Technical information

Hydraulic steering

Trucks with one hydraulically steerable axles
8x2/6 - RADT/A8/FST-PAR

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Contents

Description of the systems

Control of the steerable axle involves three linked systems.

1. Control circuit
2. Pneumatic intermediate link and safety lock
3. Hydraulic system

The Electronic Control Circuit is responsible for overall control. The electronic system determines whether the steerable axle is to be activated or locked based on the speci c signals received.

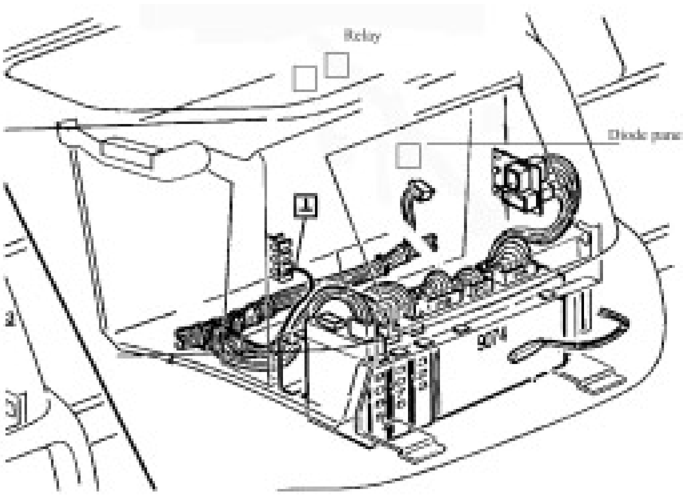
The pneumatic system functions both as an intermediate link between the electronic system and the hydraulic system and as a safety lock for the steerable axle. When the steerable axle is not activated, the axle is locked in its middle position by a pneumatic cylinder located on the axle.
The hydraulic system is the system that moves the steerable axle. The hydraulic system is a closed circuit and is not connected to the truck's other hydraulic systems

The electronic control circuit

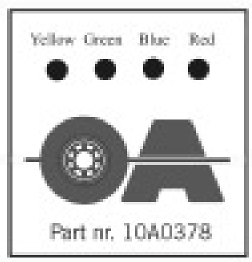
The electronic control circuit has overall control of the steerable axle.
Five factors are monitored in order to determine whether the axle power may be activated.

These ve factors are:
1. Voltage supply must be over approx. + 24 volts.
2. The speed must be under a certain limit (approx. 45 kmfh).
3. The oil pressure in the closed hydraulic system must be over 8 bars.
4. The bogie axle must be down.
5. The front wheels must reach or pass the middle position.

When all conditions are met, back axle steering is activated until at least one of conditions 2, 3 or 4 ceases to be met.
kommer bakaxelns styrning att vara aktiverad tills minst en av punkterna 2, 3 eller 4 upphör.



Service lights



Control and service lights

The system is supplied with 2 control lights visible from within the cab and 4 light diodes on the diode panel to aid system use and service.
The 2 control lights, one green and one red, are located on the right side of the dashboard. The red control light is lit when the oil pressure in the closed hydraulic circuit falls below 8 bars. When the red control light is on axle steering cannot be activated, and the axle remains locked in its middle position.
The green control light lights up when axle steering is activated.

The 4 light diodes are located on the diode panel beside the relays in K25.
The green diode indicates that the ignition is on and that there is a voltage supply to the relays. The red light diode indicates that the bogie switch is not activated. Steering can be activated.
The blue light diode indicates that the relay is supplying power to the inductive sensor located on the hydraulic master cylinder.
Power is supplied when the following conditions are met:

- Oil pressure in the closed hydraulic system is over 8 bars
- The bogie axle is down.
- Speed is under 45kmfh

Where power is being supplied to the inductive sensor, the electronic system waits for the sensor to signal that the front wheels are in the middle position.
The yellow light diode lights when the inductive sensor sends a signal when the wheels are in the middle position. Axle steering is then activated and the green control light in the cab lights. If the truck's voltage supply falls below + 22 volts, for safety reasons, the signal from the inductive sensor will be unable to activate axle steering.
Whenever there is a fault in axle steering, fault nding should take into account all control light and light diode readings.

Pneumatic intermediate link and the safety lock

The pneumatic system is used as an intermediate link between the electronic system and the closed hydraulic system. When the conditions for axle steering are met, a relay activates a magnetic valve that via the pneumatic valve directs control air to the inlet on the hydraulic valve. The control air functions as a switch, turning the valve 'on' and 'off'.

When axle steering is deactivated, the pneumatic system ensures that the axle is locked in the middle position. A pneumatic cylinder with two inner pistons is connected to the hydraulic slave cylinder located on the axle. One piston is directly connected to the slave cylinder's piston and the other is floating.
To lock the axle compressed air is fed to both ends of the pneumatic cylinder. At the same time the space between the two pistons is vented through the air lter. This causes both pistons in the pneumatic cylinder to centre and to lock in the middle position, thereby locking the axle.

The hydraulic system

The force required to move the axle is supplied by the closed hydraulic system. The hydraulic master cylinder (see page 8) is connected to the cab via a pitman arm. Movement of the steering wheel is therefore converted into flows in the hydraulic oil in the closed system's hydraulic valves, hoses and pipes. When the steering is activated, oil flows from the master cylinder through the hydraulic valves, hoses and pipes to the slave cylinder located on the back axle. The consequent movement in the cylinder piston moves the wheels.
When the steering is deactivated the oil flow is 'short circuited' in the hydraulic valve, so that the oil flow from the master cylinder is not directed to the slave cylinder.

Normal working pressure in the closed system is 25 bars. If the pressure falls below around 8 bars, axle steering is deactivated and is locked in the middle position.

Bleeding the hydraulic system

LRead the whole procedure thoroughly before beginning work on the system.

To bleed the entire hydraulic system, hydraulic oil is pumped under pressure into the system. All the trapped air is forced out through the bleeding nipples located on both the hydraulic master and slave cylinders.
The process can be carried out by using a hand pump, but it is easier to use an automatic pump.

Tools required:

- Hydraulic pump (This pump can be bought. See page 23)
- Bleeding hose in clear plastic with con nector attached
- A small transparent container for the discharge from the bleeding hose
- Hydraulic oil, type Shell ATF XS

Preparation
To bleed the hydraulic system both the front axle and the hydraulically controlled back axle must be lifted free of the floor with a jack. Both axles can therefore move freely during the process. Both axles at the start of the procedure should be in the middle position. The bogie switch should be in the ’bogie down’ position. The ignition should be turned off. To make access to the hydraulic valve and the hydraulic master cylinder easier the cab should be tilted. During the process, the red oil pressure warning light located on the right side of the dashboard can be checked. This light will glow when the pressure in the hydraulic system is under approx. 8 bars. The forward air tank, under the battery box, must be completely emptied of air to prevent the hydraulically controlled back axle from locking.

Summary of bleeding procedure
Oil is pumped into the system through the nipple on the hydraulic valve. While maintaining pressure in the system during the whole process, bleed all four nipples. When this has carried out the process is repeated, this time turning the axles fully in both directions. This presses the trapped air out of the cylinders. The hydraulic valve is bled. The system is then pumped to normal working pressure (25 bars).

Bleeding step by step
Step 1
Connect the pump to nipple no.1 on the hydraulic valve and pressurise the system. If a manual pump is used, check carefully during the whole process that the pressure in the system is 25 bars.

Step 2
Prepare the bleeding hose with connector and drain container. Connect the hose to nipple no.2 on the master cylinder and turn the front wheels to the right. Do this twice. Let the oil flow until air bubbles no longer can be seen in the hose.

Step 3
Repeat step 2 on nipple no.3 on the master cylinder and turn the wheels to the left. Do this twice.

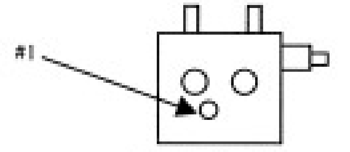
Step 4
Move the container and the hose to the slave cylinder and repeat step 2 on nipples no.4 and no.5, turning the back wheels to the left for nipple no.4, and turning the back wheels to the right for nipple no.5. Do this twice.

Step 5
Go back to the hydraulic valve. Pump the hydraulic system (no.1) up to 25 bars, remove the pump hose and attach the bleeding hose with container to the nipple for bleeding the accumulator on the valve block. Pump the pressure up to 25 bars.

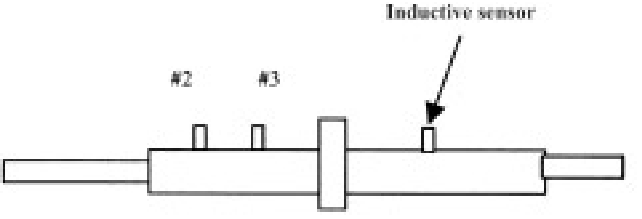
Step 6
Prepare the truck for driving and carry out a test drive, testing the operation of the steering system.
After the test drive, a plastic container with a bleeding hose is connected again to nipple no.1 and nipples nos.2 to 5 successively with the wheels in the middle position and the green lamp, ’steering activated’ lit.

Step 7
Turn the truck’s ignition on. The plastic container with the bleeding hose is connected to nipple no.1 on the hydraulic valve. Check that the red oil pressure warning light on the right side of the dashboard is on and that the green light ’steering activated’ is off when the pressure falls below 8 bars.
Finally, connect the pump again to nipple no.1 and   ll the system to full working pressure (25 bars). The bleeding process is now completed.

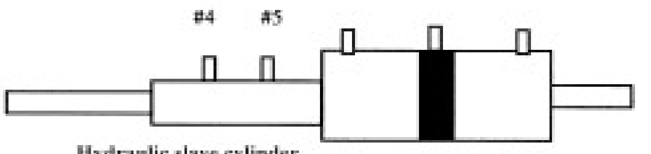
The location of bleeding nipples



Hydraulic valve



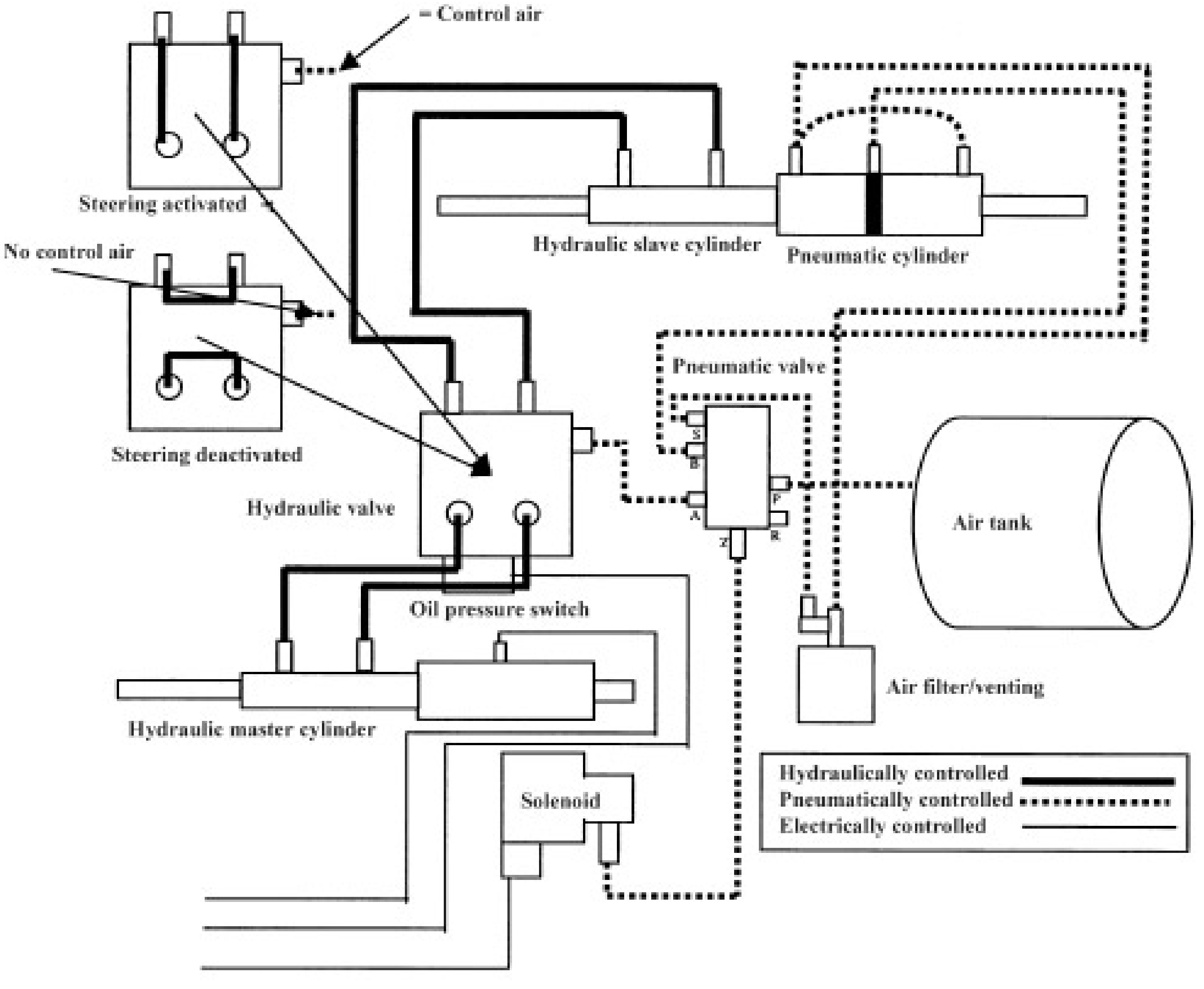
Hydraulic master cylinder
Located behind the left front wheel



Hydraulic slave cylinder
Located under the axle

Pneumatic cylinder

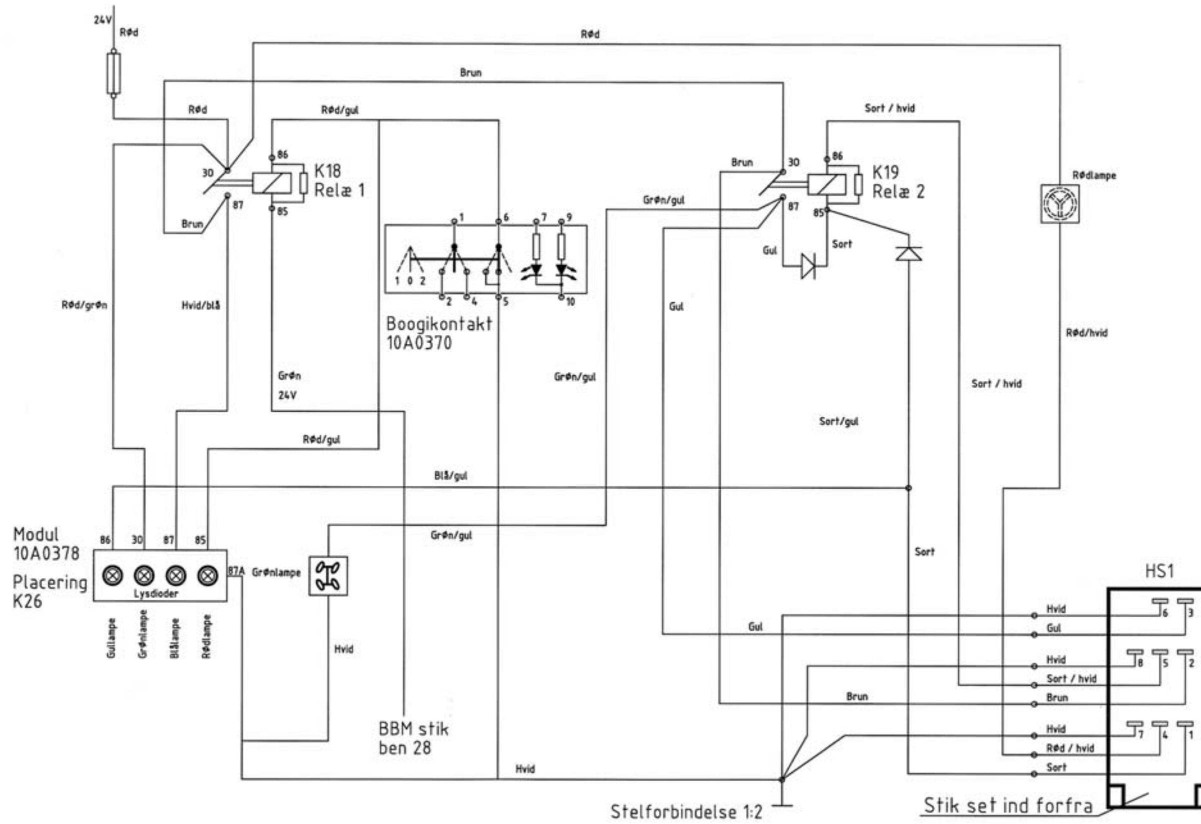
Hydraulics and Pneumatics - schematic overview



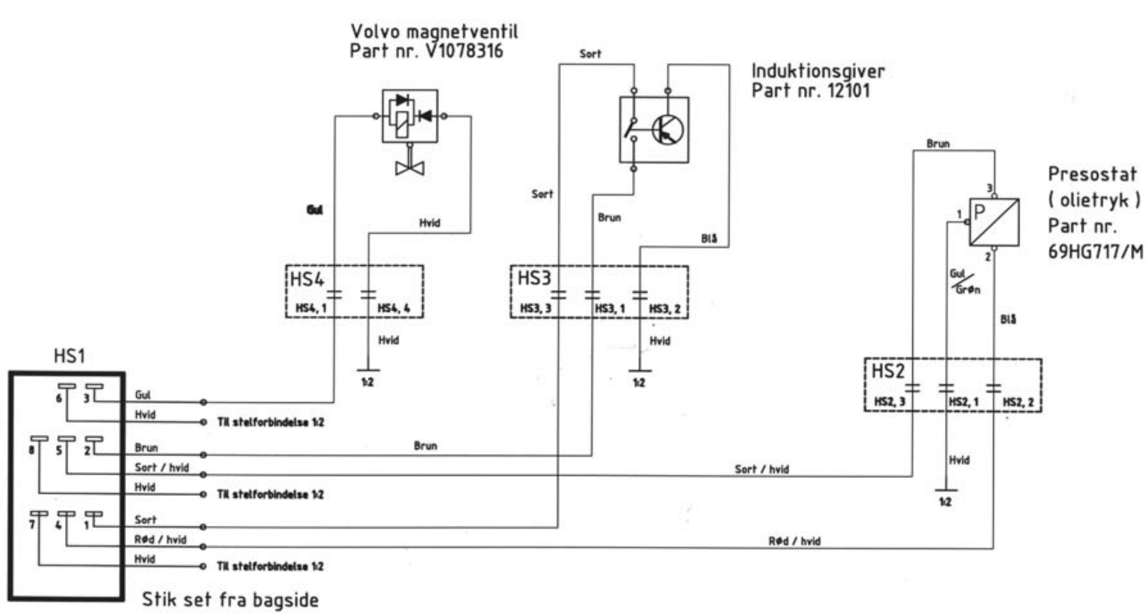
System description
Steering activated
When the electronic system has activated the signal '+ activate solenoid', the solenoid directs air to the pneumatic valve's Z inlet. The valve changes position, compressed air from the tank is sent to the hydraulic valve (P?A), and at the same time the axle's pneumatic cylinder is vented through the air   lter (B?S). The hydraulic master cylinder has therefore full control over the steerable axle.

Axle lock
When the signal '+activate solenoid' is broken by the electronic system, the pneumatic valve changes back to its deactivated position. The inlet to the hydraulic valve (A?R) is vented and the oil flow through the hydraulic valve is 'short circuited'. Both ends of the pneumatic cylinder are supplied with compressed air (P?B) and the space between the cylinders two pistons are vented through the air   lter. The axle is therefore locked in the middle position. (The letters in brackets refer to the connectors on the pneumatic valve).

Inner wiring

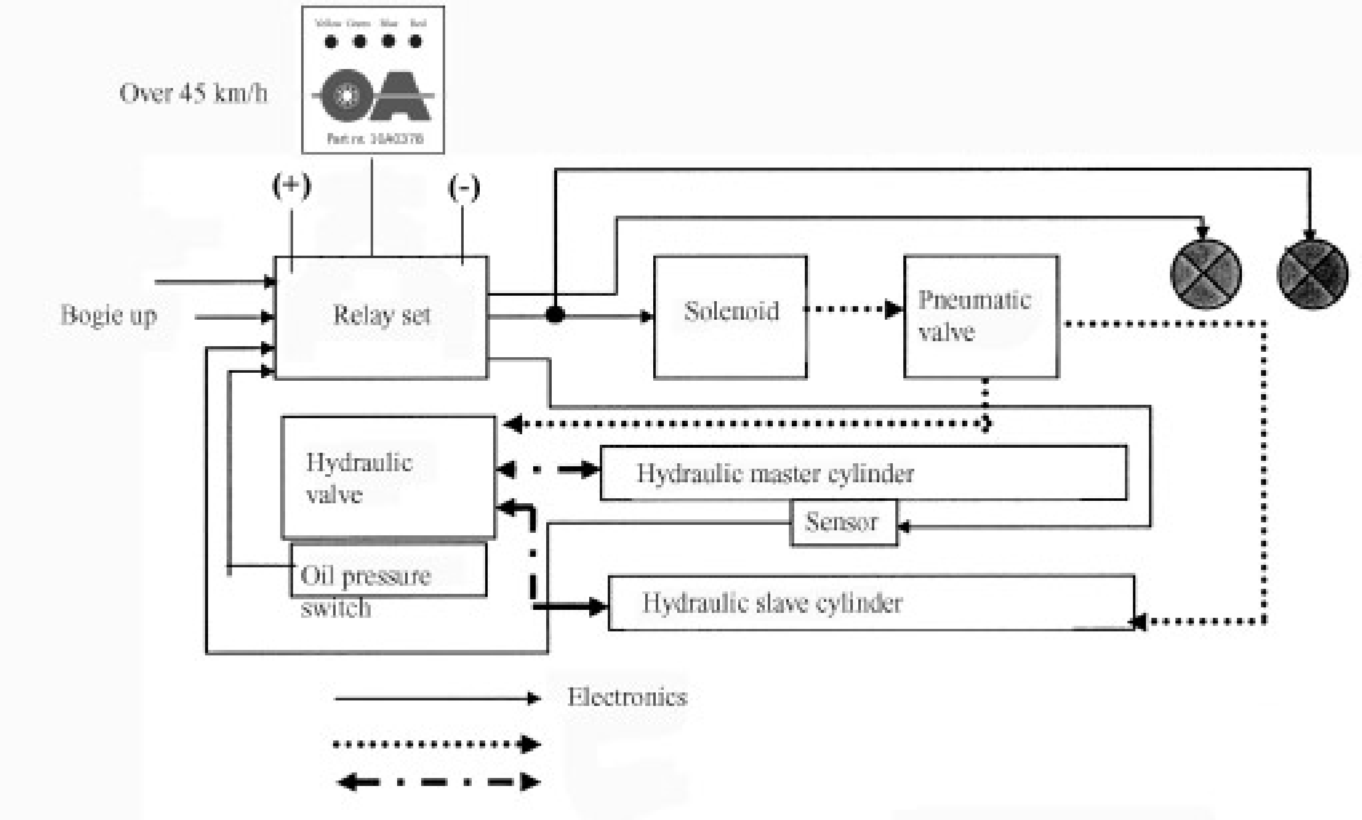


Outer wiring



The outer wiring is led into the cab on the right side at the front. Outside the cab, the wiring follows the other wires under the engine, above the forward cross member and continues inside the frame on the left side. The wiring runs all the way to the battery box, where it ends in HS4 - the plug to the solenoid on the left side of the battery box.
Behind the hydraulic valve the wiring is split twice and ends in plugs HS2 and HS3 for the oil pressure switch and the inductive sensor, respectively.

Faultfinding

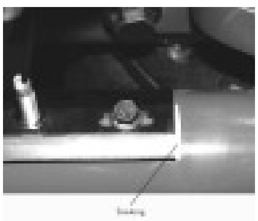
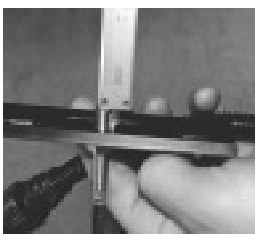


Directions
Use all the available information where there is a fault in the systems. The faultfinding procedure uses the diagrams and summaries included in this document. The above diagram shows the units, control signals and indicators that control axle steering. To activate the axle steering the following conditions must be met.

- Voltage supply must be at least + 22 volts.
- The pressure in the closed hydraulic system must be at least 8 bars.
- The truck speed must be under a certain limit (45 kmfh)
- The bogie axle must be down

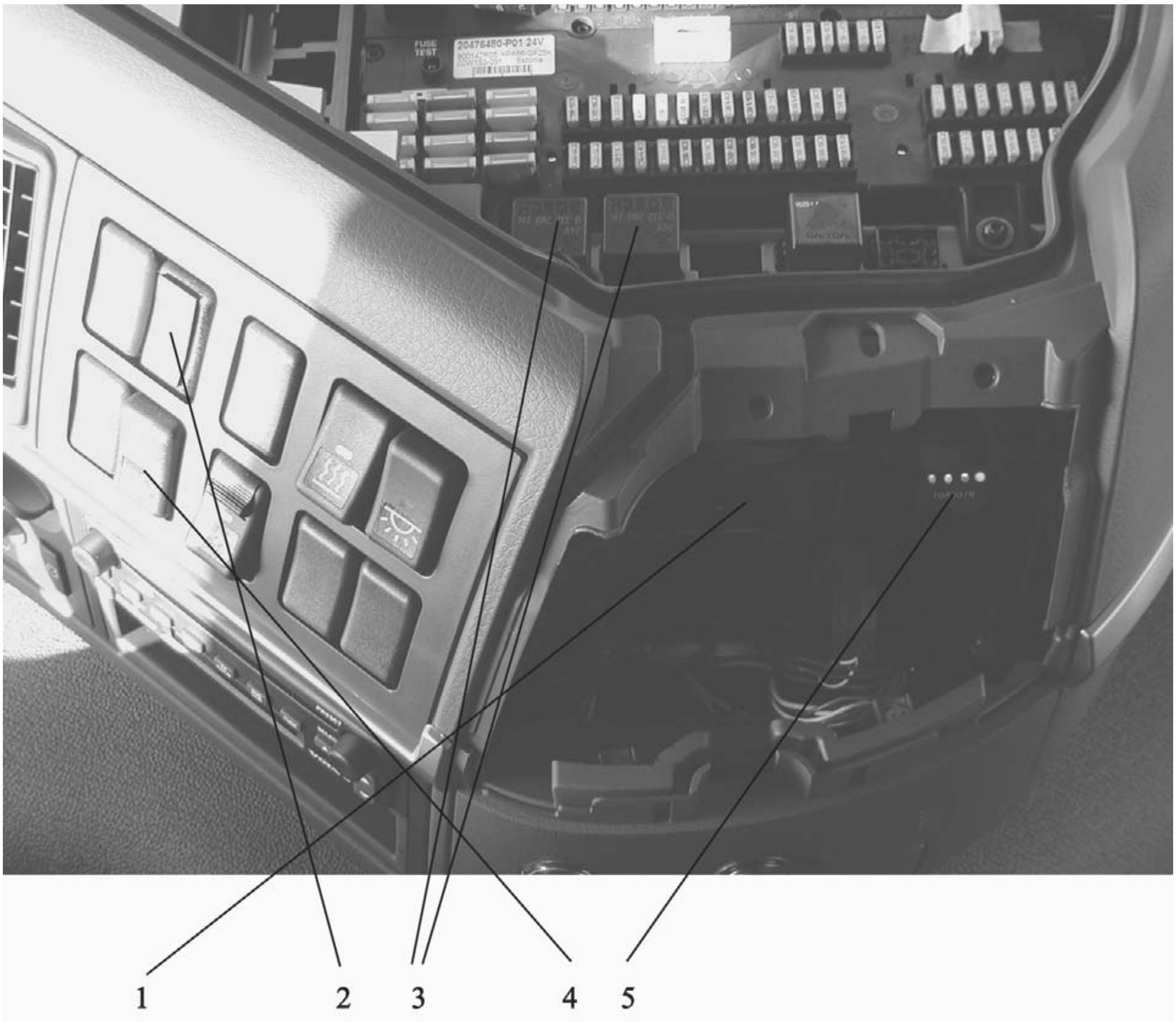
When all the above-mentioned conditions are met the signal from the inductive sensor on the master cylinder will indicate when the front wheels reach or pass the middle position. This signal activates axle steering.

The lights mounted on the dashboard are here called ’control lights’ and the light diodes mounted on the diode panel are called ’service lights’.

Symptom	Investigate and repair
Nothing indicates a fault, but steering is deactivated - the green light (steering activated) doesn't come on.  	1. Ignition is not switched on. 2. You are driving faster than 45 kmfh or the bogie is up. 3. The front wheels have not yet reached or passed the middle position. Check that the power supply is working. The voltage (green light diode) to the relay set must be more than +22 volts. If there is no power to the relay, check whether the fuse (no.60 - 5 amp) has blown. If the fuse blows again, the inner and outer wiring should be checked for a short circuit. If there is no short circuit, the relay located in K18 and K19 must be replaced. Where a fuse has blown, a thorough check of the steering functions must be carried out before the truck is released back to normal use. Inspect the green light diode. If it is not lit, measure the voltage on the red wire by the multi plug on relay K18. If the voltage to the relay is normal, the relay must be replaced. Check whether the earth connection in the relay set is working normally, white wire. Inspect the blue diode 'supply sensor'. If it is lit, check whether the yellow diode 'centred sensor' lights every time the front wheels reach or pass the middle position. If the yellow light diode does not light, inspect all connections in the inner and outer wiring that are connected to the inductive sensor. The inductive sensor has a built-in light that lights when the sensor touches metal and power is applied. Check that it lights when the wheels are in the middle position. If no faults are found in the wiring, or the inductive sensor does not light in the middle position, replace the inductive sensor. Sensor replacement. Put the front wheels in the middle position and lift the front wheels with a jack - mark with a pen on the cylinder where the plate with the sensor is located (see picture) - remove the plate with the sensor on the cylinder (before removing the sensor in the plate, measure with a vernier calliper how far the sensor is through the plate (see picture)) - loosen the lock nut on the sensor and screw the sensor out of the plate - screw the new sensor into the plate so it penetrates the same distance through the plate as the removed sensor - tighten the lock nut on the sensor - remount the plate with the sensor on the cylinder by the pen mark - check that the sensor works and is correctly adjusted - turn the wheels ¼ turn to the left - activate the bogie switch for an instant- then turn the wheels to the right, when the wheel reaches the zero point the green control light on the dashboard should come on and the steering be activated - then turn the wheels ¼ turn to the right and activate the bogie switch for an instant and the green control light goes out - turn to the left and when the steering wheel reaches the zero point the control light should come on. If in doubt about how to proceed, contact OA Opbyg AfA for further information.

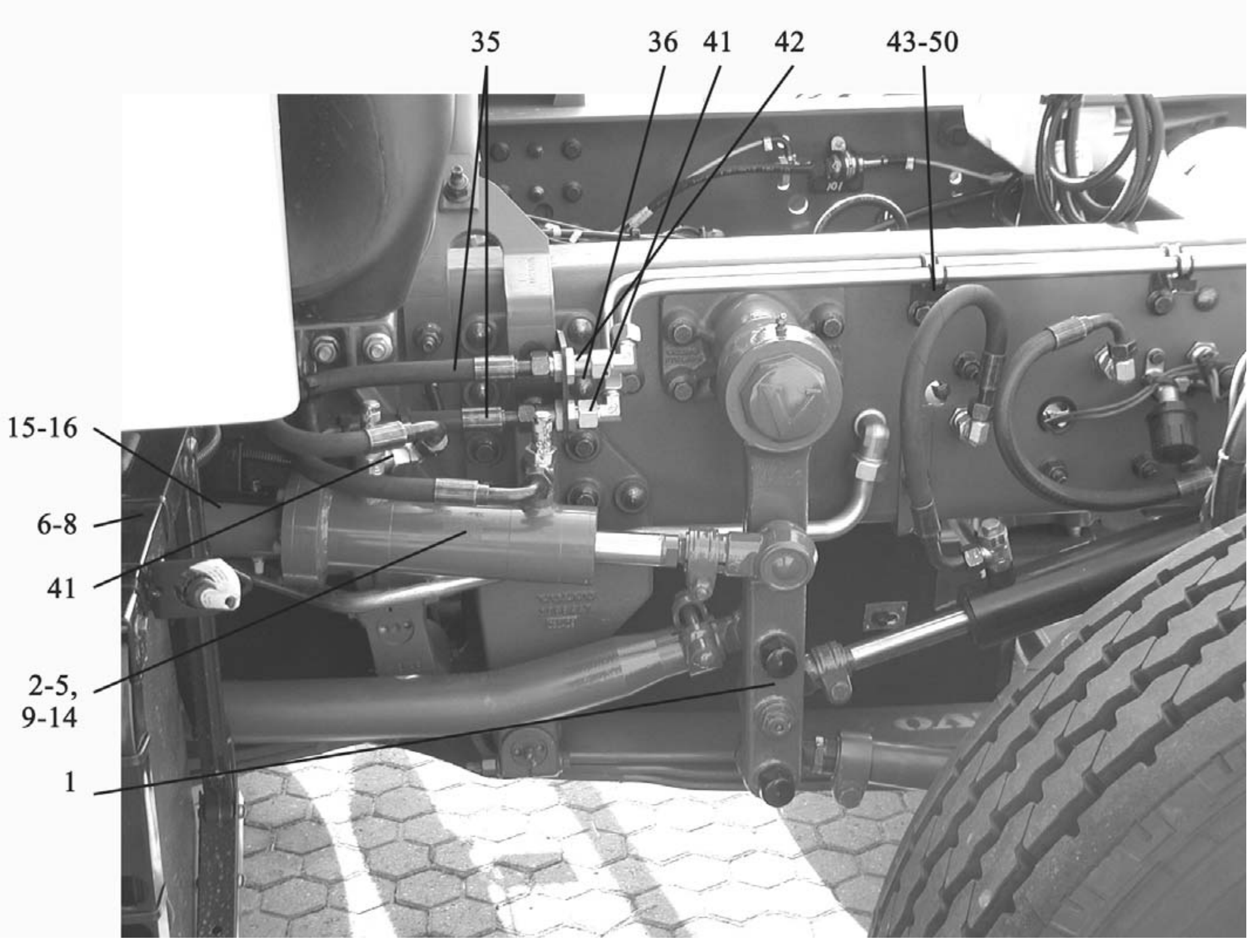
Symptom	Investigate and repair
	If the blue light diode does not light when the required conditions are met, inspect the signals from the oil pressure switch and voltage from BBM plug pin no. 28. If the red light diode lights when the bogie axle is up, inspect the signals from the bogie switch (redfiyellow wires). If the signals are normal, replace the relay.Inspect whether the bulb in the red control light has blown. Replace the bulb and if it lights, go to the section entitled 'the red oil pressure warning light lights up'.
No fault indicators, the green light is not lit but the steering works.	Check whether the bulb has blown. Check whether the connections to the green control light are in order.
No fault indicators. The green control light is lit but the steering is not activated.	Check the connections in the inner and outer wiring that connect to the magnetic valve. Check that there is a voltage supply to pin 1 on the solenoid. Check that there is an earth connection on pin 4. Check that the magnetic valve is activated - if not, replace the magnetic valve. Check that there is compressed air in the control inlet on the hydraulic valve. If there is compressed air, replace the hydraulic valve. If there is no compressed air to the hydraulic valve, inspect the inlet and outlets on the pneumatic valve; refer to the schematic diagram for hydraulics and pneumatics on page 8.NOTE! Where the hydraulic valve is replaced, bleed the system in accordance with the procedure which starts on page 6.
The red lights. Steering is not activated	Check the oil pressure in the hydraulic valve on no. 1. If the pressure is under 8 bars, there is a leak in the system. Check all hoses and pipes, paying particular attention to connections and collectors. Repair any leaks found. Refer to the procedure 'Bleeding the hydraulic system' on page 6 to bring the truck back to normal working order.If the oil pressure is normal, check the connections in the inner and outer wiring to the oil pressure switch. Repair if necessary. If pin 2 on relay K19 is at earth level and the red control light on the dashboard is on, replace the relay. The signal can easily be measured on the whitefblack wire on plug HS1 pin 2. See connections on page 9.
Other faults in the systems	Check the inner and outer wiring. Replace the relay. Contact OA Opbyg AfS on + 45 46 16 10 72

Replacement parts -index and position - in the cab

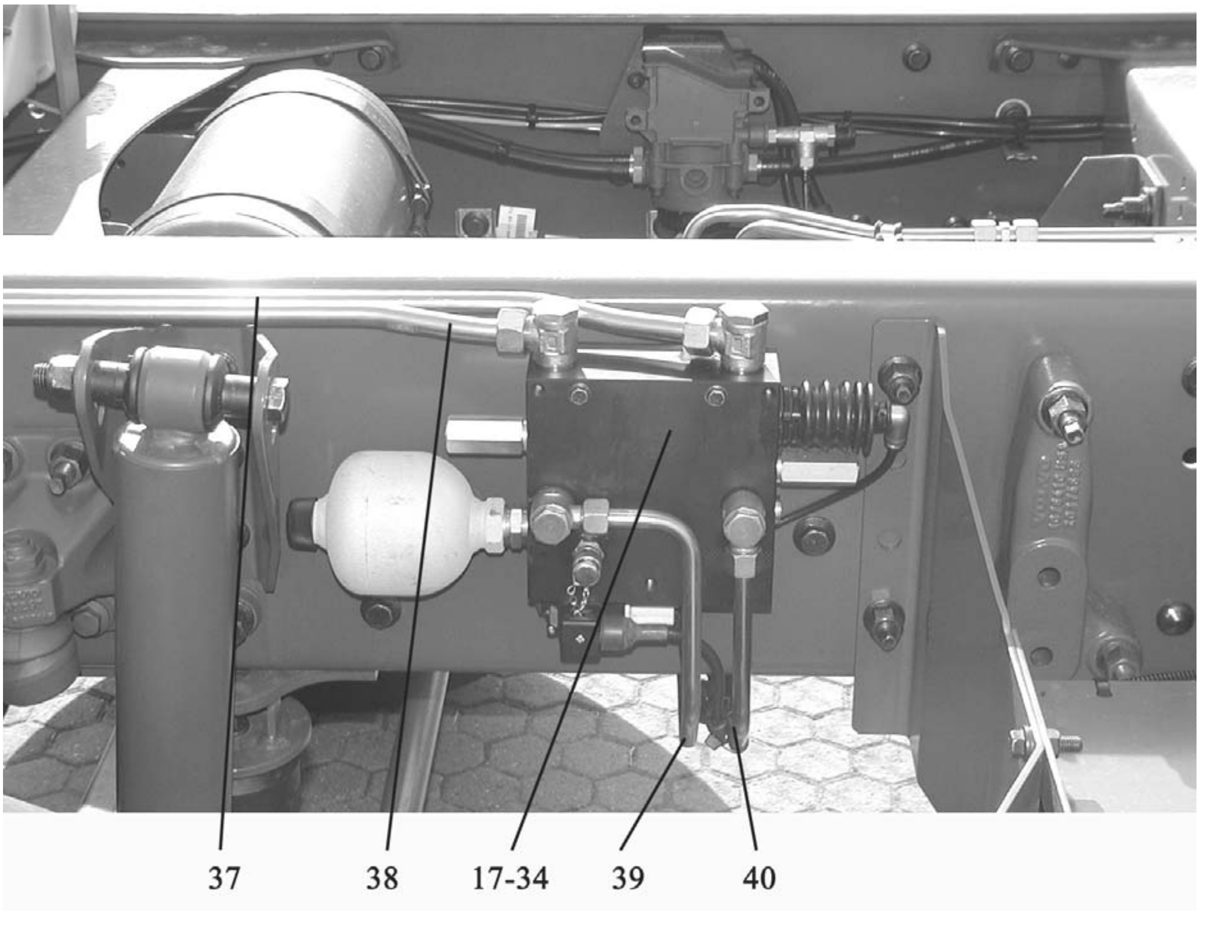


Pos.	Qty.	Description	Id. no.	Remarks
1	1	Relay set (inner wiring)	12109	
2	1	Holder with control lights	12005	
3	1	Relay	V3171420	
4	1	Switch (bogie)	12132	(10A0370)
5	1	Diode panel service lights	10A0378	

Replacement parts -index and position -front axle



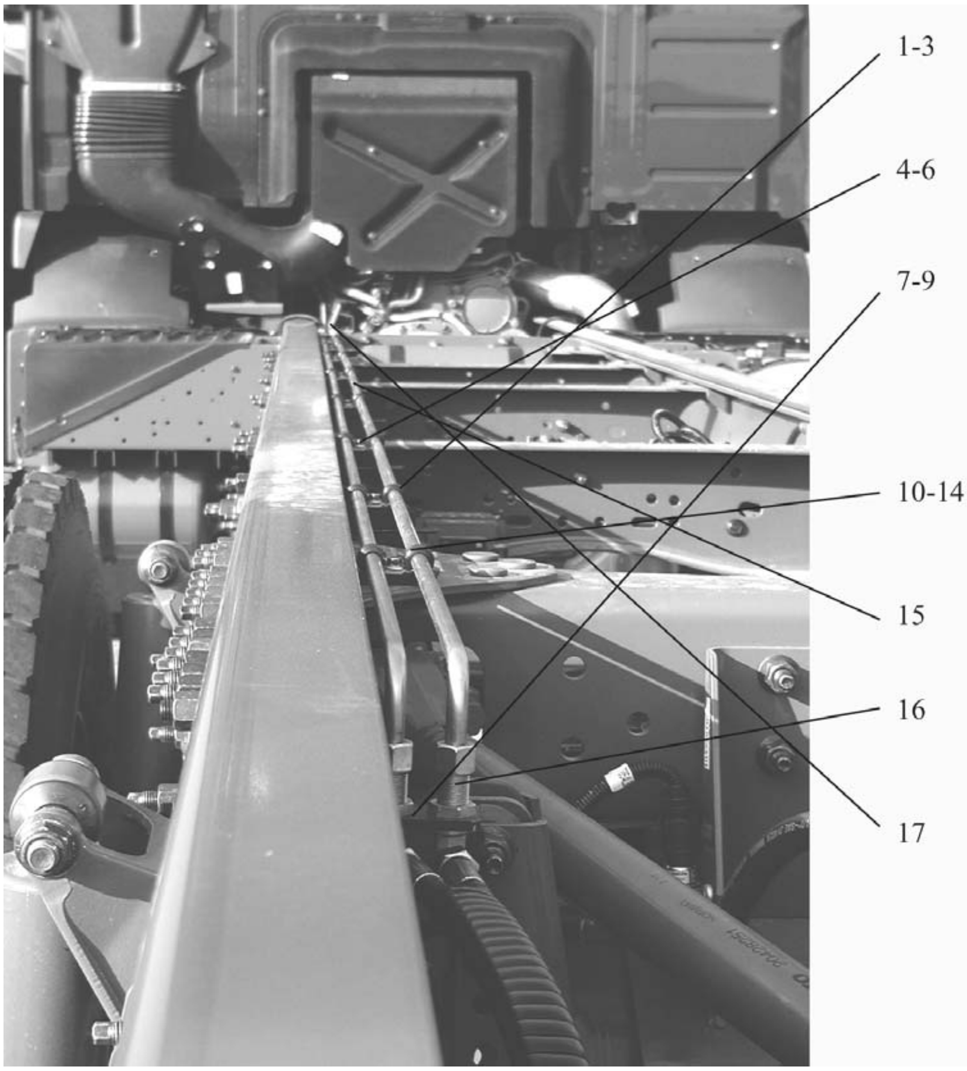
Pos.	Qty.	Description	Id. no.	Remarks
1	1	Main arm	10A0452	
2	1	Cylinder (slave)	10A0207	
3	1	Air lter	01P6M-BAA1	
4	2	Banjo nipple - M18x1.5/15	V977998	
5	2	Test nipple - M12x1.5	V1594061	
6	1	Console for slave cylinder	10A0449	
7	8	Bolt - Flange bolt 14x70	V966364	
8	8	Nut for console - M14	V979231	
9	2	Guide ball 1:10	V1606980	
10	2	Nut for ball joint	V191029	
11	2	Split pin for nut - 5x50mm	V907873	
12	1	Assemply plate for sensor	10A0303	
13	2	Flange bolt M6x16	V946544	
14	2	Washer	V948315	
15	1	Inductive sensor with wire	12101-A	



Pos.	Qty.	Description	Id. no.	Remarks
16	1	Box for sensor	10A0453	
17	1	Valve block	10A0377	
	1	Valve	69CPI10-NA-D	
18	1	Fixture for valve block	10A0458	
19	2	Bolt for fixture - flange bolt M14x40	V966359	
20	2	Nut for fixture - M14	V979231	
21	2	Bolt for valve block - M6x75	V955283	
22	2	Washer for valve block - M6	70AN82106	
23	2	Nut for valve block - M6	V949278	
24	3	Flange bolt - 8x50	V973924	
25	1	Rubber bellows - small	35V6-1019	
26	1	Air nipple - M10x1	V968694	
27	2	Air nipple - 6mm	V976444	
28	2	Hydraulic nipple - M18x1.5/12	343607031	
29	2	Banjo nipple - M18x1,5/15	V948349	
30	1	Test nipple - M12x1,5	V1594061	

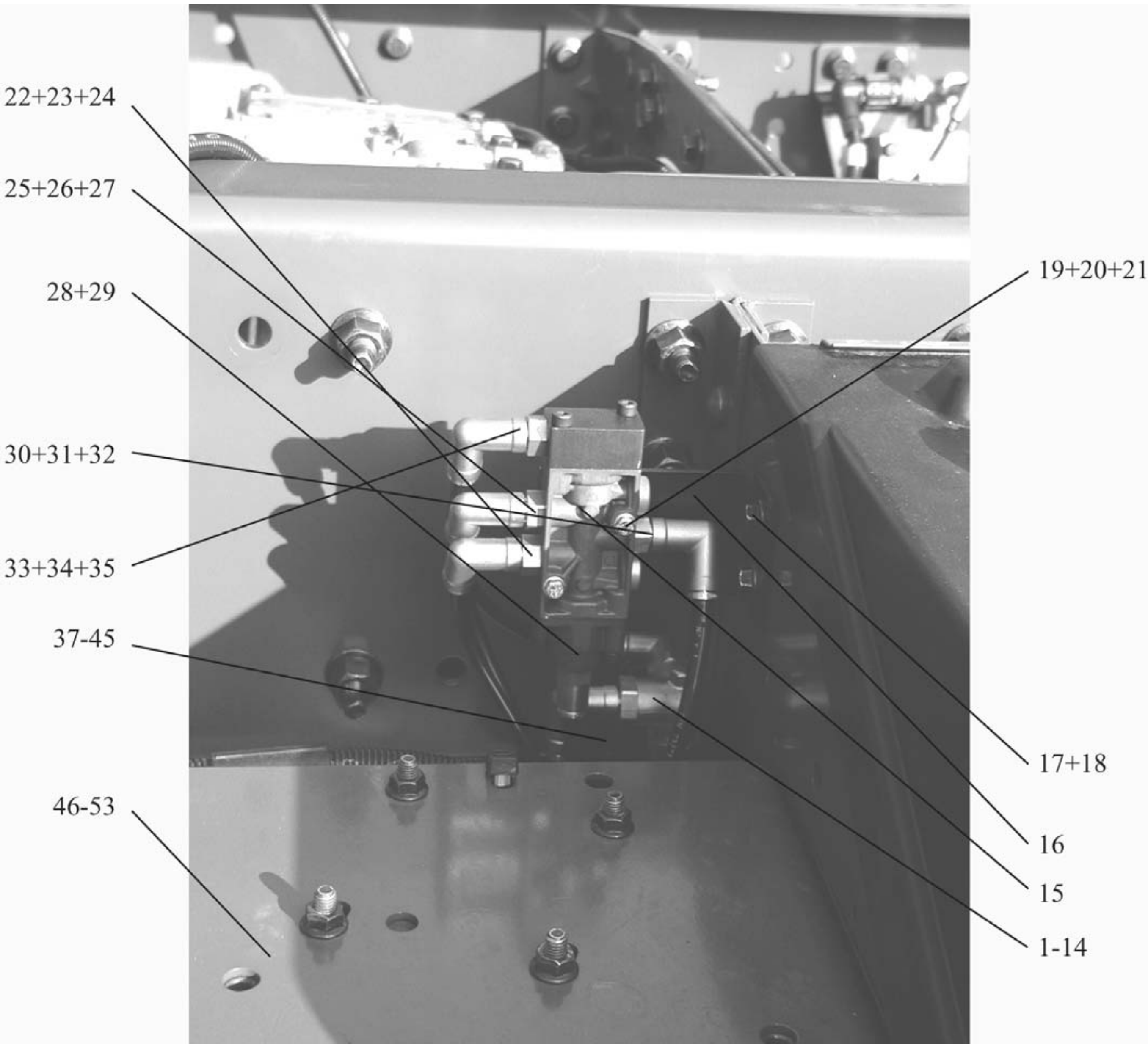
Pos.	Qty.	Description	Id. no.	Remarks
31	2	Banjo Nipple - M18x1.5fi15	V948349	
32	1	Test nipple - M12x1.5	V1594061	
33	1	Accumulator - 0.32 litrefi12 bar	69OLM-0fi12	
34	1	Hex nipple to accumulator -	6901BP08	charge pressure 10 bars
35	2	Gasket	69DOW12	for 6901BP08
36	1	Presostat - ¼ - 1 - 10 bar	69HG717fiM	excl. mounting plate
37	1	Hydr. hose - 3ff8 x 463	69HS0463	
38	1	Hydr. hose - 3ff8 x 292	69HS0292	
39	1	Hydr. pipe - FM12	698601-3	570019OA
40	1	Hydr. pipe - FM12	698601-2	570018OA
41	1	Holder - 3 hole	V965563	
42	4	Holder - 2 hole	V965560	
43	6	Flange bolt - M8x16	V946440	
44	1	Angle reinforcement	10A0067	for roll stabilisor
45	1	Clamping bracket	10A0068	for roll stabilisor
46	2	Allen bolt - M16x70	70AN10016070	for roll stabilisor
47	2	Washer - Ø16	70AN82116	for roll stabilisor
48	2	Allen bolt (U.S.) 14x30	70AN10414030	for roll stabilisor
49	2	Thick washer 30fi16.5ff5	10A0228	for roll stabilisor
50	2	Flange bolt - M14x30	V966356	for roll stabilisor
51	2	Flange nut - M16	V946673	for roll stabilisor
52	4	Flange nut - M14	V971100	for roll stabilisor
53	1	Shock absorber bracket. Compl.	10A0372	
54	1	Shock absorber bracket lower (air)	10A0353	
55	4	Bracket for level valve	10A0351	only cab L1EH1
56	1	Bracket for EBS valve	10A0373	
	1	Protective case for 10A0185	7510A0213K	incl. edging

Replacement parts - index and position - hoses and pipes CHH - STD



Pos.	Qty.	Description	Id. no.	Remarks
1	10	Holder	V965566	
2	10	Flange bolt - M14x40	V966358	
3	10	Flange nut - M14	V979231	
4	3	Spacing plate - 8 mm	1OA0363	
5	1	Spacing plate - 10mm	10A0364	
6	8	Spacing plate - 20mm	10A0365	
7	1	Holder for bulkhead cable gland compl.	10A0356	
8	1	Bolt 14x60	V966362	
9	1	Nut M14	V979231	
10	25	Pipe holder - 12mm	01-14	
11	20	Washer -Ø6	70AN82606	
12	1	Bolt for holder - flange bolt M6x25	V947542	
13	11	Bolt for holder - flange bolt M6x35	V965212	
14	14	Nut for holder -flange nut M6	V945407	
15	2	Hydraulic pipe - 12mm	12021	
16	2	Angle bulkhead cable gland - M12	69VSF12L	
17	2	Straight cable gland - 12L without coupling		69G12LX

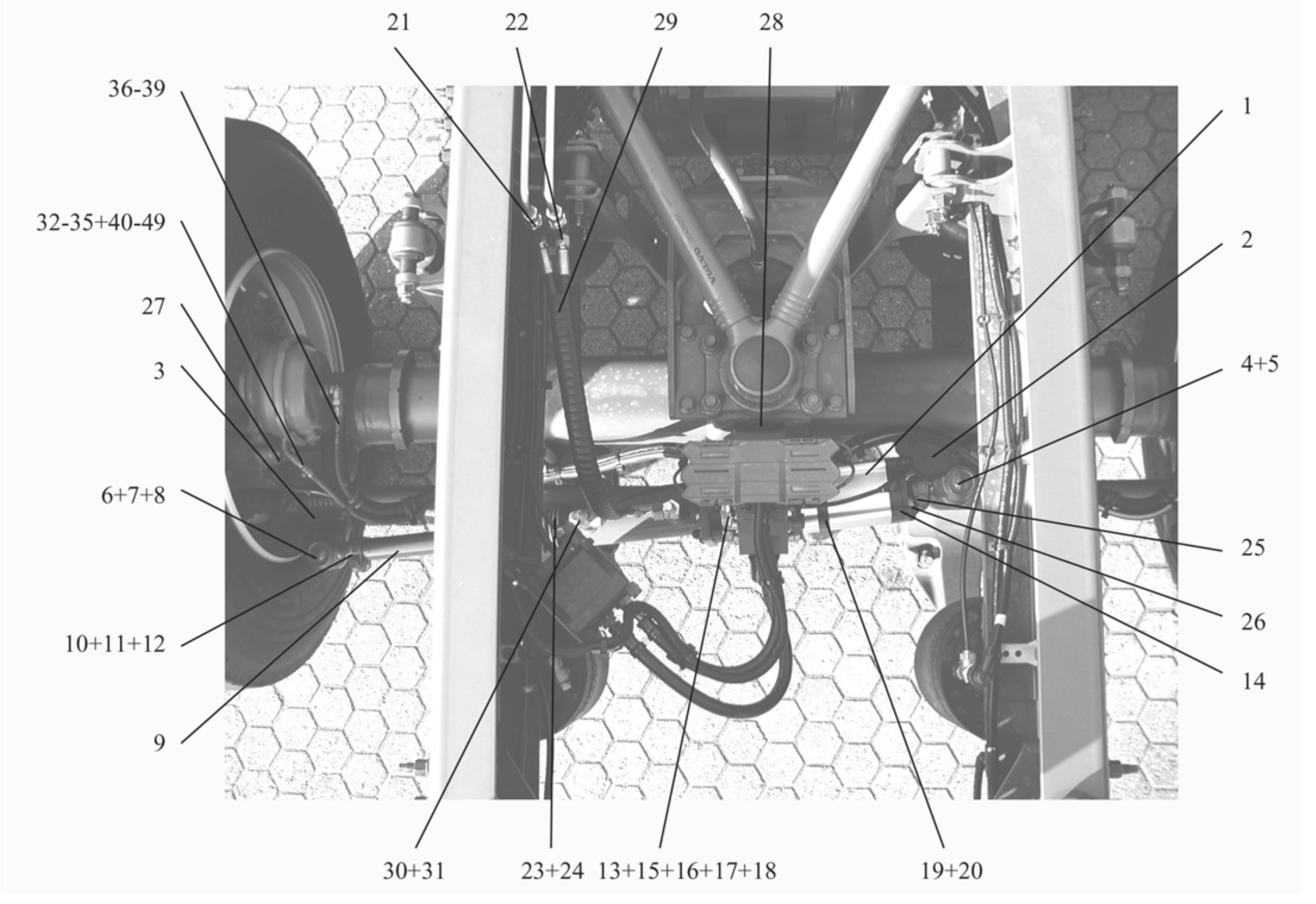
Replacement parts -index and position - battery box



Pos.	Qty.	Description	Id. no.	Remarks
1	1	Silencer tting	10A0198	
2	1	Silencer	V1096335	
3	1	Bolt for tting - M8x20	V946173	
4	1	Nut for tting - M8	V945408	
5	1	Cable gland	V966424	
6	1	Coupling	V957020	
7	1	Cable gland	V966454	
8	1	Nut	V945958	
9	1	O ring	V943924	
10	1	Cable gland	V968696	

Pos.	Qty.	Description	Id. no.	Remarks
11	1	Cable gland	V976445	
12	1	Cable gland	V976958	
13	1	Cable gland	V969326	
14	1	Cable gland	V976445	
15	1	Change valve	VF15ffS50112	
16	1	Fitting for the change valve	10A0352	
17	2	Bolt for fitting - M8x20	V946173	
18	2	Nut for fitting - M8	V945408	
19	2	Bolt for valve - M5x40	70AN11105040	
20	2	Washer for valve - M5	70AN82105	
21	2	Nut for valve - M5	70AN17905	
22	1	Cable gland - Valve - port A	V969323	
23	1	Cable gland - Valve - port A	V976958	
24	1	Cable gland - Valve - port A	V976444	
25	1	Cable gland - Valve - port B	V969323	
26	1	Cable gland - Valve - port B	V976958	
27	1	Cable gland - Valve - port B	V976445	
28	1	Cable gland - Valve - port Z	V968694	
29	1	Cable gland - Valve - port Z	V976444	
30	1	Cable gland - Valve - port P	V969323	
31	1	Cable gland - Valve - port P	V976958	
32	1	Cable gland - Valve - port P	V976445	
33	1	Cable gland - Valve - port S	V969323	
34	1	Cable gland - Valve - port S	V976958	
35	1	Cable gland - Valve - port S	V976445	
37	2	Cable gland - 8 mm	V976445	
40	1	Cable gland	V966454	
41	1	Nut	V945958	
42	1	O ring	V943924	
43	1	Cable gland	V976445	
44	1	Cable gland	V976958	
45	1	Cable gland	V969326	
46	1	Magnetic valve	V1078316	
47	1	Flange bolt - 6x40	V965176	
48	2	Washer - magnetic valve	V1589391	
49	1	Nut - 6 mm	V945407	
50	1	Cable gland - magnetic valve	V968695	
51	1	Air nipple - M10x1	V976444	
52	1	O ring for the magnetic valve	V947099	
53	2	Flange bolt -M6x12	V965175	

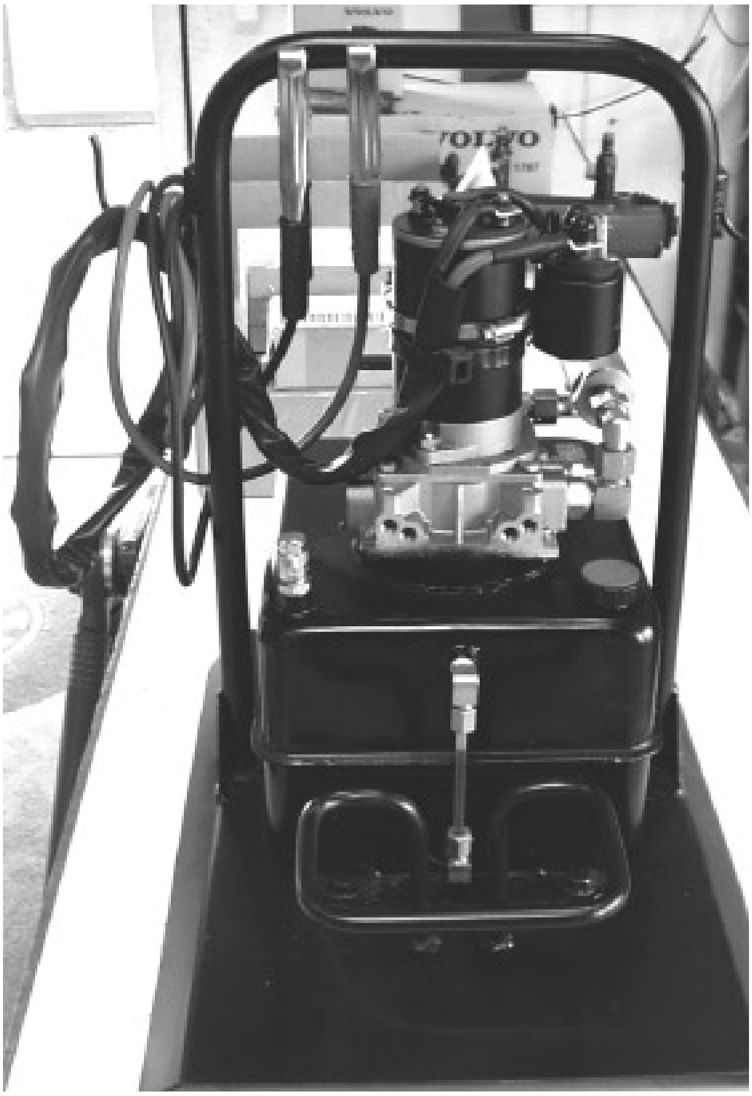
Replacement parts -index and position - steerable axle



Pos.	Qty.	Description	Id. no.	Remarks
1	1	Cylinder (main)	10A0187	
2	1	Bracket for cylinder	11A0251	
3	1	Steering arm	10A0362	
4	1	Ball joint 1:6	V3987648	
5	1	Lock nut	V981586	
6	1	Ball joint 1:6	V3092471	
7	3	Nut	V10506	
8	4	Split pin - 4x32mm	70AN8904032	
9	1	Intermediate pipe for ball joint	11A0252	
10	2	Jubilee clip	V1695141	
11	2	Bolt	V1698048	
12	2	Nut	V1695142	
13	1	Banjo throttle valve	01PTFA4-1/4	
14	1	Banjo throttle valve	01PFTA4-PB	
15	1	L cable gland	011/4MRO434	

Pos.	Qty.	Description	Id. no.	Remarks
16	1	Quick fitting	01F4PB8-1fi4	
17	1	Angle nipple	1fi4CD43BL	
18	1	Raufoss quick cable gland ¼« x 8mm	62LFRM0814	
19	1	Angle nipple	1fi4CD43BL	
20	1	Raufoss quick cable gland ¼« x 8mm	62LFRM0814	
21	1	Hyd. hose 3fi8« x 670	69HS0650	
22	1	Hyd. hose 3fi8« x 665	69HS0660	
23	1	Rubber gaiter for cylinder	35V6-69	
24	2	Strips	40EV1770	
25	8	Nut - M8	V1568477	
26	2	Nut - M10	6377M10-4	
27	4	Cable holder	10A0361	
28	1	Bracket for the brake distributor	10A0344	
29	1	Spiralflex	13SFP15	
30	2	Banjo nipple - M18 x 1.5fi15	V977998	
31	2	Test nipple - M12 x 1.5	V1594061	
32	2	Nipple	V968697	
33	0.43	Nylon pipe - 12mm	69PR12	
34	0.38	Nylon pipe - 12mm	69PR12	
35	5	Angle nipple	V977772	
36	2	Brake hose	V1075004	
37	2	Cable gland	V976282	
38	4	Cable gland	V968697	
39	2	Cable gland	V976452	
40	4	Groove	V976446	
41	2	Rubber hose	V943366	
42	6	Rubber holder	V8143276	
43	2	Cable gland	V968696	
44	2	Cable gland	V976445	
45	2	Flange bolt - 8x16	V946440	
46	2	Nipple	V968697	
47	2	Cable gland	V978269	
48	3	Flange bolt - 12x40	V965192	
49	3	Flange nut - 12	V977938	

Bleeding equipment



For usein the bleeding of hydraulic systems on trucks with hydraulically steered axles OA Opbyg AS can offer this complete set of equipment, including all hoses and fittings required.

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