pump
- Radiator
- Expansion tank
- Thermostat
- Radiator fan
- Water passages
- Gearbox oil cooler

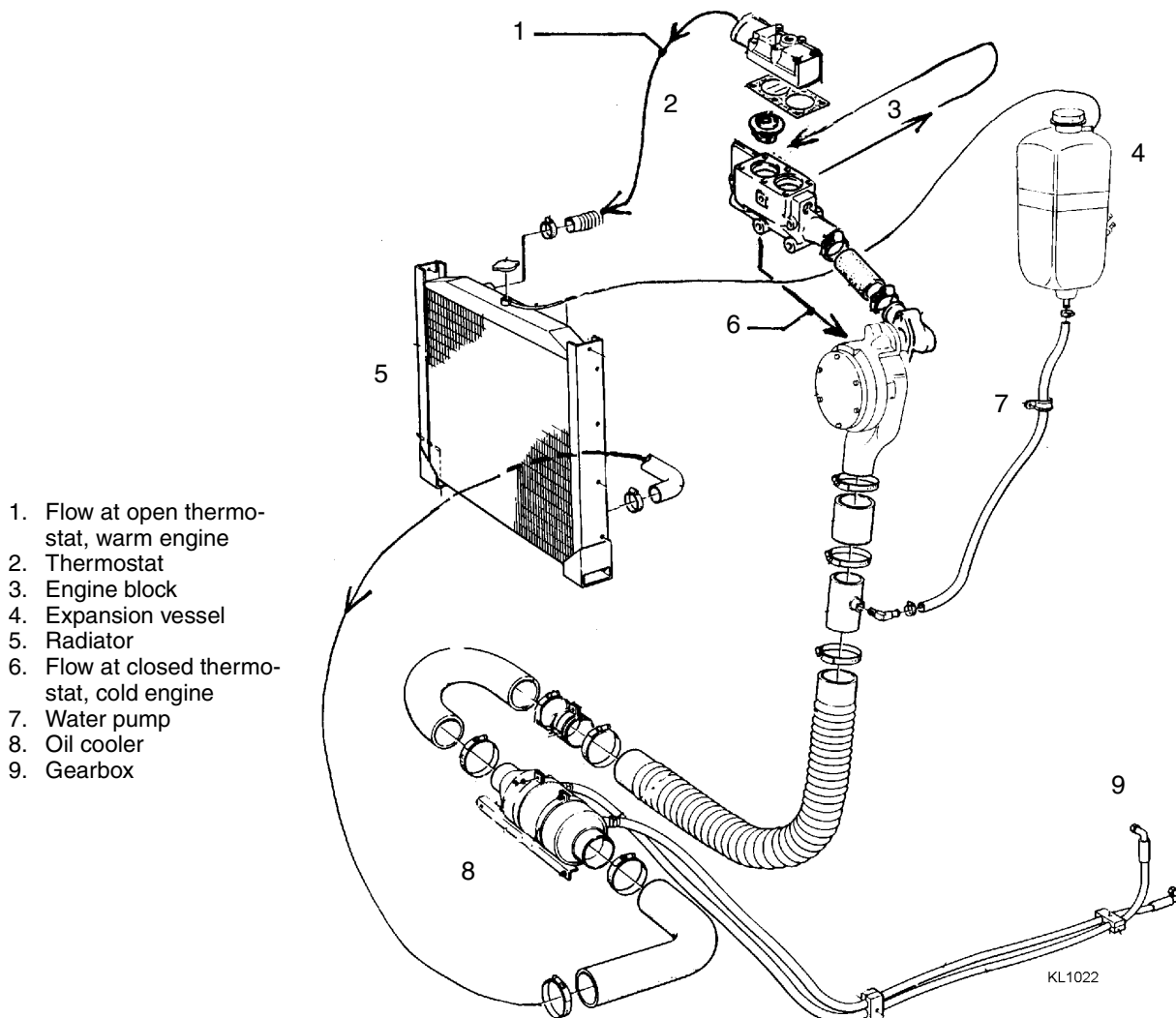
The coolant is circulated by a pump mounted on the front of the cylinder block and driven by V-belts from the injection pump gear.

From the pump, the coolant flows into the cylinder block, along the oil cooler and then up to the cylinder head.

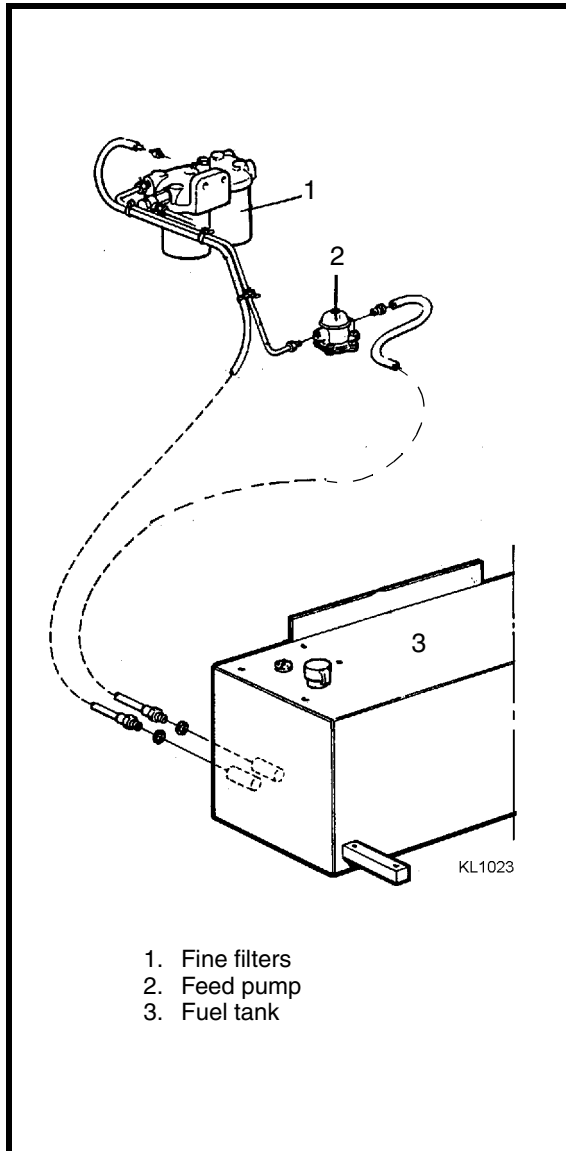
The engine has two thermostats which, in the open position, deliver the coolant to the radiator. Up to the opening temperature, the thermostats are closed and the coolant circulates only through the engine.

The cooling system has a separate expansion vessel with a filler cap located on the engine casing.

The gearbox oil is cooled in a shell-and-tube cooler connected in series with the engine radiator.



Cooling system



Fuel system

The fuel circulates in two circuits - the high-pressure circuit and the low-pressure circuit. When the engine is started, the feed pump draws fuel from the tank and delivers it at relatively low pressure through fine filters up to the injection pump. This then delivers fuel at high pressure to the injectors which supply the fuel in atomised form to the engine combustion chambers.

The engine is equipped with a colad-starting system which heats the intake air. When the starting key is turned to the heating position, a heater in the air intake system will be energised. When the key is turned to the start position, excess fuel from the injectors will be injected to the heater and ignited, thus warming up the intake air.

The fuel system includes the following components:

Fuel tank – a separate unit located on the left-hand side of the truck. The fuel volume in the tank can be read on a gauge on the instrument panel.

Feed pump – of piston type, supplies fuel at a certain pressure and flow rate to the injection pump.

Fine filters – two full-flow disposable filters connected in parallel. Built-in water separator with drain valve. prevents condensate to enter the fuel system.

Heater – connected to the starting key and designed to heat a space in the intake system when the starting key is in the heating position.

Injection pump – of C.A.V. manufacture, mounted on the right-hand side of the engine and driven by splines from a worm reduction unit on the engine. The pump is a compact, oil-tight unit which is lubricated by the fuel. The engine speed is controlled by a mechanical centrifugal governor.

Coolant quality

Throughout the year, the coolant should consist of a mixture of 60% of water and 40% of ethylene glycol. The coolant should be changed and the cooling system should be flushed once a year. Always add a corrosion inhibitor (Kalmar part No. 923.110.0003) to the coolant, if the above mixture is not used in the cooling system.

N.B. Never add a corrosion inhibitor if the cooling system contains glycol, since this would cause foaming which seriously impairs the cooling capacity.

Lubricating oil quality

See Group 90, Periodic supervision.

Draining the water from the fuel tank

Drain any water from the fuel tank by removing the drain plug. Immediately refit the drain plug as soon as the flow of fuel is free from water and other impurities.

Inspection of the air cleaner and changing the filter element

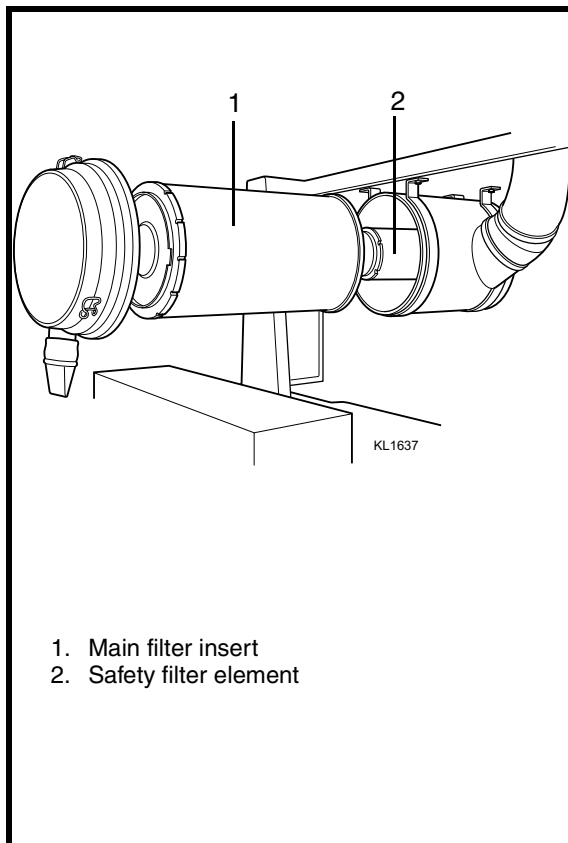
Check the indicator when the engine is running. If it shows red, the main filter element must be changed. The collecting efficiency of the filter element will not be improved if the element is changed too early. But if changing of the filter element is delayed, smoke emission from the engine will increase, the engine may lose power due to insufficient supply of combustion air, and engine damage may occur in certain cases.

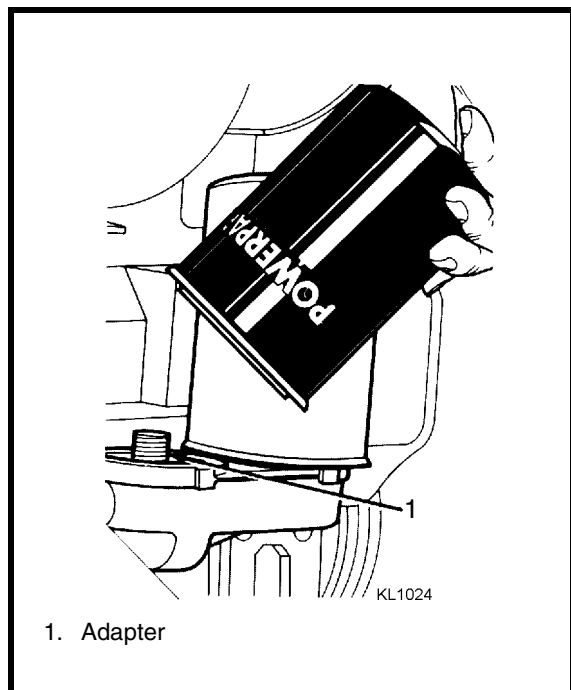
The air pipe from the air cleaner to the engine should be checked for tightness from time to time. Minor leakage, such as that caused by loose hose clips, and damaged or porous hoses may cause dust to be drawn into the engine, which will give rise to costly engine wear.

Change the filter element as follows:

1. The engine must not be running.
2. Clean the outside of the air cleaner.
3. Remove and clean the dust receiver.
4. Release and carefully remove the main filter element. Do not remove the safety filter element.
5. Fit a new main filter element. Carefully check that it is not damaged. Note on the safety filter element when the main element was replaced.
6. Change the safety filter element:
 - after the main filter element has been changed five times
 - at least every other year
 - if the indicator shows red after the main element has been changed
 - if the engine has been run with the main element damaged

The safety filter element must not be cleaned and reused. The engine must not be run without the main filter element. If the main element must be cleaned and refitted in emergency cases, don't use compressed air to clean it, since the filter element may be damaged. Before refitting it, carefully check that the main filter element is undamaged.



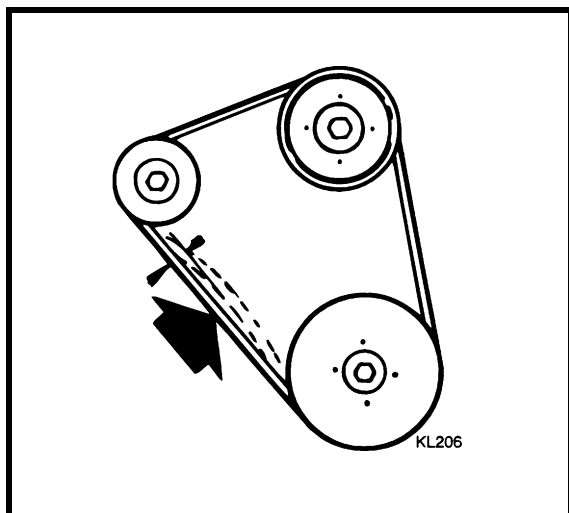


Changing the oil and oil filter

N.B. Before draining the oil, make sure that it is at normal working temperature.

1. Remove the drain plug from the underside of the sump and drain the oil.
2. Clean the area round the filters and place a tray under the filters to collect any spillage.
3. Remove and discard the filter canisters, which are of disposable type. Use special tool if needed. Check that the adapter is secured.
4. Pour clean oil in the center of the new filters to wet the filter insert, wait until the oil has penetrated the insert.
5. Lubricate the canister seals with oil.
6. Fit the new filters and tighten them - by hand only.
7. Fill the engine with oil (see Group 90, Lubrication chart).
8. Run the engine and check that no oil leaks at the filters.
9. Stop the engine and check the oil level after a few minutes. Top up as necessary to the MAX level on the dipstick.

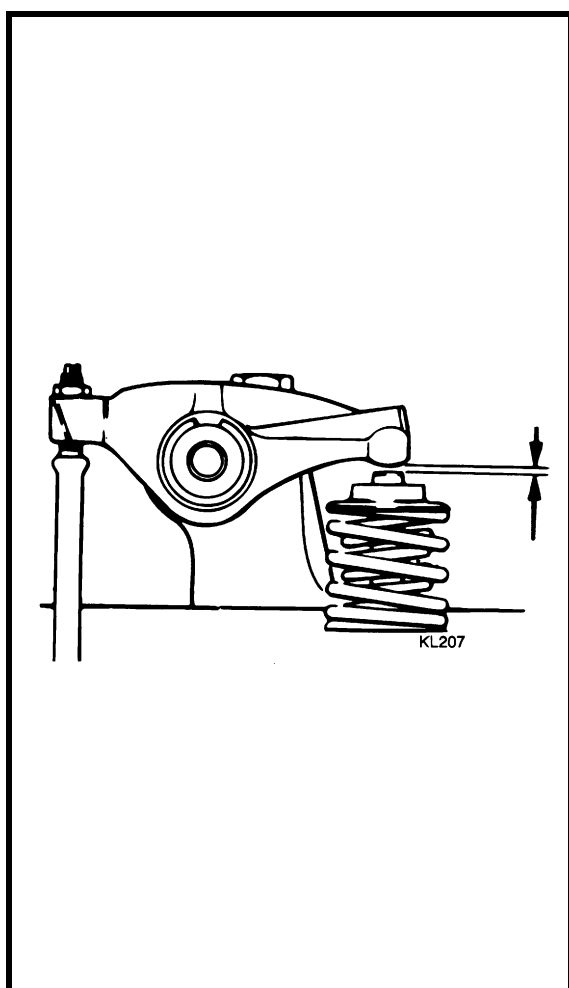
N.B. To avoid serious damage to the engine, use only genuine Kalmar filters.



Checking the V-belt tension

1. Check at regular intervals that the V-belts are correctly tensioned. It should not be possible to depress the V-belt more than 10–12 mm mid-way between the pulleys.
2. The belts are adjusted by harging the alternator position.

N.B. If the belt drive consists of two belts, always change both belts.



Checking and adjusting the valve clearances

N.B. Never attempt to check the valve clearances when the engine is running. The engine must be stationary and cold.

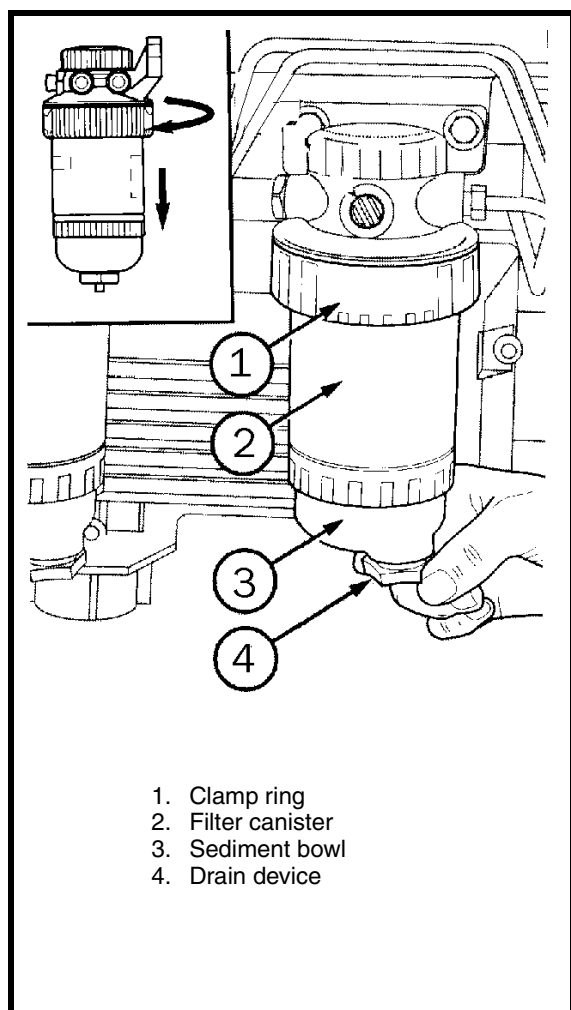
1. Turn the crankshaft in its normal direction of rotation until the inlet valve of No. 6 cylinder has just opened and the exhaust valve of the same cylinder has not yet closed fully. Check the valve clearances on No. 1 cylinder and adjust as necessary.

Valve clearances

Engine	Perkins 1006-60T1/T2 Cold engine
Inlet	0.20 mm
Exhaust	0.45 mm

2. Check the other valves in accordance with the table below.

Check the valve clear- ance of cylinder No	1	5	3	6	2	4
...when the inlet and ex- haust valves of the follow- ing cylinders are just changing over (are moving simultaneously)	6	2	4	1	5	3



Changing the fuel filters

1. Clean the outsides of the filters.
2. Loosen the draining device (4) and allow the water/fuel to drain into a suitable container.
3. Turn the sediment bowl (3) to the left and remove the bowl.
4. Turn the clamp ring (1) to the left and remove the clamp ring.
5. Remove the canister from the filter head by a direct pull downwards, and discard the old canister.
6. Ensure the filter head is clean and push the new canister fully into the filter head.
7. Fit the clamp ring and turn it fully to the right to fasten the canister to the filter head.
8. Remove the cover of the sediment bowl and thoroughly clean the bowl.
9. Check that the two O-ring seals of the sediment bowl cover for damage and, if needed, renew them.
10. Clean the threads of the sediment bowl fastener, to secure the bowl to the canister. Turn the bowl fully to the right and tighten by hand only.
11. Bleed the fuel system (for further instructions, see the Operator's manual).



WARNING!

Never run the engine with the air inlet or exhaust pipes disconnected from the turbocharger, since personnel could then sustain injuries.

IMPORTANT!

Adjustments on the injection pump are to be performed by authorized personnel only.

Preventive maintenance on the turbocharger

The turbocharger may be damaged and, in the worst case, may break down if the engine is not properly serviced.

1. Check that the engine air inlet system is in good condition, i.e. that the air cleaner is clean, that none of the hoses are worn and that hose connections are not defective, which would allow oil to seep past the seals on the compressor side and be entrained by the inlet air. The latter may lead to high exhaust gas temperatures and overheating of the turbine shaft bearing. If corrective action is then not taken, the turbocharger may break down.
2. Change the lubricating oil and filter at the specified intervals. Check at regular intervals that the lubricating oil lines to the turbocharger are in good condition and do not leak. Also check regularly that the oil pressure is not too low, since this could quickly lead to damage to the turbocharger.
3. Ensure that the fuel system is serviced at the specified intervals. Inadequate fuel supply caused by clogged fuel filters or incorrect setting of the injection pump reduces the turbocharger speed which, in turn, results in a lower engine output.
4. Check that the crankcase ventilation evacuation hose has unrestricted flow. If the vent is blocked, pressure may build up and may force oil into the inlet air system of the turbocharger and engine.

Group 40

Transmission, drive axle, brakes

Specification	2
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Gearbox.....	4
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Service	8
Oil level check	8
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Inspection of dismountable rims	see group 60
Safety test when changes tyres	see group 60

Torque converter and gearbox

Model	Clark 1207 FT 20302	Clark - 13.7 HR 28000/32000
Number of gears	3F – 3R	3F – 3R
Oil capacity, total system, l	17	21
Oil grade	See Group 90	
Oil operating temperature, °C	80–95	
Max. permissible temperature, °C	120	
Clutch pressure, bar with parking brake applied, oil temp. 80–95°C, engine idling at 400–600 r/min	17–20	17–20
Indicated on pressure gauge in cab		
Clutch type	Multiple disc, hydraulic. Modulation on FORWARD and REVERSE Automatic wear compensation (no adjustment). All clutches oil cooled and lubricated.	
Stall speed, r/min	1950±50	1870±50
Oil filtration	Full-flow oil filter with safety by-pass; also strainer screen in sump at bottom of transmission case.	

Drive axle

Model	Kessler D81	
Brake system	Wet disc brakes	
Parking brake system	Spring-activated disc brake on drive axle input-shaft.	
Wheel dimensions, in / Tyre pressure, MPa	90-6: 10.00x20/16PR - 0.7 100-6: 10.00x20/16PR - 0.8 120-6: 11.00x20/16PR - 0.9 136-6: 12.00x20/20PR - 0.9	
Oil capacity, l	2x2+17,5	
Oil grade	See Group 90	
Tightening torque		
Drive axle mounting bolts (oiled), Nm (kpm)	M24: 650 (66)	M30: 1275 (130)
Rim clamp nuts, Nm (kpm)	M22: 650 (66)	
Universal drive axle joint, Nm (kpm)	UNF 3/8": 59 (6.0)	

The transmission consists of a torque converter integrated with the gearbox, and a propeller shaft, driven axle with differential, hub reductions and brakes.

The torque converter and gearbox run together, using a common hydraulic system. The torque converter can be regarded as a hydraulic coupling and is located between the engine output shaft and the gearbox input shaft.

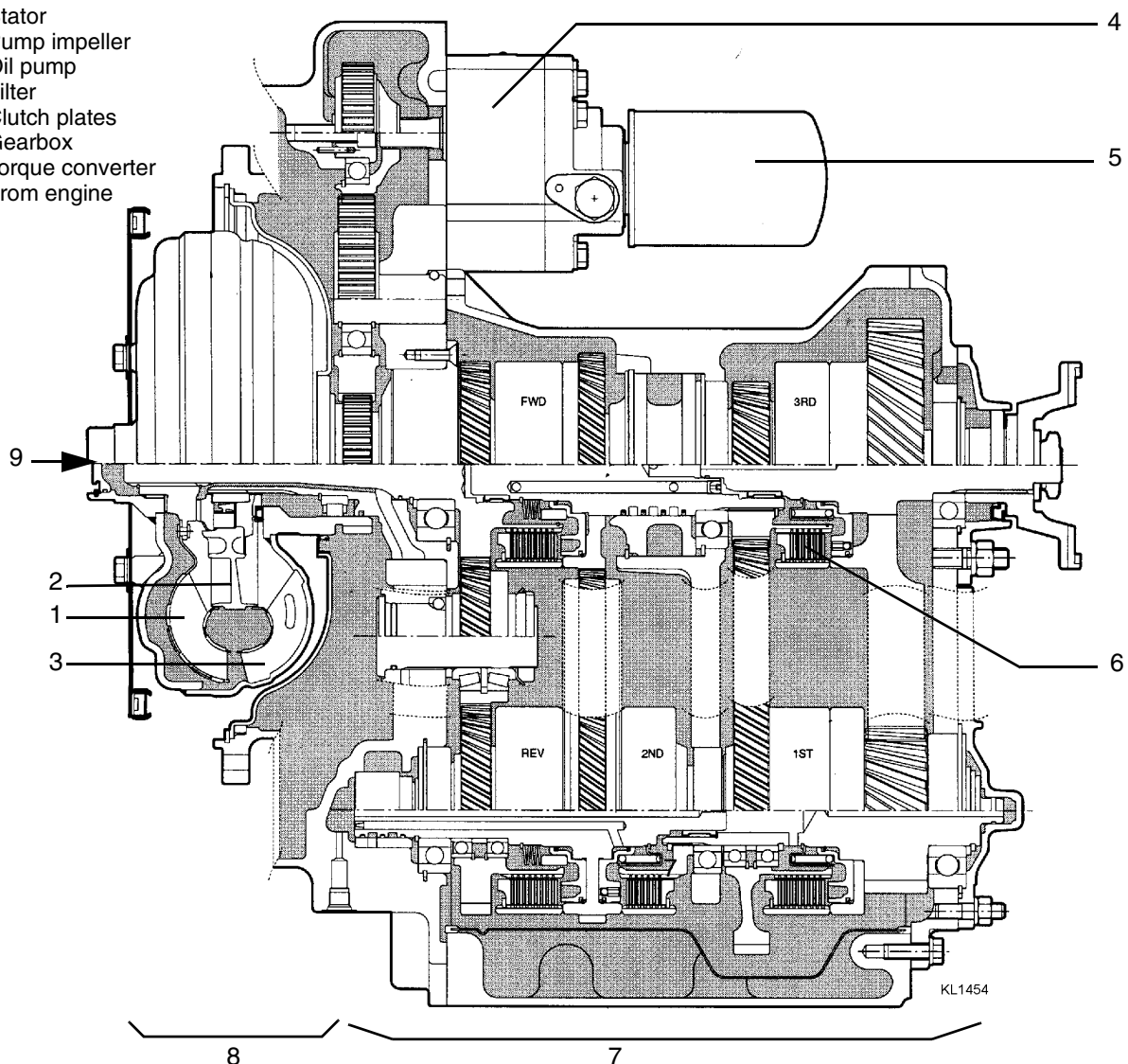
Torque converter

The most important components of the torque converter are the pump impeller, turbine wheel and stator. Engine power is transmitted mechanically to the pump impeller. The impeller starts an oil flow in the torque converter, and is comparable to a centrifugal pump which draws oil into the centre and discharges it at the periphery.

The turbine wheel is located opposite the pump impeller and is connected to the torque converter output shaft. The oil enters the turbine wheel at the periphery and is discharged at the centre.

The stator is located between the pump impeller and the turbine wheel, at their inside diameter. The function of the stator is to guide the flow of oil from the inside diameter of the turbine wheel back to the inside diameter of the pump impeller in the best possible way.

1. Turbine wheel
2. Stator
3. Pump impeller
4. Oil pump
5. Filter
6. Clutch plates
7. Gearbox
8. Torque converter
9. From engine



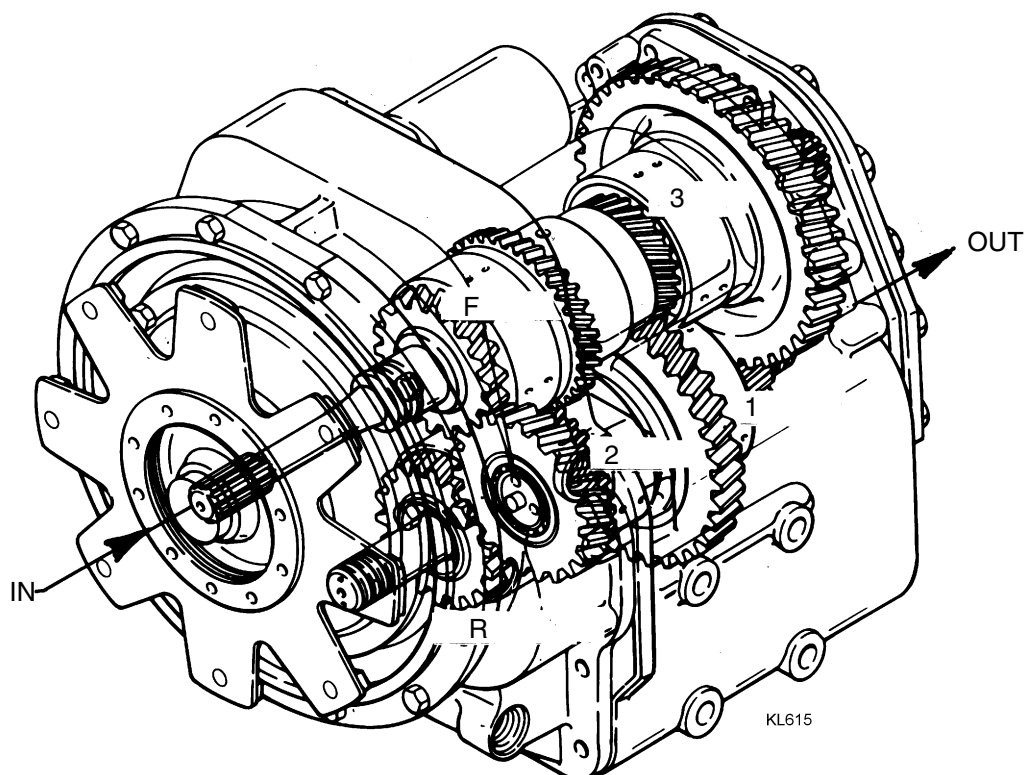
Torque conversion takes place in the oil circuit of the torque converter. When the load on the truck increases, i.e. when the torque required increases, the turbine wheel slows down in relation to the pump impeller, and the oil flowing through the stator then increases the torque.

The output torque gradually increases as the speed of the output shaft decreases and is a maximum when the output shaft and thus also the turbine wheel are stationary, i.e. are stalled.

Gearbox

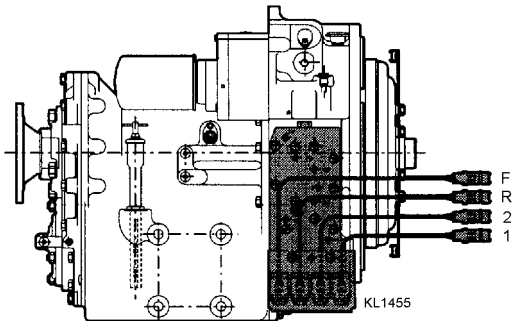
The gearbox is of constant-mesh type. Gear-changing is carried out by clutch plates for the various gears being hydraulically actuated.

The clutches for FORWARD and REVERSE are hydraulically modulated, which implies that the clutch pressure is built up gradually. This allows changing between forward and reverse on driving with a maximum speed of 6 km/h. The modulation also results in a soft changing between FORWARD and REVERSE, SEE ALSO GEARBOX DIAGRAM.



- IN Input
- OUT Output
- F Forward
- R Reverse
- 1. 1st gear
- 2. 2nd gear
- 3. 3rd gear

The various clutches in the Clark 20000 gearbox

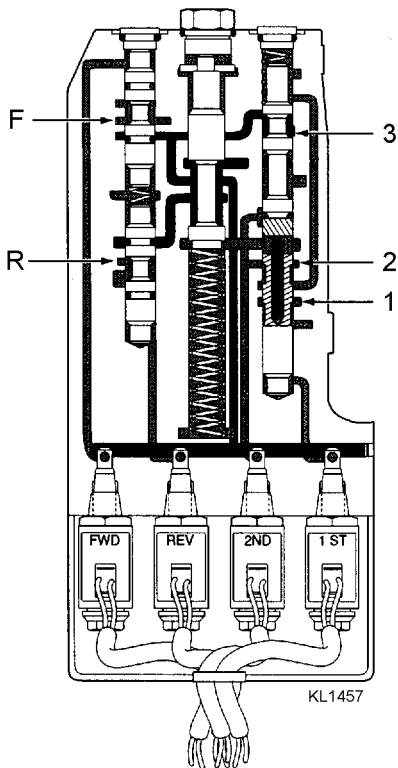


The gearbox valve housing,
electrical connections

The valve body mounted on the side of the gearbox includes spool valves which guide the oil flow to the various clutches. The spools, in turn, are electrically activated from the selector lever in the cab. A mechanical gear-changing system is available as an option.

The gearbox has three ratios in each direction and is also provided with disengagement, which is actuated by a separate inching pedal at the left brake pedal and comes into operation at a certain brake pressure.

The electrical gear-changing system is either manual or automatic, see Group 20.



The gearbox valve housing

Gear	Activated solenoids
F3	F
F2	F, 2
F1	F, 1, 2
N3	-
N2	2
N1	1, 2
R3	R
R2	R, 2
R1	R, 1, 2

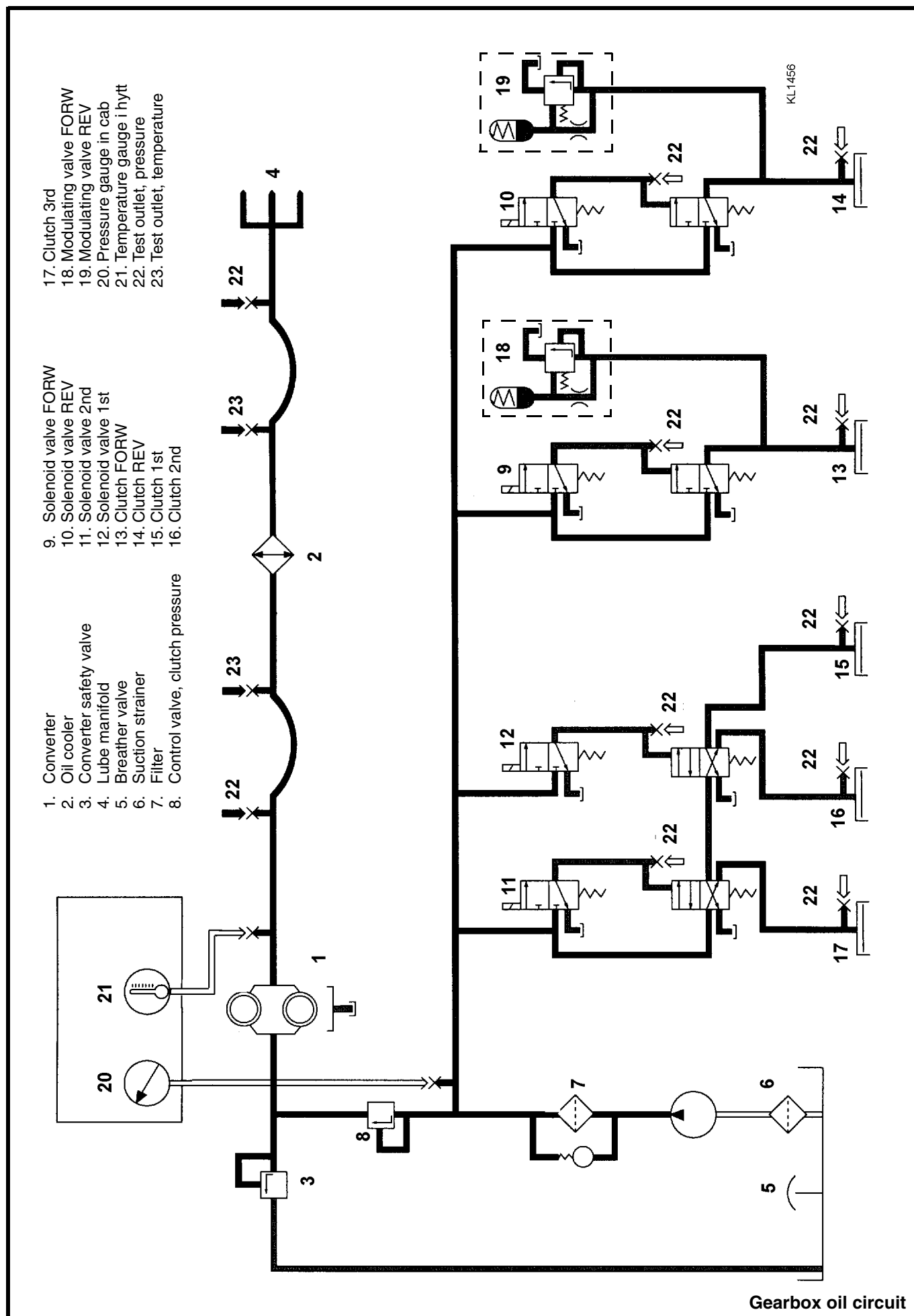
Oil circuit

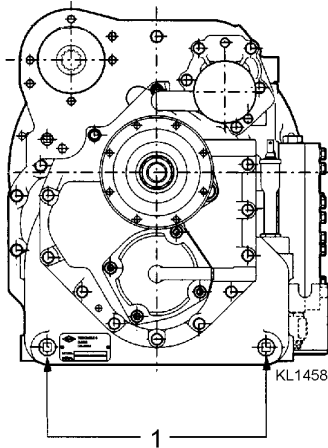
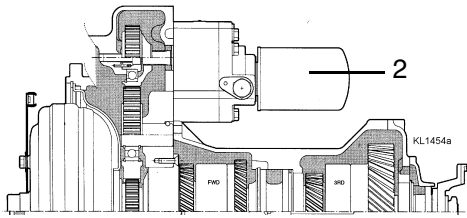
The function of the oil is:

- to transmit the engine output to the gearbox. The torque converter can multiply the engine torque by up to three times, but at the expense of the speed rotation.
- to apply the clutches in the gearbox.
- to dissipate the heat from the torque converter.
- to lubricate the gearbox and the torque converter.
- to transport any solid particles to the filter.

When the engine is running, the oil pump draws oil through a suction strainer from the gearbox sump and then delivers it through a fine filter to a pressure regulating valve.

The regulating valve delivers oil at the right pressure to the gearbox valve body, which actuates the clutch plates for Forward/Reverse and 1st/2nd/3rd. The clutches use only a small proportion of oil delivered by the pump. The remainder is fed through the torque converter circuit to the oil cooler, and returns to the gearbox for lubrication.





1. Magnetic drain plug
2. Filter

Clark 20000

Oil level check (transmission, incl. converter)

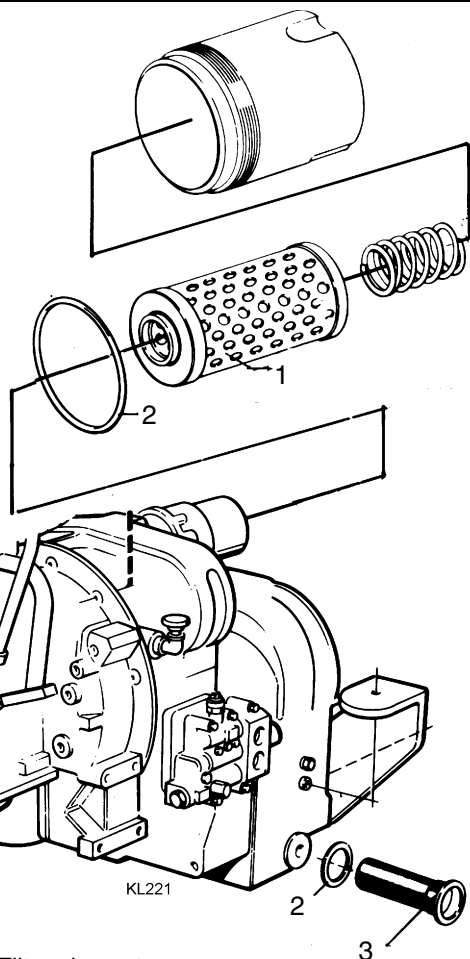
Check the oil level daily with the engine at idling speed and the oil temperature between 80 and 95°C.

Maintain the oil level at the FULL mark.

Changing the gearbox oil and filter

This should be carried out when the oil is at normal working temperature (80–95°C).

1. Remove the gearbox drain plugs and drain the oil.
2. Unscrew the filter bowl, remove the filter and fit a new filter element. Clark 20000 is equipped with throw-away filter of spin-on type.
3. Fit the new filter and tighten it.
4. Fit the drain plugs and tighten them.
5. Fill with oil to the MIN mark on the dipstick.
6. Start the engine and run it at 600–700 r/min until the oil has reached working temperature, and the hoses, cooler and torque converter have been filled with oil.
7. Keep the engine running at idling speed, check the oil level and top up to the MAX mark on the dipstick.



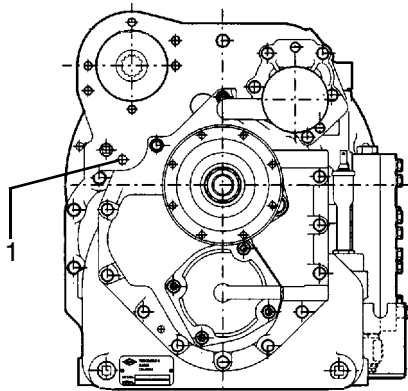
1. Filter element
2. Gasket
3. Suction strainer

Clark 28000/32000

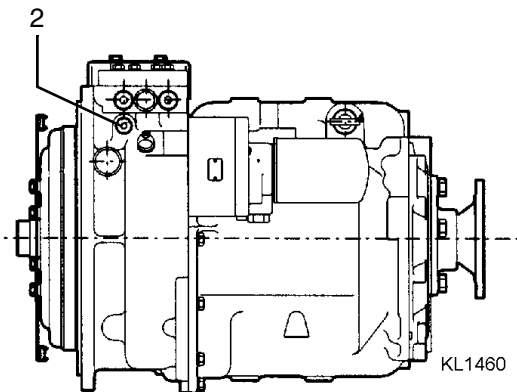
IMPORTANT!

In the event of gearbox damage, always replace the oil cooler – the damage may have been caused by the oil cooler being faulty.

Checking pressures



KL1458a



KL1460

1. Measurement point "converter outlet"
2. Clutch pressure sensor

Checking the pressure in the Clark 20000

Converter outlet pressure: ("Converter out")

1. The pressure should always be checked when the oil is at the normal working temperature of 80–95°C, the gearbox is in neutral and the engine is running at 2000 r/min.
2. The pressure should be above 1.7 bar, although the pressure must not exceed 4.9 bar when the engine is running at top speed.

Clutch pressure, all gears:

1. Indicated on the pressure gauge in the cab.
2. Parking brake set, oil temperature 80–95°C and engine at low idle.
3. Shift through all gears and F/R. The pressure should be 17–20 bar.

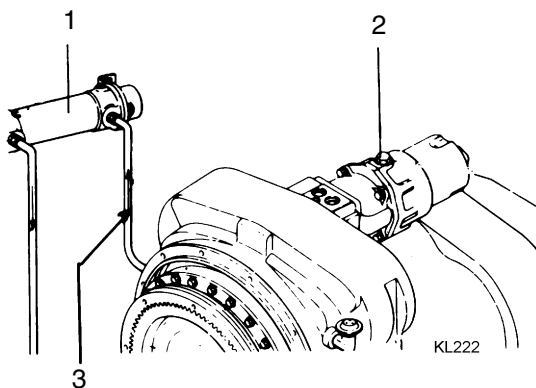
IMPORTANT!

The pressure must not vary by more than 0.4 bar between the various clutches.

N.B.

In case of incorrect clutch pressure, first check the gearbox pressure sensor, see picture.

If more details concerning individual test outlets are required, contact KALMAR INDUSTRIES SERVICE



KL222

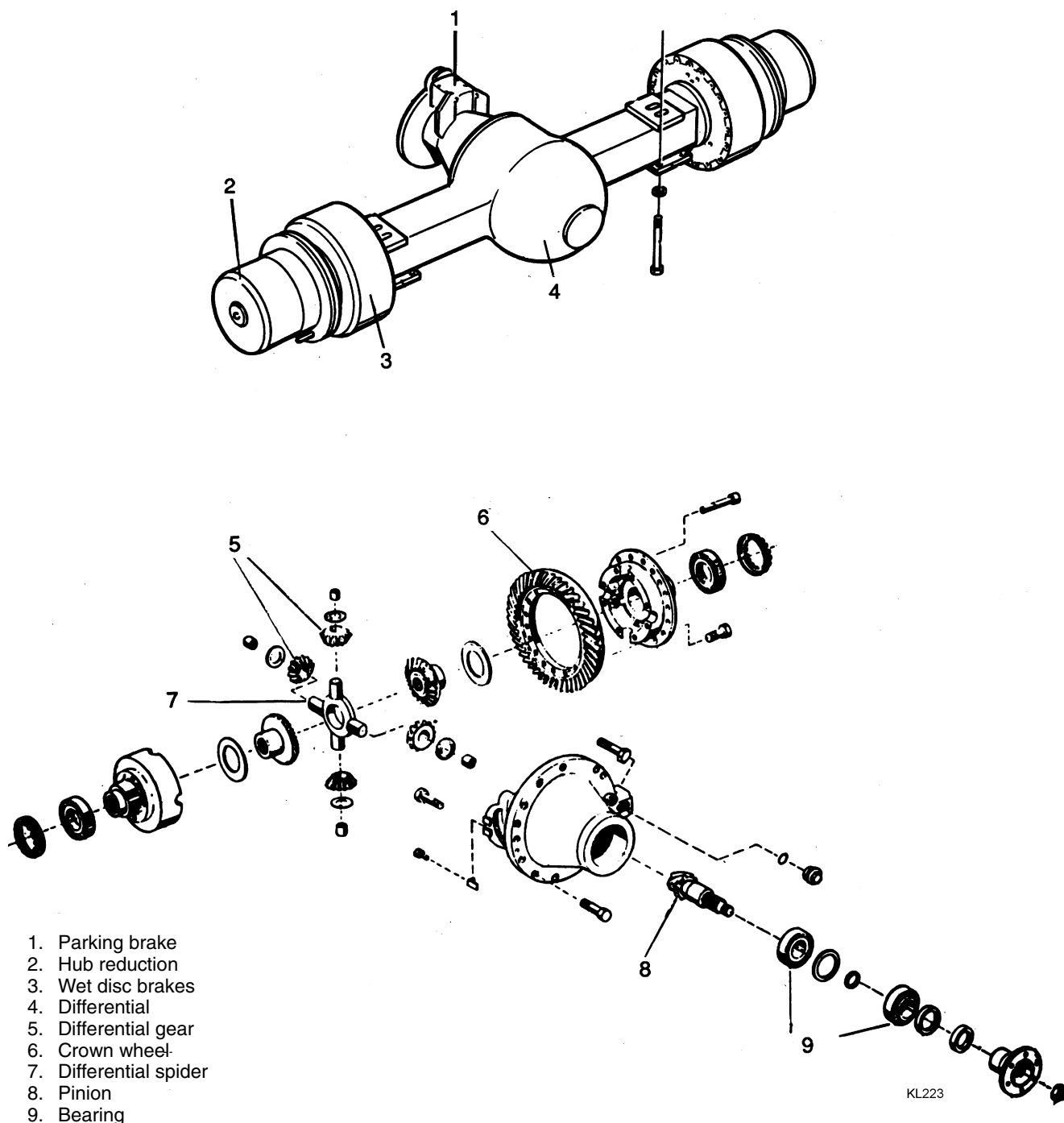
1. Oil cooler
2. Clutch pressure
3. From converter to cooler (measurement point: converter outlet pressure)

Checking the pressure in the Clark 28000/32000

Downshifting in the drive axle is in two stages: in the differential, and in the hub reduction. This gives a minimum of stresses in the power transmission system since the final torque is achieved first at the driven wheels..

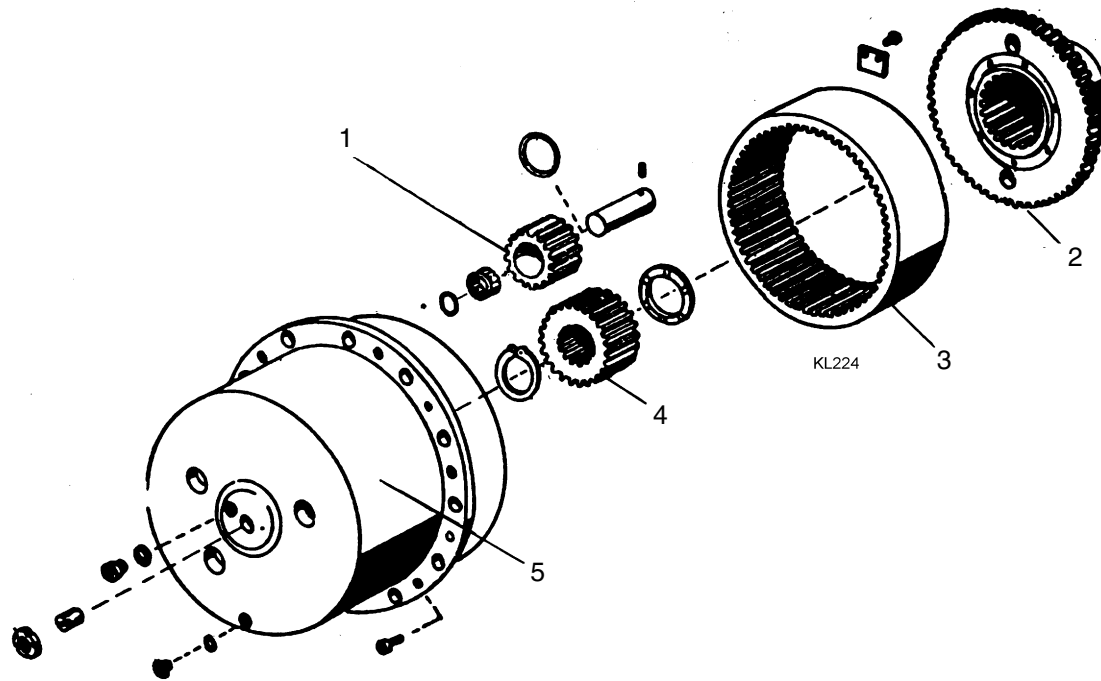
The differential

The differential is a simple, hypoid type of taper gear drive, which means that the centre line of the pinion is offset in relation to the centre line of the crown wheel. The pinion is firmly journaled in two robust bearings.



Hub reduction

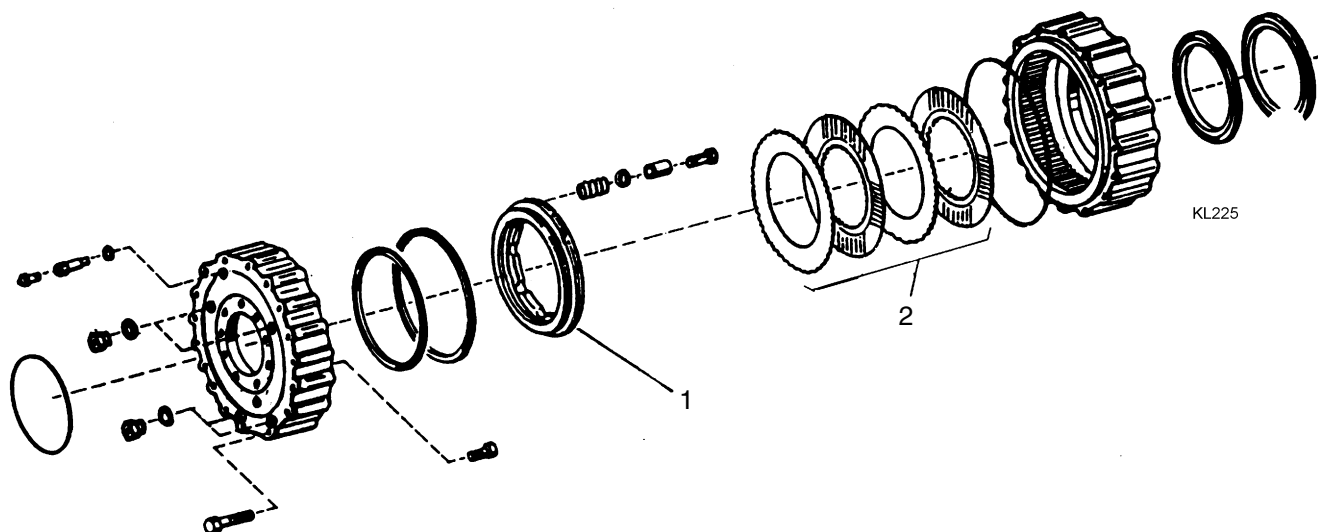
The hub reduction consists of a cylindrical planetary gear in each hub. The planetary gear comprises a sun gear, 4 planet gears, and a ring gear that surrounds the planet gears. When the drive axle, and thereby the sun gear, rotates, the rotational movement is transmitted to the planet gears. Because the ring gear is fixed firmly in the planetary gear carrier/hub, the planet gears move towards the ring gear. The hub follows this movement and the rotation is transmitted to the wheels. The gear ratio is determined by the number of teeth in the various gears.



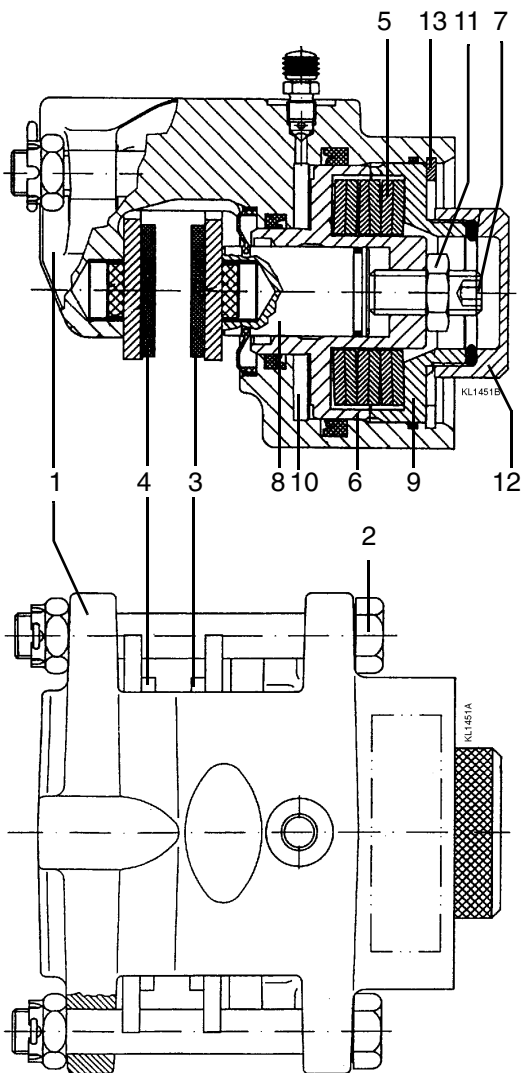
1. Planet gear
2. Ring gear carrier
3. Ring gear
4. Sun gear
5. Wheel hub/Planetary gear carrier

Service brake

The service brake consists of oil-cooled discs that are alternately fixed to and rotating with the hub. Hydraulic pressure is applied to activate a piston in each hub, the discs are then pressed together, and the wheels are braked. The resulting heat caused by friction is led away by the cooling oil circulating in the system. Oil from the truck's hydraulic system is used as cooling oil, and this gives a high cooling capacity.



1. Brake piston
2. Brake discs



1. Housing
2. Bolt
3. Brake lining
4. Brake lining
5. Plate spring package
6. Piston
7. Adjusting screw
8. Thrust shaft
9. Ring
10. Space for hydraulic oil on releasing the parking brake
11. Lock-nut
12. Lid
13. Lock ring



WARNING!

The parking brake contains a powerful, plate spring package under heavy tension. If the cylinder is dismantled in an improper way, parts may become loose and fly out thus causing serious damage.

DANGER TO LIFE!

Always check that the spring package tension is released before dismantling the brake cylinder, see Dismantling of the brake cylinder.

Parking brake

The parking brake is a disc brake that acts on the drive axle's input shaft and is applied by means of a powerful spring in a spring brake cylinder. The brake is released by a hydraulic pressure of at least 10 MPa from the parking brake valve in the driver's cab. When the hydraulic pressure is too low, the parking brake is applied automatically. To be able to move the truck in that situation, the parking brake must be released by mechanical means, see below.

When the parking brake is applied, the parking brake valve evacuates hydraulic pressure from the brake cylinder. The cup spring then expands and its force is transmitted through the piston (6) to the adjusting screw (7) and then on to the thrust shaft (8), which in turn transmits the braking force to the brake linings. The position of the adjusting screw (7) determines the location of the spring's working range in relation to the brake linings.

Adjustment

1. Apply a pressure to the brake cylinder by putting the parking brake valve in the 'OFF' position.
2. Unscrew the lid 12.
3. Loosen the lock nut 11 and screw in the adjusting screw 7 clockwise until the brake pads are close up to the brake disc.
4. Unscrew the adjusting screw 7 counter-clockwise until the space between the pads and the disc is approx. 1 mm. Note that the spring in the brake cylinder has a very small working space.
5. Fix the adjusting screw with a hexagonal socket head wrench and lock the lock-nut 11.
6. Fasten the lid 12 by hand.

Releasing the parking brake by mechanical means



WARNING!

Chock the wheels on sloping ground.

If the truck needs to be moved:

1. Unscrew the lid 12.
2. Loosen the lock-nut 11 and unscrew the adjusting screw 7 counter-clockwise until the brake pads have loosened from the brake disc.
3. Fasten the lid 12 by hand.



WARNING!

If the parking brake has been mechanically disengaged it must always be reset in order to restore the parking brake function.

Dismantling of the parking brake cylinder

Normally, there is no need of dismantling the parking brake cylinder. However, if for some reason it needs dismantling, follow the instructions below:

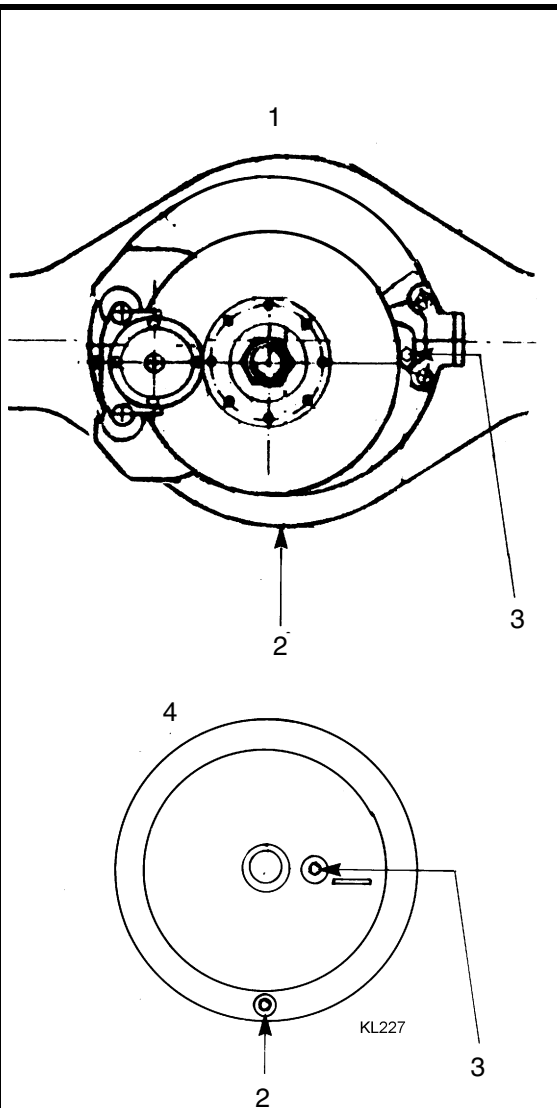
1. Unscrew the lid 12.
2. Loosen the lock-nut 11 and unscrew the adjusting screw 7 counter-clockwise until the brake pads have loosened from the brake disc.
3. Remove the lock ring 13, thereafter the integral parts can be removed.

Changing the drive axle oil

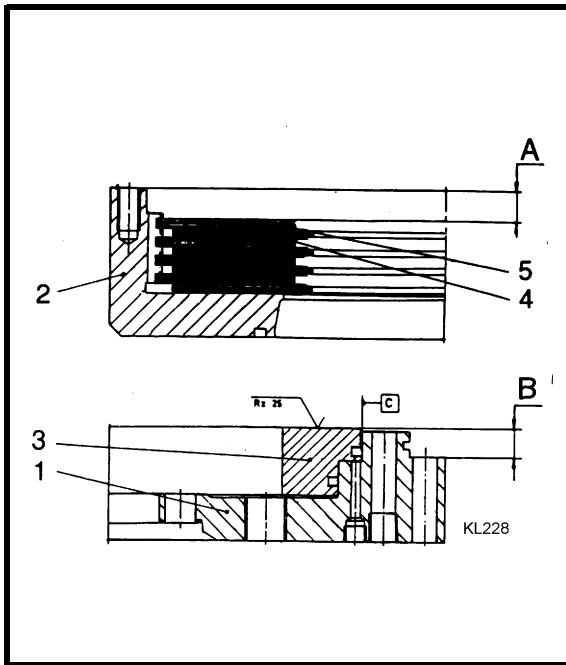
IMPORTANT!

To assure that the wheel ends of planetary axles with a common wheel end/housing bowl oil level are initially lubricated, fill each wheel end directly with oil before vehicle is put back into operation. **DO NOT FILL THE AXLE THROUGH THE DRIVE UNIT OR DIFFERENTIAL HOUSING ONLY.**

1. Drive the truck forward until the oil drain plug on one of the wheel hub reductions is at its lowest point of travel.
2. Remove the oil plug and drain the oil and refit the plug.
3. Repeat the procedure on the other wheel.
4. Remove the drain plug from the underside of the differential and drain the oil. Refit and tighten the drain plug.
5. Drive the truck forward so that the mark at the filling hole hub is horizontal.
6. Fill the hub reduction with oil and refit the plug.
Volume: See specifications.
7. Repeat for next wheel.
8. Remove the level plug from the differential and fill the differential with oil. Refit and tighten the level plug.
Volume: See specifications.
9. Check oil level and refill as necessary.

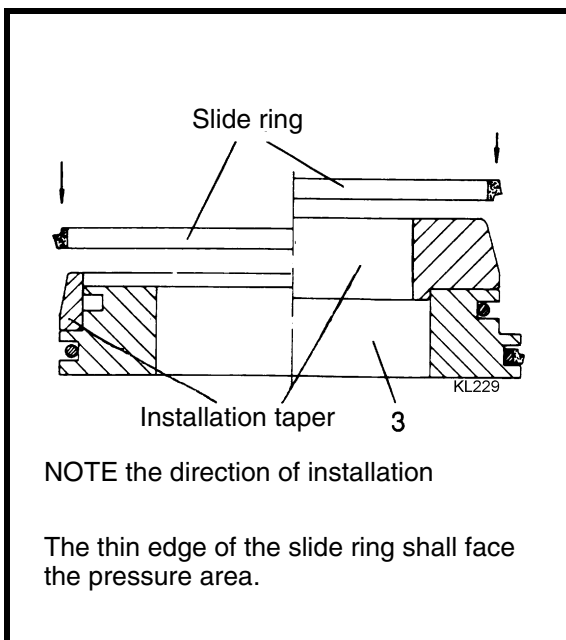


1. Differential
2. Drain
3. Fill up/level
4. Hub



Installation of disc brake

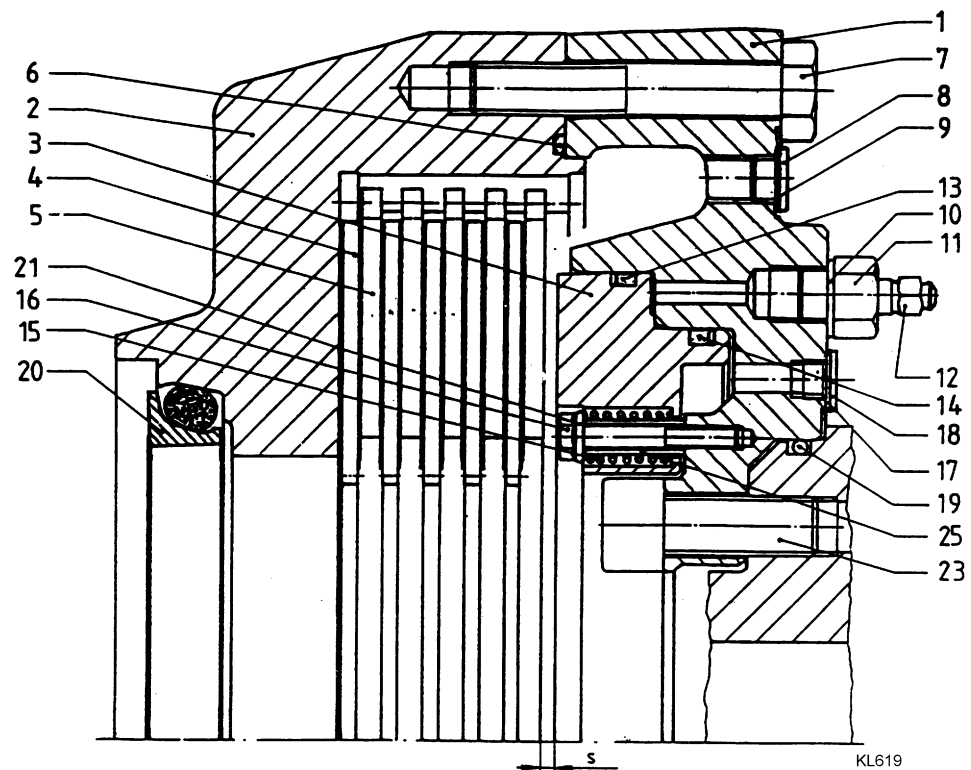
1. Insert the brake discs (4) and (5) alternately in the brake housing (2).
2. Measure the clearance A.
3. Fit the piston (3) in the brake spider (1).
4. Measure the clearance B. The difference between clearance A and B should be 2.5–3 mm.

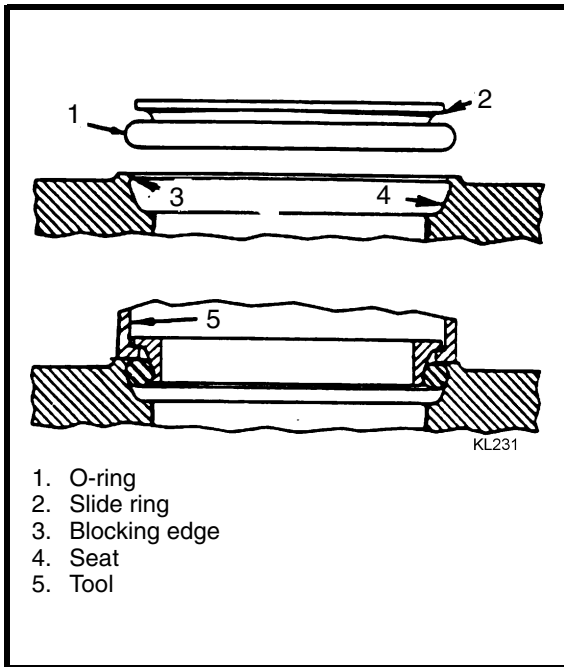


5. Fit the piston (3) so that the part with the largest diameter is facing downwards. Then place the seals in the groove using special installation tapers, one large and one small, free from any scratches, and not lubricated.
6. Fit the O-ring in the lower groove using an installation taper, and push it over the large slide ring with the thinner edge facing upwards.
7. Fit the O-ring in the upper groove using the other installation taper, and push it over the small slide ring with the thinner edge facing downwards.

8. Check to make sure the brake carrier (1) is free from scratches. Lubricate all internal surfaces, fit the brake piston (3), and align it to the tapped holes.
9. Insert the springs (15) and washers (21) in the piston. Screw the piston firmly into the brake carrier (1) using the screws (16) coated and sealed with LOCTITE 262.
10. Fit the O-rings (6) and (19).
11. Screw in the breather (12) with seal (10) and connection (11).
12. Screw in the sealing plugs (8) and (18) with seals (9) and (17).
13. Move the brake carrier (1) up against the brake housing (2) and screw on securely using screws (7).
14. Bleed the brake circuit and then check to make sure the circuit is fully sealed. When loading with a pressure of 12 MPa for 15 minutes, a pressure drop of 2% (down to 11.76 MPa) is permitted.

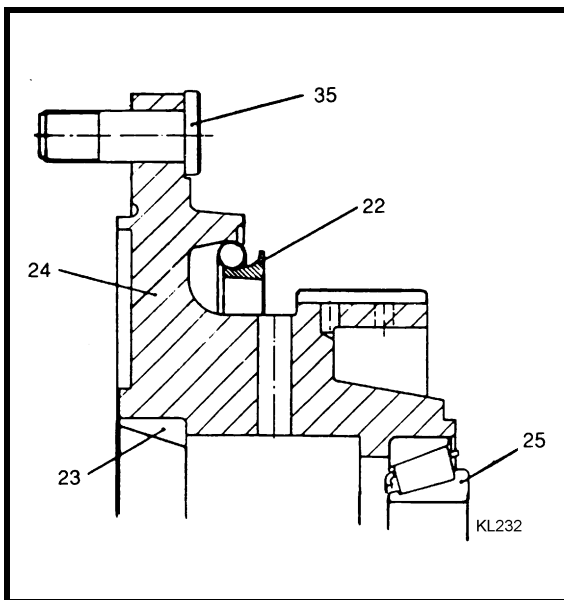
1. Brake
2. Brake housing
3. Piston
4. Inner disc
5. Outer disc
6. O-ring
7. Screw
8. Plug
9. Seal
10. Seal
11. Connection piece
12. Breather
13. Sealing ring
14. Sealing ring
15. Spring
16. Screw
17. Seal
18. Plug
19. O-ring
20. Face seal
21. Washer
23. Screw
25. Tube

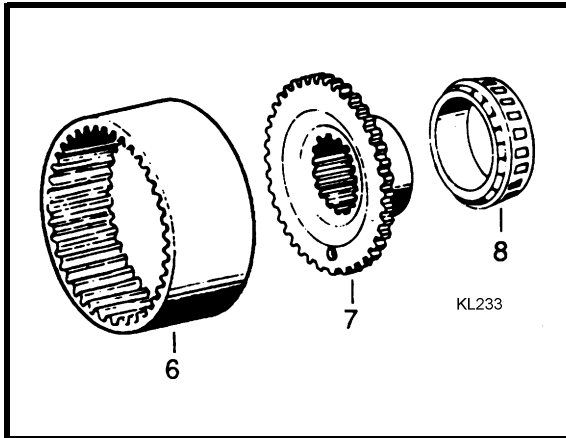




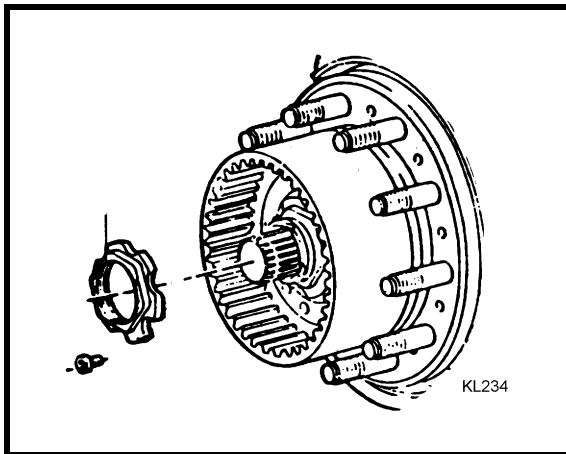
Installing the brake on the axle

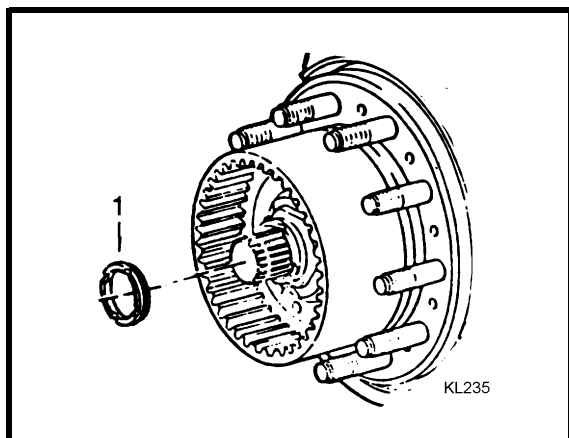
1. Check the sealing surfaces for the O-ring and apply a coat of LOCTITE 270 to the contact surfaces on the brake spider.
2. Push the brake onto the axle and screw on securely.
3. Fit the slide ring seal (20) into the brake housing (2) using an installation tool.
 - Lubricate the sealing ring seat
 - Place the slide ring seal onto the tool; the tool presses only on the O-ring;
 - Push the O-ring over the blocking edge until it snaps into position;
 - Lubricate the slide ring.
4. Screw the wheel studs (35) into the wheel hub (24).
5. Press the taper roller bearing's cones (23) and (25) into the wheel hub (24). N.B. Do not hit it!
6. Fit the slide ring seal (22) in the wheel hub (24). See also item 3.
7. Fit the wheel hub.





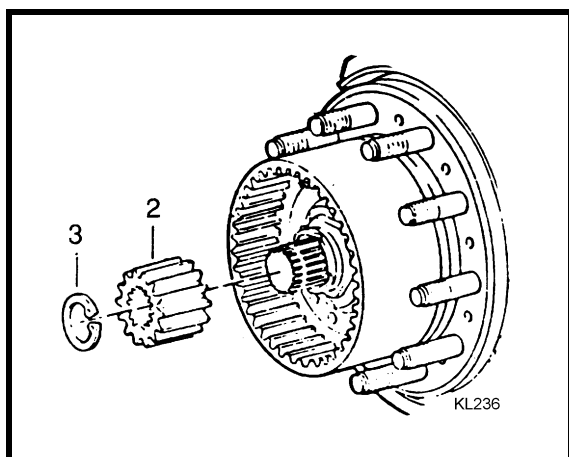
8. Align and centre the discs (4) using the tool. Apply pressure to the discs with the help of the brake's hydraulic system.
9. Fit the wheel hub onto the axle's splines. Release the brake pressure.
10. Insert the taper roller bearing (8) against the stop in the ring gear carrier (7). Fit the ring gear (6) onto the ring gear carrier and secure with screws.
11. Fit the ring gear carrier and ring gear onto the axle's splines. Turn the ring gear carrier so that the oil flow hole faces downwards. Then push the carrier and ring gear into the hub.
12. Screw the bearing nuts on and tighten them so that the hub can be turned by hand only with some difficulty. Then unscrew the bearing nut 1/8 of a turn and secure the nut. Check the resistance to roll – in the case of new bearings it should be about 11–17 Nm.



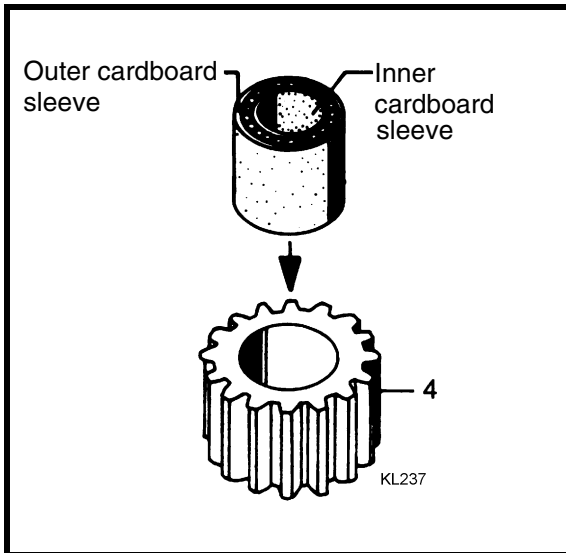


Installation of hub reduction

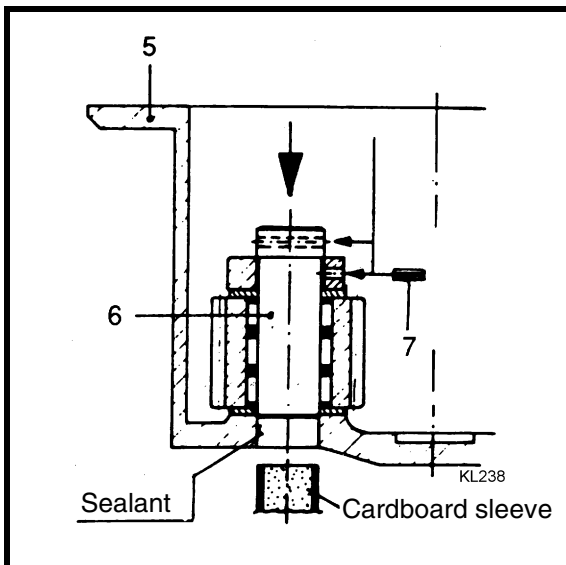
1. Press the spacer washer (1) onto the spindle and seal with LOCTITE 270.



2. Push the sun gear (2) onto the spindle and secure with the lock ring (3). Push the input shaft into the hub so that the spacer washer, sun gear, and lock ring are closely flush with each other.



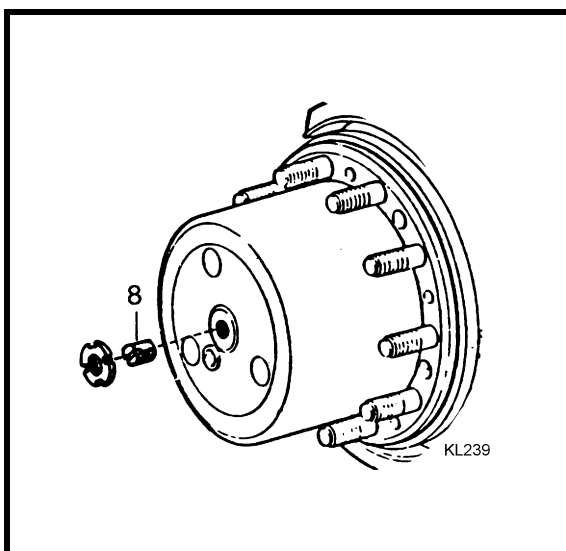
3. Push the needle bearing into the planet gear (4). The outer cardboard sleeve in which the bearings are packed will then slide off.

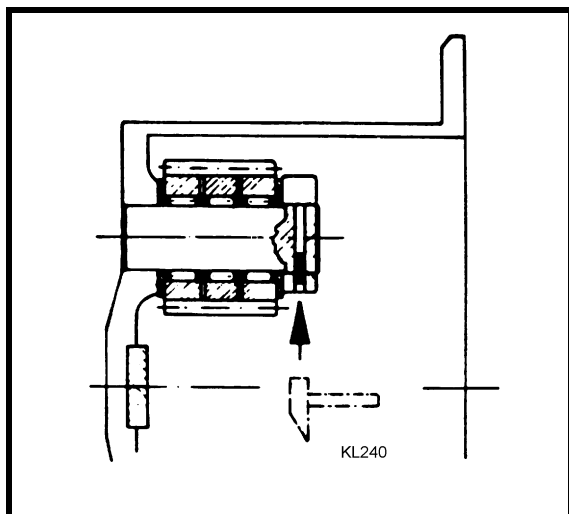


4. Fit the planet gears (4) onto the planetary gear carrier (5)
 - with needle bearing, inner cardboard sleeve, and spacer washer – as follows:
 - Apply a sealant to the hole in the planetary gear carrier for the planet gear shafts (6). (Fit an O-ring where applicable).
 - Press the planet gear shaft (6) in from the inside, and make sure the security holes in the shaft and planetary gear carrier are opposite each other. When the planet gear shafts are pressed in, the inner cardboard sleeves in the bearings will be pressed outwards.

N.B. The shafts are slightly tapered and cannot, therefore, be pressed outwards in the other direction as the planetary gear carrier would then be damaged.

5. Secure the planet gears with the safety pin (7).
6. Install the planetary gear carrier onto the hub.
7. Screw the adjusting screw (8) in against the stop on the insert shaft and then unscrew the adjusting screw 45–90°. This corresponds to an axial clearance of between 0.2 and 0.4 mm for the insert shaft.
8. Secure the adjusting screw with the lock nut. Hold the adjusting screw firmly to prevent it from turning with the lock nut.



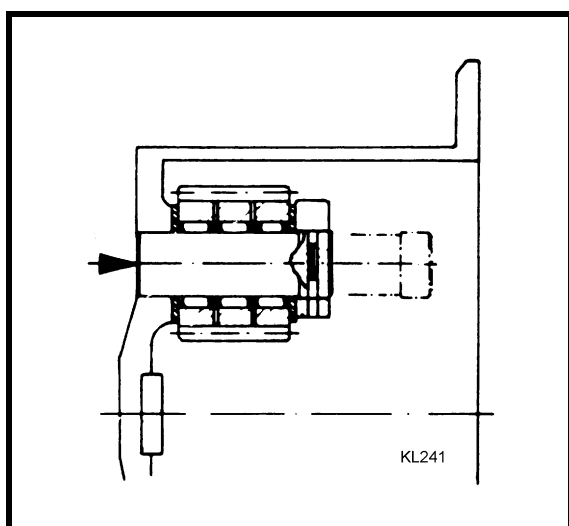


Dismantling the planet gear

1. Tap the safety pin out from the inside.
2. Press the planet gear shafts out from the outside and inwards in the planetary gear carrier.

N.B. The shaft are slightly tapered and cannot, therefore, be pressed outwards in the other direction as the planetary gear carrier would then be damaged.

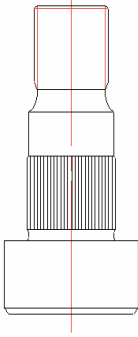
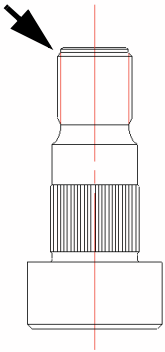
3. Remove the planet gear, spacer washers, bearings.



Group 60

Steering axle

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Steering axle.....	3
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Replacement of steering cylinder	4
Replacement of steered wheel bearings	4
Replacement of knuckle pin bearings	6
Inspection of dismountable rims	8
Safety test when changing tyres	10

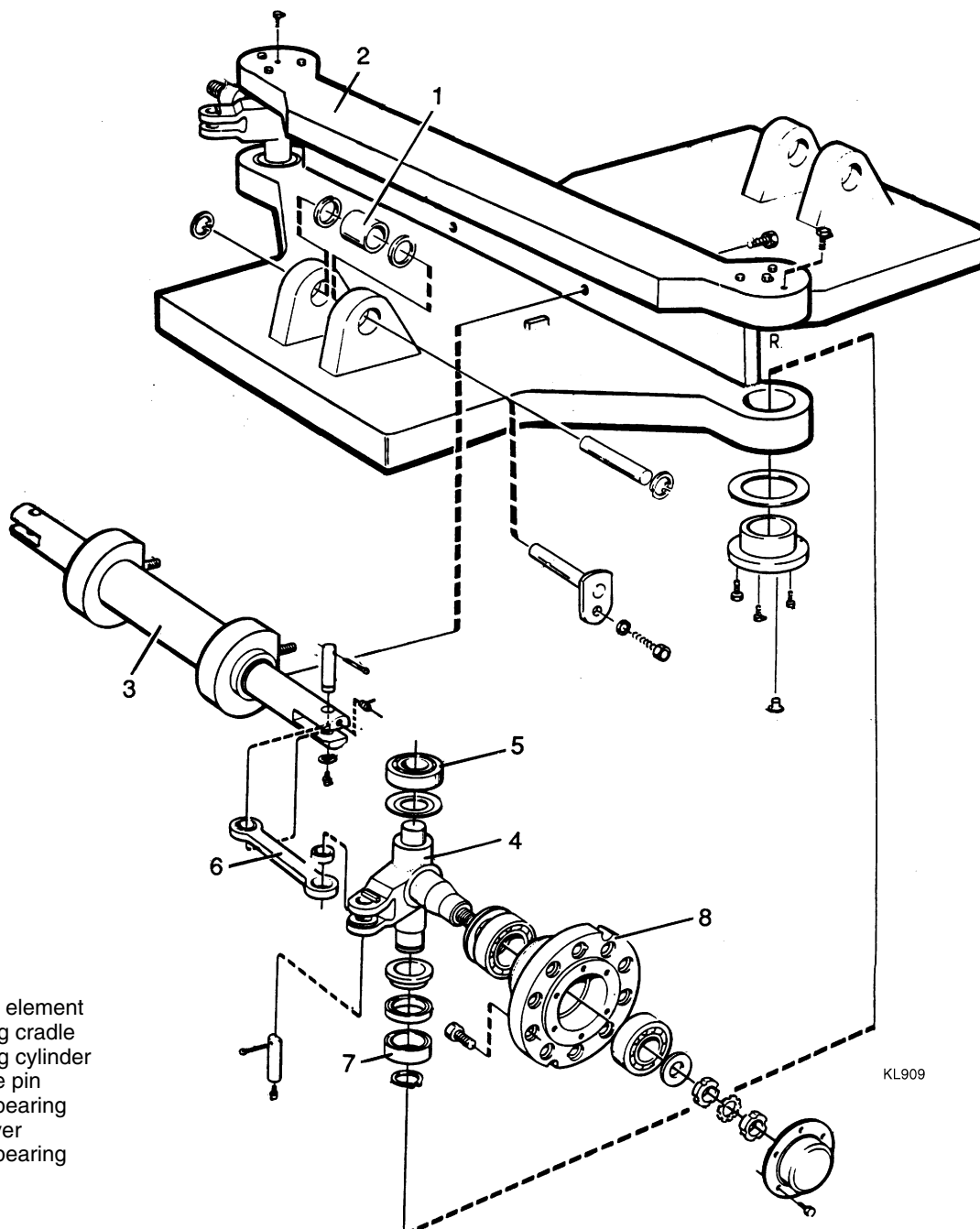
Tightening torques	before week 945	after week 945
Wheel nuts, Nm (kpm) Note the different design of the bolts.	550 (56)	650 (66)
		
Steered wheel bearing nuts, Nm (kpm)		500 (51) ¹⁾
Nuts for upper knuckle-pin bearings, Nm (kpm)		500 (51)
Nuts for lower knuckle-pin bearings, Nm (kpm)		500 (51)
Steering cylinder, mounting screw M20, Nm (kpm)		385 (39), oiled bolt

- 1) Steered wheel bearings should be tightened during simultaneous rotation of the wheels. This makes the bearing rollers set correctly.
Note that a jacked-up wheel gives a certain resistance when rotated.
After tightening of steered wheel bearings, the truck should be run for some 100 meters. After that the bearing nut should be tightened again to 500 Nm. Then the bearing nut must not be loosened.

The steered axle is supported by a pendulum suspension and is operated by a double-acting steering cylinder. The mechanism includes the smallest possible number of moving parts to minimise the number of service points and to simplify maintenance.

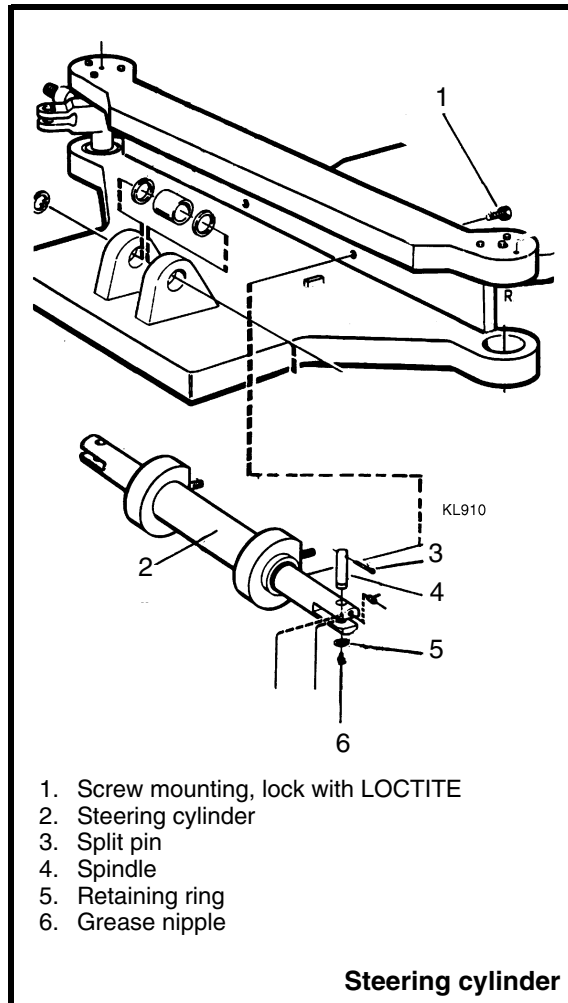
The mounting in the chassis comprises entirely maintenance-free rubber elements.

The knuckle pins and wheel axles are mounted in taper roller bearings. The hydraulic circuits of the steering system are described in Group 70.



1. Rubber element
2. Steering cradle
3. Steering cylinder
4. Knuckle pin
5. Upper bearing
6. Link lever
7. Lower bearing
8. Hub

KL909



Replacement of steering cylinder

1. Disconnect the hydraulic connections from the steering cylinder, and protect the open ends of the cylinder and hoses by means of caps or plugs.
2. Release the retaining rings and remove the piston rod pivot spindles.
3. Remove the bolts retaining the cylinder on the steering cradle.
4. Remove the cylinder.
5. Fit the new cylinder and coat the mounting bolts with LOCTITE. Tighten according to specification.
6. Connect the piston rod ends to the link levers. Secure the pivot spindles by means of the locking washers.
7. Connect the hydraulic hoses.

Replacement of steered wheel bearings

Dismantling

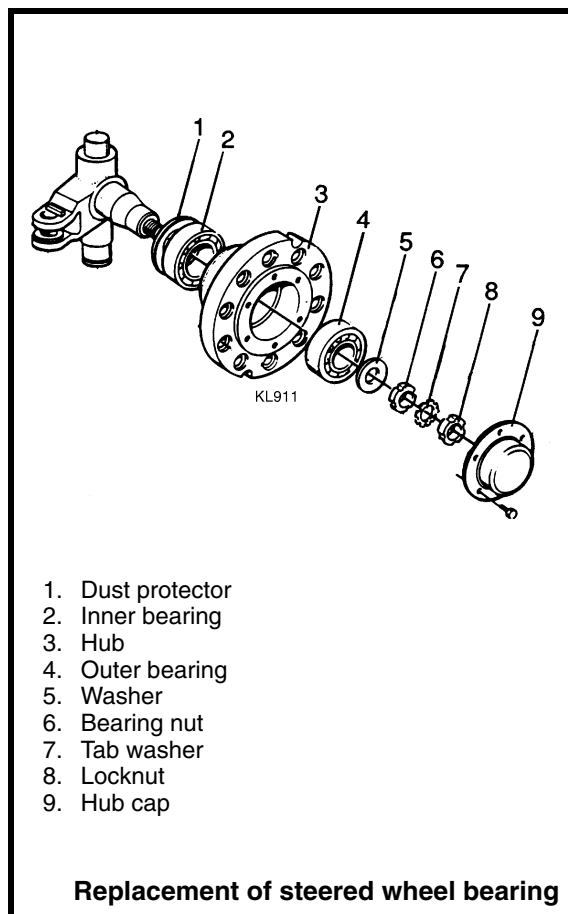
1. Jack up the steered wheel end of the truck and block it up in a safe manner.
2. Unscrew the wheel bolts from the steered wheel and remove the wheel.

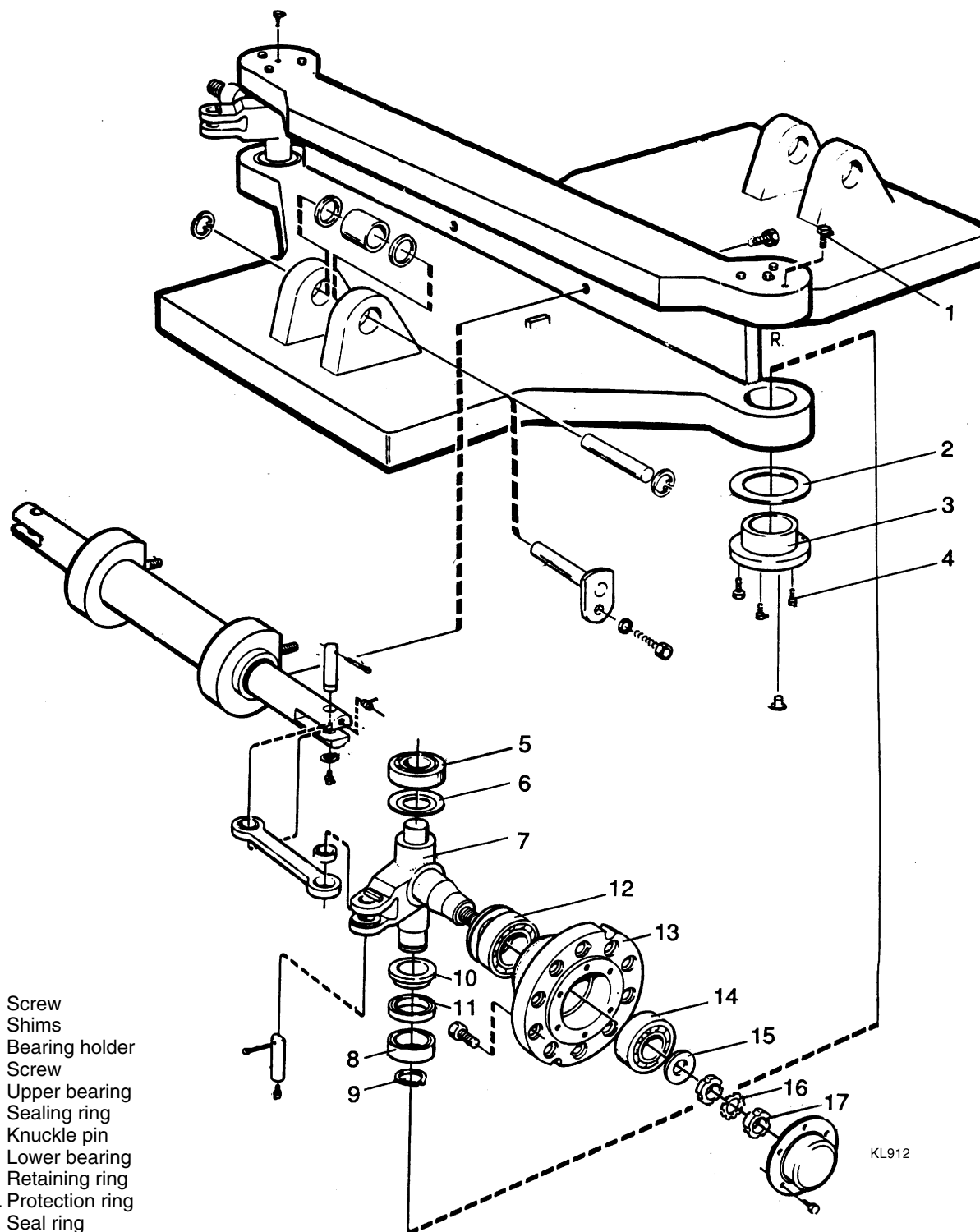
N.B. A trolley with a rest for holding the wheel securely will be needed for handling purposes.

3. Remove the hub cover.
10. Secure a lifting sling to the hub, preferably using one of the hub bolts. Fit a nut to secure the bolt. Use a hand trolley, pallet truck or the like for lifting the hub.
11. Remove the tab washer, locknut and bearing nut. The plain washer is loose.
12. Remove the hub off the wheel axle by means of the hand truck. The inner race of the outer bearing will accompany the hub.
13. Withdraw the inner race of the inner bearing from the wheel axle.
14. Remove the seal, but leave the spacer in position.

Assembly

1. Pack the outer races of the bearings with grease and press them into the hub.
Note that these are taper bearings. Fit the inner races so that the larger inside diameter faces outwards.
A round plate should be made for each bearing size for pressing in the races. A heavy hammer can then be used to hammer the plate for driving in the race. Don't hammer the bearings directly since they may not enter straight and may become jammed in the housing.
2. Tap the inner race of the inner bearing onto the wheel axle, using a suitable tube. Pack the inner race with grease.
3. Lift the hub onto the axle, fit the inner race of the outer bearing position and pack it with grease.
4. Fit the plain washer and bearing nut with the flat surface facing inwards. Tighten the bearing, see specification.
5. Fit the tab washer and locknut. Grease the tab washer to prevent damage by the nut. Tighten the locknut and lock both the bearing nut and the locknut with the tabs.
6. Pack the outer bearing with grease, pack the bearing cover with grease and fit it into position.





1. Screw
2. Shims
3. Bearing holder
4. Screw
5. Upper bearing
6. Sealing ring
7. Knuckle pin
8. Lower bearing
9. Retaining ring
10. Protection ring
11. Seal ring
12. Inner bearing
13. Hub
14. Outer bearing
15. Bearing nut
16. Tab washer
17. Lock nut

Replacement of steered wheel bearings and knuckle pin bearings

Replacement of knuckle pin bearings

Dismantling

To replace the knuckle pin bearings, the wheel bearings must also be removed. See Replacement of steered wheel bearings, Dismantling.

1. Jack up the steered wheel end of the truck and block it up in a safe manner.
2. Remove the wheel nuts from the steered wheel and remove the wheel.

N.B. A trolley with a rest for holding the wheel securely will be needed for handling purposes.

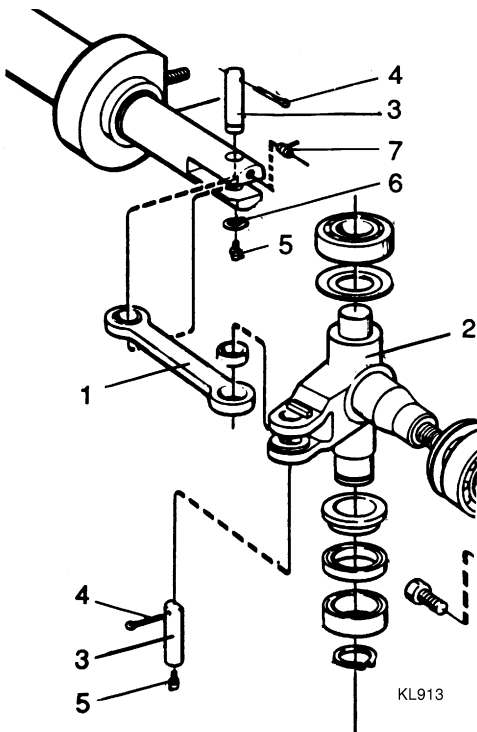
3. Remove the protective cover and release the lock washer. Remove the locknut and bearing nut, and remove the inner part of the outer bearing.
4. Remove the hub, leave the inner bearing inner race on the spindle.
5. Remove the steering link.
6. Remove the protective cover and the shims at the lower bearing.
7. Unscrew the three screws (1) above the knuckle pin's upper bearing, on top of the steering cradle. Depress the knuckle pin by screwing three screws (length 17 mm) into the holes.
8. Lift out the knuckle pin.
9. Remove the inner race of the upper and lower bearing.
10. Pull the lower bearing outer race out of the bearing holder.

Assembly

1. Tap the outer race of the upper bearing into the steering cradle from below, using a piece of tube.
2. Fit the three screws back into their holes. Seal with sealing compound.
3. Attach the following parts to the knuckle pin: upper bearing's inner race and sealing, ring, lower bearing's inner race and protective ring.
4. Mount the knuckle pin.
5. Tap the outer race of the lower bearing into the bearing holder.
6. Tighten the bearing holder with shims needed upon the lower bearing.
7. Check that the knuckle pin rotates smoothly with a maximum play of 0.25 mm. If not, adjust with shims.
8. Lubricate the bearings by means of the grease nipples.
9. Mount the link lever.
10. Mount the steering wheel bearing. See Replacement of steering wheel bearing, Assembly.

Miscellaneous

The steered wheel alignment is not adjustable. If the link levers have been deformed so that the wheel alignment has been disturbed, the link levers must be replaced.

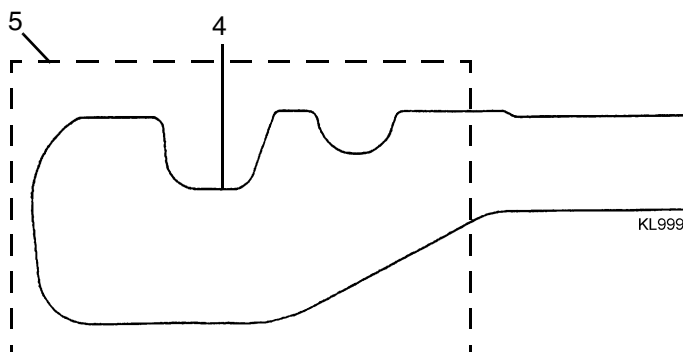
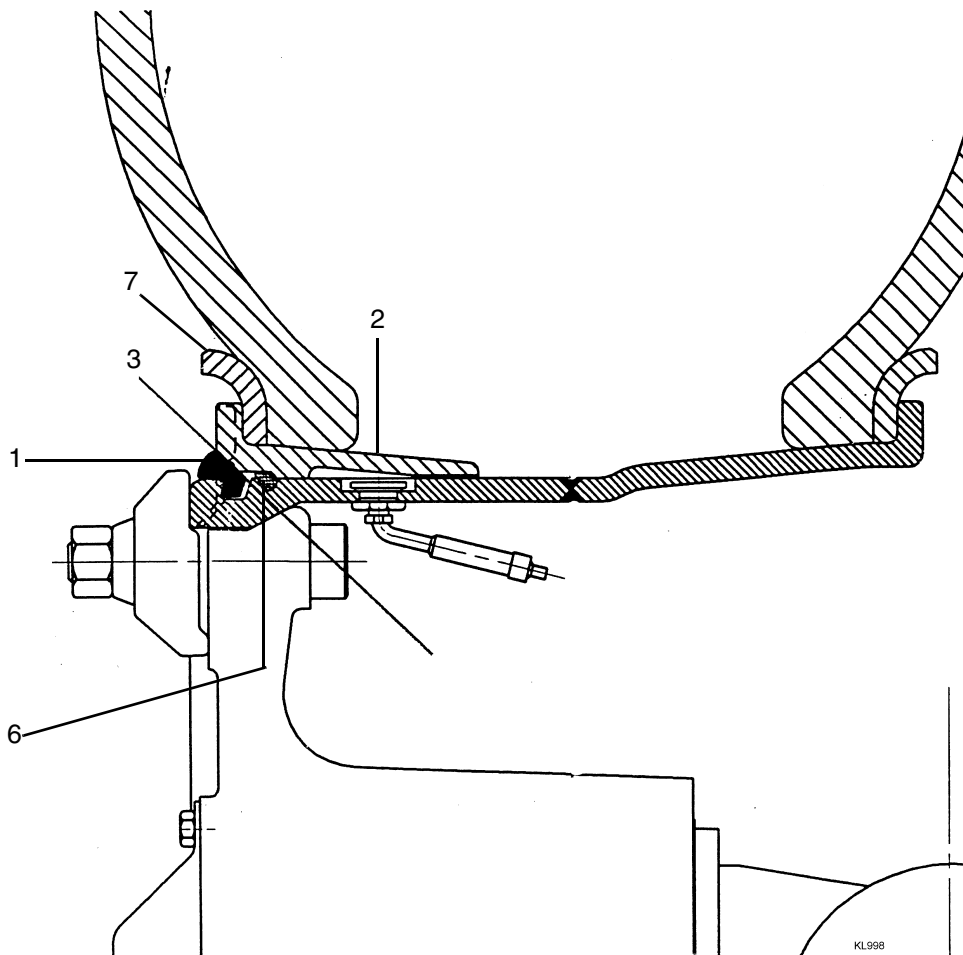


1. Link lever
2. Knuckle pin
3. Shaft
4. Split pin
5. Grease nipple
6. Retaining ring
7. Lock nut

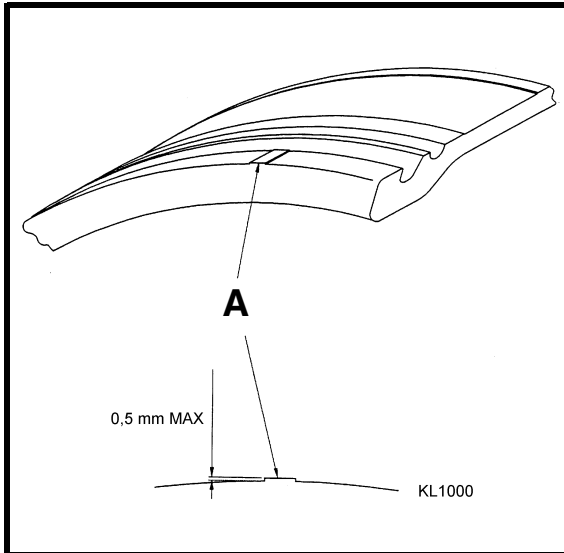
Inspection of dismountable rims

Due to special operating conditions for dismountable rims, there is a risk of excessive wear of the lock ring groove in the rim bead, the lock ring itself and the 45° face on the beadseat or loose flange. In extreme circumstances this can lead to breakage of the rim bead which in turn has potentially dangerous consequences.

To minimize the risk of an accident the inspection should be carried out on all EM-wheels (EM=Earth Moving) and dismountable rims.



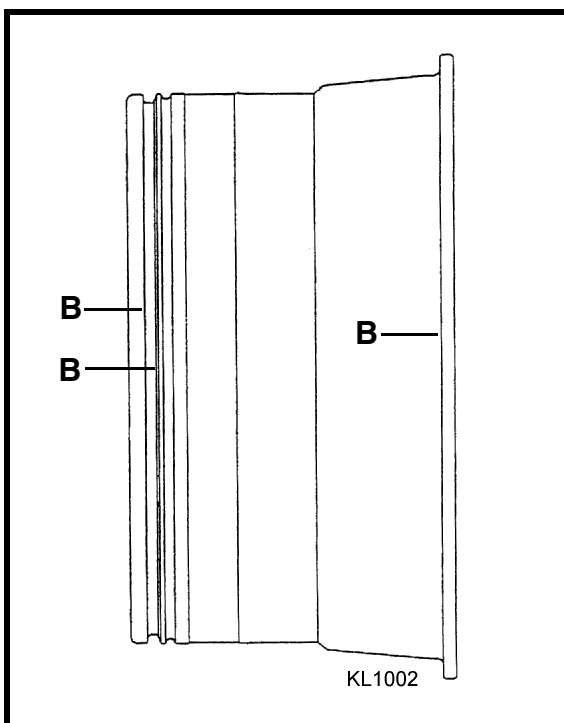
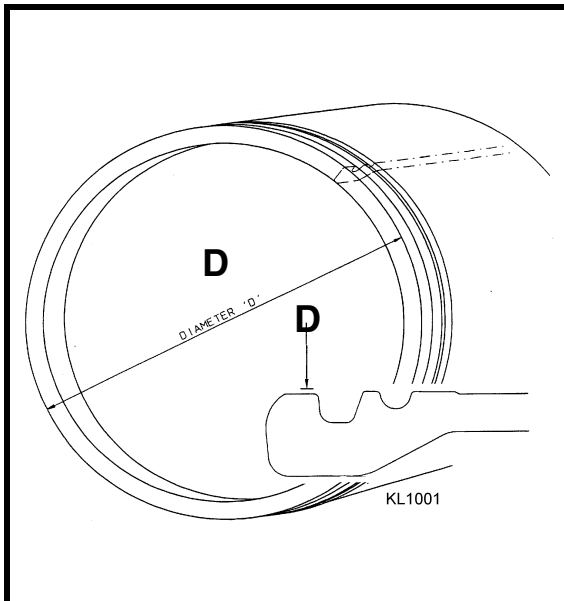
1. Lock ring
2. Beadseat
3. 45° surface on the beadseat or loose flange
4. Lock ring groove
5. Rim bead
6. O-ring
7. Support ring



Inspection procedure

1. Dismantle the rim according to the standard procedures, see also Safety instructions when working with tyres, group 00.
2. Carefully clean the outside of the rim beadrim bead by using a wire brush.
3. The wear of the lock ring on the rim bead outside diameter can produce a mark A. The mark is located between the ends of the lock ring, see picture.
4. Measure the depth of the wear at this point using a straight edge and feeler gauge. If the wear exceeds 0,5 mm, the wheel, the lock ring, and the beadseat or loose flange must be discarded and replaced with new.
5. If a wear mark is not possible to find, measure the circumference of the rim bead using a measuring tape.
6. Calculate the diameter $D = \text{Circumference} / 3.14$
7. If the diameter is below the minimum specified, the wheel, the lock ring and the beadseat or loose flange must be discarded.

Information on the minimum diameter of your rim bead can be received from Kalmar.



High stress areas, how to identify rim damage

1. High stress areas are marked with B on the illustration
2. Typical faults are: circumferential cracks, fretting, corrosion pitting, distortion, wear.
3. Inspect above areas at each tyre change

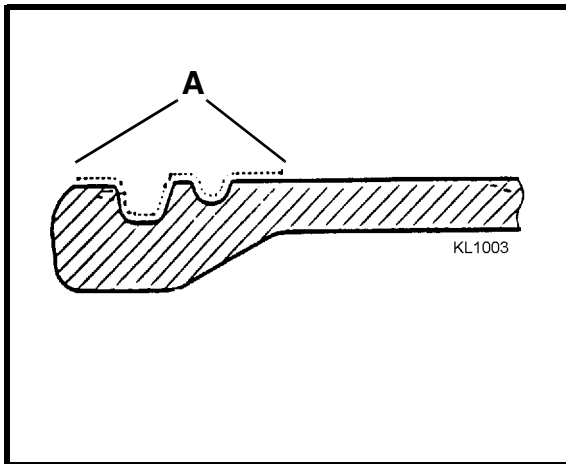
Safety test when changing tyres

The test is intended for detecting cracks in wheels. Cracks can lead to safety risks if they are not detected and remedied.

Potential cracks that cause air leakage are not detected in the test described here.

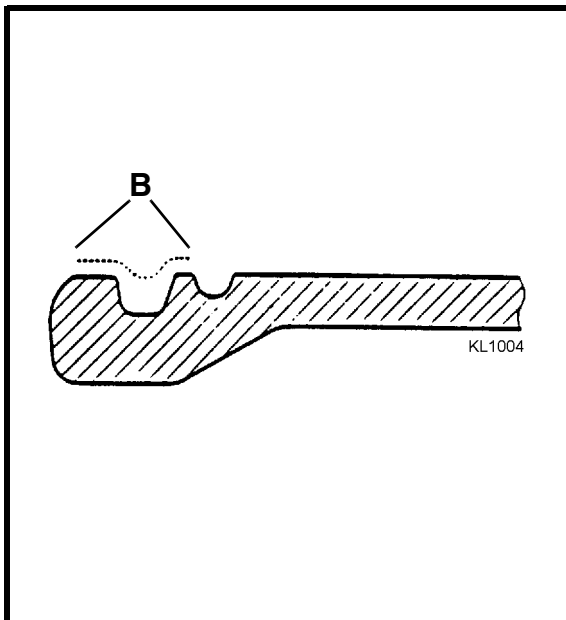
The test is carried out in two steps

1. Magnetic examination, which quickly indicates the crack.
2. The actual crack is then tested with penetrance.



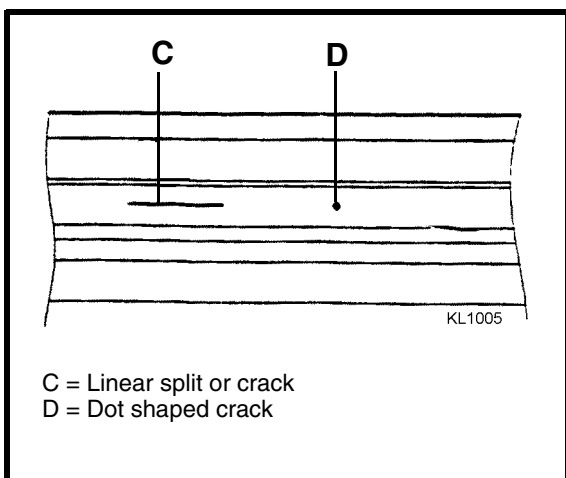
Magnetic examination

1. Dismantle the loose components of the wheel
2. Clean area **A** on the the wheel totally for paint residue by using shot blasting.
3. Carry out magnetic examination by using e.g.:
Equipment: Yoke Tiede
Technique: a. Electricity AC
b. Contrast paint
Test medium: a. Wet
b. colour (E-G- Tiede ferrolux)
4. If no cracks are indicated in the magnetic examination, the test is completed and the wheel approved. In case cracks are indicated, carry out the penetrance test.



Penetrance test

1. Clean area **B** with cleaning fluid, part.no. 923626.0668.
2. Spray penetrance on the cleaned area and let the sprayed area dry for approximately 10 minutes
Penetrance: Part no. 923626.0669
3. Clean off the penetrance by using cleaning fluid (Part.no. 923626.0668). All excessive penetrance should be removed.
4. Wipe off the cleaning fluid with a cloth, the remaining penetrance must evaporate.
5. Spray developer on the area **B**.
Developer: Part.no 923626.0670
6. Let the sprayed area dry for 1-2 hours.
7. Inspect the lock ring groove visually.
8. If the marked area **B** shows no linear or dot shaped cracks the wheel is approved.
9. If the marked area **B** shows linear or dot shaped cracks, the wheel must be rejected.



C = Linear split or crack

D = Dot shaped crack

Group 70

Hydraulic system

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Hydraulic circuit diagram Volvo	155892.2100/3800
Hydraulic circuit diagram Perkins	155892.1400/3900

Main system

Hydraulic pressure, Bar	According to specification for each truck
Hydraulic fluid	
Volume, litres	180 (90 - 120-6) 220 (120-12 - 180-12)
Grade of fluid	Hydraulic fluid for mobile applications from a reputable oil company. The oil should correspond to ISO 6743-4
Viscosity:	Class HV, ISO VG 46 at normal working temperatures. Class HM, ISO VG 68 at tropical climate Class HV, ISO VG 32 at extremely cold conditions
Additive:	6% of Lubrizol for brake function
Lifting speed	According to specification for each truck
Lowering speed, fixed, m/s	0.40
Hydraulic fluid filter, type	High pressure filter
Filtering capacity, µ	20

General survey (Volvo-engine)

The hydraulic system consists of the following sub-systems.

- Main hydraulics with the following functions:
 - Lifting
 - Tilting
 - Sideshifting
- Steering system
- Driving brake system for wet brakes with:
 - Brake circuit
 - Cooling circuit
- Parking brake system

The hydraulic system is configured around three hydraulic pumps, one double and one single, driven directly from the engine and fitted to the torque converter.

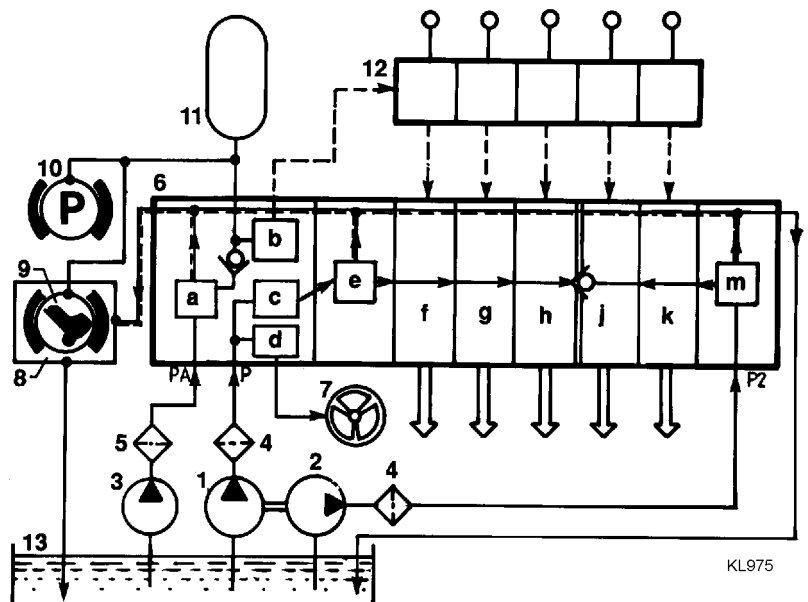
All of the essential hydraulic functions are concentrated to a valve block that is directly connected to the main valve.

The outer section of the double pump powers the lift and tilt sections. A portion of the unutilized flow passes on the brake system's cooling circuit to dissipate heat and is then lead to the reservoir.

The inner section of the double pumps powers the other functions of the main system. When the lifting function is defelcted to maximum, the capacity of both pumps is utilized to power the lifting action.

The separate single pump powers the hydraulic accumulator which in turn serves the parking brake, driving brake and servo system of the control levers (optional). The excess flow passes on partly to the reservoir, partly to the brake system,s cooling circuit.

1. Hydraulic pump, main system, steering
2. Hydraulic pump, lift/tilt
3. Hydraulic pump, accumulator charging
4. High pressure filter
5. Oil strainer
6. Main valve and valve block
 - a. Accumulator charging valve 160–165 bar
Supplies brake cooling circuit or return to reservoir when accumulator is fully charged
 - b. Supply to servo system 35 bar (optional equipment)
 - c. Priority valve, steering system
Stand-by pressure 11 bar.
 - d. Supply to steering system max 175 bar
 - e. Main pressure limiting valve
Pressure = m
 - f. Control valve LEVELLING
 - g. Control valve FORK SPREADING
 - h. Control valve SIDESHIFTING
 - j. Control valve TILTING
 - k. Control valve LIFTING
 - m. Main pressure limiting valve
Pressure = e
7. Steering system
8. Cooling circuit for driving brake system
9. Driving brake circuit
10. Parking brake system
11. Accumulator, pre-charging pressure 70 bar
12. Servo-assisted control levers (Optional)
13. Hydraulic reservoir



Hydraulic system 90-180 (Volvo-engine)

General survey (Perkins-engine)

The hydraulic system consists of the following sub-systems.

- Main hydraulics with the following functions:
 - Lifting
 - Tilting
 - Sideshifting
- Steering system
- Driving brake system for wet brakes with:
 - Brake circuit
 - Cooling circuit
- Parking brake system

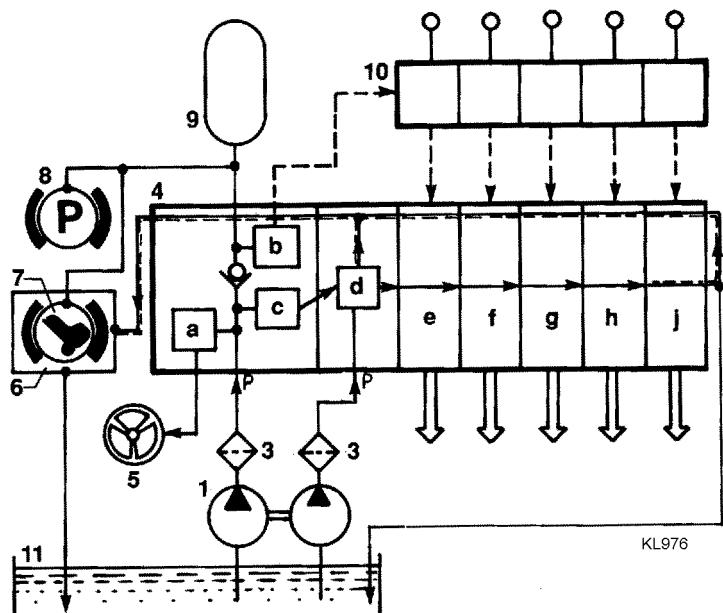
The hydraulic system is configured around a double hydraulic pump which is directly driven by the engine and is mounted on the torque converter.

All of the essential valve functions are concentrated to a valve block that is directly connected to the main valve.

The outer section of pump powers the main hydraulics. Some of the fluid that is not utilized is by-passed to the cooling circuit of the driving brake system to dissipate heat and is then lead to the reservoir.

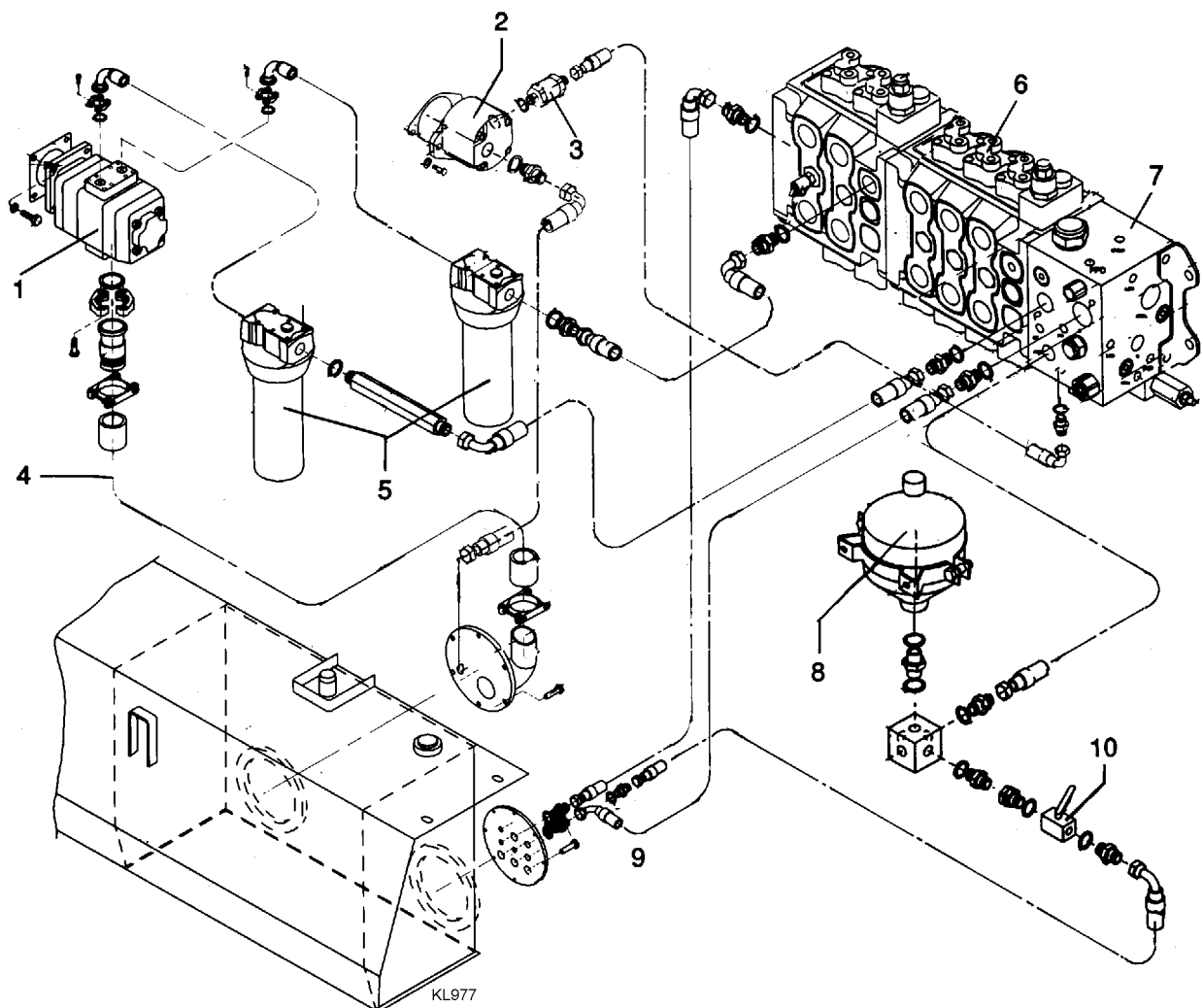
The inner section of the hydraulic pump delivers fluid to the accumulator which in turn serves the parking brake, driving brake and servo system of the control levers (optional). All surplus fluid is supplied to the main hydraulics. When the accumulator is fully charged, the capacity of both pumps is utilized to power the main hydraulics.

1. Hydraulic pump, accumulator charging
2. Hydraulic pump, main system
3. High pressure filter
4. Main valve and valve block
 - a. Supply to steering system max. 175 bar
 - b. Supply to servo system 35 bar (optional equipment)
 - c. Accumulator charging valve 160–165 bar
 - Supplies main system when accumulator is fully charged
 - Stand-by pressure 11 bar.
 - d. Main pressure limiting valve
- e. Control valve LEVELLING
- f. Control valve FORK SPREADING
- g. Control valve SIDESHIFTING
- h. Control valve TILTING
- j. Control valve LIFTING
5. Steering system
6. Cooling circuit for driving brake system
7. Driving brake circuit
8. Parking brake system
9. Accumulator, pre-charging pressure 70 bar
10. Servo-assisted control levers (Optional)
11. Hydraulic reservoir

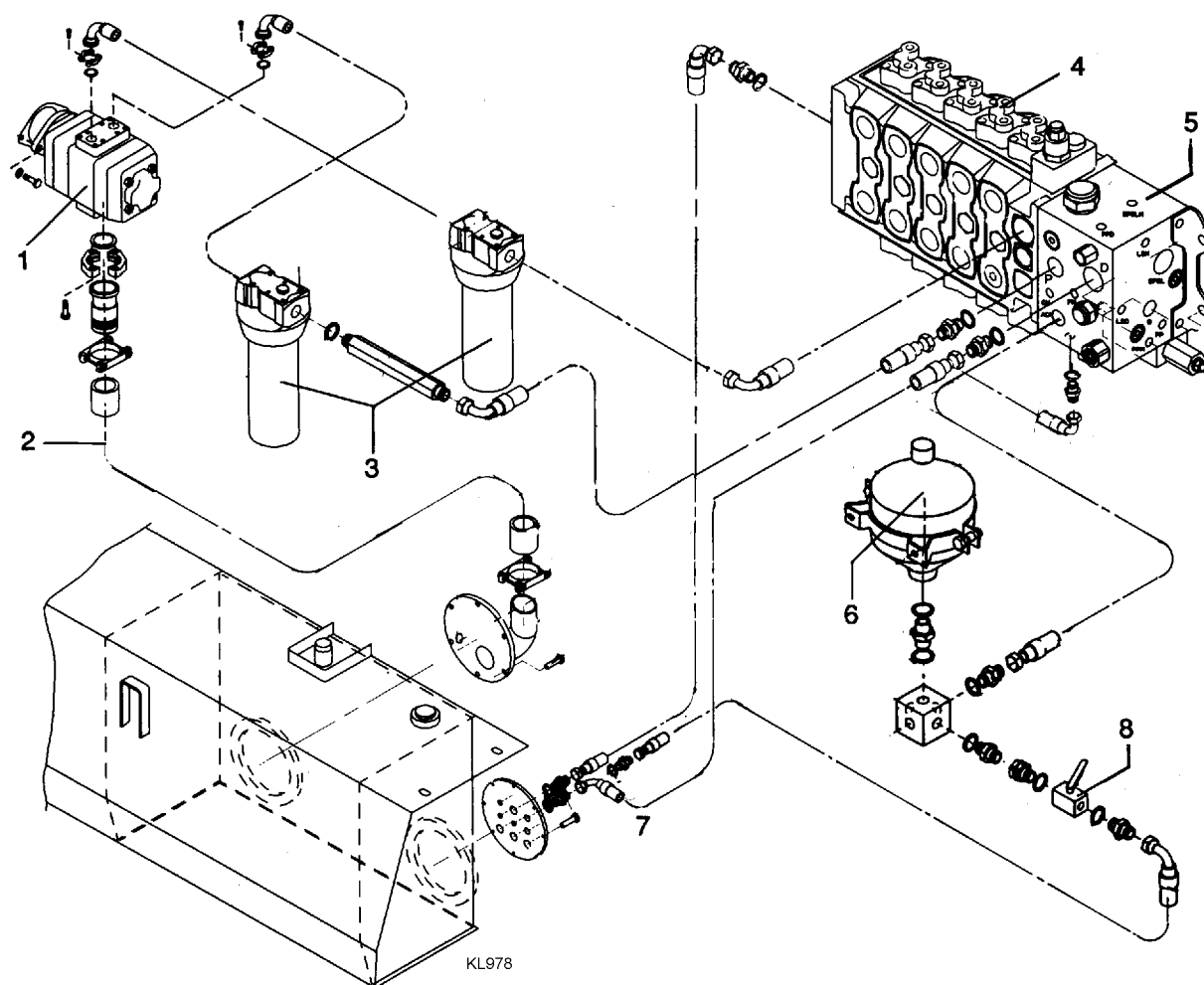


The fluid is cleaned through a high pressure filter upstream after each pump, the flow from the separate accumulator charging pump passes a washable strainer.

In its standard version, the hydraulic system is equipped with a servo-operated main valve. A pressure reducing valve in the valve block delivers 35 bar servo pressure for the control-lever valves. The servo fluid is then supplied to the main valve for re-setting the valve spools, at a rate that is proportional to the lever movement.



1. Hydraulic pump
2. Hydraulic pump, accumulator charging
3. Oil strainer (A filter on later models)
4. Suction line
5. High pressure filter
6. Main valve
7. Valve block
8. Accumulator
9. Return to reservoir
10. Accumulator evacuating valve



KL978

1. Hydraulic pump
2. Suction line
3. High pressure filter
4. Main valve
5. Valve block
6. Accumulator
7. Return to reservoir
8. Accumulator evacuating valve

Lifting

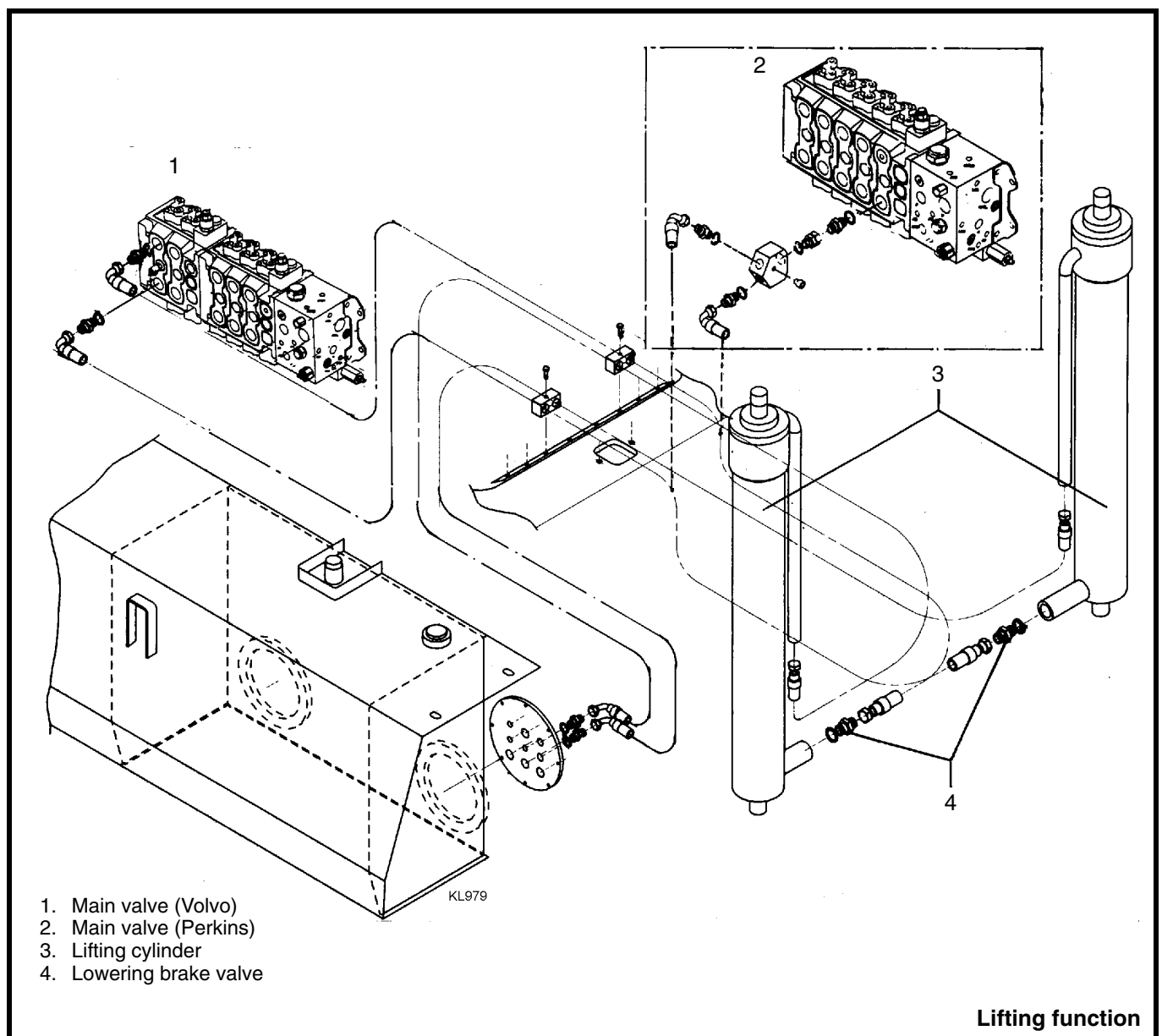
The lifting cylinders are supplied from a single-acting valve spool in the main valve. The lifting speed is determined by the position of the lift control lever. The flow of fluid from the hydraulic pumps can be changed by altering the engine speed, which thus provides an additional means of controlling the lifting speed.

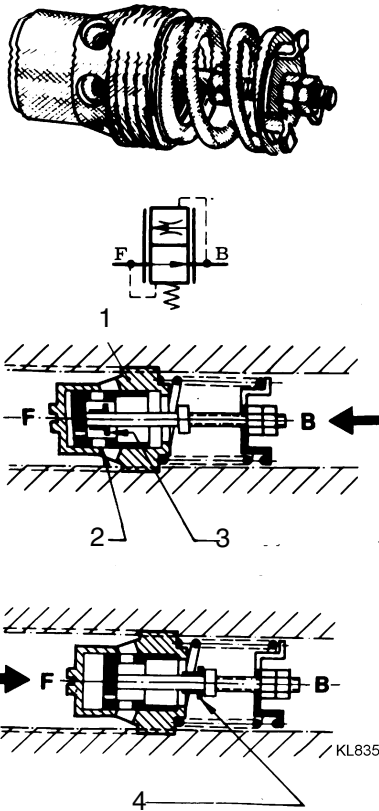
The main valve has a separate section for lifting. See Main Valve.

During lowering, the fork carriage and the effect of the load force the fluid from the lifting cylinders into the reservoir. A lowering brake valve in the supply line to each lifting cylinder determines the lowering speed and also limits the flow of fluid in the event of hose failure. The lowering brake valves are of pressure-compensated type and therefore permit only a certain predetermined flow, thus ensuring a constant lowering speed, regardless of the actual load.

Some of the fluid that is not utilized for lifting is by-passed to the valve block and from there to the cooling circuit of the driving brake.

The lifting cylinders are filled with fluid on the piston side to prevent corrosion. This fluid is not pressurized and is fed back to the reservoir in step with movement of the piston. Any leakage is also drained to the reservoir through these lines.





1. Control plunger
2. Throttling slot
3. Orifice plate in the throttling position
4. Orifice plate in the open position

Lowering brake valve

Lowering brake valve

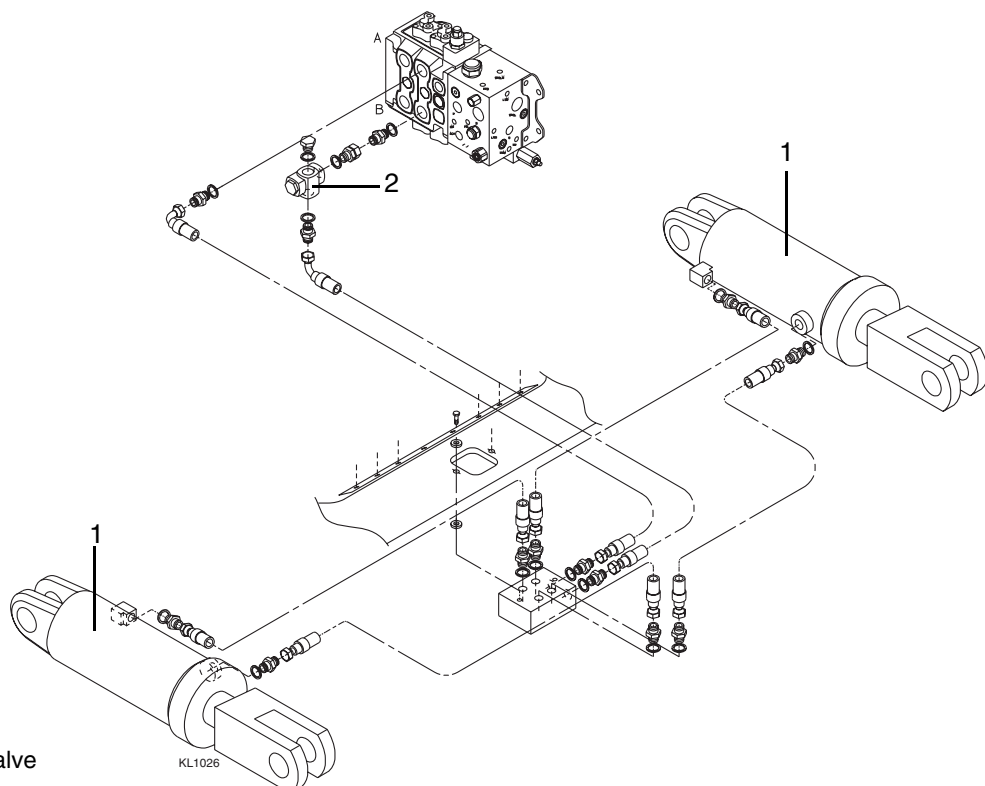
The lowering brake valves are screwed into the connecting pipes at the bottom of the cylinders. They are preset and no adjustment facilities are provided.

The valve contains a spring-loaded control plunger and a movable orifice plate, both of which interact to provide a constant flow through the valve regardless of the prevailing load.

During lifting, the orifice plate and the control plunger are in a position which allows unrestricted flow of fluid. During lowering, the orifice plate moves to the throttling position. The internal pressure drop in the valve and the pre-load force of the control plunger spring counteract one another and set the control plunger in an equilibrium position, ie. in relation to the corresponding size of the throttle gap. Large load – small gap, small load – large gap.

Tilting

The two tilting cylinders enable the mast to be tilted 5° forward and 10° to the rear. In one of the return lines is a valve which provides counter-pressure to avoid inadvertent forward tilt, which would otherwise occur in unrestricted flow in the forward tilt mode.



1. Tilt cylinder
2. Counter pressure valve

Tilting function

Fork spreading

The main valve opens and closes the supply of fluid to the two hydraulic cylinders at the forks.

A flow distributor, located between the valve and the cylinders, ensures that the forks move equal distances, even if the resistance affecting the forks should be different.

When reducing the distance between the forks, the flow distributor ensures that equal quantities of fluid are supplied to the piston rod side of each cylinder. When increasing the distance between the forks, the flow distributor controls the fluid returning from the cylinders.

Flow distributor

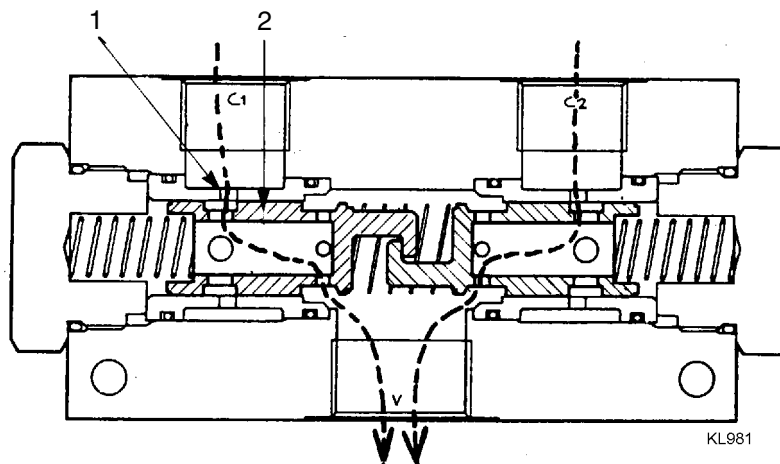
The flow distributor is a pressure-compensated valve which synchronizes the movements of the forks during fork spreading. The valve divides the flow from the main valve into the equal partial flows, regardless of the load on the two connected cylinders. The difference between pressure P_1 and P_2 behind the two control valve spools set the valves so that the control slots are of the appropriate size. When the fluid flows in the opposite direction, the valve combines the flows so that the flow from each of the cylinders to the common return line will be equal.

Sideshifting

In trucks provided with fork spreading and sideshifting, the same hydraulic cylinders are used for both of these functions. When the sideshifting control lever is moved, the corresponding valve will supply fluid to the piston rod side of one of the cylinders. As the piston moves, it displaces fluid to the piston side of the other cylinder. This results in equal sideshifting of both forks.

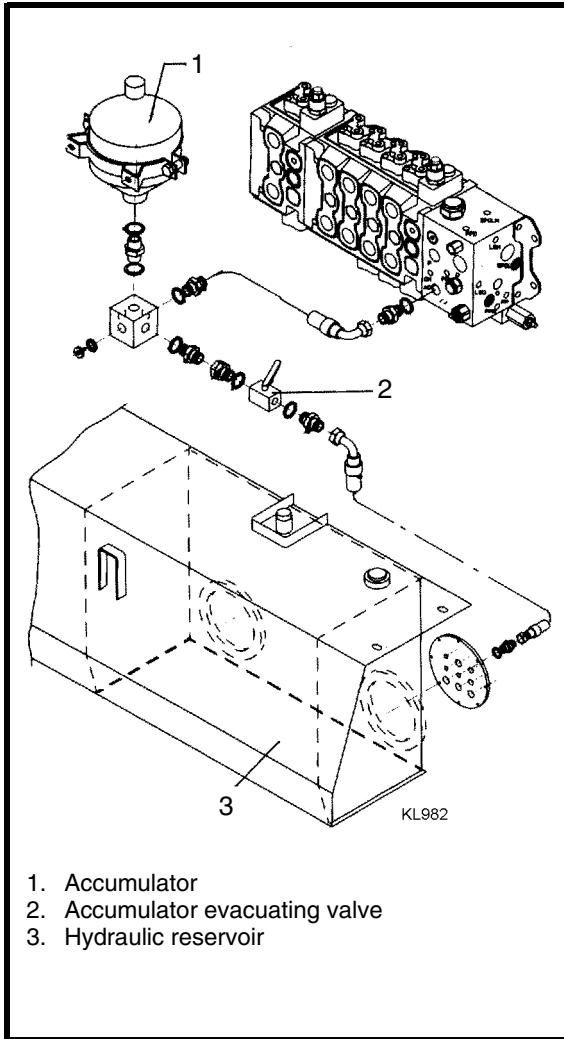
Fork levelling

On trucks with the fork levelling function, one of the forks is suspended by a hydraulic cylinder that moves the fork vertically.



- 1. Control slot
- 2. Control spool

Flow distributor



WARNING!

The hydraulic system includes a high-pressure accumulator. Open the accumulator evacuating valve to release pressure before working on the hydraulic system.

Take great care during all work on the hydraulic system. Avoid being close to pressurized hydraulic components and hoses. Observe strict cleanliness, since the presence of foreign matter can easily result in a valve seizing or in other operational disturbances.

Checking the hydraulic hoses

Check hydraulic hoses and connections for leakage, cracking and wear. Replace hoses if there is the slightest indication of weakness. Tighten the connections as required.

Breather filter

The hydraulic reservoir is fitted with a breather filter which prevents airborne impurities from entering the reservoir. Change the filter as specified in the lubrication chart. The filter is of the spin-on type. To change the filter, remove the old filter element, discard it and screw on a new element.

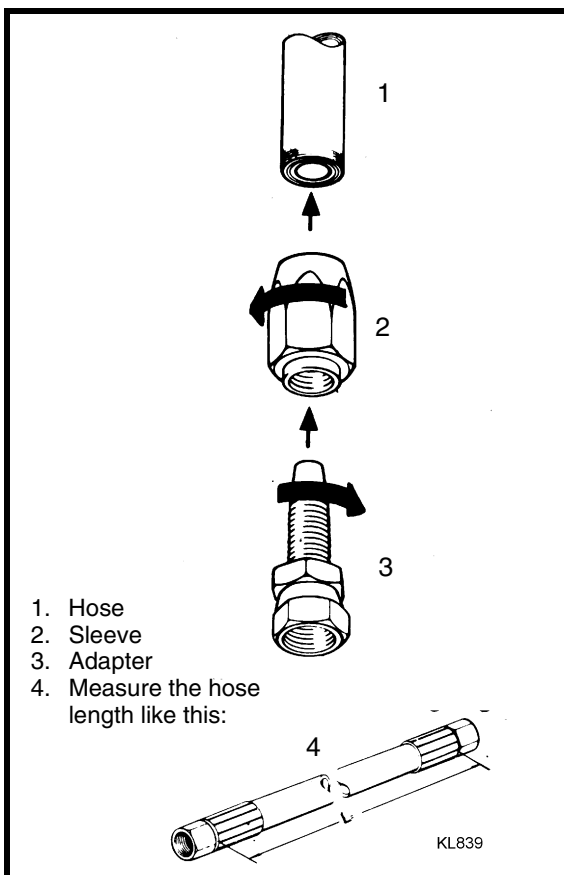
Changing the hydraulic fluid

Change the hydraulic fluid in accordance with the lubrication chart.

1. Remove the bottom plug of the hydraulic reservoir and drain off the fluid.
2. Refit the plug and fill the reservoir with fresh hydraulic fluid. The capacity is given in the Technical Specification.

Mounting of fittings on hydraulic hoses.

1. Measure the length of the hose to be replaced.
2. Thread the sleeve ANTICLOCKWISE onto the end of the hose until the hose bottoms in the sleeve. The sleeve has an internal thread which will thus be pressed into the hose.
3. Grease the adapter thread and screw in the adapter CLOCKWISE until it bottoms on the sleeve. The hose will thus be clamped between the threads of the sleeve and adapter.
4. Carefully flush the hose with white spirit, or equivalent, and blow compressed air through it, so that the hose is absolutely clean.

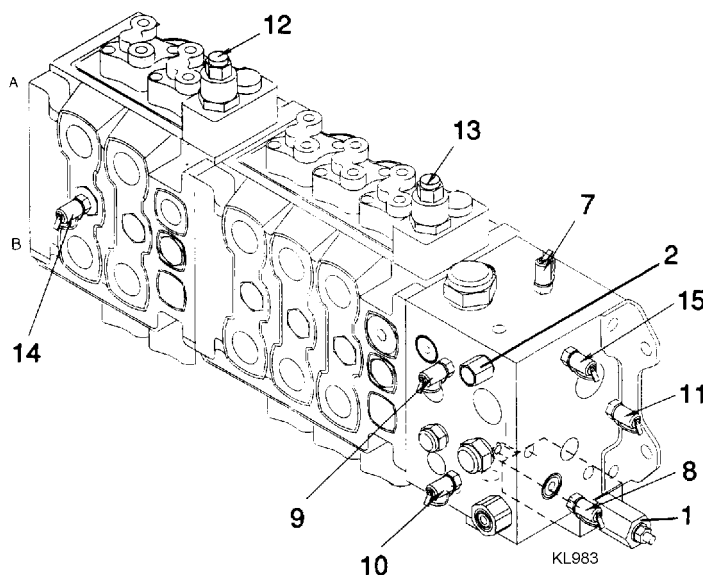


IMPORTANT!

The above procedure may be used only on 1" and smaller diameter hoses. In addition, it may only be used on hoses shown in the spare parts catalogue, with the sleeve and adapter separated from the hose. Hoses shown in the spare parts catalogue as complete units with the end connections fitted must be ordered as complete units in accordance with the catalogue.

Checking the pressure and settings

1. Start the engine and allow it to idle. When making the following pressure tests, use a pressure gauge with a sufficiently long hose to enable reading from the cab.
2. Servo pressure on test point 8. The pressure should be 35 ± 5 bar and it cannot be adjusted.
3. Steering pressure on test point 11. Allow the engine to run in the mid-speed range and turn the steering wheel to full lock in one direction. The pressure should be 173–180 bar. Correct with adjusting screw 2 as required.
4. Accumulator charging pressure on test point 10. Pressure should be 160–165 bar. Correct with adjusting screw 1.
5. **(Volvo-engine)**
Main hydraulic pressure on test point 9, and lifting section pressure on test point 14. The pressure of each output shall be equal.
The pressure is set individually for each truck and is stated in the delivery specification.
The pressure should be set equally on adjusting screws 12 and 13 so that the truck can only just lift its rated load at the appropriate load centre.
The adjusting screw must be sealed after making any adjustment.
6. **(Perkins-engine)**
Main hydraulic pressure on test point 9. Tilt the mast to the rear to the limit of its travel and read the pressure gauge.
The pressure is set individually for each truck and is stated in the delivery specification.
The pressure should be set so that the truck can only just lift its rated load at the appropriate distance of the centre of gravity.
The adjusting screw must be sealed after making any adjustment.



(Numbering is the same as in the Hydraulic Circuit Diagrams)

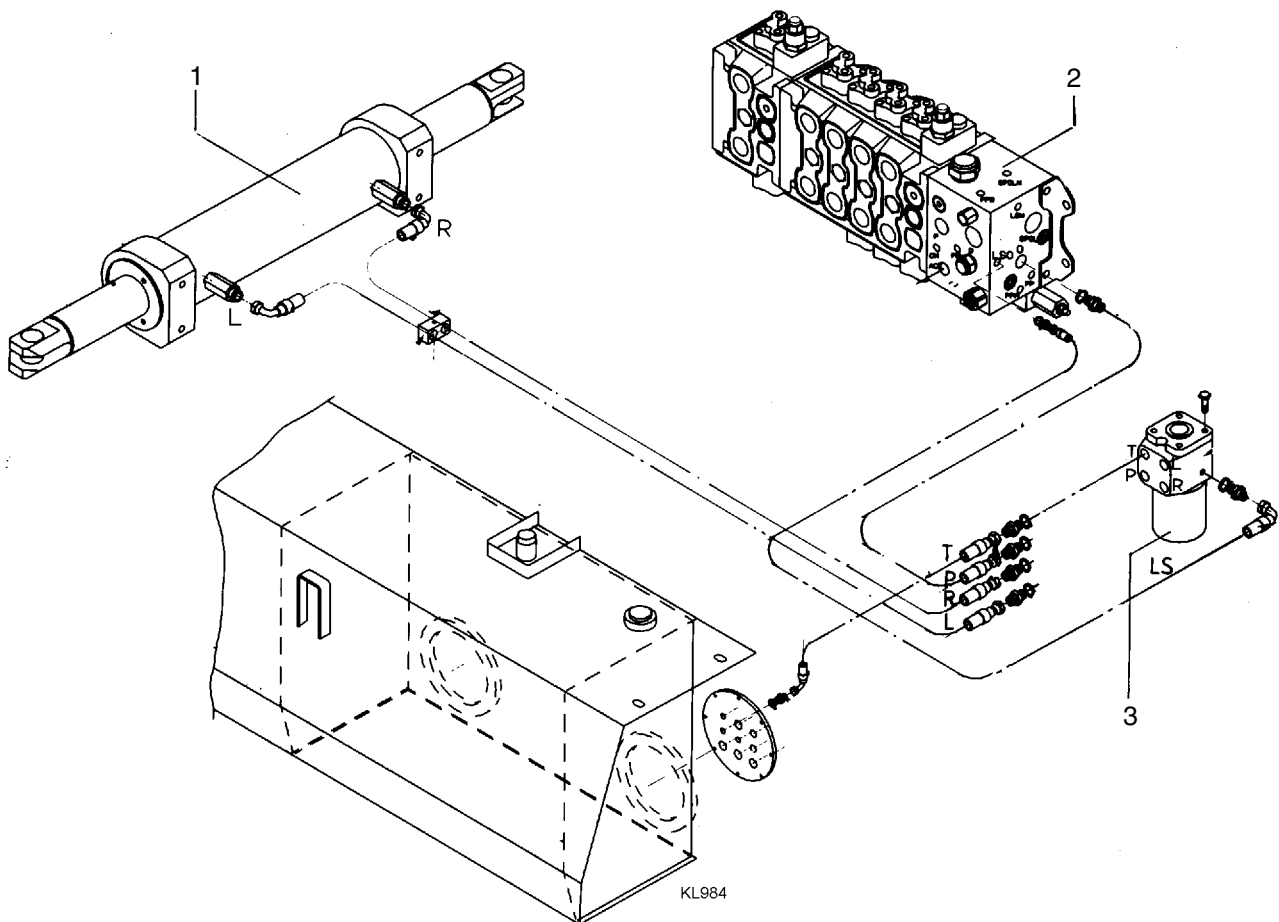
1. Adjusting screw, accumulator charging pressure
2. Adjusting screw, steering system pressure
7. Test point, brake system cooling circuit, max. 1 bar
8. Test point, servo pressure 35 ± 5 bar, not adjustable
9. Test point, main hydraulics
Shall be same pressure as 14 (only Volvo-engine)
10. Test point, accumulator charging
160–165 bar
11. Test point, steering system 173–180 bar
12. Adjusting screw, main pressure limiting valve
Set the same as 13 (only Volvo-engine)
13. Adjusting screw, main pressure limiting valve
Set the same as 12
14. Test point, separate lifting section (only Volvo-engine)
Shall be same pressure as 9
15. Test point, LS-signal from steering valve

Test and adjusting points for valve block and main valve

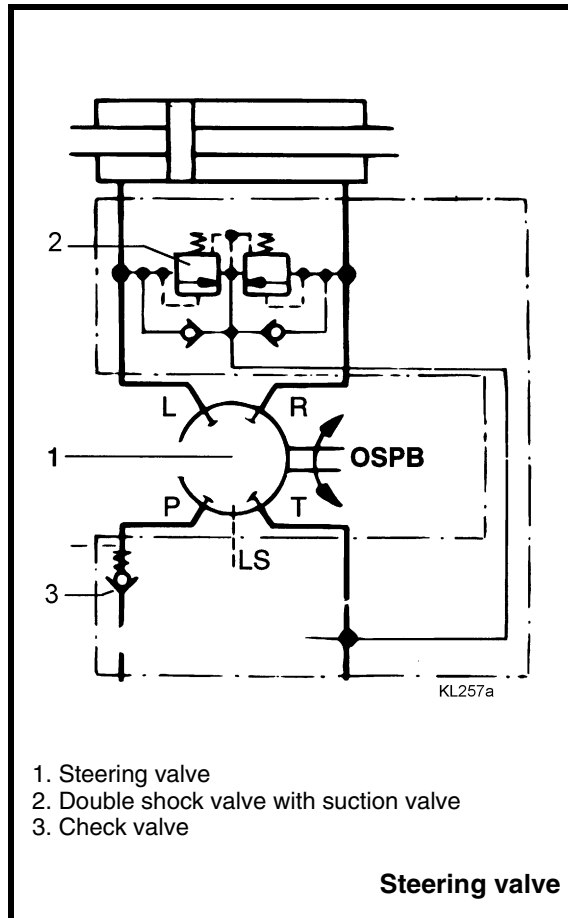
Steering system

The steering system comprises the steering valve and the steering cylinder. The system is supplied with fluid from the valve block adjoining the main valve. An adjustable pressure limiting valve provides the control pressure.

An LS signal from the steering valve actuates the priority valve in the valve block to always ensure sufficient supply to the steering system.



1. Steering cylinder
2. Valve block
3. Orbitrol steering valve

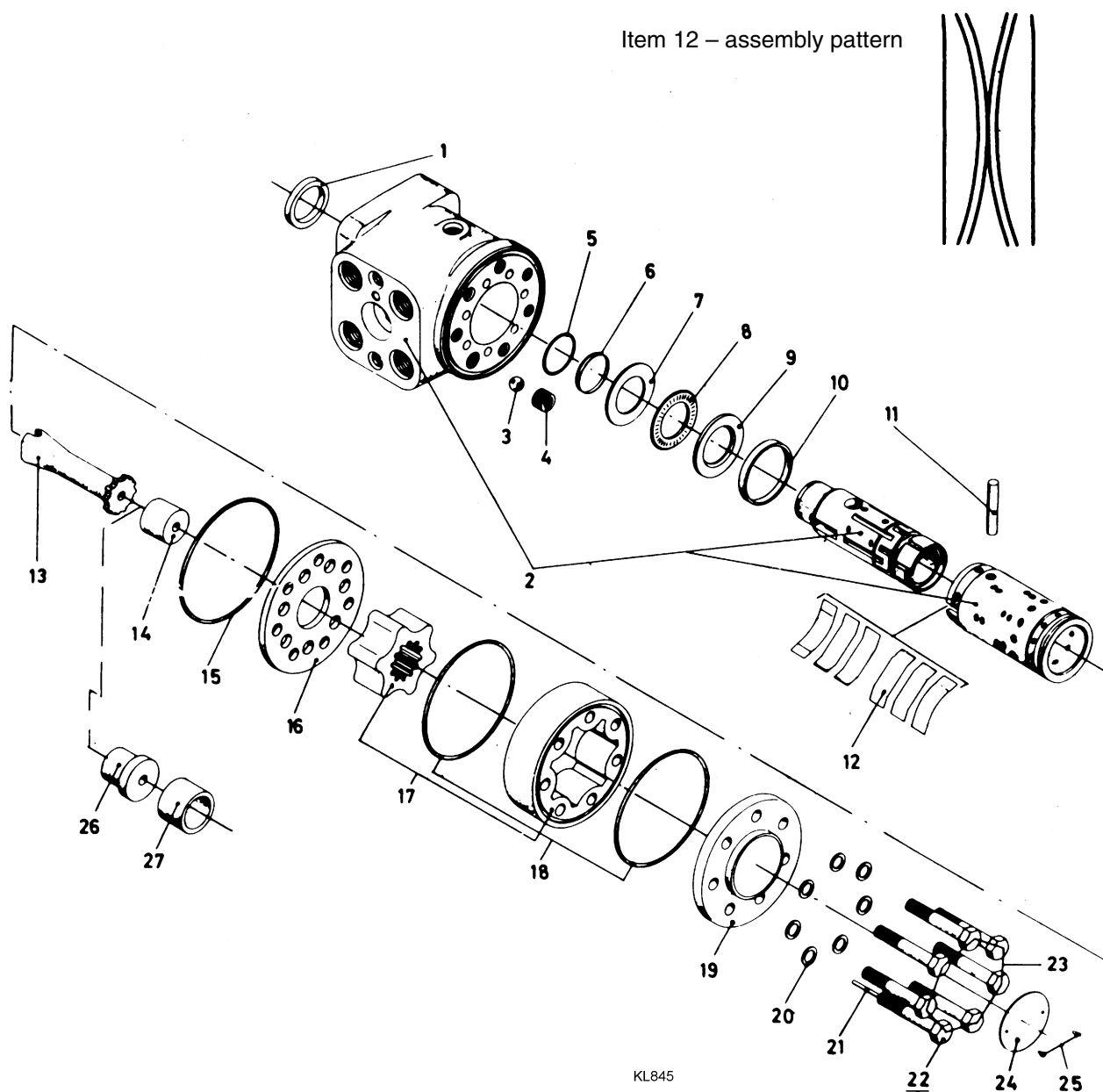


Orbitrol steering valve

The steering valve is of the closed centre, non-reaction type with load sensing signal connection to the valve block. The load signal gives load-dependent control of the fluid pressure from the valve block to the steering valve. The type closed centre implies that it closes for flow of fluid between the pump and reservoir in the neutral mode. This is necessary to enable signal pressure to be connected to the steering valve.

The steering valve consists of a gear pump and a distribution valve. When the steering wheel is turned, fluid is supplied from the valve block via the gear pump to the distribution valve which ensures that the flow of fluid will be supplied to the port corresponding to the direction in which the steering wheel has been turned. Due to the gear pump, the flow of fluid supplied to the steering cylinder is proportional to the angle through which the steering wheel has been turned.

The steering valve has built-in double shock and suction valves. The shock valves open at 280 bar and prevent pressure surges caused by blows against the steered wheels from being propagated to the steering valve. The suction valves open to prevent vacuum on the opposite side of the piston, which could lead to cavitation.



Tightening torquet: 30 ± 5 Nm

- | | |
|-------------------------------------|-----------------------------|
| 1. Dust cover | 15. O-ring |
| 2. Body – spool – sleeve | 16. Distributor plate |
| 3. Ball | 17. Gear set |
| 4. Threaded bush | 18. O-ring |
| 5. O-ring | 19. End plate |
| 6. Guide ring | 20. Washer |
| 7. Front bearing race | 21. Pin |
| 8. Needle bearing holder | 22. Screw with drilled head |
| 9. Rear bearing race | 23. Locking wire |
| 10. Ring | 24. Nameplate |
| 11. Pin | 25. Self-tapping screw |
| 12. Neutral position springs, 1 set | 26. Spacer |
| 13. Shaft | 27. Spacer |
| 14. Spacer | |

Brake system

The foot brake system is known as the wet disc brake system, in which each hub is equipped with a multiple-disc assembly.

The disc assembly comprises stationary discs arranged alternately with a number of rotating discs. The disc assembly is compressed by hydraulic pressure to provide effective braking action. The assembly is submerged in a hydraulic fluid bath to dissipate the heat generated by braking. A separate cooling circuit is provided to cool the hydraulic fluid.

The advantages of the wet disc brake system include the fact that no adjustment is needed, and that no fading or wear occurs. Moreover, the enclosed oil bath keeps the system completely free from water and impurities.

The brake system comprises three separate hydraulic circuits, i.e. the foot-brake circuit, the cooling circuit and the parking brake circuit.

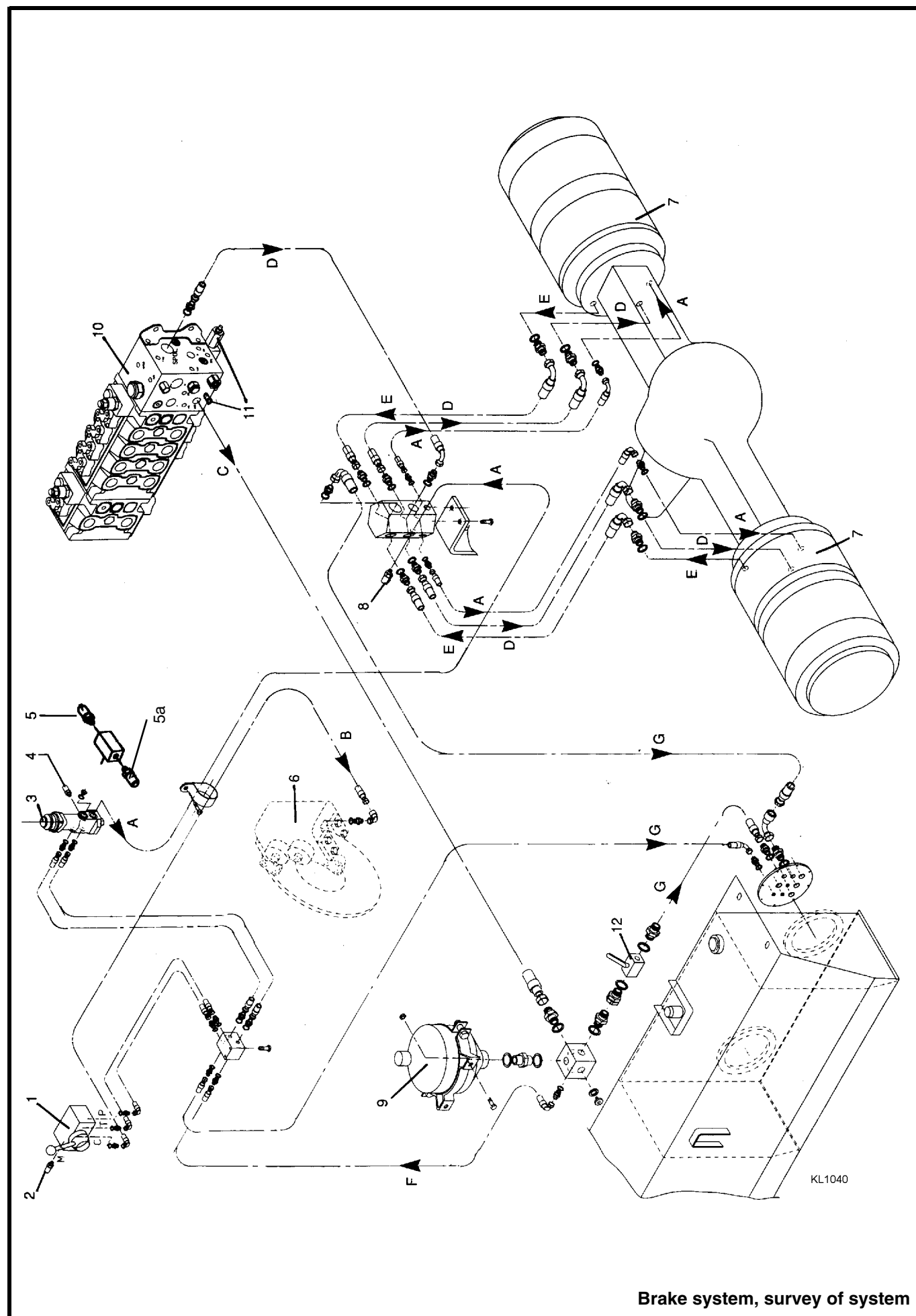
All circuits are supplied with hydraulic fluid under pressure from the same hydraulic pump. The brake circuits are supplied from four hydraulic accumulators and the cooling circuit from the valve block. Excess fluid from the main hydraulic system is passed on to the cooling circuit.

Parking brake, see group 40

Component parts in Braking system

The numbers of the parts are the same as given in the 'General layout of system' and 'Hydraulics schematic diagram'.

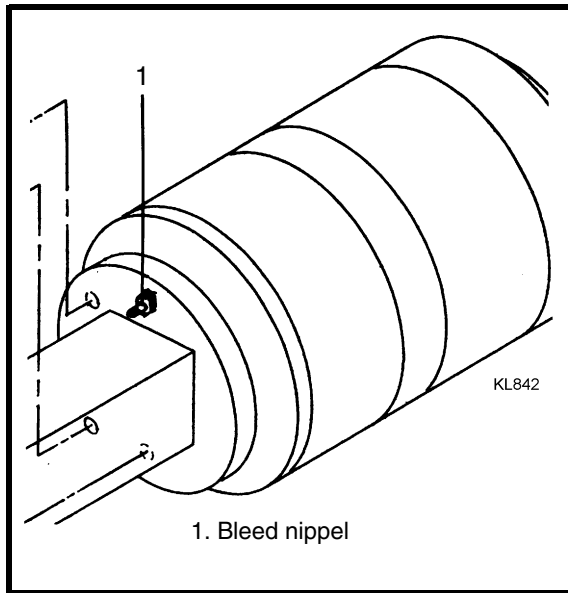
1. Parking brake valve
 2. Pressure switch:
 - 'ON' engagement of pilot lamp for parking lamp;
 - engagement of seat buzzer when the driver leaves the seat with the parking brake in the 'OFF' position;
 - gearbox in 'NEUTRAL' mode when parking brake is 'ON'.
 3. Brake pedal
 4. Pressure switch, warning lamp 'LOW BRAKE PRESSURE 100 bar
 5. Pressure switch, brake lights
 - 5a. Pressure switch, inching
 6. Parking brake cylinder
 7. Wet disc brakes in drive axle hub
 8. Measuring outlet for brake pressure, 100–110 bar
 9. Hydraulic accumulator, pre-charging pressure 70 bar
 10. Main valve
 11. Measuring outlet and adjusting screw for accumulator charging pressure, 160–165 bar
 12. Accumulator evacuating valve
-
- A. Brake pressure, 100–110 bar
 - B. Parking brake 'RELEASED' (=accumulator pressure)
 - C. Accumulator charging pressure, 160–165 bar
 - D. Cooling oil, supply
 - E. Cooling oil, return
 - F. Accumulator pressure for braking
 - G. Return to tank



Brake system, survey of system



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Checking the braking system

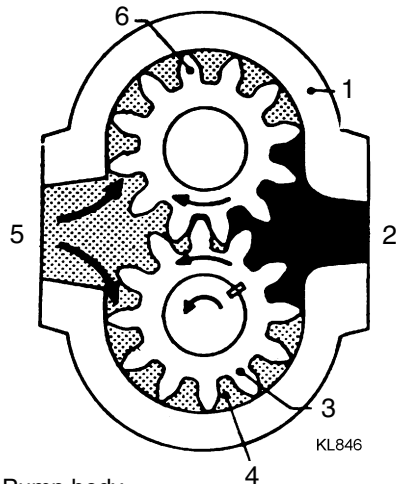
The figures in the following text refer to the picture on page 10 and Hydraulic circuit diagram.

The checks are to be made with the hydraulic system at the working temperature.

1. Bleed the brake lines
 - open the bleed nipple located on the inside of one of the hubs;
 - press the brake pedal until oil free of any air starts to flow from the bleed nipple;
 - repeat the procedure for the other hub.
2. Connect a manometer to the measuring outlet (10) on the main valve.
3. Allow the engine to run, release pressure from the accumulator through the evacuating valve (12) and check that the pressure is 160–165 bar after completed charging. If the pressure exceeds 180 bar, stop the engine immediately and make sure that the cause is remedied. Adjust with adjusting screw (1) when necessary.
4. Check to make sure that there is enough charge in the accumulator to cover at least eight brakings e.g. the remaining pressure is over 70 bar after eight brakings.
5. Check the accumulator's pre-charging pressure as follows
 - it should be 70 Bar.
 - open the accumulator evacuating valve (12) carefully, keeping a check on the manometer in the measuring outlet (10). At 70 bar, the pressure should drop sharply to 0.

If the pressure is lower, the pre-charging pressure shall be raised to the correct level using special filling equipment for nitrogen gas accumulators.

N.B. The charging equipment may be handled only by specially trained personnel.

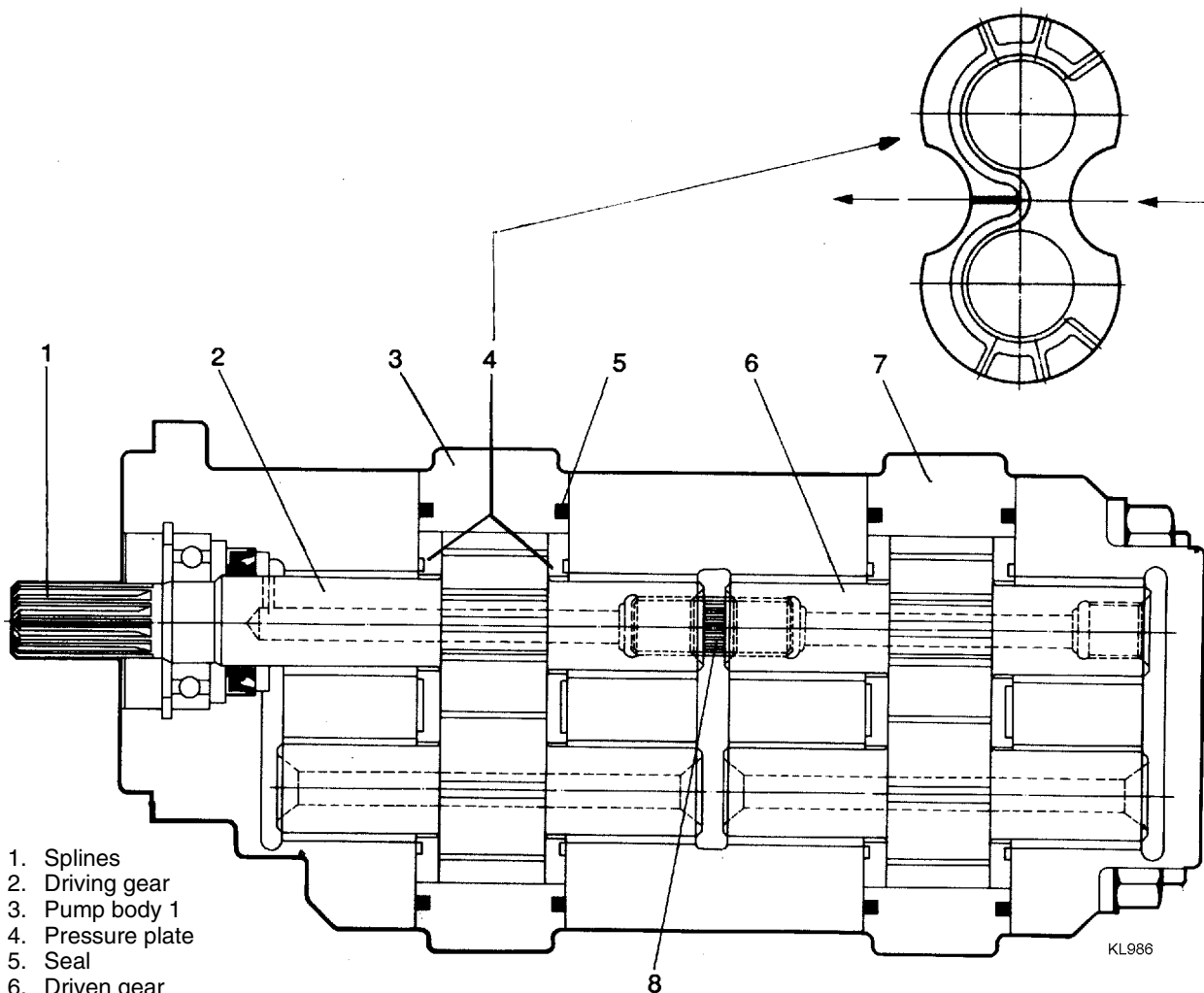


1. Pump body
2. Outlet
3. Driving gear
4. Gap between teeth
5. Inlet
6. Driven gear

Hydraulic pump

The hydraulic pump is of the gear type and is directly driven by the engine via splines. The pump spindles are mounted in plain bearings which are lubricated by the hydraulic fluid flowing through the pump.

Pressure plates on each side of the pump gearwheels seal between the suction and pressure side.



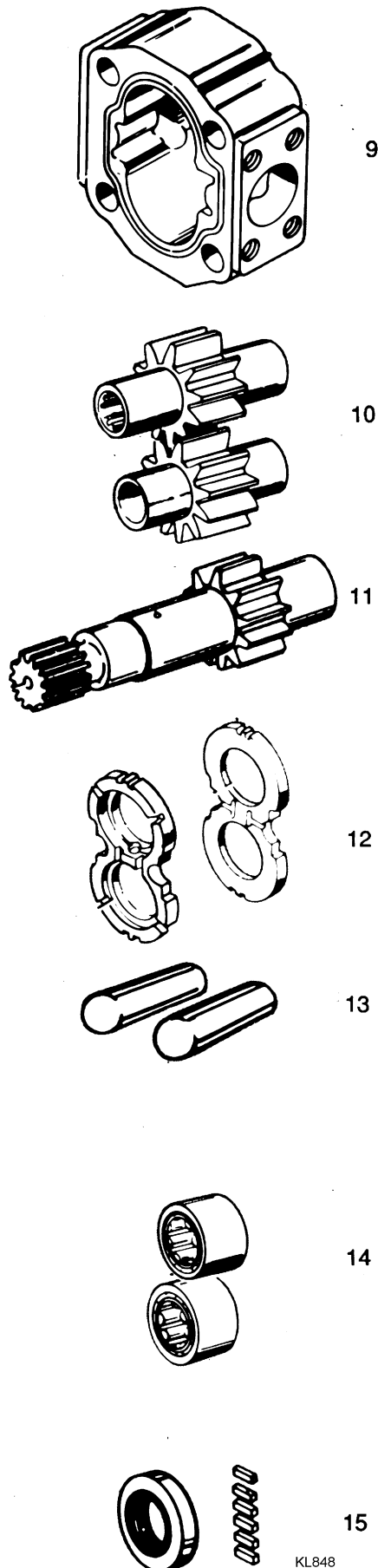
1. Splines
2. Driving gear
3. Pump body 1
4. Pressure plate
5. Seal
6. Driven gear
7. Pump body 2
8. Carrier spindle

Double hydraulic pump

Hydraulic pumps

General instructions are given below for service operations that should be carried out on the pumps and how much wear is acceptable on the various components before a particular component must be replaced.

1. If different sections of the pump must be prised apart, take great care not to damage any of the machined surfaces. The use of excessive force may damage the parts.
2. It is essential that all parts are blown clean and wiped with a lint-free linen cloth before being assembled.
3. If the parts are difficult to fit during assembly, tap with a soft mallet - never use a steel hammer.
4. The gears are carefully matched, and they must therefore be kept together as a unit during dismantling. Treat them with extreme care, so that the shafts and the teeth are not damaged. Avoid touching the shaft ends.
5. Never hammer a plain bearing or roller bearing into place. Use a press or other suitable tool.
6. Before assembly, fill all ports with hydraulic fluid, so that the pump is thoroughly lubricated from the start. All pumps must turn in the intended direction of rotation, since the pressure will otherwise damage the seals.
7. Hot fluid must not be allowed into a cold pump, since it may otherwise seize.
8. After starting, run the pump without load and with the engine running at idling speed for at least two minutes. During this running-in period, check that the pump does not run hot.



Permissible wear of the pump components

9. Pump body

The pump pressure presses the pump gears towards the walls of the body on the low-pressure side, and since the shafts and bearings wear, the pump gears will rub against the body.

If the pump body has worn more than 0.13 mm, it must be changed. Check by placing a straight edge inside the pump body, and use feeler gauges to measure the wear.

10. Driven gear

The driven gear must be replaced if any kind of scoring or wear is found on the shaft ends or teeth.

11. Driving gear

Fit a new driving gear if wear can be felt on the sealing surfaces.

12. Pressure plates

The pressure plates seal at the sides of the pump section. Wear of the pressure plates will cause internal leakage. The maximum permissible wear is 0.05 mm. Fit new pressure plates if the existing ones are scored, worn or pitted.

Check the centres of the pressure plates where the teeth mesh. Wear here indicates that there are impurities in the fluid. Pitting indicates cavitation or the formation of gas. Discolouration of the pressure plates indicates overheating.

13. Dowels

If a dowel or its hole has been damaged, the dowel and possibly the section containing the dowel must be changed.

If more than reasonable force is needed for pressing in a dowel, this may be due to inadequately deburred or fouled parts, deformation of the dowel or poor fit of the dowel hole.

14. Plain bearings and roller bearings

If new gears are fitted, the bearings must also be changed. Plain bearings must be a hard press fit. Roller bearings must be a light press fit, and it is acceptable if they can be pressed in by hand. If a bearing can drop out of its seat, the hole is too large.

15. Seals

Replace all rubber and plastic seals, including all O-rings, seals at the pressure plates, shaft seals and gaskets.

Accumulator

The hydraulic system is connected to membrane type accumulators which are pre-charged with nitrogen at a pressure of 70 bar.. The membrane is forced upward causing the pressure of the nitrogen to increase as the accumulator becomes charged with hydraulic fluid. When the hydraulic system requires power from the accumulator, the membrane presses fluid back into the system.

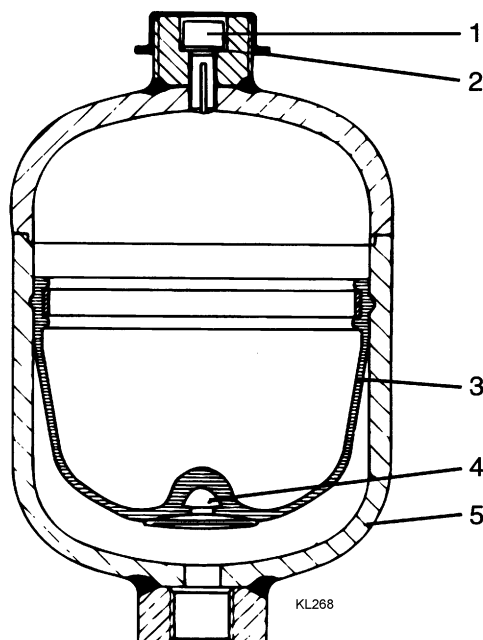
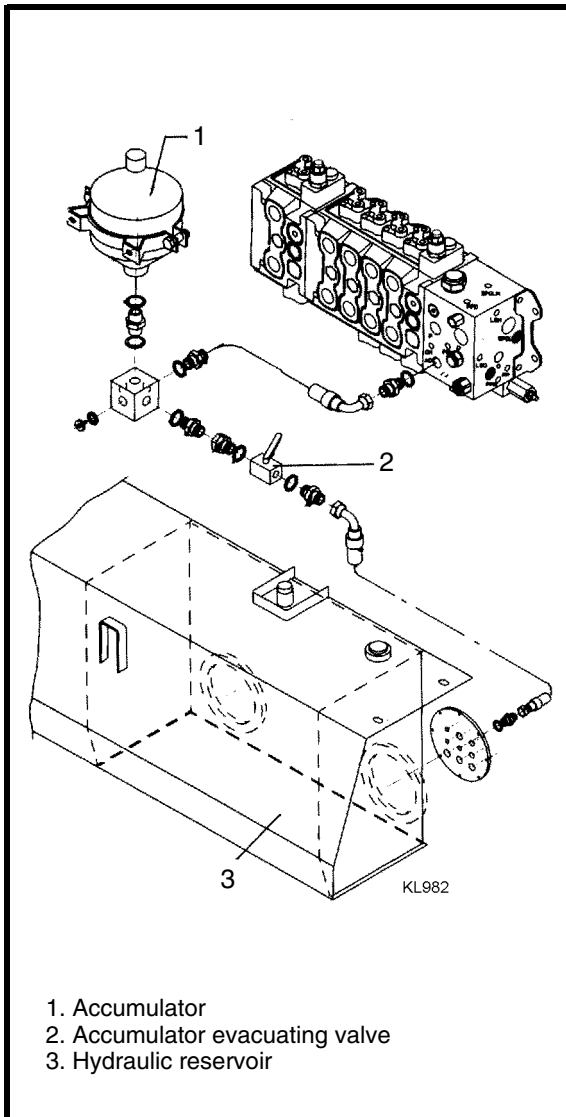
The accumulator is fitted at the top with a connection for testing the pressure of the nitrogen, and for refilling nitrogen with the aid of special filling equipment.

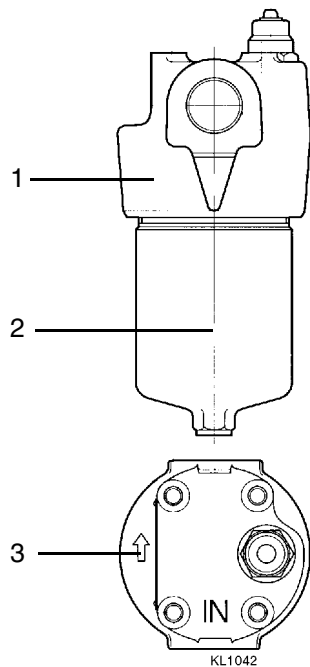
The pressurized fluid from the accumulator is utilized to power the driving brake and parking brake systems, and to supply the pressure reducing valve of the servo hydraulics.

An evacuating valve is fitted between the accumulator and reservoir. This valve shall be used to relieve the accumulator of pressure before carrying out any work on the hydraulic system.

IMPORTANT!

The hydraulic system includes high-pressure accumulators. Open the accumulator evacuating valve to release pressure before working on the hydraulic system.





1. Filter head
2. Filter bowl
3. Arrow, flow direction

High pressure filter

Two high pressure filters located immediately after the pumps are used to clean the fluid. The filter head is equipped with a by-pass valve which opens at 5 bar. The opening area is initially small but gradually increases with the pressure drop across the filter, ie, as the amount of impurities trapped by the filter cartridge increases.

The filter element is a fibreglass cartridge with an absolute mesh of 20 μ .

High pressure filter

The high pressure filter for the hydraulic fluid must be changed at the intervals specified in the lubrication chart.

In addition, the filter must always be changed whenever work has been carried out on the hydraulic system.

1. Clean the outside of the filter and the area around it.
2. Place a vessel under the filter to collect any spillage.
3. Remove the filter bowl. Use an open-ended or ring spanner.
4. Remove the filter cartridge.
5. Replace the O-ring between the filter head and the bowl and the O-rings on the adapter. The O-rings are packed together with the filter cartridge.
6. Lubricate the O-ring for the filter head with hydraulic fluid.
7. Carefully clean the filter bowl and fill it half-full with hydraulic fluid.
8. Remove the filter cartridge from its package and fit it immediately.
9. Fit the bowl and tighten it to a torque of 140 Nm.
10. Start the engine to purge the system of air, and check that the filter does not leak.

IMPORTANT!

The high pressure filter cartridge must always be changed when a pump has been exchanged.

The filter must always be fitted with its top arrow pointing in the flow direction.

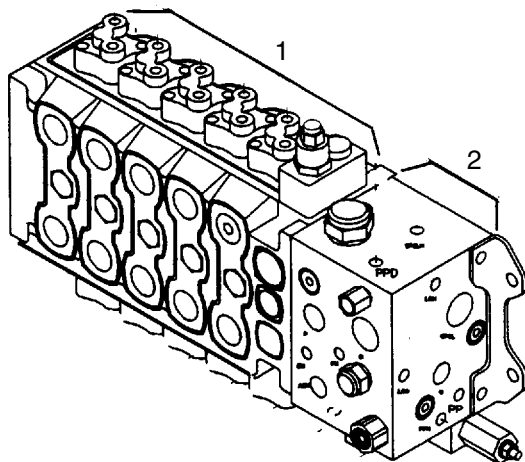
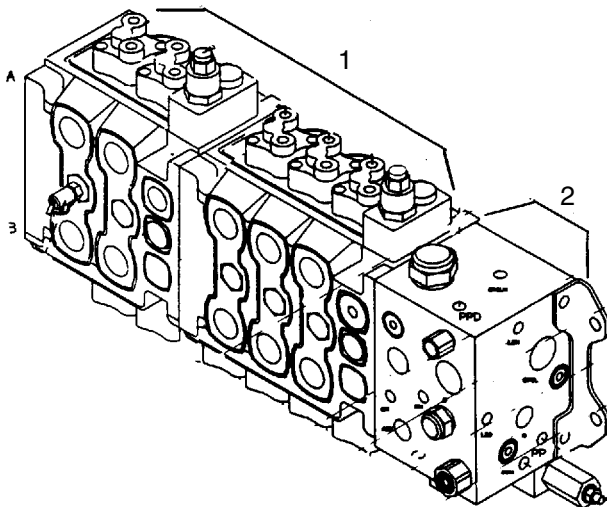
Valve block

Several hydraulic functions are concentrated to a valve block which is connected directly to the main valve. The valve block has a pressure reducing valve for servo to the control levers.

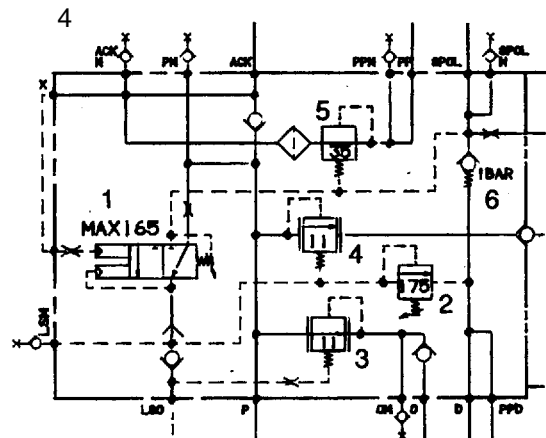
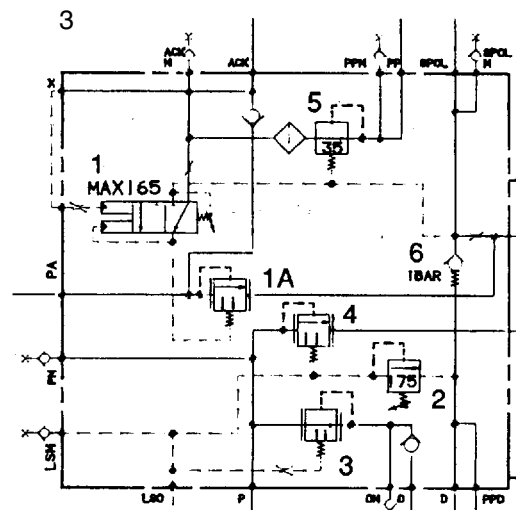
Valve block, main functions:

(Numbering is the same as in the Hydraulic Circuit Diagrams)

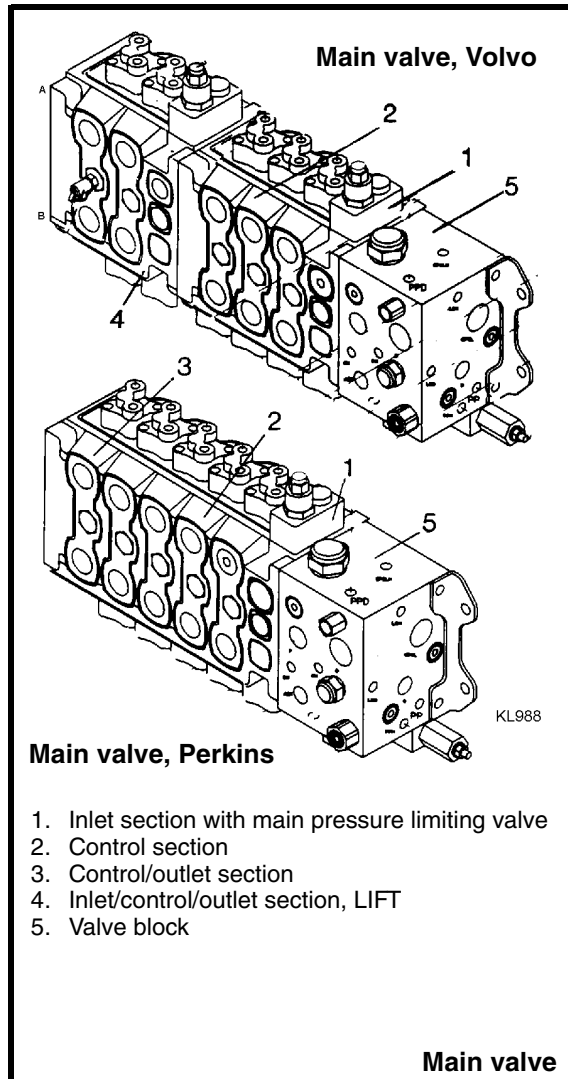
1. Accumulator charging valve
- 1A. Priority valve for accumulator charging. (Only Volvo-engine)
2. Pressure limiting valve, steering system
3. Differential valve, providing max. 11 bar difference between the steering valve LS-signal and the pump pressure
4. Priority valve for the steering circuit
Provides 11 bar initial pressure in the main valve
Actuated by the steering valve LS-signal and ensures that the steering circuit has sufficient supply
5. Pressure reducing valve for servo to control levers
6. Relief valve, cooling circuit. Provides max. 1 bar, opens to the reservoir at higher pressure in the cooling circuit.



1. Main valve
2. Valve block
3. Volvo engine-valve configuration
4. Perkins engine-valve configuration



KL987



Main valve

The main valve is actuated by hydraulic servo.

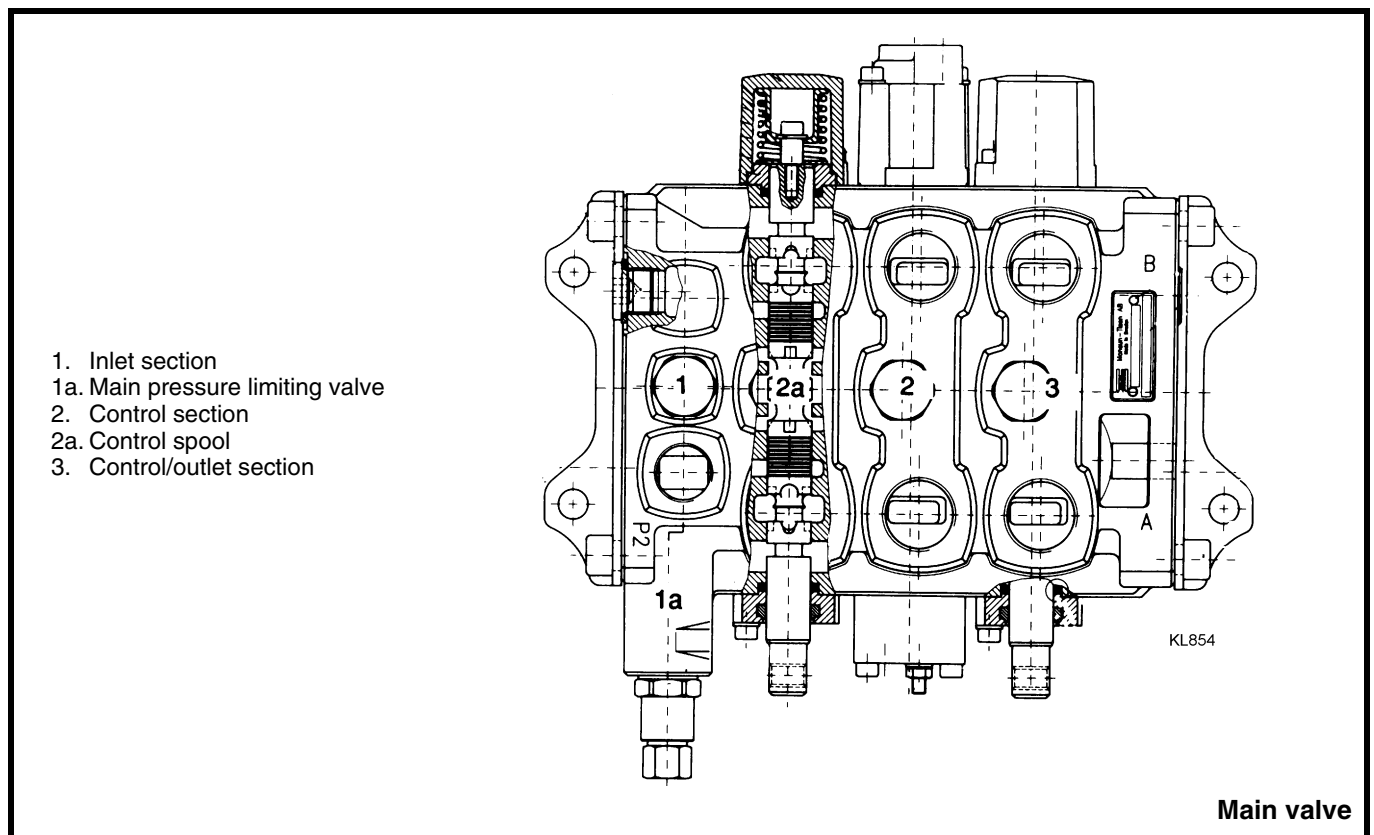
The valve consists of the following main components:

- Inlet section
- Control sections, corresponding to the number of functions of the truck
- Combined control and outlet section

The main valve has for trucks equipped with Volvo engines a separate inlet and outlet section, and also a separate main pressure limiting valve for the lifting section. The entire flow from one of the hydraulic pumps goes to this section. If the lifting or tilting function is not actuated, the flow from this pump goes instead to the cooling circuit of the driving brake or to the reservoir.

In addition, any flow from the other pump that is not utilized in the remaining main hydraulic functions is also supplied. When the lifting or tilting function is not actuated, a partial flow from this pump goes to the cooling circuit of the driving brake and the rest to the reservoir.

On trucks fitted with a Perkins engine, the entire main hydraulics, including the lifting function, is related to the same main pressure limiting valve. Even in this case, both of the hydraulic pumps interact to provide maximum flow when required to ensure maximum power to the lifting function. Any surplus flow goes partially to the cooling circuit of the driving brake and the remaining flow to the reservoir.



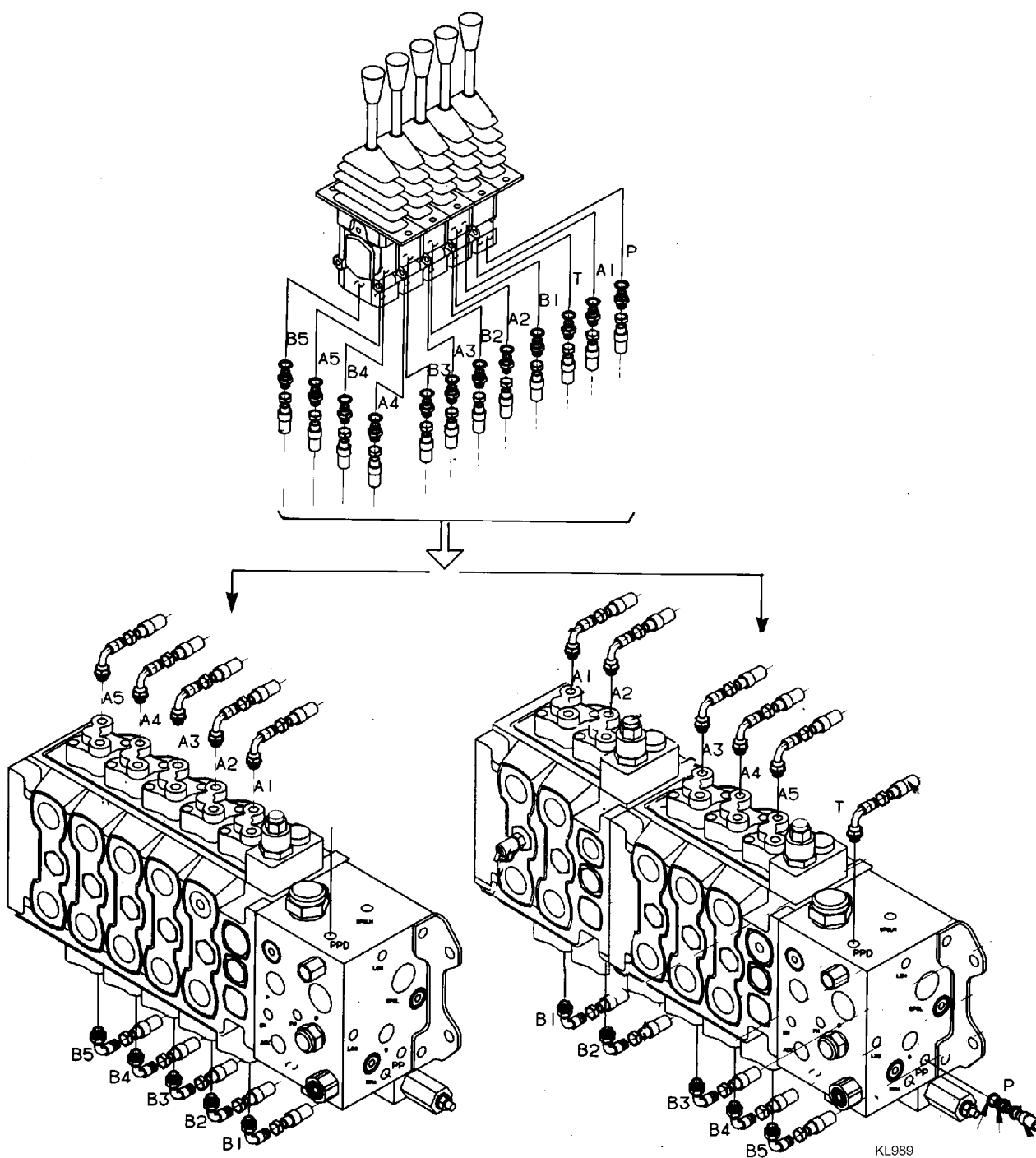
The inlet section is screwed directly onto a valve block. One port supplies pressurized fluid from the hydraulic pump to the control sections and one port leads any surplus fluid from the control sections to the cooling circuit of the driving brake system. A nozzle determines the amount.

The inlet section includes an adjustable, sealed main pressure limiting valve which regulates supply pressure to the main hydraulics.

The control section is equipped with a spring-centred control valve spool. A check valve is provided inside the spool on the supply port (shown on the diagram by a symbol in the supply line). This check valve prevents any undesirable lowering of the load should several functions be operated simultaneously.

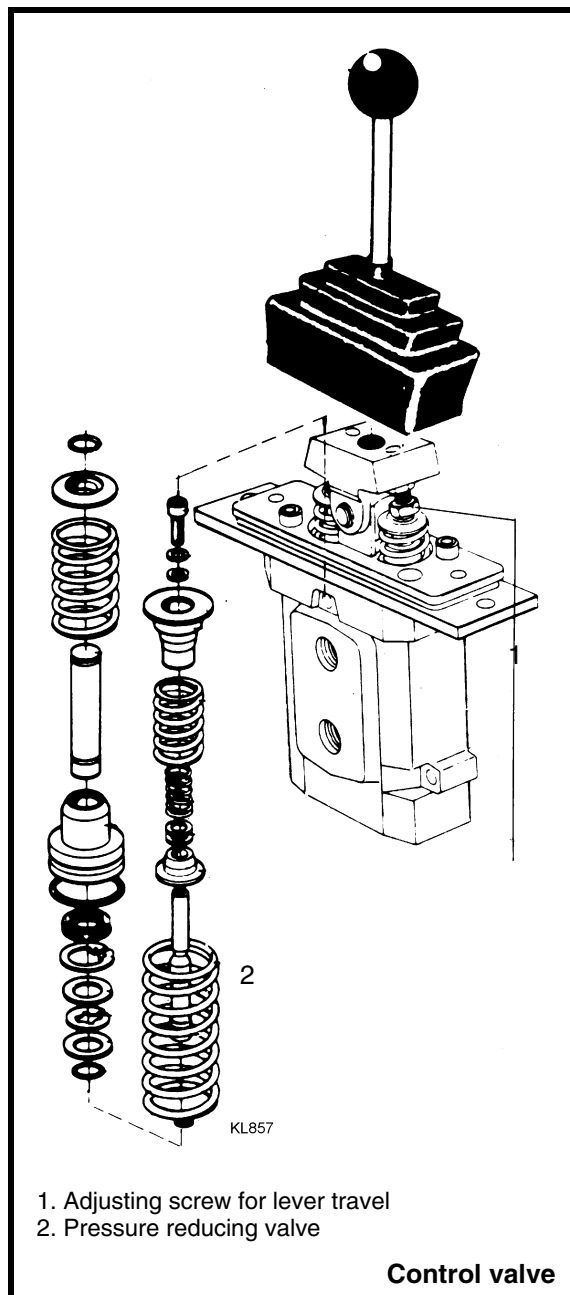
The main valve has incorporated hydraulic actuators for setting the control valve spools. The actuators include springs which centre the spool when the actuators are not pressurized.

See the hydraulic circuit diagram at the end of Group 70.



CONNECTIONS FOR PERKINS ENGINE

CONNECTIONS FOR VOLVO ENGINE

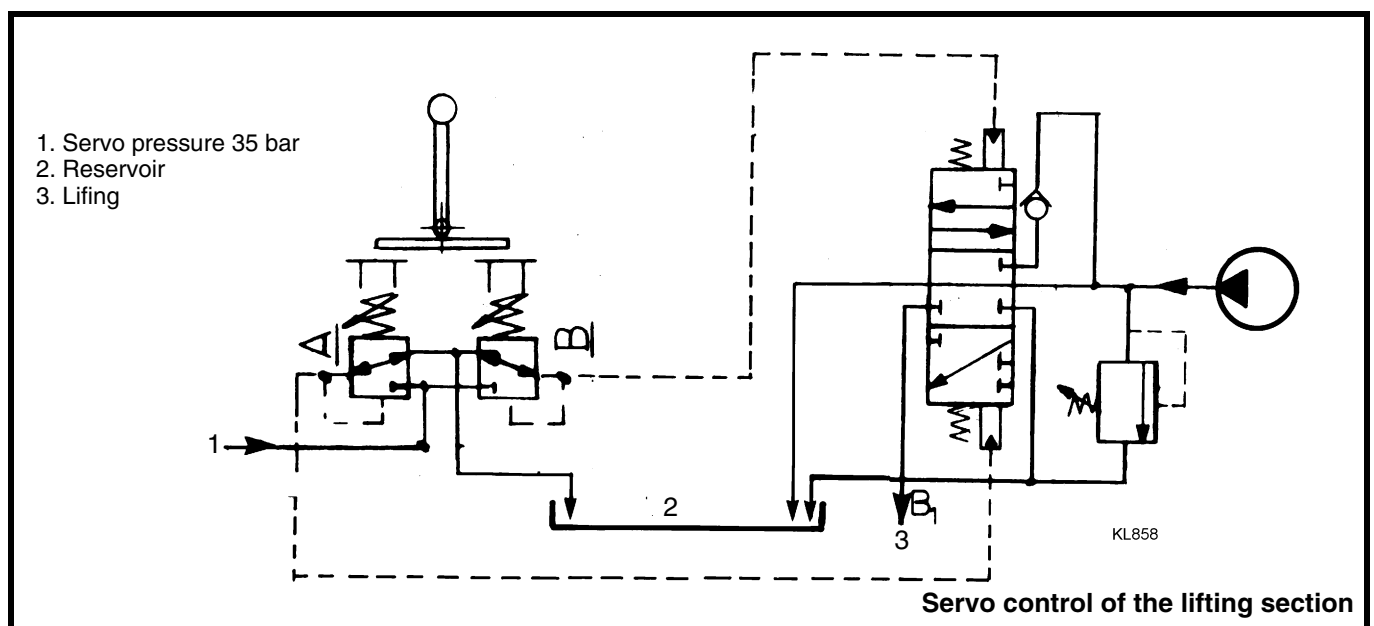


Control valve for servo control of the main valve

The control valves are integrated into a block, and the number of valves corresponds to the number of functions of the truck.

Each valve or section is equipped with two pressure reducing valves. The valve spools are hardened and precision-ground to minimize any internal leakage.

The control forces are low, and the valve travel is proportional to the lever travel, which ensures smooth control of the main hydraulics.



Main valve

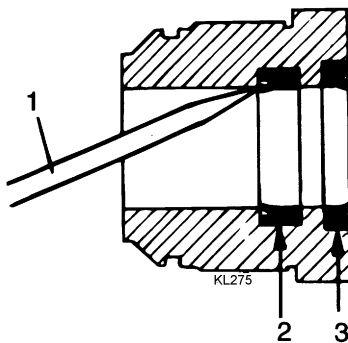
The main valve is precision made and must be treated with great care so that its performance will not be impaired. The following rules apply whenever service work is carried out.

1. Protect the valve against moisture and dirt. Take particular care to avoid dirt entering the connection ports. Also protect the ports from damage by scratching or bruising. Keep unconnected ports plugged with plastic plugs or the like.
2. Protect the ends of the spools and covers against blows. The valve spool may be bent if handled carelessly, and it will then immediately jam on being used.



WARNING!

Never use compressed air for removing the piston from the cylinder. You could sustain serious injuries.



1. Screwdriver
2. Lip seal
3. Scraper ring

Repairs to leaking hydraulic cylinders – replacing the seal

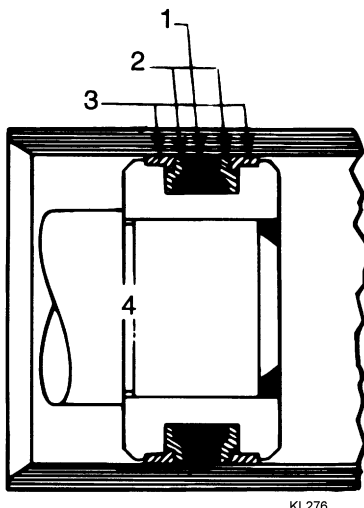
See also separate Supplement

Hydraulic cylinders, Publ. No.920 937-9279

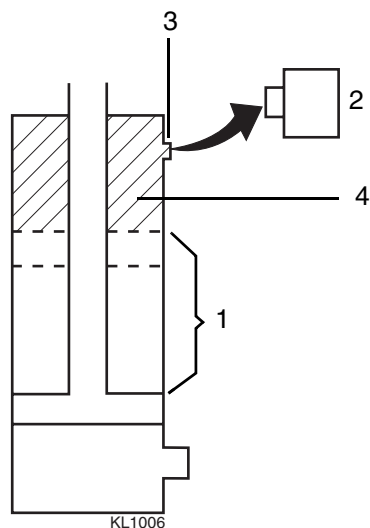
General instruction applicable to all cylinders

If necessary, see Group 80 for instructions of the dismantling of the fork carriage and mast.

1. Remove the relevant hydraulic cylinder. Fit immediately protective caps or plugs to the hydraulic cylinder and hose connections.
2. Take the cylinder to the workshop, drain any oil remaining in it and carefully wash the outside of the cylinder.
3. Dismantle and assemble the cylinder in accordance with the instructions for that particular cylinder type.
4. Removing the seals:
 - Whenever repair work is carried out on hydraulic cylinders, all seals, scraper rings, etc. must be replaced.
 - Take extreme care when removing the seal in the cylinder head, to avoid scratching the bottom of the groove, since oil leakage will otherwise occur in the future. Use a screwdriver as shown in the figure.
 - Clean all components very thoroughly.
5. Fitting of lip seals:
 - Fit the seal in the cylinder head with the lip facing inwards towards the piston. Oil the seal and press it in by hand. N.B. Don't use any tools, since the seal may otherwise be scratched. Even a minute scratch may cause the seal to leak.
6. Fitting the piston seals:
 - All piston seals are of the same design and consist of five components, i.e. a centre sealing ring, two backing rings and two guide rings.
 - Dismantle the piston seal and start by fitting the sealing ring onto the piston, and then fit the backing rings and the guide rings. All of this must be done by hand.



1. Sealing ring
2. Backing rings
3. Guide rings
4. Piston head



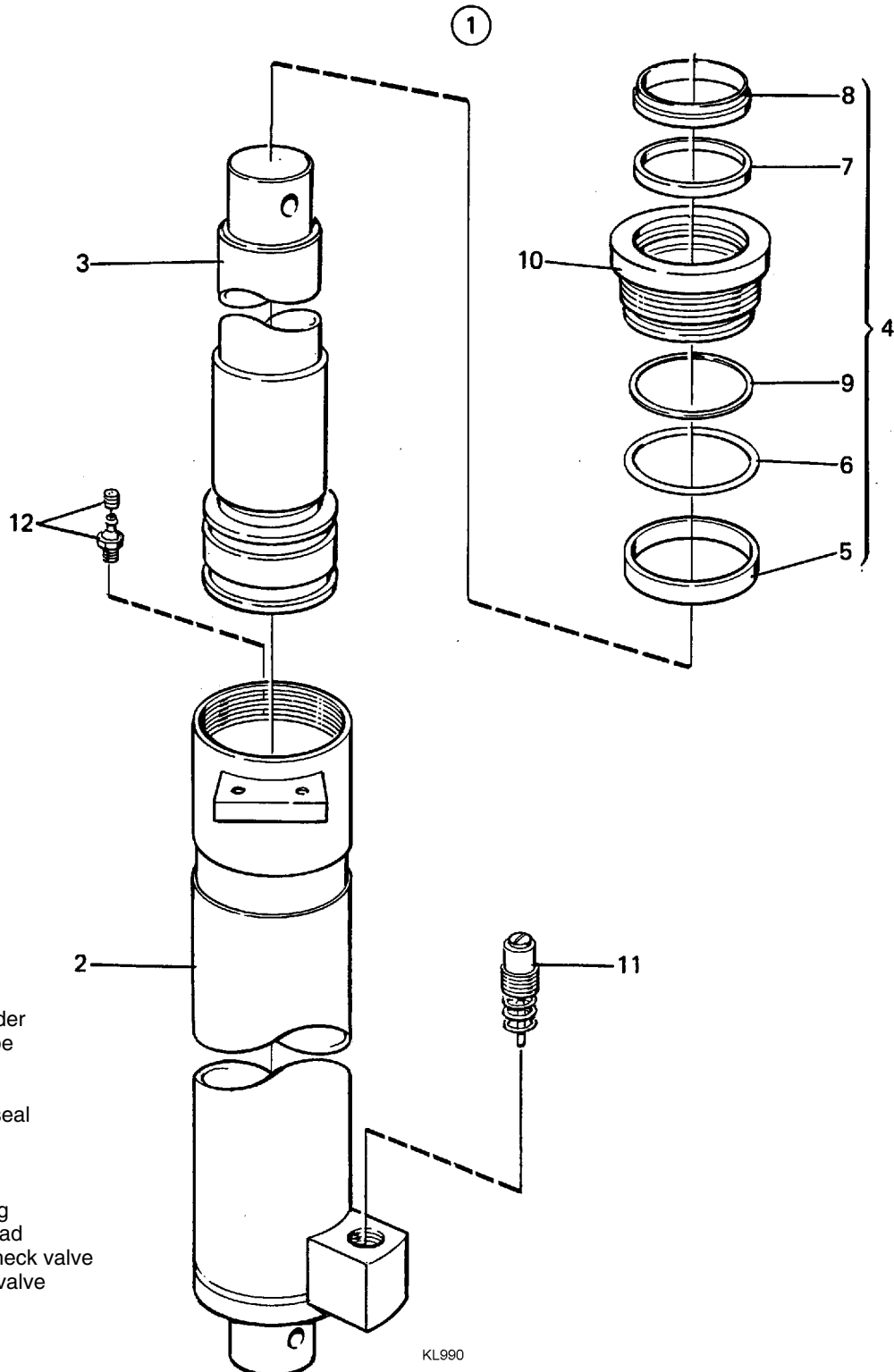
1. Normal operating stroke
2. Breather filter
3. Filter connector
4. Area with corrosion risk

Lubrication of single acting cylinders

1. This type of cylinders have no oil supply on the piston side. If the cylinders are operated in a limited stroke (1), there is a risk of corrosion damage to the upper part of the cylinder inner surface (4).
2. Loosen the breather filter (2).
3. Inject 300-500 ml of oil into the filter connector (3).
4. Operate the cylinder in its full travel a number of times until no more oil is pressed out from the connector (3).

Lifting cylinder

1. The cylinder head is threaded into the cylinder pipe, and a C-spanner must be used for fitting and removing it.
2. When reassembling an overhauled cylinder, after the piston has been fitted and the cylinder head is to be tightened, it is extremely important that the piston rod is well centred and aligned in the cylinder head so that the threads are not damaged. Lubricate the threads with molybdenum disulphide (Molykote) grease.



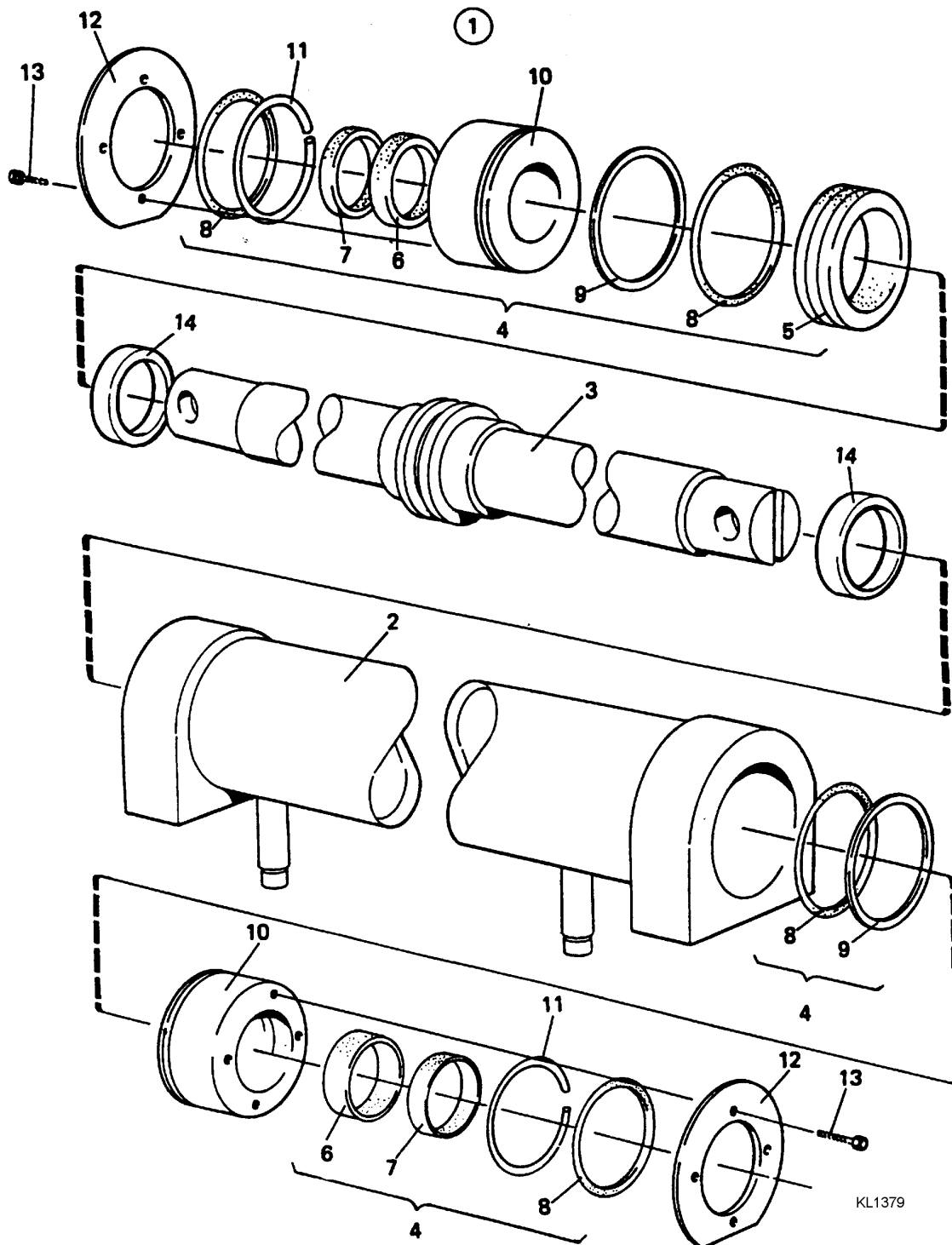
1. Lifting cylinder
2. Cylinder pipe
3. Piston rod
4. Seal kit
5. Piston rod seal
6. O-ring
7. Seal
8. Wiper
9. Back-up ring
10. Cylinder head
11. Lowering check valve
12. Air venting valve

KL990

Lifting cylinder

Steering cylinder

1. The steering cylinder has a double-acting piston, with the piston seal in the centre.
2. A cylinder head which is fixed into the cylinder tube with a locking ring is provided at each end.



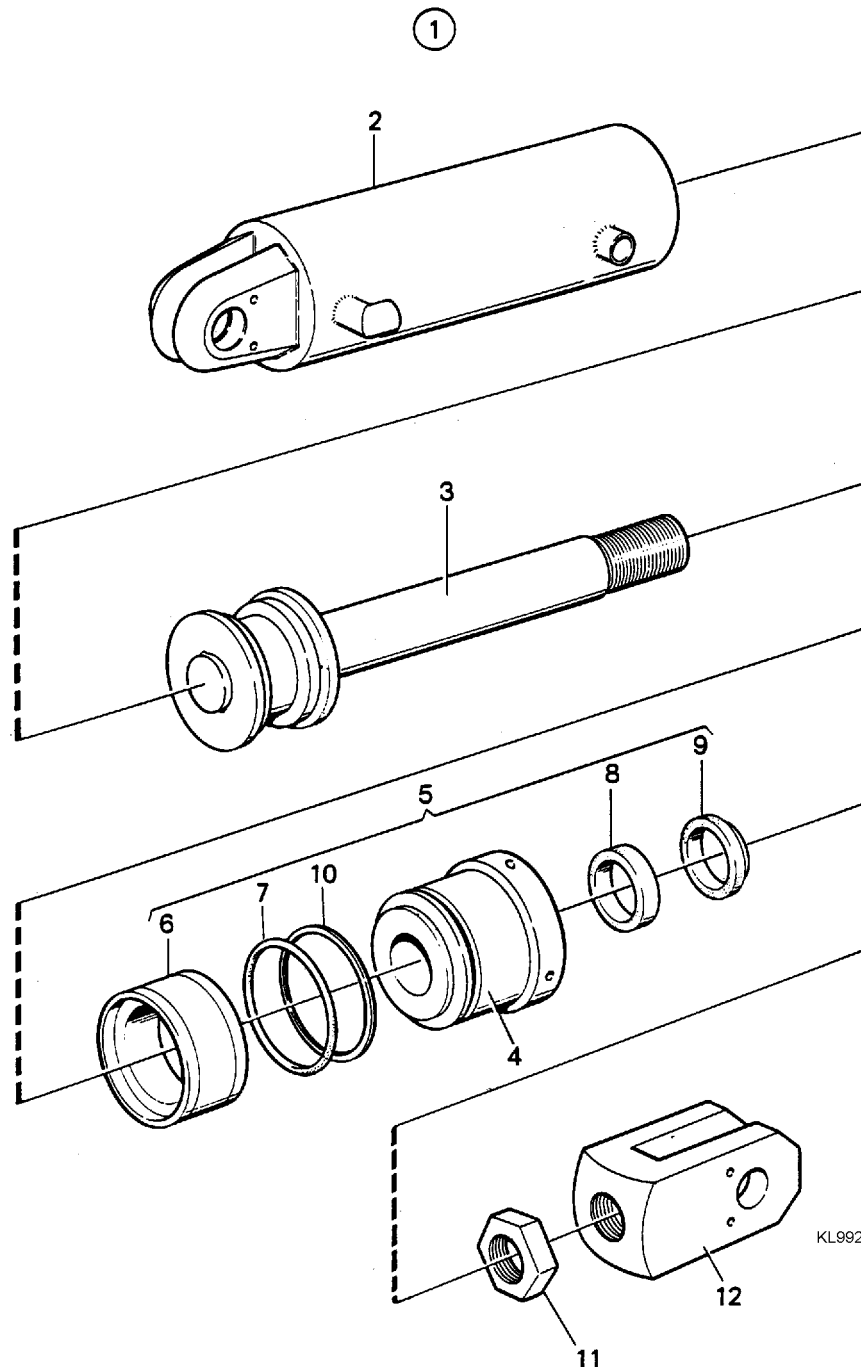
KL1379

- | | | |
|----------------------|-------------------|------------------|
| 1. Steering cylinder | 6. Seal | 11. Locking ring |
| 2. Cylinder pipe | 7. Wiper | 12. Washer |
| 3. Piston rod | 8. O-ring | 13. Screw |
| 4. Seal kit | 9. Back-up ring | 14. Spacer ring |
| 5. Piston seal | 10. Cylinder head | |

Steering cylinder

Tilting cylinder

1. Both ends of the tilting cylinder are fitted with a clevis mount. The piston rod clevis is threaded onto the piston rod and is secured by locknuts and locking plate.
2. The cylinder head is threaded into the cylinder tube, and a C-spanner must be used for fitting and removing it.

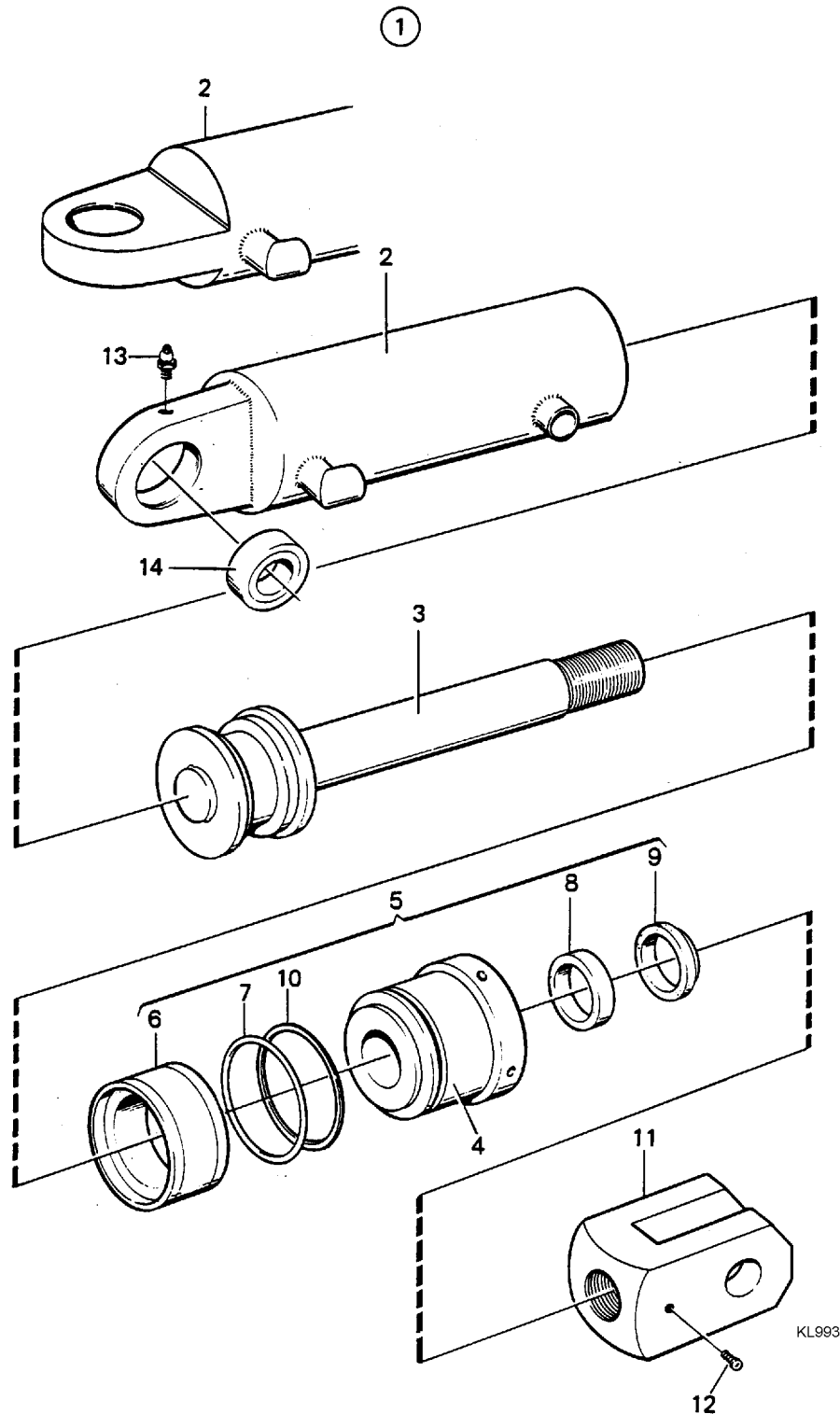


1. Tilt cylinder
2. Cylinder pipe
3. Piston rod
4. Cylinder head
5. Gasket kit
6. Piston seal
7. O-ring
8. Seal
9. Wiper
10. Back-up ring
11. Nut
12. Clevis mount

KL992

Fork spreading and sideshifting cylinder

1. Both ends of the fork spreading and side shifting cylinder is provided with a lug bearing. The piston rod clevis is threaded onto the piston rod.
2. The cylinder head is threaded into the cylinder tube, and a C-spanner must be used for fitting and removing it.



1. Fork spreading cylinder
2. Cylinder pipe
3. Piston rod
4. Cylinder head
5. Seal kit
6. Piston seal
7. O-ring
8. Seal
9. Wiper
10. Back-up ring
11. Clevis mount
12. Lock screw
13. Lubricant nipple
14. Lug bearing

KL993

Hydraulic circuit diagram (Volvo engine)

Hydraulically controlled main valve

Rotatable operator's seat 155892.2100

(Includes standard operator's seat 155892.3800)

Components

1. Accumulator charging valve
- 1A. Priority valve for accumulator charging, controlled by the accumulator charging valve. Deverts the pump flow to the brake system's cooling circuit and to reservoir when the accumulator is fully charged.
2. Pressure limiting valve, steering system
3. Differential valve, gives max. 11 bar difference between LS-signal of the steering valve and the pump pressure
4. Priority valve for steering circuit. Gives 11 bar basic pressure in the main valve. Actuated by LS-signal of the steering valve and ensures sufficient supply to the steering system.
5. Pressure reducing valve for servo to the control levers
6. Safety valve in cooling circuit, permits max. 1 bar, opens to the reservoir in event of higher pressure in the cooling system.
7. Test point, brake system cooling circuit, max. 1 bar
8. Test point, servo pressure 35±5 bar, non-adjustable
9. Test point, main hydraulics
(Shall be same pressure as 14, Volvo engines only)
10. Test point, accumulator charging 160–165 bar
11. Test point, steering system 173–180 bar
12. Main pressure limiting valve
Set the same as 13
13. Main pressure limiting valve
Set the same as 12
14. Test point, separate lifting section
Shall be same pressure as 9
15. Test point, LS-signal from steering valve
16. Hydraulic pump
- 16A. Separate hydraulic pump for accumulator charging
- 16B. Oil strainer
17. High pressure filter
18. Lifting cylinder
19. Lowering brake valve
20. Tilting cylinders
- 20A. Counter pressure valve. 50 bar
21. Sideshifting/fork spreading cylinder
22. Flow distributor
23. Sideshifting cylinder
24. Levelling cylinder
25. Breather filter
26. Hydraulic reservoir
27. Orbitrol steering valve
28. Steering cylinder
29. Hydraulic accumulator, pre-charging pressure 70 bar at 20°C
30. Supply to brake system
31. Supply to driving brake cooling circuit
33. Control valve, LIFT
34. Control valve, TILT
35. Control valve, SIDESHIFTING
36. Control valve, FORK SPREADING
37. Control valve, LEVELLING
38. Shift valve for rotatable operator's seat
39. Hydraulic motor for seat rotation
40. Accumulator evacuating valve

Hydraulic circuit diagram (Perkins engine)

Hydraulically controlled main valve

Rotatable operator's seat 155892.1400

(Includes standard operator's seat 155892.3900)

Components

1. Accumulator charging valve
2. Pressure limiting valve, steering system
3. Differential valve, gives max. 11 bar difference between LS-signal of the steering valve and the pump pressure
4. Priority valve for steering circuit. Gives 11 bar basic pressure in the main valve. Actuated by LS-signal of the steering valve and ensures sufficient supply to the steering system.
5. Pressure reducing valve for servo to the control levers
6. Safety valve in cooling circuit, permits max. 1 bar, opens to the reservoir in event of higher pressure in the cooling system.
7. Test point, brake system cooling circuit, max. 1 bar
8. Test point, servo pressure 35 ± 5 bar, non-adjustable
9. Test point, main hydraulics
10. Test point, accumulator charging 160–165 bar
11. Test point, steering system 173–180 bar
13. Main pressure limiting valve
15. Test point, LS-signal from steering valve
16. Hydraulic pump
17. High pressure filter
18. Lifting cylinder
19. Lowering brake valve
20. Tilting cylinders
21. Sideshifting/fork spreading cylinder
22. Flow distributor
23. Sideshifting cylinder
24. Levelling cylinder
25. Breather filter
26. Hydraulic reservoir
27. Orbitrol steering valve
28. Steering cylinder
29. Hydraulic accumulator, pre-charging pressure 70 bar at 20°C
30. Supply to brake system
31. Supply to driving brake cooling circuit
32. Control levers for hydraulically controlled main valve
33. Control valve, LIFT
34. Control valve, TILT
35. Control valve, SIDESHIFTING
36. Control valve, FORK SPREADING
37. Control valve, LEVELLING
40. Accumulator evacuating valve

Supplement Hydraulic Cylinders Technical Handbook All Trucks

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Clean hydraulics

Hydraulic systems are extremely sensitive to impurities - a hydraulic system is just as sensitive as a diesel engine's fuel system, with its pumps, filters and lines.

It is therefore extremely important that hydraulic systems are kept clean and free from impurities. A clean system means that there are no impurities in the system, whether it be in the hydraulic fluid, component parts of the system or hydraulic lines and hoses.

By impurity, we refer to everything and anything that is not intended to be in the system:

- solid particles such as dust, grit, threads of cotton waste, flakes of rubber from hoses or seals, etc.
- liquids
- gasses

Possible sources of impurity

- Existing impurities
 - Casting sand, welding cinder, dust, water, etc., from components, hydraulic lines and hoses.
- Generated impurities
 - Scaling. When particles that come between two moving surfaces attach themselves to one of the surfaces and thereafter act as a cutting surface to the opposite surface where it cuts or grinds off material. The newly formed particles then harden and cause even more wear and tear as they circulate in the system.
 - Erosion
 - Cutting or "cold welding"
 - Cavitation, insufficient flow to pump
 - Corrosion that generates particles
 - Fatigue/wear and tear that generates particles
- Accidentally added impurities
 - During repair operations
 - As a result of topping up with impure hydraulic fluid
- Penetrative impurities
 - Penetration via breather air to the hydraulic tank
 - Penetration via the piston rod's lubricating film
 - Penetration through poorly sealed inspection hatches
 - Condensation
 - Penetration via rod seals

Solid particles

It is possible to see a particle of 40 μ in size with the naked eye, but not one of 10 μ . (1 μ = 1/1000 mm).

By comparison, a strand of human hair is approx. 70 μ thick. The smallest particles are less than 25 μ in size and are not visible to the naked eye. If the number of small particles is sufficiently large, they merely discolour the hydraulic fluid - by which time there are far too many impurities in the system.

It is not, therefore, possible to judge, with the naked eye, whether or not hydraulic fluid is sufficiently clean! A particle count using special machinery or magnification equipment must be made to establish the degree of impurity.

Solid impurities in hydraulic systems cause many different types of problem. Large quantities of impurity dramatically reduce the operative lifespan of the system. Hydraulic components break down as a result of internal wear. Particles cause directional and servo valves to seize, which, in turn, leads to the burning out of the magnetic spools.

Gasses

The most common gas that occurs as an impurity in a hydraulic system is air. Unlike fluids, gasses can be compressed. If air is allowed to enter a hydraulic system, this compression will be experienced as a “sponginess” of operation, making hydraulic movements difficult to control.

Air in the hydraulic fluid can also cause corrosion damage, particularly when localized, sudden reductions in pressure, known as cavitation, occur.

Liquids

The most common liquid impurity that occurs in a hydraulic system is water, for example, through condensation. This can cause rust to form, resulting in flakes or particles of rust entering the system. This most commonly occurs in the tank and those parts that are above the level of the hydraulic fluid. Such parts can be inside single action cylinders where the complete length of the hydraulic piston stroke, is seldom or never used. One simple preventive measure for such parts is to regularly run all hydraulic functions to their end positions so that the whole of the cylinders are lubricated.

Measures to prevent pollution of the hydraulic system

When changing attachments

Many machines have attachments that can be changed, which also means that hydraulic lines and hoses must be loosened and switched over. This entails a major risk of impurities penetrating into the system.

- Always clean the connection point extremely thoroughly before disconnecting
- If possible, use quick release connectors fitted with a non-return valve. This will then reduce the risk of impurities entering the system and fluid being spilt
- Clean the connectors extremely thoroughly before making the connection. Make sure that no impurities are forced into the connectors themselves.

When the system is operating

All protruding hydraulic components, such as hydraulic piston rods, are at considerable risk from both mechanical damage and impurities. Due to the fact that the level of hydraulic fluid in the tank varies, the tank will “breathe” through the breather filter and if the level becomes too low, the hydraulic pump will fill the system with air.

- Be extremely careful with hydraulic piston rods so as to avoid physical damage to them
- Regularly empty condensation water from the hydraulic tank
- Make sure that the fluid level in the hydraulic tank is always as high as possible
- Make sure that all filters in the system function correctly. Regularly replace filter elements, in accordance with the machine’s lubrication chart
- Regularly check the wiper and rod seals and replace them as required

Storage and topping up of hydraulic fluid

- Be particularly careful when topping up hydraulic fluid - carelessness is one of the major causes of impurities entering the system
- Store drums, cans and funnels in as clean conditions as possible, for example, under a tapaulin and not directly on the floor.
- Handle drums, cans and funnels with care and clean them as necessary
- Store drums of hydraulic fluid horizontally so that bungs and taps are below the fluid level, which will reduce the risk of impurities and humid air entering the drum.
- Always top-up hydraulic fluid through a clean strainer, preferably through a filter, using a top-up pump.
- Never use the very last of the fluid in the drum. This could contain water and other impurities, depending on the number of times that the drum has been opened.

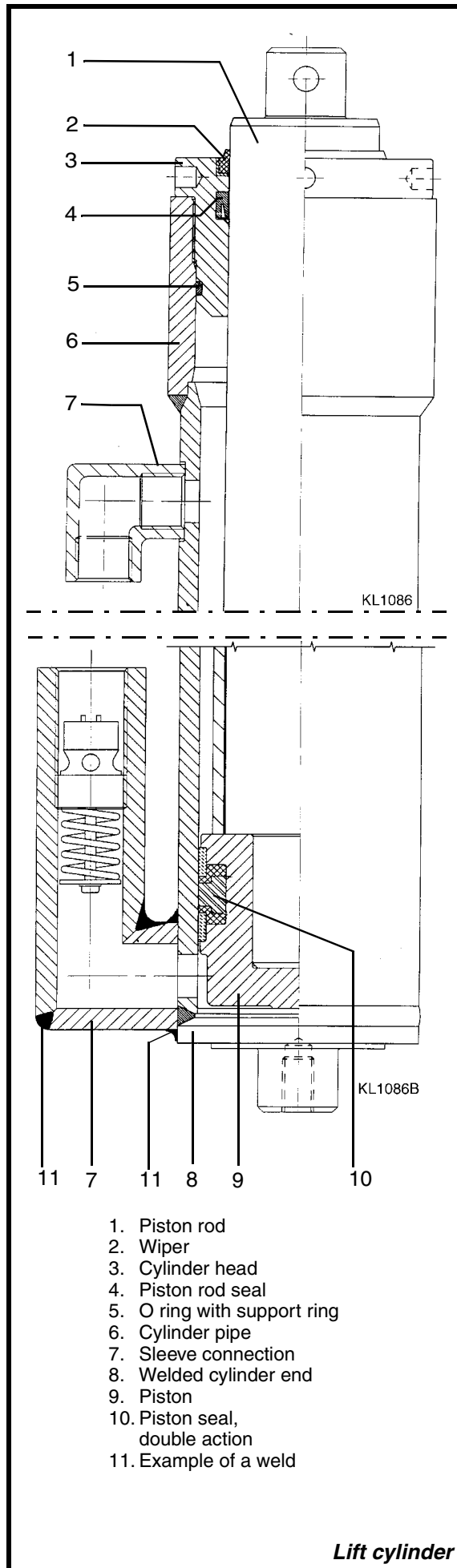
Repairs and Service

As soon as a hydraulic system is opened, there is always a great risk of impurities entering the system

- Thoroughly clean the area around the area of the system on which work is to be carried out
- Isolate the area where work is to be carried out with the help of, for example, clean protective plastic sheeting
- Do not open sensitive components out in the field, replace the complete component instead
- Immediately insert protective plugs in all open connections
- Make sure that exchange components are thoroughly clean
- Carry out the repair as soon as possible
- After dismantling, clean all parts
- If a serious breakdown has occurred, for example, if a pump or hydraulic motor has seized, metal particles may have been spread and polluted the entire system. In such cases, it is extremely important to carefully filter or replace the hydraulic fluid. Under all such circumstances, the system's filters must always be replaced
- Never fit components where the protective plugs have fallen out - impurities may have entered the system

IMPORTANT!

If there is the slightest doubt about the purity of the hydraulic fluid - send a fluid sample to the manufacturer of the fluid, or to Kalmar Service



Fault finding for leakage

1. All fault finding should take place with the minimum hydraulic pressure required to actually discover the leakage. High pressure will tighten all seals and make it more difficult to discover any leakage.
2. Check extremely carefully where the leakage comes from before taking any action. It may be possible to stop the leakage without the necessity of costly dismantling.
3. Check for external leakage
 - welds on cylinder ends
 - welds on coupling connections
 - leakage between the cylinder pipe and the cylinder head, could be due to a faulty O ring or damage to the O ring's sealing surface. Both problems can be corrected with the cylinder in place
 - leakage between the cylinder head and the piston rod, could be due to a damaged piston rod or damaged/worn piston rod seal
4. Check for internal leakage
 - leakage between the hydraulic piston seal and the cylinder pipe, due to worn piston seal. Put the cylinder under pressure and check to see if the piston sinks back

Dismantling hydraulic cylinders

Before dismantling, always check that the piston rod is free from any remains of paint. Also check to ensure that there are no burrs or impact damage by the connections or couplings. Make sure that the chamfer up to the chrome surface of the piston rod is free from burrs and any remains of paint.

1. Loosen the cylinder from its mounting and loosen the hydraulic connections
2. Immediately plug the cylinder connections and hoses/lines.
3. When the cylinder is opened - observe the highest possible level of cleanliness! Study the Technical Handbook to see how respective cylinders are designed and constructed.

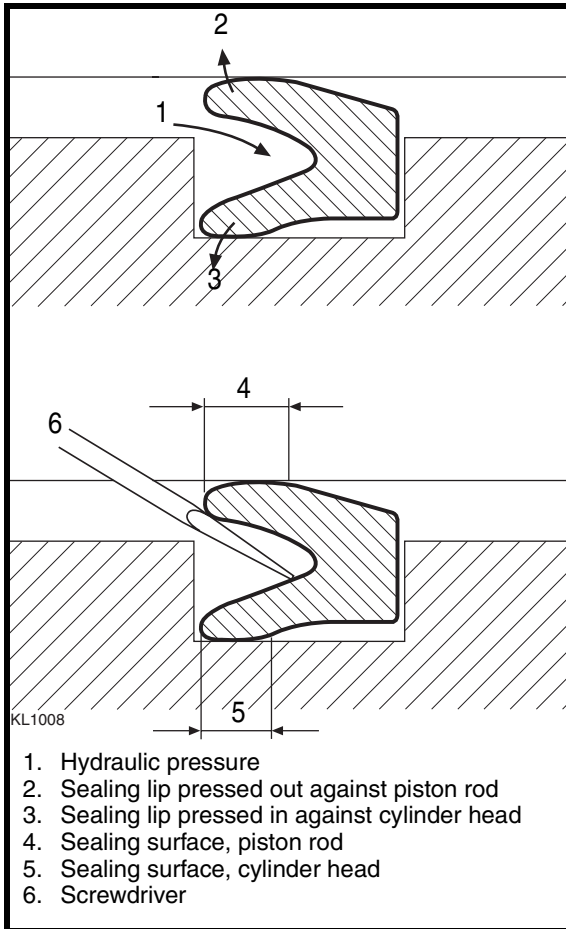
Check surfaces

1. Check the surfaces of seals. Always think about how the seals function and the type of sealing surfaces that they have. See the following descriptions:
 - O ring grooves internal and external
 - piston rod seals in the cylinder head
 - sealing groove on the piston
 - cylinder pipe surface
 - piston rod surface. The piston rod has a chromium plated surface of 20-50 μ in thickness. Very minor damage to this plated surface will not necessarily directly result in leakage
 - all sliding surfaces (dynamic surfaces). These are always the most difficult to ensure a tight seal, for example, cylinder pipe and piston rod.

IMPORTANT!

When fitting the cylinder head:

Fit the head absolutely straight, preferably by hand. Do not, under any circumstances, hit it with a mallet or hammer. If the cylinder head is fitted askew the lip of the piston rod seal can be damaged and any sealing function will be lost. This applies to all types of piston rod seals.



The function and removal of seals

Piston rod seals

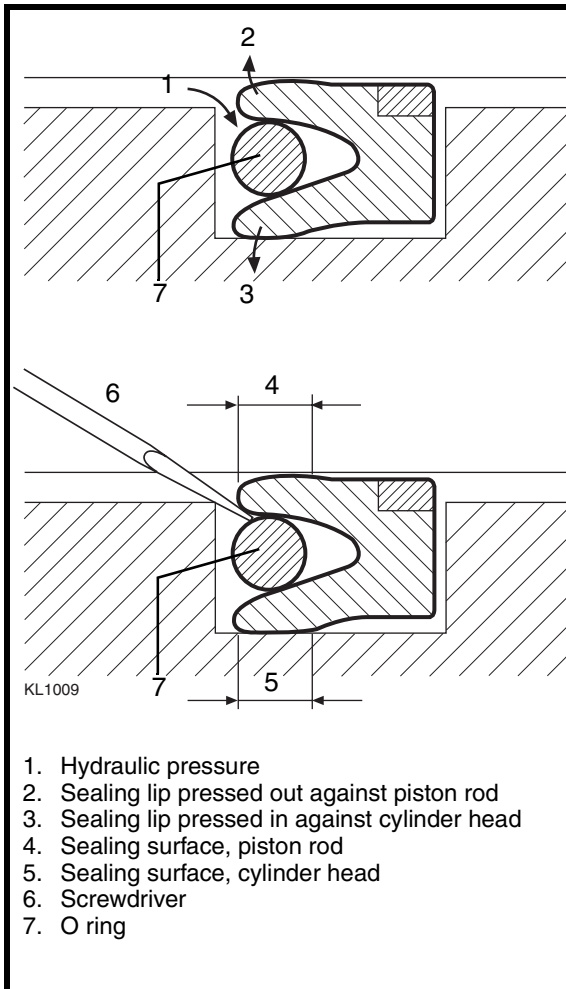
The piston rod seal is the seal that sits in a groove in the hydraulic cylinder head forming a seal against the piston rod. This seal is very exposed as it performs both dynamic and static sealing functions, i.e., it is seals against the moving surface of the piston rod whilst the sealing surface against the cylinder head is static.

There are different types of piston rod seals:

- Single V seals
- Pre-tensioned V seals with support ring
- Compressible seals

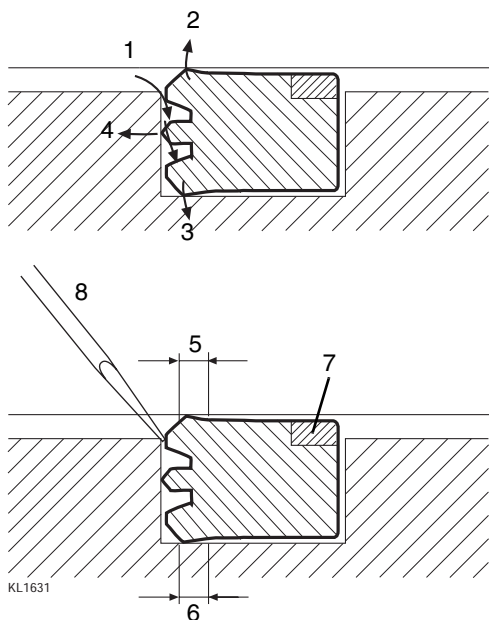
The single V seal has a V shaped section with two lips which seal in each respective direction. The hydraulic pressure works it-self into the V shape and presses the sealing lips outwards against the sealing surface of the piston rod and in the cylinder. Even the smallest amount of damage to the sealing lips can cause a major leakage. Check the sealing lips by carefully feeling around the seal with a finger nail.

Use a screwdriver to remove a V seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver only comes into contact with the inside of the V shape so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



The pre-tensioned V seal has, in addition, an O ring within the space formed by the V shape. The O ring provides a greater sealing effect at low hydraulic pressure as the O ring, even when not under hydraulic pressure, presses the sealing lips out against the sealing surfaces. It is equally sensitive to damage as the V seal. Check the seal in the same way.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver only comes into contact with the inside of the V shape so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



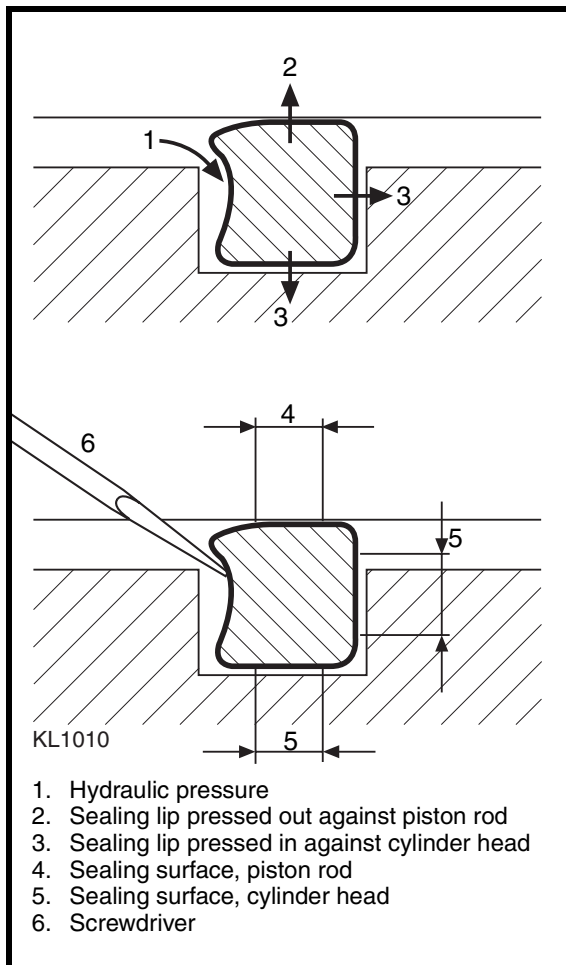
1. Hydraulic pressure
2. Inner sealing lip, pressed against the piston rod
3. Outer sealing lip, pressed against the cylinder head
4. Beam for axial fixation
5. Sealing surface, piston rod
6. Sealing surface, cylinder head
7. Support ring
8. Screwdriver

Piston rod seal type TICLA is of compact design with integrated support ring. It has an inner sealing lip against the piston rod and an outer sealing lip which seals with press fit against the cylinder head. An intermediate bead between the sealing lips provides axial fixation

The bead has recesses to admit hydraulic pressure on both outer and inner sealing lips.

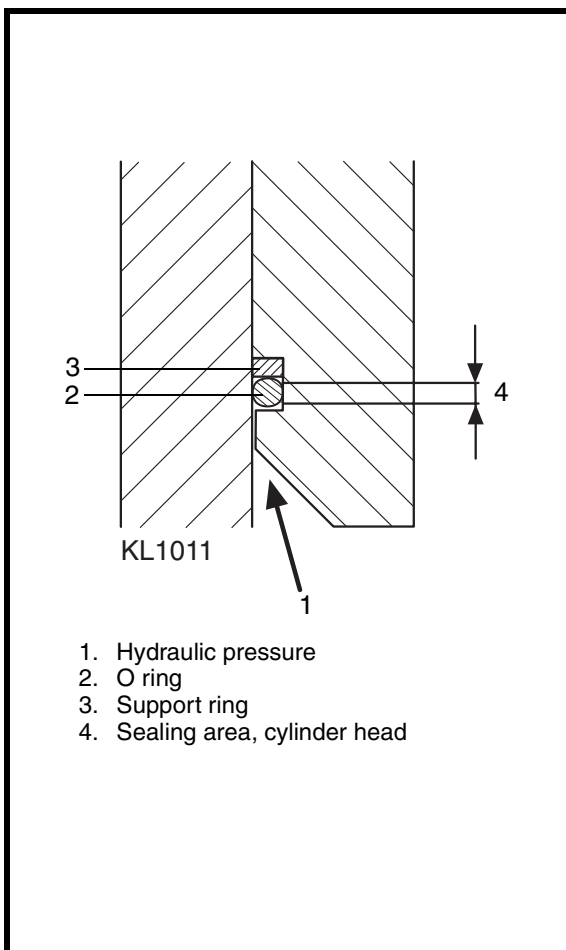
Even the smallest amount of damage to the sealing lips can cause a major leakage. Check the sealing lips by carefully feeling around the seal with a finger nail.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver is inserted between the inner sealing lip and the intermediate bead so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.



The compressible piston rod seal consists of a solid rubber profile and gives a greater sealing area than V seals.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. With this type of seal where the sealing area covers such a large part of the sealing groove, it is vitally important that the screwdriver is not allowed to make any mark.



Support ring and O ring

The support ring and O ring combination is used to seal between two static surfaces, such as, for example, between the cylinder pipe and the cylinder head, even in those cases where the cylinder head is threaded onto the cylinder pipe.

The task of the support ring is to brace the O ring so that it does not change shape. The O ring is pressed against the support ring and the sealing surface by the hydraulic pressure in the cylinder.

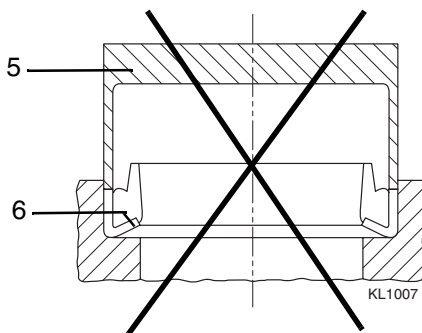
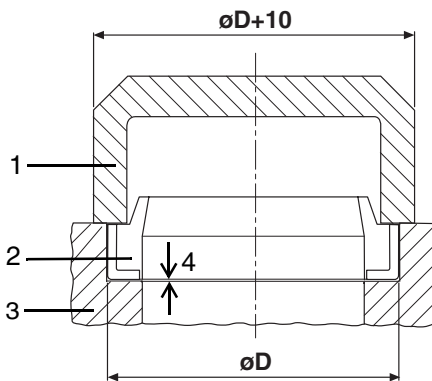
When the cylinder head is to be fitted into the pipe: Be extremely careful so as not to damage the O ring.

Wiper

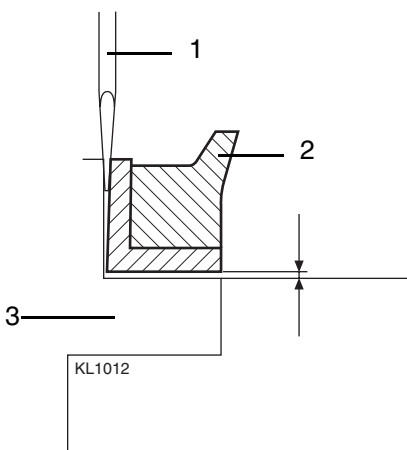
The task of the wiper is to scrape the piston rod clean and prevent any impurities being drawn into the cylinder pipe.

The wiper must be fitted with a special tool. This tool must have a greater outer diameter than the wiper, so that the pressure against the wiper ceases just as the wiper is pressed into position. If the wiper should be pressed further in, the metal cap will be deformed (see lower illustration) which would thereby reducing the efficiency of the wiper.

To prevent the wiper "bottoming" in its slot in the cylinder head, the slot in the cylinder head is somewhat deeper than the width of the wiper.



1. Correct fitting tool
2. Wiper, correctly fitted
3. Cylinder head
4. Play between the wiper and the bottom of the cylinder head slot
5. Incorrect fitting tool
6. Deformed wiper

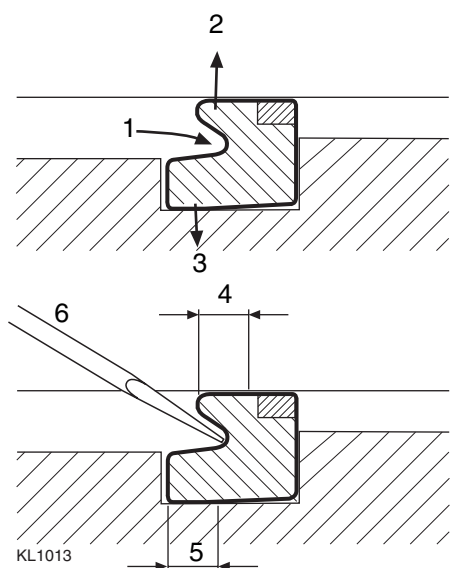


1. Screwdriver
2. Wiper
3. Cylinder head

The wiper can be removed without the necessity of dismantling the cylinder. A screwdriver can be used to remove the wiper. This must always be employed against the outer edge of the wiper, see illustration. Carefully tap the screwdriver down between the wiper and the cylinder head and thereafter, lever the wiper out. Polish off any marks on the cylinder head.

IMPORTANT!

No tools should be introduced from the inside. This can score the cylinder pipe, which in turn, can damage the piston rod. Scoring can also damage the piston rod seals when the piston is fitted.

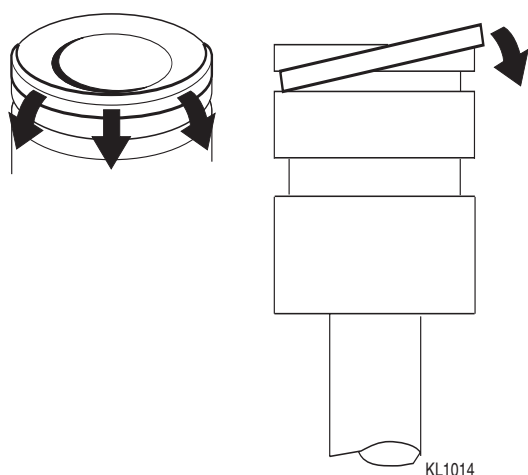


1. Hydraulic pressure
2. Seal pressed outwards against cylinder pipe
3. Seal pressed inwards against piston
4. Sealing surface, cylinder pipe
5. Sealing surface, piston
6. Screwdriver

Single action V type piston seals with support ring

On single action V seals it is always the long side that seals against the static and the short side that seals against the moving surface.

Use a screwdriver to remove the seal, see illustration. Lever out and twist up the seal. It is extremely important that the screwdriver only comes into contact with the inside of the V shape so that it cannot touch and thereby damage any sealing surface. A score from a screwdriver on the sealing surface will have a disastrous effect and cause major leakage.

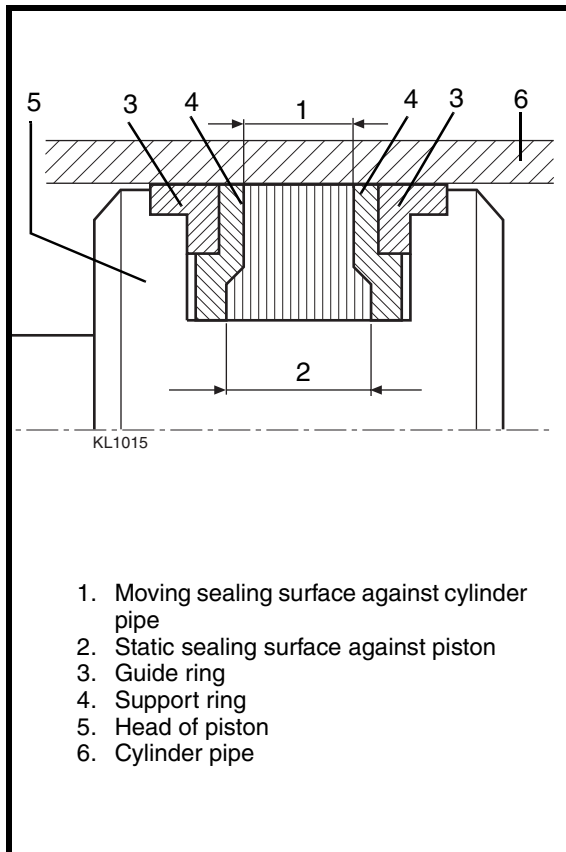


The seal must always be fitted coupled together with the support ring.

Always fit by hand, no tools should be used as the surface of the piston can be easily damaged.

To make fitting easier, the seal can be warmed in hot water to soften it.

Lubricate with hydraulic fluid.



Double action piston seals

Double action seals function with pressure from both directions, e.g., in a steering cylinder.

The whole of the surface within the cylinder pipe is the sealing surface, it is therefore extremely important that this surface is not damaged in any way.

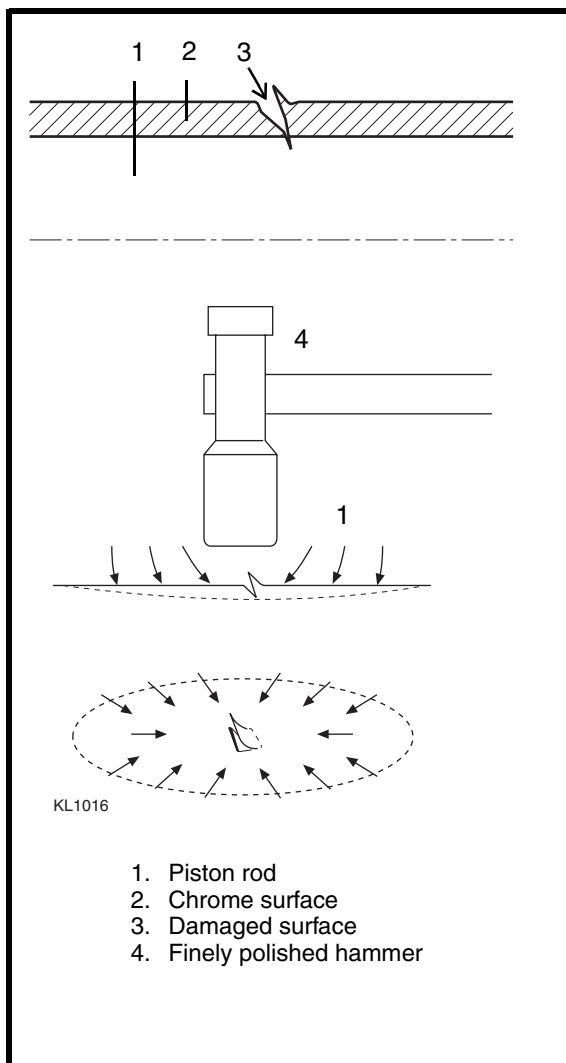
Be very careful when fitting the piston in the cylinder pipe to avoid any damage to the seal from the threading in the cylinder pipe.

Dismantling

1. Remove guide rings and support rings.
2. Move the sealing body over to one side of the sealing groove.
3. Press up the materials so that there is a gap between the seal and the piston.
4. Without damaging the surface of the piston, cut the seal off with a knife.
5. Carefully check the seal to discover any damage that can have caused leakage. This can be achieved most easily by bending over the seal section by section and checking the sealing surface with a finger nail.

Fitting

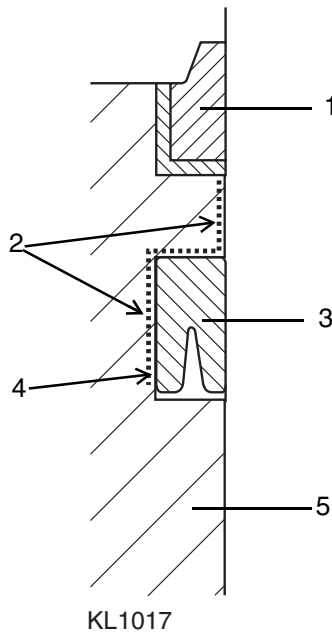
1. All double action piston seals are constructed in the same way, a middle sealing body, thereafter support rings and finally, guide rings, see illustration.
2. First fit the sealing body, thereafter the support rings and finally the guide rings - everything must be done by hand, without the use of tools, in order to prevent damage.



Repairing the piston rod surface

The smallest damage to a piston rod can be enough to cause leakage. The chromium plating has a thickness of 20-50 μ and can be worked on to repair smaller damage. This can be a viable alternative to costly dismantling.

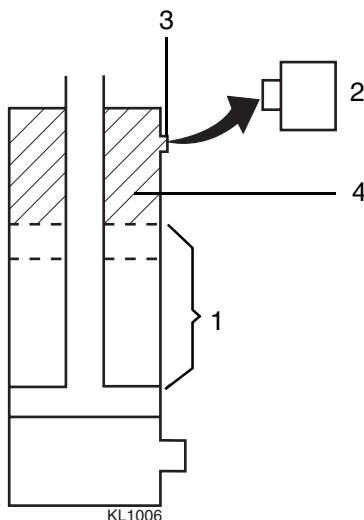
1. Locate the damage with finger tips and finger nails.
2. Use a small, finely polished, panel beating hammer and work in the material from the area surrounding the damage, work from the outside in towards the damage.
3. Instead of a sharp mark, there will now be a more even irregularity in the chrome surface.
4. Polish with emery cloth, in stages, use grades from 240 - 600. Wrap the emery cloth around a file to support the cloth well. N.B. Sufficient chrome must always be visible at the point of damage.
5. It is important, before both dismantling and fitting, to repair small dents and other physical damage so that they do not damage the cylinder head.
6. For larger damage to a piston rod:
 - fill the damaged area with a weld
 - completely remove all welding cinder
 - file down the weld to the same level as the chrome surface
 - polish to an even finish with emery cloth



1. Wiper
2. Areas at risk for condensation
3. Piston rod seal
4. Rust formation on sealing surfaces causes leakage
5. Cylinder head

Lubrication

1. Within the actual hydraulic system - never anything other than the normal hydraulic fluid used in the hydraulic system.
2. On the cylinder head thread - use copper paste (e.g., Moly-cote CU 7439). Make sure that the paste does not enter the system.
3. In areas where there is a risk of condensation building up - grease with a thin layer of copper paste in the sealing groove of the cylinder head, in order to prevent condensation. Condensation causes rust formation that can corrode the sealing groove and cause leakage. Apply the copper paste with a finger.
4. If any copper paste comes outside the sealing groove - wipe clean with lint free paper. Never use cotton waste



1. Normal working area
2. Breather filter
3. Filter connection point
4. Area at risk from corrosion

Lubricating single action cylinders

1. This type of cylinder does not have any hydraulic fluid supply on the piston rod side. If a cylinder normally operates over only a limited part of the piston stroke, there is a risk for corrosion in the upper part of the cylinder.
2. Unscrew the breather filter.
3. Spray 300-500 ml of hydraulic fluid into the filter connection.
4. Run the cylinder to the limits of the piston stroke a number of times until no more hydraulic fluid is forced out of the breather filter connection point.

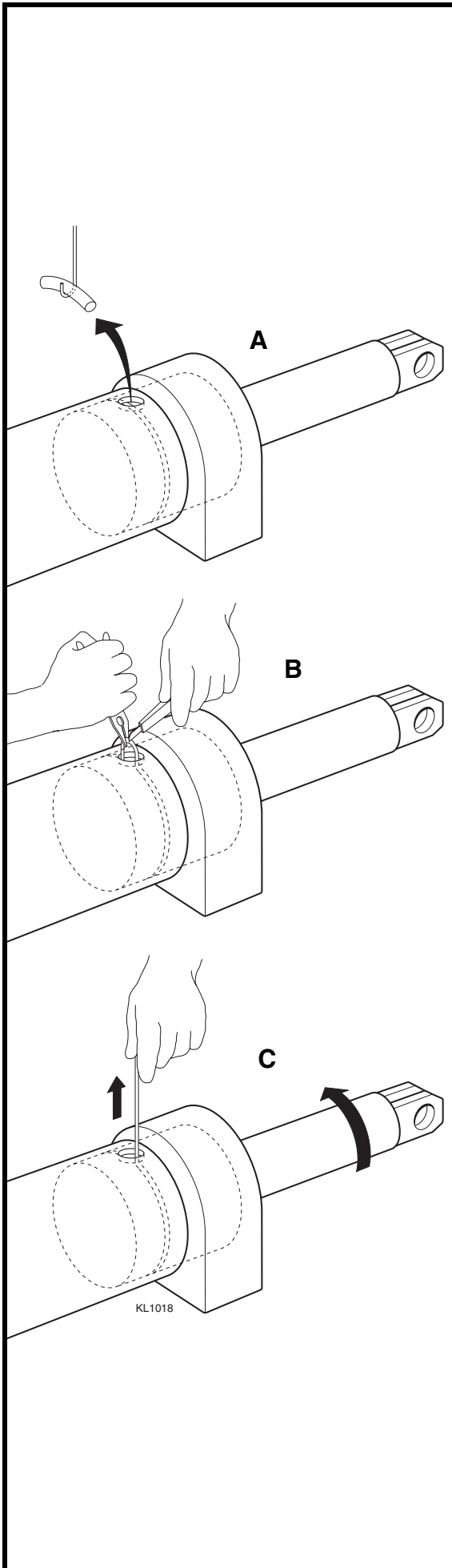
Daily lubrication, all cylinders

Run all cylinders to the piston stroke limit so that the whole of the cylinder is lubricated.

Dismantling the steering cylinder

On the steering cylinder, it can be very difficult to remove the piston from the cylinder as the O ring in the cylinder head sticks in the locking ring groove of the cylinder pipe. It is best, therefore, to first remove the O ring before attempting to draw out the piston rod from the cylinder.

1. Unscrew the end piece at the cylinder head.
2. Unscrew the connection nipple for the hydraulic hose.
3. Push in the piston rod with piston head until the O ring is visible through the nipple hole.
4. Use a strong, bent steel wire to hook onto the O ring, illustration A.
5. Draw up the O ring a little and get a grip on the O ring with a pair of thin nosed pliers, illustration B.
6. Continue and draw out the O ring through the hole.
7. Maintain a grip on the O ring and cut through it with a knife.
8. Rotate the piston rod and simultaneously draw out the O ring through the hole, illustration C.
9. Remove the locking ring from the cylinder pipe.
10. Carefully draw out the piston rod from the cylinder pipe.



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Group 80

Lifting mast and fork carriage

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Permissible wear of forks 10% at point a
(see instructions)

Lifting chains
Max. permissible wear 3%
(see instructions)

Clearance between the forks
and ground when the forks
are in the lowest position 10-20 mm

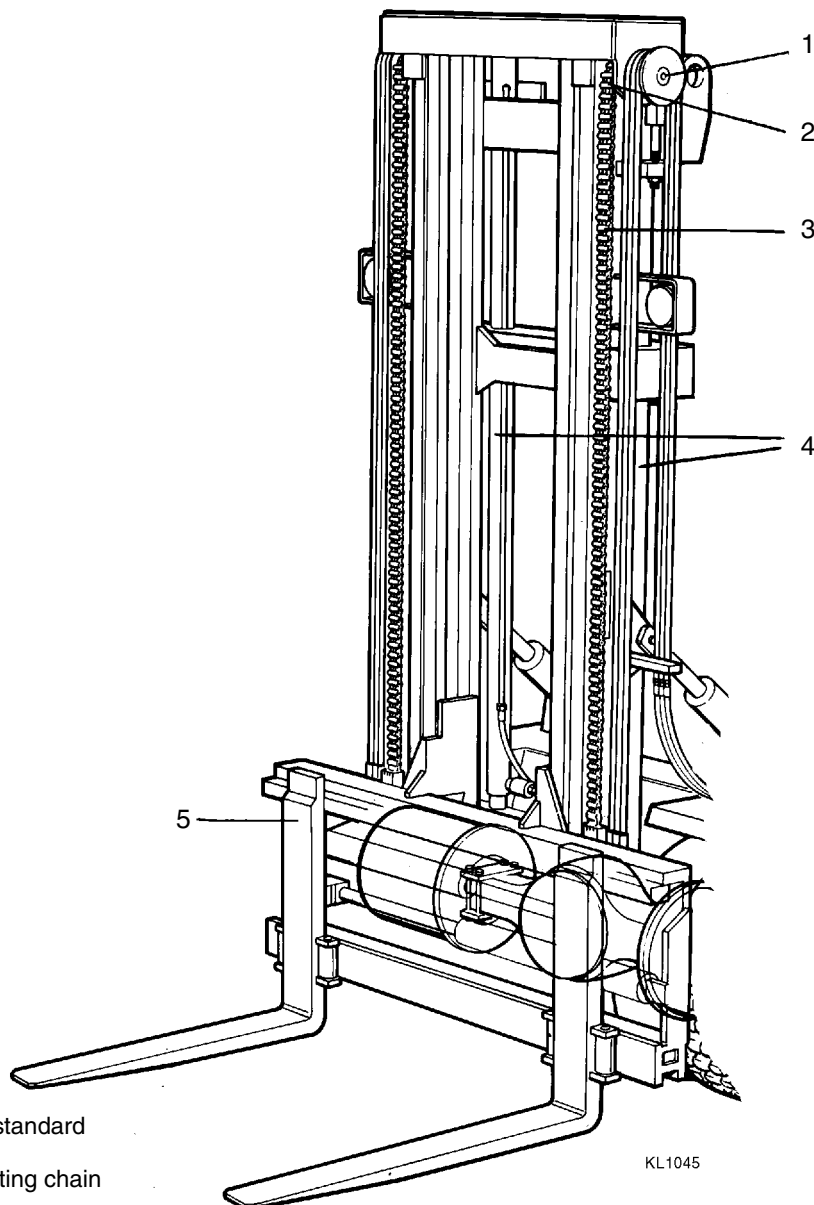
Lifting mast

The mast on Kalmar forklift trucks is of very sturdy design. The number of welds has been kept down to a minimum, to ensure the highest possible strength. The stresses on the mast components are low. Both duplex and triplex masts are of free-vision type.

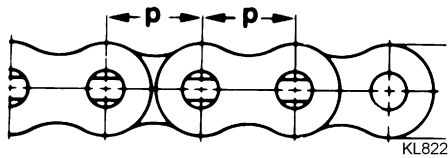
All rollers and wheels of the mast are mounted in high-quality bearings. The mast sections are made of high-strength steel and have slender dimensions, to restrict the field of vision as little as possible.

Fork carriage

The fork carriage offers excellent visibility. The standard carriage is equipped with manually movable forks. The most common design is however with hydraulic sideshifting and fork positioning.



1. Lifting mast, duplex standard
2. Hose wheel
3. Guide sprocket for lifting chain
4. Lifting chain
5. Lifting cylinders
6. Fork carriage with fork positioning and sideshifting



Dimension P		Dimension across 25 links of new chain, mm	Max permissible dimension across 25 links at 3% extension, mm
Inch	mm		
3/4	19,05	476,25	490
1	25,4	635	654
1 1/4	31,75	793,75	817
1 1/2	38,1	952,5	981
2	50,8	1270	1308
2 1/2	63,5	1587,5	1635

Inspection of lifting chains

To increase safety, the lifting chains should be inspected regularly in accordance with the points below. This should be carried out during each 1000 h service.

For inspection, the whole length of each chain should be thoroughly clean. Carry out the inspection without any load on the forks.

1. The chain extension should not exceed 3%.
Measure the extension across the 25 links that run across the guide sprocket most frequently during lifting. The extension will be greatest here. Compare the value obtained with that in the table. If the 3% limit is exceeded, the chain or chains must be replaced.
A special wear measurement tape may be used for chains of up to 1 1/2" pitch.
The tape is marked:
 - "Zulässige Verlängerung" (Permissible extension)
 - "Kette austauschen" (Replace the chain)
 This type of tape may be ordered from Kalmar.
2. Check that no pins are loose in the outer washers.
3. Check that there are no visible cracks in any of the links.
4. Check that there is no mechanical damage.
5. Check that the chain is not corroded.
6. Check that the chain bends easily around the guide sprocket and does not jam when bent.
7. Drive the truck onto a flat surface and set the mast to the vertical position (0° tilt). Lower the forks to the bottom position. Check that there is a space of 10-20 mm between the forks and the ground. If not, adjust the lifting chains equally.

After inspection, spray the chains with chain spray.

IMPORTANT!
If a lifting chain does not pass this inspection, replace the whole chain. Lifting chains must not be joined or re-riveted.

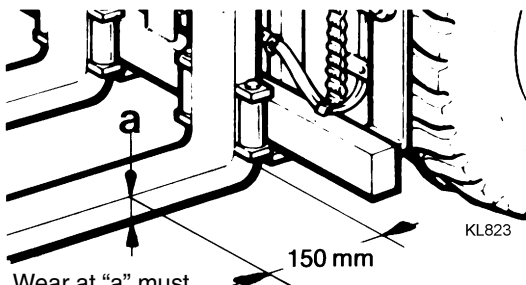


WARNING!

Never carry out service work on a lifting mast when the engine is running.

Inspection of the lifting mast

1. Inspect the lifting mast for damage or wear on the outer or inner masts.
2. Investigate whether any wear of the lifting mast has been caused by the support rollers.
3. Run the fork carriage up and down the mast and listen for any unusual sounds from the ball bearings.
4. Check that the hose guide pulley runs freely and that it does not damage the hoses.
5. Run the fork carriage up and down and check that the hoses do not tend to climb over one another. If they do, find out whether the hoses are twisted, by disconnecting the appropriate hose connections.



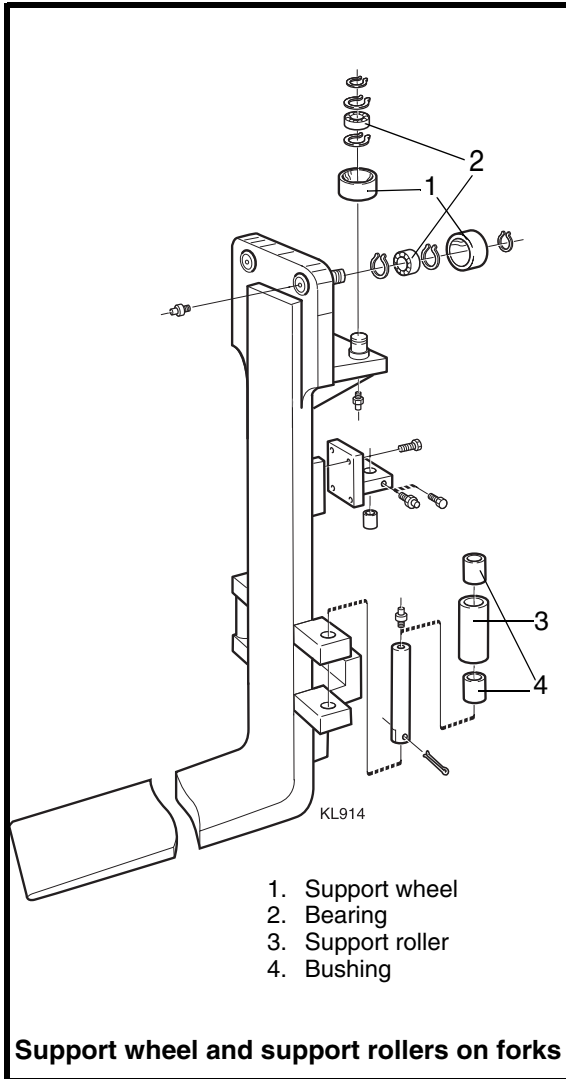
Wear at "a" must not exceed 10% of the original dimension

The forks must be inspected by specially trained personnel at least once a year

Inspection of forks for wear

Wear inspection - forks

1. Inspect the forks for cracks and deformation and check the thickness of the fork.
 - Fork wear must not exceed 10% (calculated from the original dimension and measured 150 mm from the heel of the fork).
 - Cracks that are visible to the naked eye are not permissible. Pay special attention to the heels of the forks. Superficial cracks are generally not longer than about 5 mm. (If superficial cracks are detected, grind down the area by about 0.5 mm. Carry out magnetic particle examination to determine whether the crack is still visible. This work must be carried out by an approved company.)
2. Check the fork suspension for play.
3. If the forks need repairing, get in touch with Kalmar or service personnel authorised by Kalmar, who will decide whether the forks can be repaired.
4. Superficial cracks and wear must not be repaired by welding.
5. Forks that have been heat straightened must be heat treated again. This work must be carried out by an approved company.



Replacing the bearings of the fork support wheels

1. Remove the circlip securing the bearing.
2. Remove the support wheel using an extractor.
3. Remove the internal circlips and press out the bearing.
4. Fit a new bearing and fit the circlips.
5. Press the support wheel on and fit the circlip.

Replacing the bushes in the lower fork-support rollers

1. Remove the tubular dowel securing the support roller shaft and tap out the shaft upwards.
2. Fit new bushes into the support roller.
3. Fit the support roller and tap in the shaft. Lock it with a tubular dowel.

Dismantling the fork carriage, duplex

1. Loosen all the hoses that connect the fork carriage with the mast. Put immediately protective caps on all hoses and connectors.

N.B. Never use rags, cotton waste or wooden plugs. Use only protective caps and plugs of plastic or metal.

2. Raise the fork carriage a little.
3. Fit blocks under the lower beam of the fork carriage.
4. Lower the fork carriage so that it rests with the bottom beam on the blocks and with the forks on the ground.
5. Remove the pins from the chain mountings and secure the chains with a rope, so that they will not run off the guide sprockets.
6. Lift the inner mast by a sufficient amount so that the fork carriage is clear of the inner mast.
7. Reverse the truck from the fork carriage.

Dismantling the lifting mast

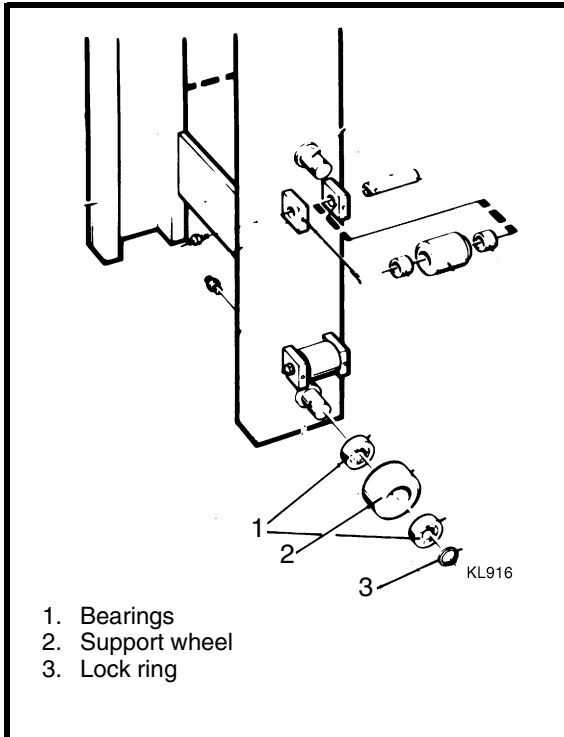
1. Remove the fork carriage as described above
2. Disconnect the hydraulic hoses connecting mast and chassis. Cap or plug all connections.
3. Set the tilt control lever to the neutral position and secure a sturdy lifting chain to the yoke or lifting lugs on the mast.
4. Disconnect the piston rods from the outer mast.
5. Lift the outer mast so that the mast suspension is unloaded, loosen the screws for the masts suspension shafts and knock out the shafts.



WARNING!

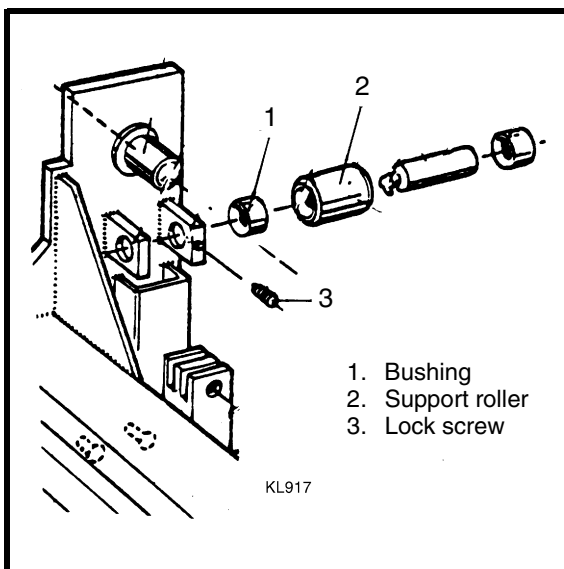
Risk of injury by crushing

6. Lower the mast forward and lay it down.
7. Fit blocks under the lifting cylinders, loosen the piston rod (split pin and shaft) from the inner mast and withdraw the inner mast.



Replacing the support wheels in the fork carriage and inner mast

1. Dismantle the fork carriage/inner mast.
2. Remove the circlip securing the support wheel.
3. Remove the support wheel using an extractor.
4. Dismantle the bearings and check that the wheel bearing seats are free from damage.
5. Press the new bearings into the wheel seats. Check that there is a correct fit between the wheel and the bearings.
6. Fit the wheel and secure with the lock ring.

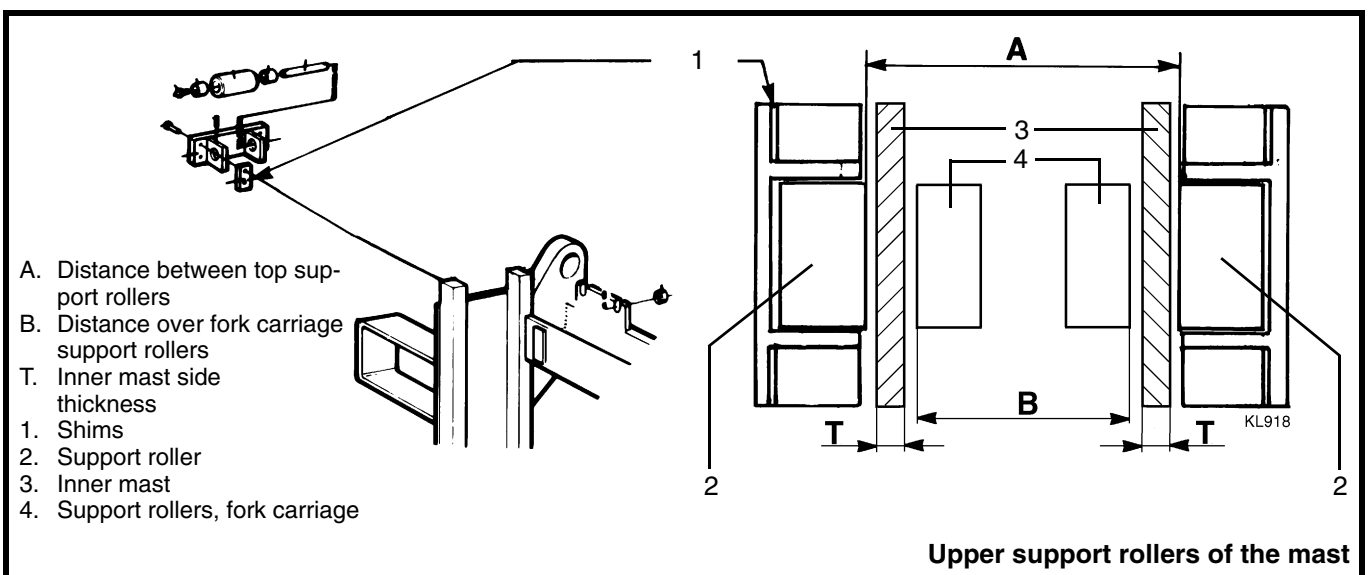


Replacing the bushes and the support rollers of the mast and fork carriage

1. Back off the stop screws securing the support roller shaft.
2. Tap out the shaft.
3. Change the bushes in the support roller.
4. Fit the support roller into place, tap in the shaft and secure it by means of the stop screws. Lock the stop screws by means of Loctite.
5. If the dimension between the upper support rollers (**A** in the figure) must be adjusted, this can be done by adjusting the shimming under the support roller holders. Other support rollers cannot be adjusted.

IMPORTANT!

Check to ensure that the measure **A** is bigger than measure $B+(2 \times T)$.
If **A** is smaller than $B+(2 \times T)$, the rollers run the risk of seizure.



Checking lateral support roller alignment

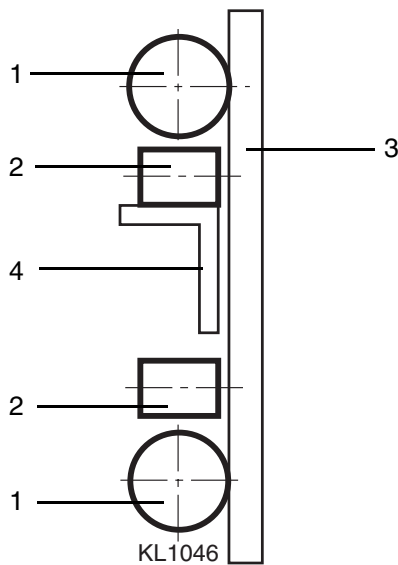
To ensure correct function, the lateral support rollers must be both parallel and at right-angles to their respective contact surfaces.

If a roller is not aligned at right-angles to the contact surface, it will slide laterally in one direction with upward movements and in the opposite direction with downward movements. Both of the end surfaces of the roller will then become worn.

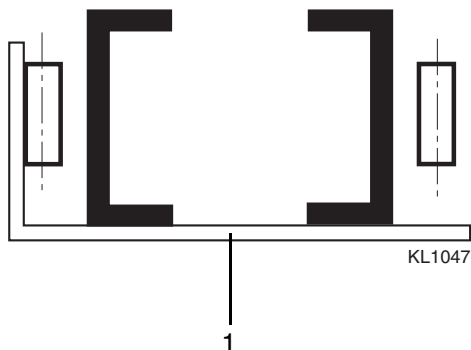
If a roller is not aligned parallel to the contact surface, it will slide in one direction when moving both upwards and downwards. One of the end surfaces of the roller will then become worn.

In both cases, the rollers will rotate sluggishly due to the lateral force against the mounting, restricting rotation. This can cause the roller to cease rotating completely, resulting in excessive wear and at the same time cause severe damage to the beam.

1. Check that the rollers are at right-angles using a straight-edge (and set-square) between the support wheels, i.e., along the length of the beam.

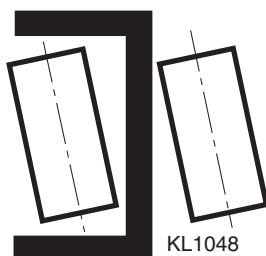


1. Support wheel
2. Support roller
3. Straight-edge
4. Set-square



1. Set-square

2. Check that the rollers are parallel to the beam and at right-angles to the beam flanges on both sides.



3. Check that the rollers do not run askew so that uneven pressure causes uneven wear to one edge of the roller. This can be caused by the rollers not being truly parallel to the contact surface or the beam, against which the rollers rotate, being out of true, or shims having been incorrectly fitted.

Lifting mast and fork carriage for high-lift empty container truck

On these lifting masts the traditional support wheels and rollers have been replaced with sliding plates of a plastic material. There are 4 plates in the mast and 12 plates in the fork carriage.

IMPORTANT!

The lubricant should be of a brand approved by Kalmar, or another of the same specification. The use of any other lubricant can lead to excessive wear and also invalidate the Kalmar guarantee. Lubricants can be ordered from Kalmar's spare parts department. See group 90.

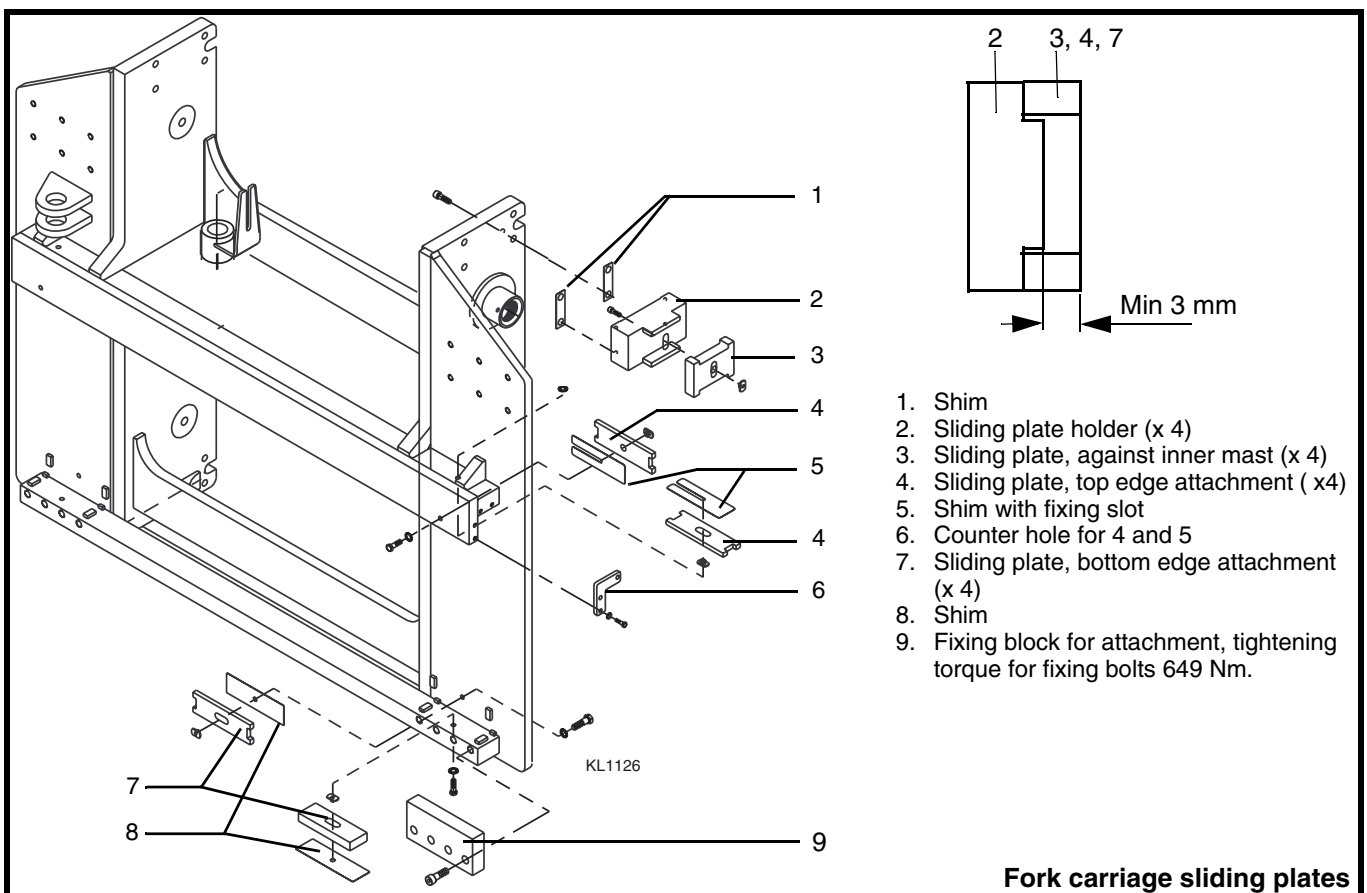
Maintenance of the sliding plates is extremely important otherwise the sliding surfaces on the mast and carriage could become damaged, resulting in the need for expensive repairs.

Lubrication of sliding plates – every 200 hours

1. To be able to lubricate the whole length of the mast, a hydraulic lift or other lift equipment is best used.
2. Lubricate all sliding surfaces with the lubricant. Use a brush and spread the lubricant evenly. Raise the mast to its maximum lifting height.

Check sliding plates – every 400 hours

1. Thoroughly clean the sliding plate and around its holder.
2. The plate should be 3 mm proud of the holder to avoid the risk of the holder or the sliding plate fixing nuts damaging the opposite sliding surface. If less than 3 mm of the sliding plate remains, it should be replaced.



Inserting shims for sliding plates - general

1. Check the play in the mast and between the fork carriage and the mast.
2. When a noticeable gap occurs, equivalent to a play of at least 2 mm, reduce the play with shims.
3. When inserting the last shim, the sliding plates should have at least 5 mm wearing surface remaining, if this is not the case, they should be replaced.

Inserting shims for the upper sliding plate in the attachment mounting

See the "Fork carriage sliding plates" illustration.

1. Shim 5 has a fixing slot, making attachment removal unnecessary when inserting additional shims.
2. Remove holding plate 6.
3. Loosen the sliding plate fixing screws so that the sliding plate loosens from the carriage.
4. Slide in the required shim to adjust/remove the gap between attachment and carriage.
5. Replace the holding plate and secure the sliding plate in place.

Bleeding the lift cylinders



WARNING!

Risk for injury!

During the bleeding of the cylinders the inner mast and carriage will lower. Ensure that nobody is in the way!

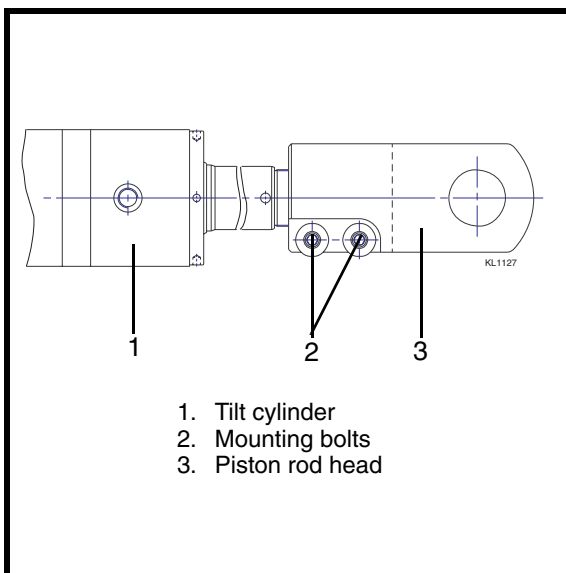
1. Use a hydraulic lift or similar.
2. When the mast is fitted, raise the inner mast approx. 0.3 m.
3. Connect a tube to each of the bleed nipples at the top of each cylinder to collect any spill fluid, in a suitable container.
4. Open the bleed nipples on each of the lift cylinders, until all air has been evacuated.
5. Re-tighten the bleed nipples.

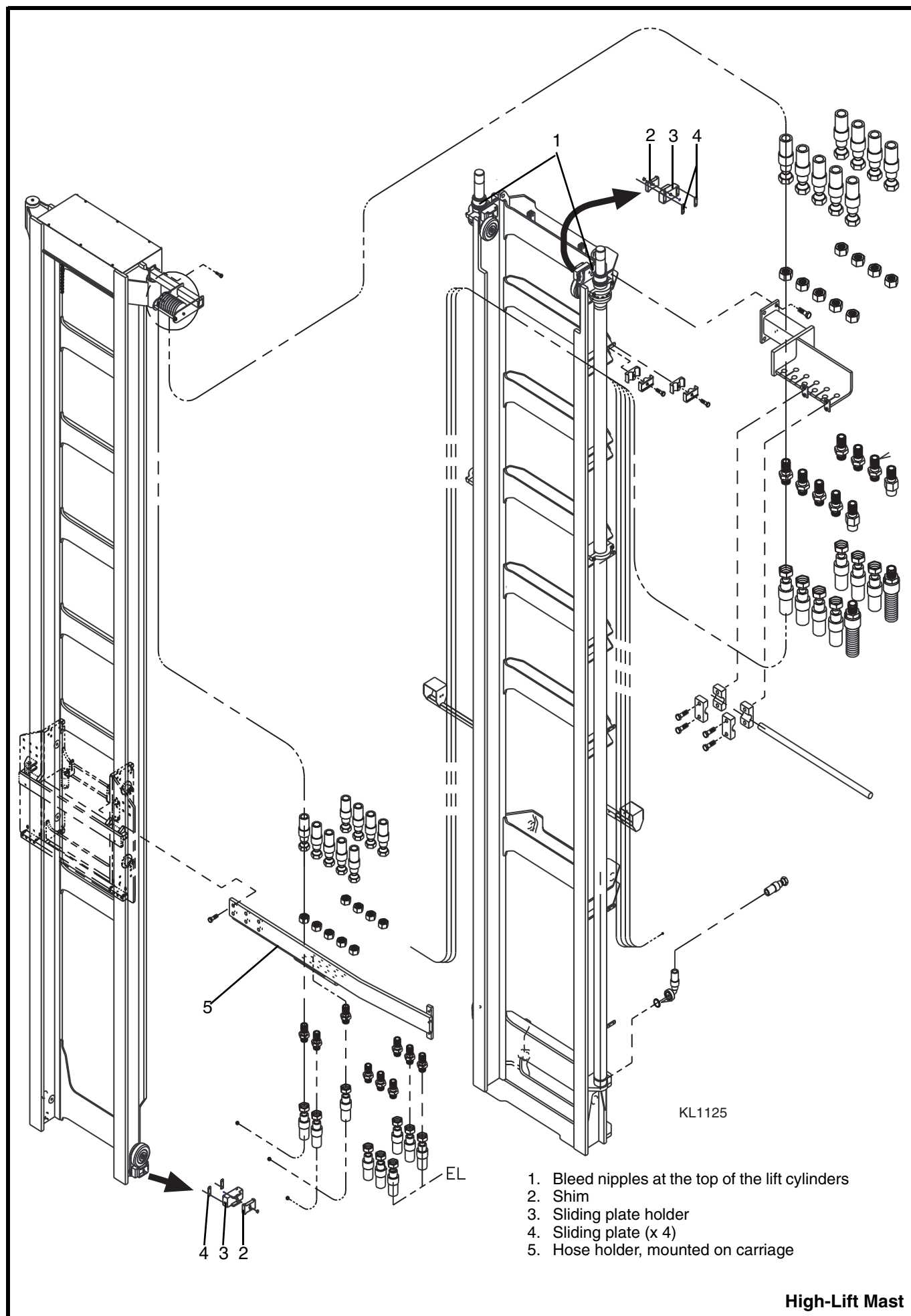
Stretching of hoses

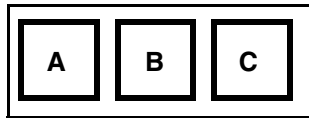
1. After a certain amount of use, the hoses will become stretched and will therefore need to be tightened.
2. Stretch the hoses by loosening the hose holder from the carriage and move them down to a suitable new hole profile on the carriage. See the "High-Lift Mast" illustration.

Tilt cylinder mounting, tightening torque

1. After any adjustment of the tilt angle, the piston rod head's mounting bolt should be tightened to a torque of 136 Nm. See adjacent illustration.







- A. Twist-locks locked (green)
- B. Alignment (orange)
- C. Twist-locks unlocked (red)

Lamp panel

Side lift attachment

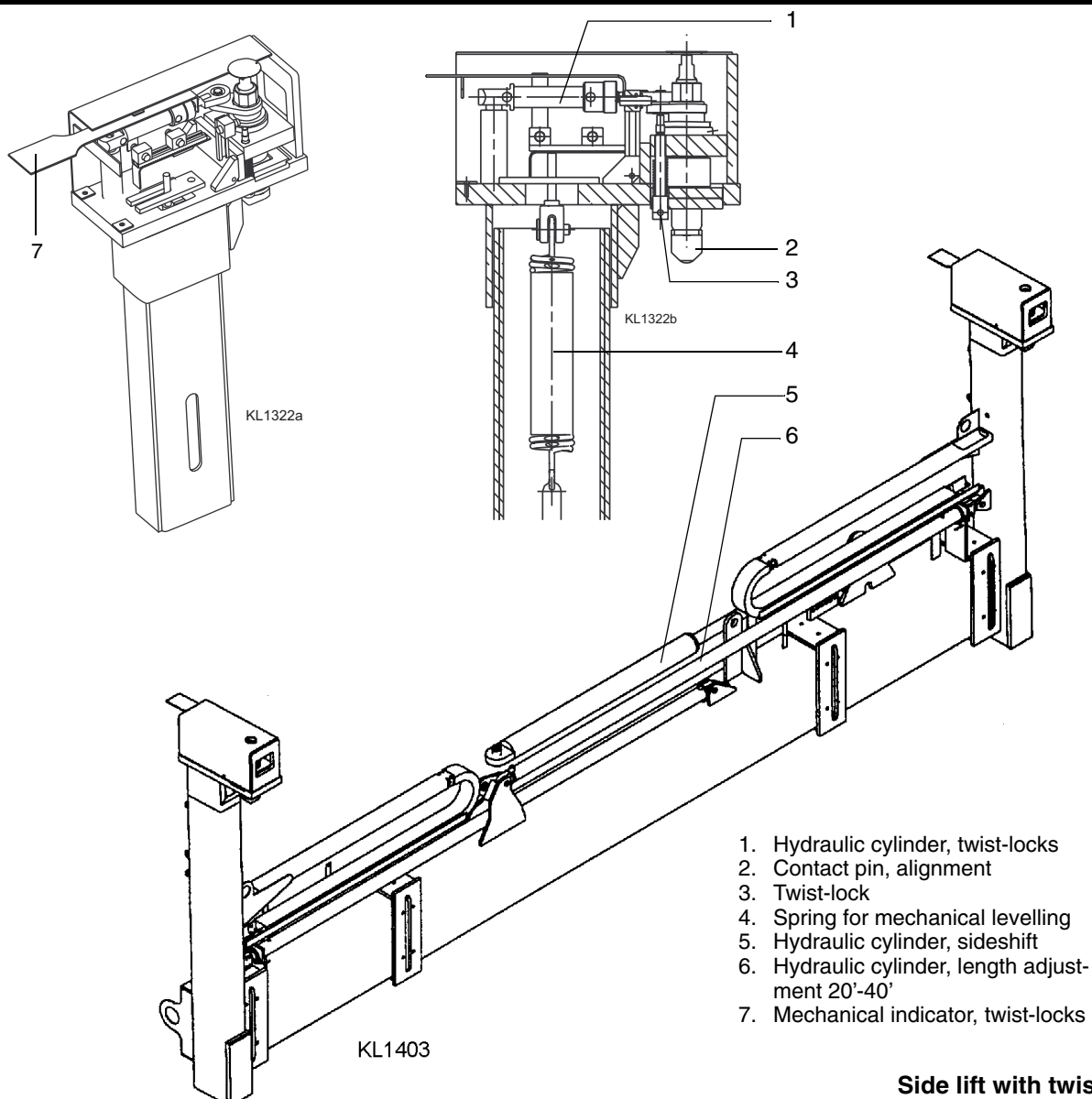
The side-lift attachment has been designed for easy, safe and rapid handling, low weight and ease of maintenance. The attachment is integrated with the carriage.

Both of the attachments' corner pieces are telescopic and suspended from the main beam by means of springs, which enables 195 mm levelling to both sides for the connection to leaning containers. A hydraulic cylinder between the attachment and the carriage allows ± 600 mm side-shift.

A hydraulic/mechanical safety system ensures that the container (or both containers) are locked onto the attachment prior to lifting.

An electrical safety system prevents the locking and release of the twist-locks if the attachment is not correctly positioned against the container. The system also prevents lifting if the twist-locks are not either completely locked or released.

A lamp panel displays alignment, locked and released container respectively. See also Group 70, Hydraulic diagram



Side lift with twist-locks

Group 90

Periodic supervision

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Every 1000 hours	11
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General survey

To extend the service life of the truck and to prevent the risk of faults causing injury to personnel or damage to equipment, the truck must be subjected to regular periodic supervision.

If the truck is used under conditions in which road traffic regulations are applicable, the special maintenance instructions issued by the authorities must be followed.

The intervals at which service measures are carried out can be determined on the basis of the operating hour meter readings.

When carrying out a 1000-hour service, it is advisable to work in the following order:

1. Every 1000 hours
2. Every 600 hours
3. Every 200 hours

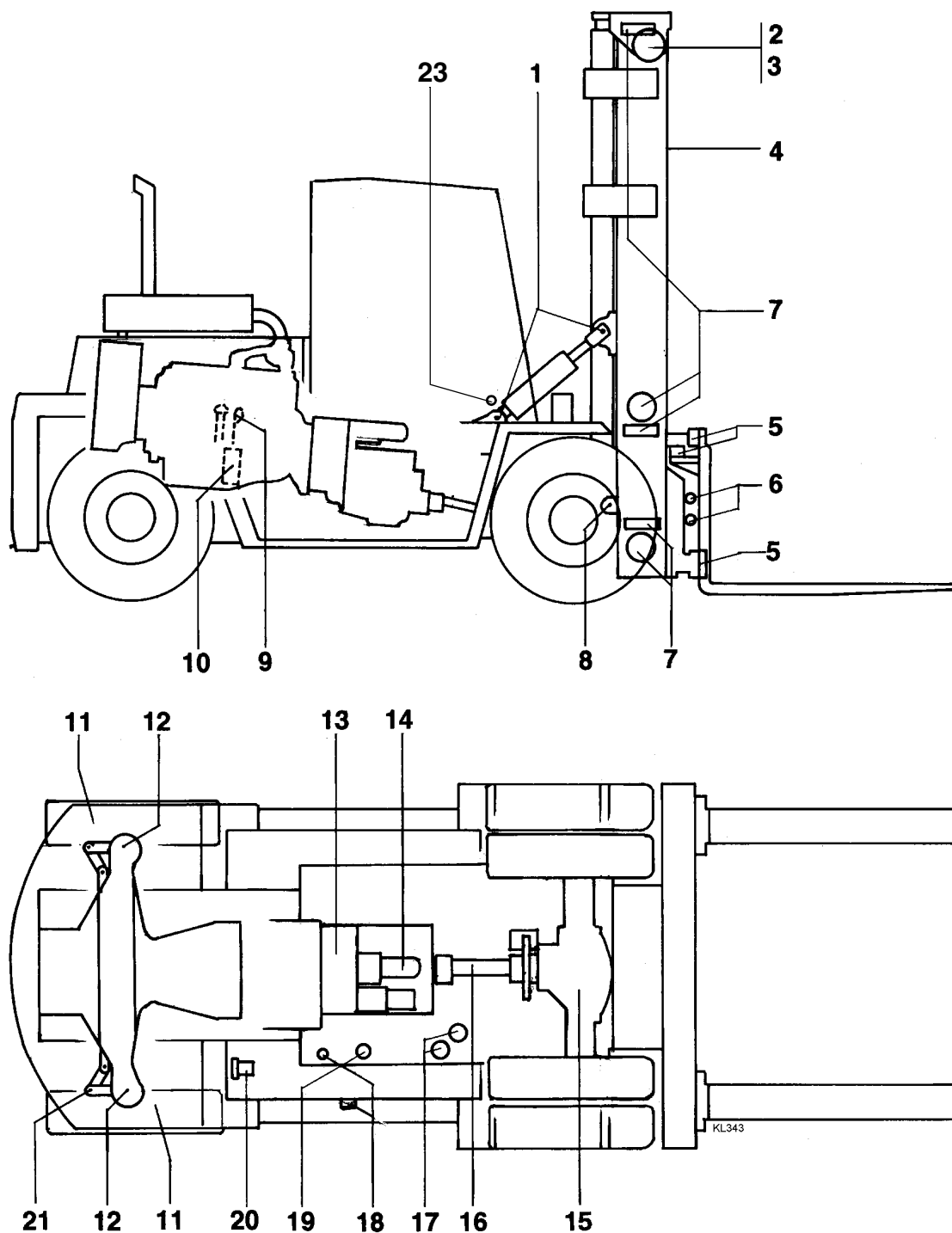
The same procedure also applies to work carried out in a 600-hour service.

General survey chart

Operating time	Maintenance intervals, hours			Note
	1000	600	200	
200				Guarantee service after 50 hours. Work in accordance with list below:
600		•	•	
1000	•	•	•	
1200			•	
1600		•	•	
2000	•	•	•	
...				

WARRANTY SERVICE at 50 working hours

1. 200 hours service according to Technical Handbook, group 90
2. Perform and fill in control chart in the Warranty certificate
3. Changing of oil in engine, gearbox, rotator reduction gear and reduction gear on the top lift.
4. Changing filter in engine, gearbox and hydraulic system, (all filters incl. WDB, servo filter etc)
5. Valve clearance adjustment (engine)
6. Check all bolt joints (see also SI94-003)



IMPORTANT!

If the truck is standing unused outdoors, with the piston rods exposed, all piston rods must be greased to prevent corrosion.

After they have been washed with degreasing agent, all pistons should be moved backwards and forwards several times to obtain a new protective oil film.

LUBRICATION CHART

Item No.	Description	Interval operating hours			No. of lub. points	Remarks
		200	600	1000		
1	Cylinder bearing, tilt cylinders	L				
2	Hose roller			x	1	x) Dismantle, clean, lubricate and reassemble
3	Chain wheels	L			2	
4	Lifting chains	L			2	Brush or spray with chain oil
5	Support rollers, forks	L			12	
6	Cylinder bearing	L			4	
7	Support wheels and support rollers, mast	L			10	
8	Mast suspension	L			2	Relieve the mast of load when lubricating
9	Engine oil	x			1	x) Oil change every 200 hours ¹⁾
10	Oil filter engine	x	xx			x) Perkins: Filter change every 200 hours xx) Volvo: Filter change every 400 hours
11	Steered wheel bearings				2	Dismantle, clean, inspect and pack with grease every 4000 hours
12	King pin bearing				4	
13	Gearbox oil	C		x	1	x) Oil change. Check level while idling
14	Gearbox oil filter		x		1	x) Filter change
15	Drive axle	C x		xx	3	x) First oil change max 200 hours after first operation. xx) Oil change, differential and hubs. Drain the oil at working temperature. Check the levels after refill.
16	Propeller shaft	L			3	
17	Hydraulic fluid filter			x	2	x) Filter change
18	Hydraulic fluid	C			1	Oil change every 2000 hours
19	Breather filter, hydraulic reservoir			x	1	x) Filter change
20	Hydraulic pump, cab tilt	C				
21	Linkage	L			4	
22	Hinges, doors and hatches		L			Dismount doors and hatches
23	Brake pedals			C L	2	Check and retighten the pedal axle locking screws. Lubricate axle nipples

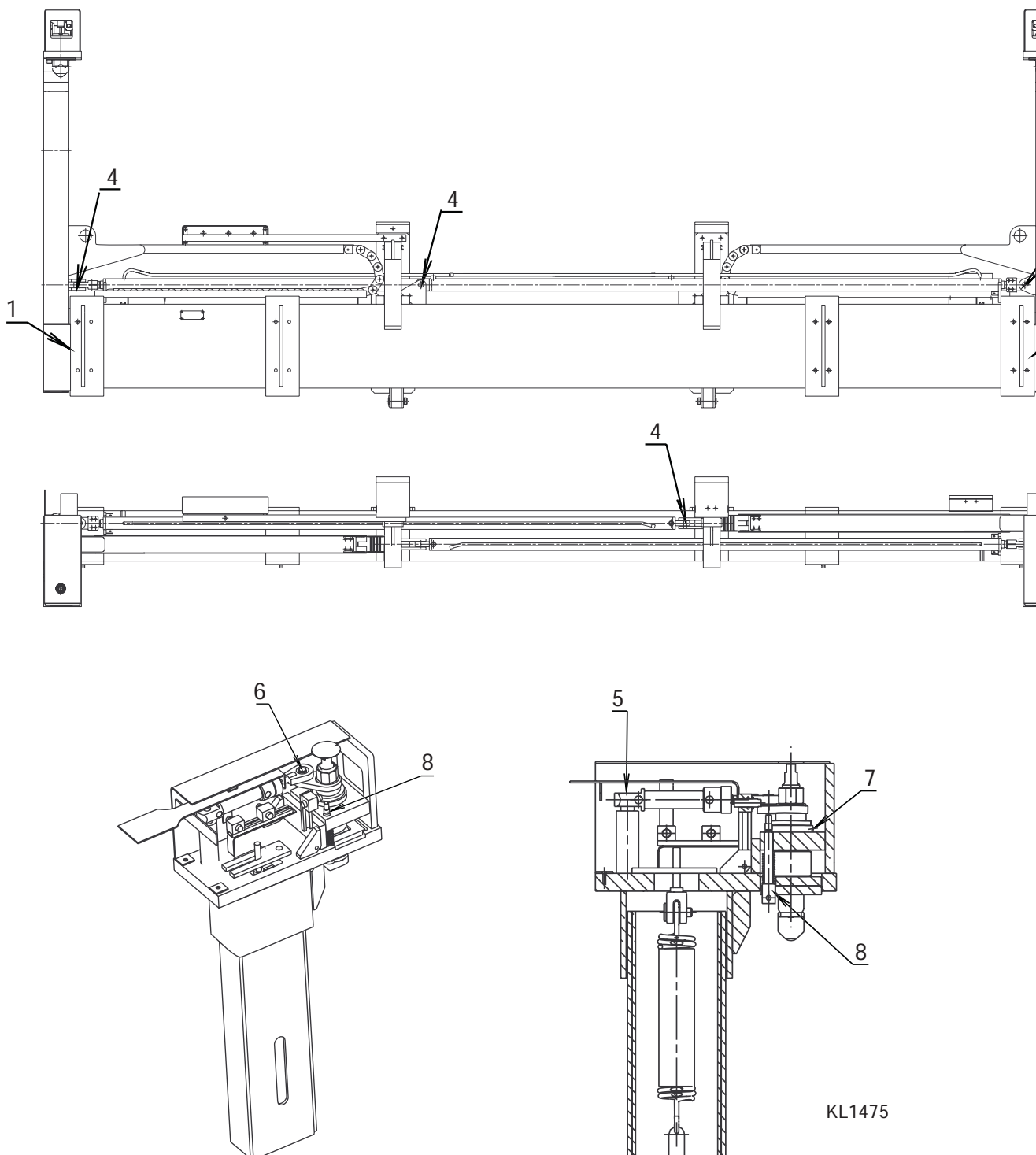
¹⁾ The interval is greatly dependent on the fuel and lubricant quality as well as the operating conditions. If intervals longer than 200 hours are desired, the condition of the oil must be checked by the company making the oil, by means of regular lubricant tests.

For volumes, see **Technical Data**.

For lubricating oil grades, see **Oil and lubricant recommendations**

L=Lubricate

C=Check



Pos No.	Description	Interval		No. of lub. points	Remark
		500	1000		
1	Sliding surfaces, length adjustment	L			Brush onto all sliding surfaces with the attachment in the fully extended position
2	Sliding surfaces, sideshift	L			Brush onto all sliding surfaces with the sideshift to the limit in each direction
3	Cylinders, sideshift	L		2	
4	Cylinders, length adjustment	L		4	
5	Locking cylinders	L		4	Check that the sensors are undamaged and free from grease
6	Lifting pinion twist connection		L	4	
7	Lifting pinion	L	C	4	Disassemble the twist-locks every 2000 h. Check for wear. If needed, change components accordingly. Clean and pack with grease. Same procedure should be used at suspected damage to the twist-locks.
8	Contact pin	L		4	Check that the sensors are undamaged and free from grease

C = Check

L = Lubricate

DAILY SUPERVISION

DAILY SUPERVISION	Or when refueling	Check	Refill if required
Brakes		Function	
Steering		Function	
All instruments. Blinkers, brake lights, horn, Headlights, reflectors		Function	
Lifting chains Links, suspension		Damage	
Lift, tilt, sideshift fork positioning		Function	
All hydraulic functions		Run all functions to stop for cylinder lub- rication	
Engine, gearbox, drive axle		Noises?	
Hydraulic hoses		Oil leakage?	
Fuel		Amount The fuel meter must never show 0	•
Engine oil		Level	•
Air cleaner		Indicator	•
Coolant	•	Level	•
Hydraulic fluid	•	Level	•
Gearbox oil	•	Level	•
Windscreen washers	•	Fluid level	•
Wheels	•	Tyre pressure See Instruction Manual	•

Every 200 hours

Item	Unit	Action	Remarks
1	Truck	Wash	Note! Do not use high-pressure on bearings or bearing housings
2	Radiator	Clean the fins of the radiator with water and detergent	Note! Do not use high-pressure.
3	Engine	Check the oil and coolant connections for leakage	
4	Air cleaner	Check the indicator. Empty dust container.	See Group 30.
5	Brakes	Check for oil leakage. Test brake performance.	See Group 70.
6	Battery cables, terminals and fuses	Clean the terminals and apply petroleum jelly. If necessary, replace cables and terminals.	
7	V-belts	Check the belt tension	
8	Upright and fork carriage	Check for damage. Retighten the bolted joints.	See Group 80
9	Steering axle	Check for play and damage	
10	Steered and driven wheels	Tighten the wheel nuts	See Group 40 resp 60 Specifications
11	Drive axle and propeller shaft	Tighten bolt joints Check for leakage	See Group 40 Specifications
12	Transmission	Check for oil leakage.	
13	(Air conditioner)	Check the performance	See Group 10
14	(Exhaust gas emission control system)	Inspect the catalyst and top up as necessary.	See Group 30
15	Lubrication points, oil and filter changes in accordance with the Lubrication chart.		
16	Inductive sensors	Check setting Clean the sensors	See Group 80
17	For optional equipment, please refer to special instructions issued.		

IMPORTANT!

Always attend to any damage, wear or faults that are important to the performance of the truck and its service life or the safety of the personnel.

Every 600 hours

Item	Unit	Action	Remark
1	Air cleaner	Change the filter element if the indicator shows red.	See Group 30
2	Turbo charger	Check for leakage.	See Group 30
3	Exhaust system	Check for leakage.	
4	Steered wheels	Check the wheel alignment, and check for deformation or bearing play.	See Group 60
5	Lifting upright	Check that the hose guide pulleys run freely and that the hoses are in good condition.	
6	Forks	Check for damage and wear	See Group 80
7	Chains	Wash, lubricate and adjust the length	See Group 80
8	Lubrication points, oil and filter changes in accordance with the Lubrication chart.		
9	Wet disc brake system WDB incl. parking brake	Check function	See Group 70
10	200 hours service		

IMPORTANT!

Always attend to any damage, wear or faults that are important to the performance of the truck and its service life or the safety of the personnel.

Every 1000 hours

Item	Unit	Action	Remarks
1	Cabin filter element	Change filter element	See Group 10
2	Engine	Check valve clearances, cooling system, starter motor, alternator and fuses	See Volvo Workshop Manual and Group 30
3	Fuel tank	Drain	
4	Fuel filter	Change the filter. Bleed the fuel system.	
5	Injectors	Check	See Volvo Workshop Manual
6	V-belts	Check and change as necessary.	
7	Batteries	Check	
8	Wheels	Check for damage	
9	Propeller shaft	Check the bolted joints and check the universal joints for play	See Group 40
10	Transmission and drive axle	Clean the breather filter	
11	Lifting chains	Check	See Group 80
12	Painting and safety marking	Touch up	
13	All functions	Test-drive and check	
14	(Air conditioner)	Check the refrigerant level	
15	Check accumulator charging pressure		See Group 70
16	Lubrication points, oil and filter changes in accordance with the Lubrication chart.		
17	600 and 200 hours service		

IMPORTANT!
Always attend to any damage, wear or faults that are important to the performance of the truck and its service life or the safety of the personnel.

	Oil quality	Recommended viscosity at different outer temperatures									
		°C	-30	-20	-10	0	+10	+20	+30	+40	+50
		°F	-22	-4	+14	+32	+50	+68	+86	+104	+122
Engine Cummins Perkins Scania Volvo	Engine oil ACEA: E2 API: CF4										
Gearbox Clark 18000 Clark 20000 Clark 28000 Clark 32000	Transmission oil ATF DEXRON II **										
Drive axle Kessler D81	Hypoid oil API GL5 MIL-L-2105B										
Hydraulic system	Hydraulic fluid * SS 155434										
	Hydraulic fluid * DIN 51524										
	Hydraulic fluid * ISO 6743/4										

* Additive: 3% LUBRIZOL LZ9990A
** DEXRON is a registered Trade Mark

Grease

Use EP universal grease to NLGI Grade 2 with 3–5% molybdenum disulphide additive for all lubrication points, including wheel bearings.

Lubricant for plastic sliding plates

Use lubricant approved by Kalmar. Order from Kalmar Spare parts department

0.65 kg cartridge for greasegun
5 kg can

Art.no. 923110-0360
Art.no. 923595.0003

IMPORTANT!
Any deviations from the above table must be supported by written approval from Kalmar.

Cooling oil for air conditioning system
ZXL100 Seltac PAG-oil