

SERVICE MANUAL

COMPRESSOR WITH HIGH TORQUE CLUTCH
MAN APPLICATION



TRUCKSERVICES

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SAFETY AND ENVIRONMENT GUIDELINES

Safety and Environmental Guidelines for Knorr-Bremse Commercial Vehicle Systems products

Note:

The safety advice listed below is applicable to general service and diagnostic work on braking systems. Also observe any recommendations from the axle or vehicle manufacturer concerning towing, jacking-up and securing the vehicle.

Caution!

Knorr-Bremse is not liable for any costs and damage caused by improper installation and use of Knorr-Bremse aftermarket products, in particular in the event of (i) use in non-approved applications and/or use in non-compliance with the technical specifications and installation instructions, (ii) incorrect installation or removal of Knorr-Bremse aftermarket products and (iii) failure to observe instructions on the use of tools.

In addition to product-specific installation and hazard warnings, the following precautions and additional hazard warnings must be observed before and during work on and around compressed air systems:

1. Always wear safety glasses when working with air pressure.
2. Never exceed the vehicle manufacturer's recommended air pressures.
3. Never look into air jets or direct them at anyone.
4. Never connect or disconnect a hose or line containing pressure; it may whip as air escapes.
5. When removing or servicing a product, ensure all pressure related to the specific system it is contained in has been depleted to 0 bar. Be aware that if the vehicle is equipped with an air dryer system, it can also contain air pressure along with its purge reservoir, if fitted, even after pressure has been drained from the other reservoirs.
6. If it is necessary to drain the air pressure from reservoirs, etc., keep away from brake actuator push rods and levers since they may move as system pressure drops. On vehicles fitted with air suspension, it is advised when undertaking such work, to support the chassis from sudden lowering and therefore prevent any possibility of being trapped between the chassis and axle or ground.
7. Park the vehicle on a level surface, apply the parking brakes, and always chock the wheels as depleting vehicle air system pressure may cause the vehicle to roll.
8. When working under or around the vehicle, and particularly when working in the engine compartment, the engine should be shut off and the ignition key removed. Where circumstances require that the engine be running, **EXTREME CAUTION** should be taken to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components. Additionally, it is advisable to place a clear sign on or near the steering wheel advising that there is **WORK IN PROGRESS ON THE VEHICLE**.
9. When working on vehicles equipped with air suspension, to guard against injury due to unexpected downward movement of the chassis caused by sudden pressure loss in the suspension system, ensure that the vehicle chassis is mechanically supported with a 'prop' between the chassis and the axle or between the chassis and the ground.
10. Examine all pipework for signs of kinks, dents, abrasion, drying out or overheating. Be aware that kinks in pipework may result in air pressure being trapped in the pipework and associated equipment. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems. Check the attachment of all pipework; it should be installed so that it cannot abrade or be subjected to excessive heat. Only use tools specially designed for cutting pipes in order to prevent incorrect cutting and, in particular, to avoid shavings remaining in the pipes or other impurities which may later lead to leaking connections and subsequent malfunctions of the system.
11. Components with stripped threads or damaged/corroded parts must be replaced completely. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle or component manufacturer.
12. Never attempt to install, remove, disassemble or assemble a device until you have read and thoroughly understood the recommended procedures. Some units contain powerful springs and injury can result if not properly dismantled and reassembled. Use only the correct tools and observe all precautions pertaining to use of those tools.
13. Before removing any device note its position and the connections of all pipework so that the replacement/serviced device can be properly installed. Ensure that adequate support or assistance is provided for the removal/installation of heavy items.
14. We highly recommend to use only genuine replacement parts, components, and kits as supplied by Knorr-Bremse or the vehicle manufacturer containing original Knorr-Bremse parts. Knorr-Bremse will not be liable for any issues arising from the usage of non-Knorr-Bremse products. Only use the recommended tools as specified in related Knorr-Bremse instructions.

SAFETY AND ENVIRONMENT GUIDELINES

15. The serviced or replaced product must be checked for correct function and effectiveness.
16. If products have been dismantled, serviced or replaced, whose performance could affect braking performance or system behaviour, this should be checked on a roller dynamometer. Bear in mind that a lower performance may be experienced during the bedding-in phase if new brake pads/linings and/or brake discs/drums have been fitted.
17. The use of impact screwdrivers or impact wrenches in conjunction with Knorr-Bremse service tools for air disc brakes is not permitted. The service tools are not designed for such use. It is likely that the tools or the vehicle will be damaged and there is a serious risk of injury – see Caution on previous page.
18. Do not use compressed air to clean the disc brake. Avoid air contamination of brake dust.
19. Prior to returning the vehicle to service, make certain that all components and the complete brake systems are leak free and restored to their proper operating condition.
20. During service work on vehicles with electronic parking brake, service or parking brake, or bus stop temporary hold brake, the brake system must be set to service and maintenance mode. Please also observe the instructions of the vehicle manufacturer.

Welding

To avoid damage to electronic components when carrying out electrical welding, the following precautions should be observed:

1. In all cases, before starting any electrical welding, remove all connections from any electronic control units or modules, noting their position and the order in which they are removed.
2. When re-inserting the electrical connectors (in reverse order) it is essential that they are fitted to their correct assigned position - if necessary this must be checked by PC Diagnostics.

Disposal of Waste Equipment by Business Users in the European Union



This symbol on the product, packaging or in user instructions, indicates that this product must not be disposed of with other general waste. Instead, it is your responsibility to dispose of the waste electrical and electronic parts of this product by handing them over to a company or organisation authorised for the recycling of waste electrical and electronic equipment. For more information about arrangements for waste equipment disposal please contact your Knorr-Bremse distributor or local Knorr-Bremse representative.

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Note: If service work is carried out on a vehicle based on information provided herein, it is the responsibility of the workshop to ensure the vehicle is fully tested and in full functional order before the vehicle is returned into service. Knorr-Bremse accepts no liability for problems caused as a result of appropriate tests not being carried out.

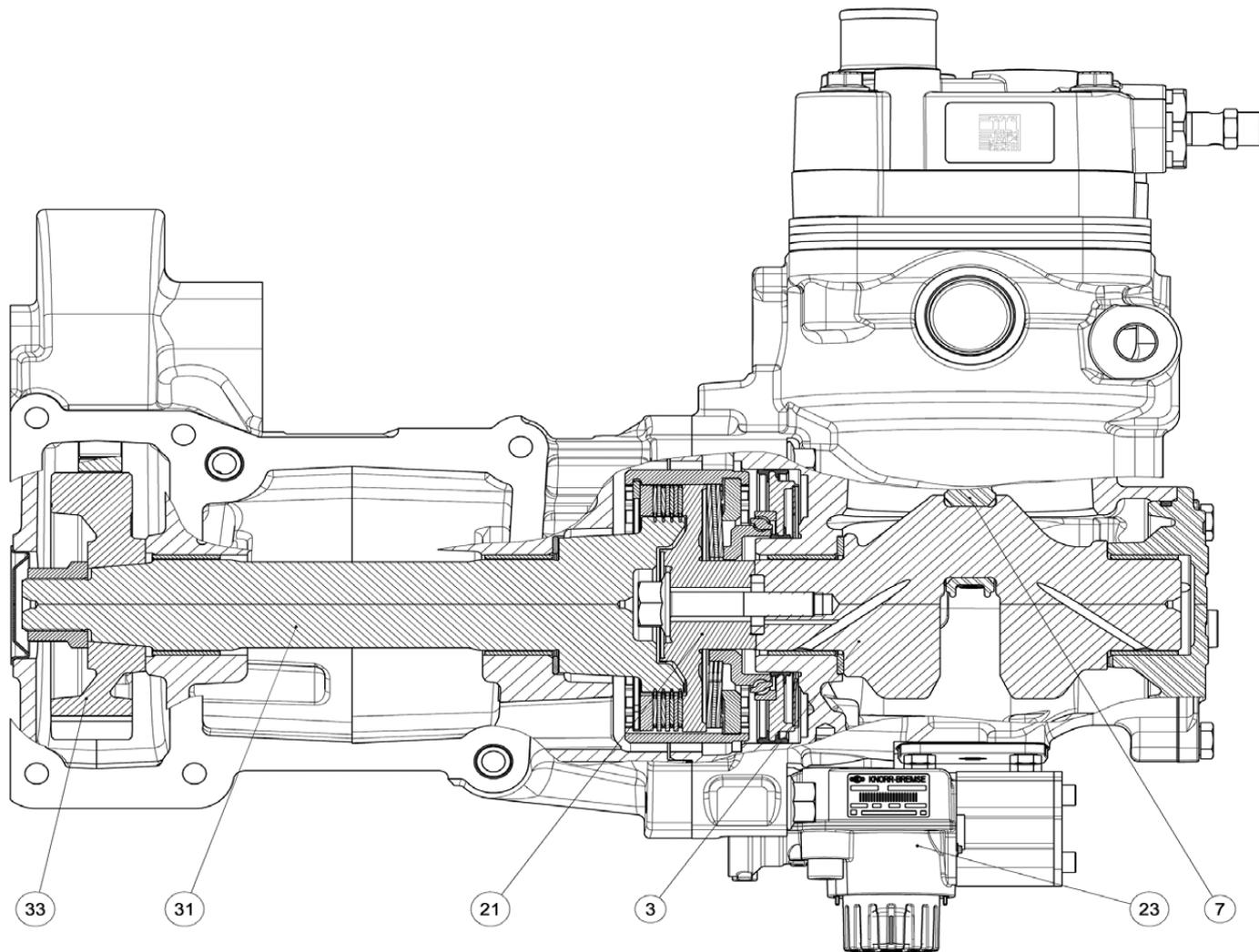
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Revision Details		
Rev. 001	July 2017	New tools and work process + new layout throughout
Rev. 002	September 2023	Updated content and lay-out
Rev. 003	October 2023	Added chapter 4.2.16

1 DESCRIPTION AND FUNCTION

1.1 Sectioned view

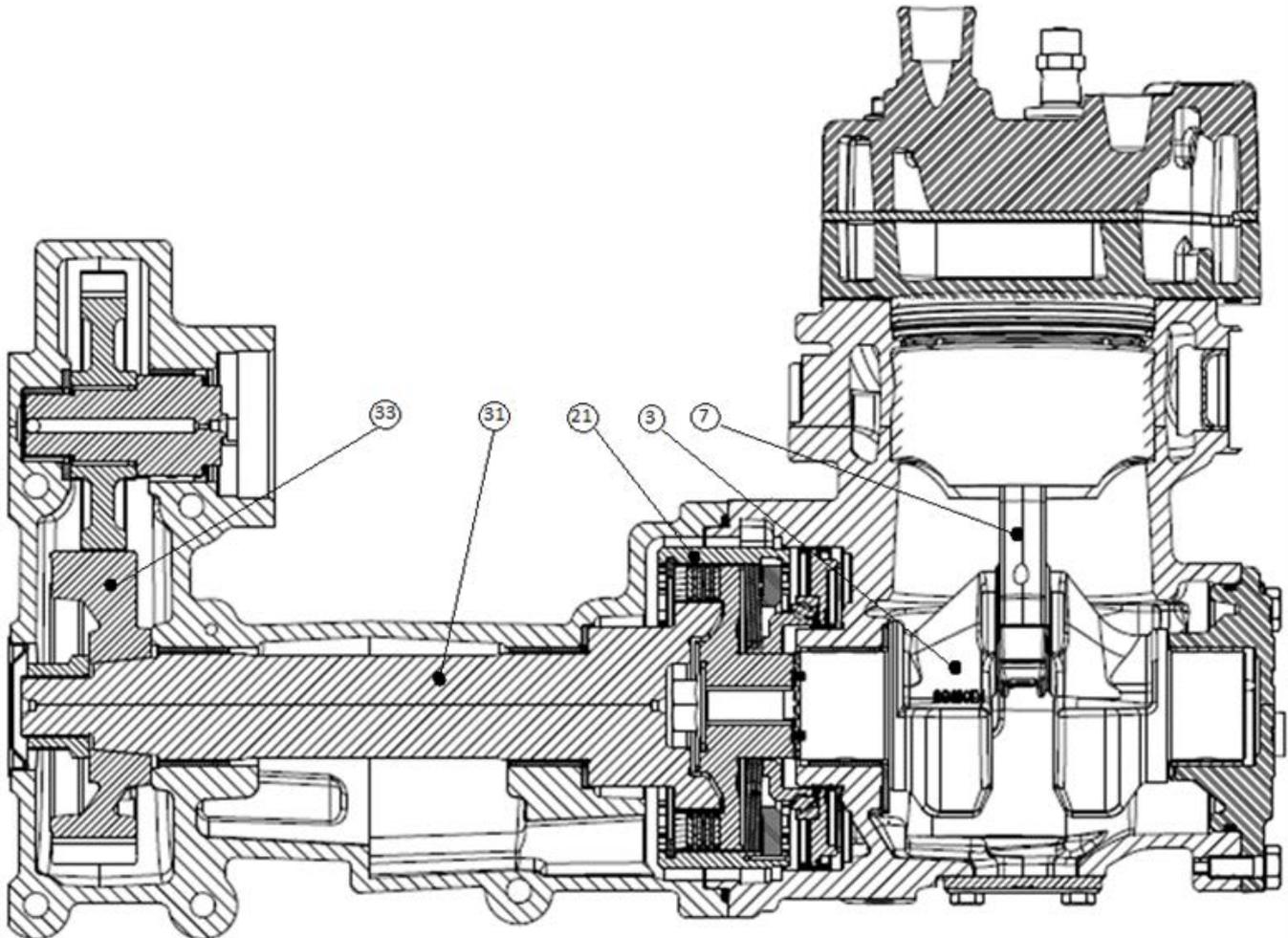
LS3907 version



Legend

- 3 Crankshaft
- 7 Connecting rod
- 21 Clutch
- 23 Solenoid valve (Luka only)
- 31 Driveshaft
- 33 Drive gear

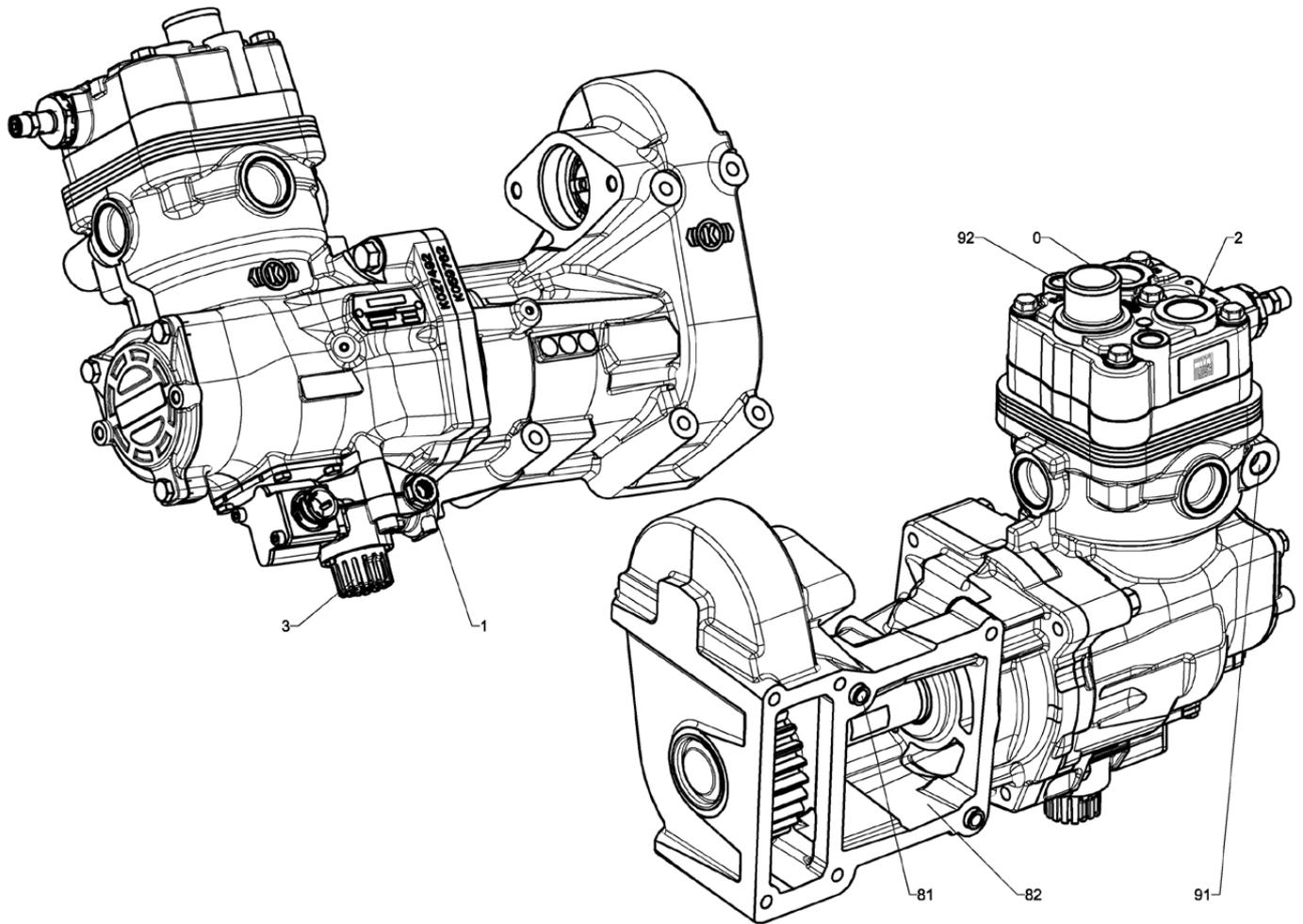
LS3909 version

**Legend**

- 3 Crankshaft
- 7 Connecting rod
- 21 Clutch
- 31 Driveshaft
- 33 Drive gear

1 DESCRIPTION AND FUNCTION

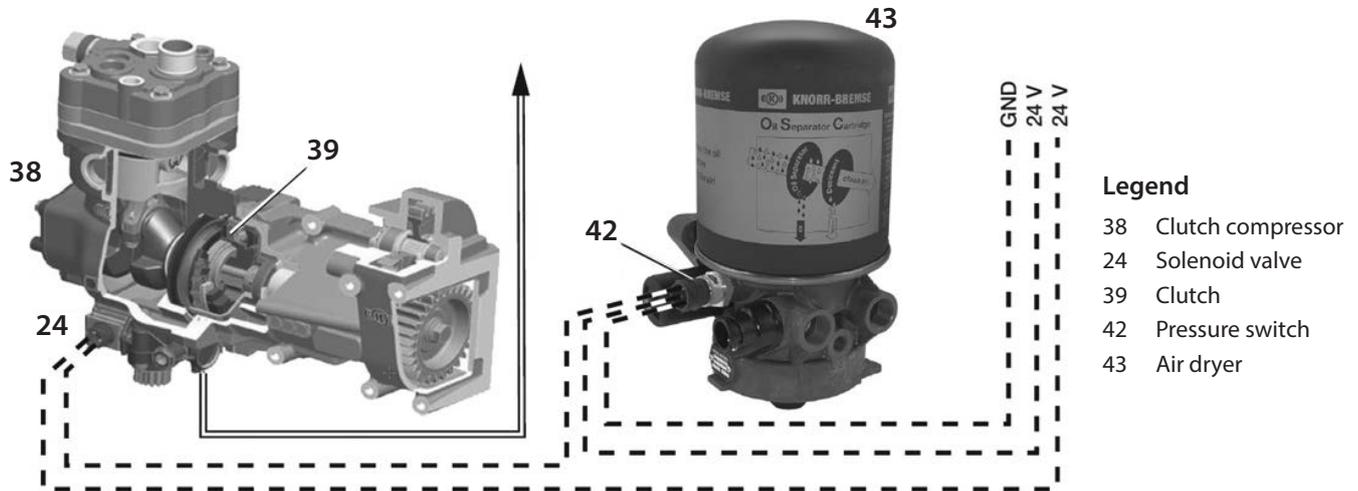
1.2 Fluid connections



Legend

- | | | | |
|---|---|----|--------------------------------|
| 0 | Air intake connector | 81 | Lubricant feed |
| 1 | Clutch actuation Energy feed (solenoid valve) | 82 | Window for lubricant discharge |
| 2 | Air discharge (pressure line) | 91 | Coolant feed |
| 3 | Venting (solenoid valve) | 92 | Coolant discharge |

1.3 Components and function description



Construction (see also Section 2.3)

The compressor with clutch consists of the drive unit (37), the clutch (complete) (39), and the compressor unit (38).

The drive gear (33) is connected to the engine and transfers the torque to the driveshaft (32). The driveshaft runs in sliding bearings and is connected to the clutch (22) via the splines, the clutch is toothed on its interior.

The clutch (22) is screwed onto the crankshaft (3) and is controlled using the actuation piston (20). The actuation piston (20) seals compressed air on the one side and oil on the other.

The crankshaft drive, consisting of the crankshaft (3) and connecting rod (7), converts the rotary movement into an up-and-down movement. The force is transmitted through the piston pin to the piston (8), which slides up and down in the cylinder bore.

The cylinder bore and cylinder cover (17) are water-cooled.

Function (see Section 1.2)

Delivering phase

As the piston moves downwards, the intake reed (13) on the valve plate opens and ambient air flows in through intake connection 0. Once the piston reaches its lowermost position (lower dead point = LDP), the intake reed closes, and the piston starts its upwards movement. During the upwards movement, the air is compressed in the ever-smaller space between the piston and the valve plate.

Once a certain pressure has been achieved, the outlet reed in the valve plate (14) opens, and the compressed air is forced through pressure connection 2 into the pressure line. To lubricate the bearings, the compressor is connected to the oil circulation of the engine through lubrication oil intake 81 and outlet 82. Oil channels in the housing and in the crankshaft allow the lubricating oil to reach the sliding and connecting rod bearings.

The other bearing points are lubricated by sprayed oil or the oil mist in the crankcase. The cooling water flows through connection 91 into the cooling chamber of the cylinder, the cylinder cover (17) and the valve plate (14), so that the heat generated during compression process can be transferred through the walls and the cooling plate (16) into the cooling water. The coolant leaves the cylinder cover through connection 92.

Clutch opens

Once the cut-out pressure is achieved, connection 4/2 of the air dryer (43) is vented. The pressure switch (42) trips and the solenoid (23) is activated (LS3907 only). The actuation piston (20a) is vented and presses the release bearing (20b) against the clutch (22). The clutch (22) breaks the connection between the driveshaft (32) and the crankshaft (3). The entire crankshaft drive and the piston are no longer driven.

Clutch closes

If the pressure in the system falls below the cut-in pressure of the pressure regulator, the pressure switch interrupts the actuation of the solenoid (LS3907 only). The actuation piston (19) is vented. The clutch (22) closes and the compressor delivers air again.

2 GENERAL SPECIFICATIONS

2.1 Instructions for service and repair measures

Flow diagrams within chapter 3 are shown depicting an efficient procedure to carry out any maintenance and service tasks required. The diagrams are supplemented by the points in chapter 4. If a reference is listed, it should also be considered.

By the design of the service manual, service personnel are guided to damages based on their effort and probability.

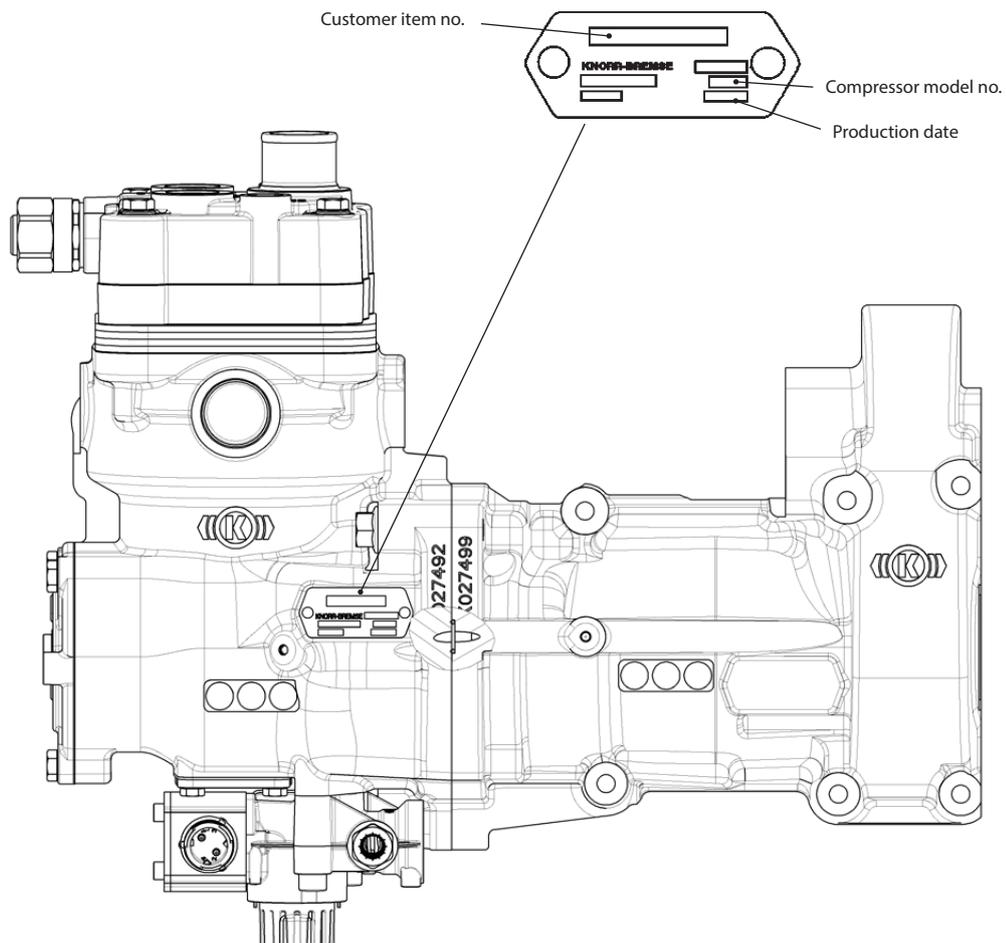
After each repair action, the error-free function of the system must be checked to see whether the error has been corrected. The condition of the compressor with clutch depends primarily on its peripherals. This means that the air filters, intake lines, pressure lines, any leaks in the system, oil quality, oil pressure and the cooling system of the compressor must be in error-free condition.

The service and oil change intervals specified by the vehicle manufacturer must strictly be followed.

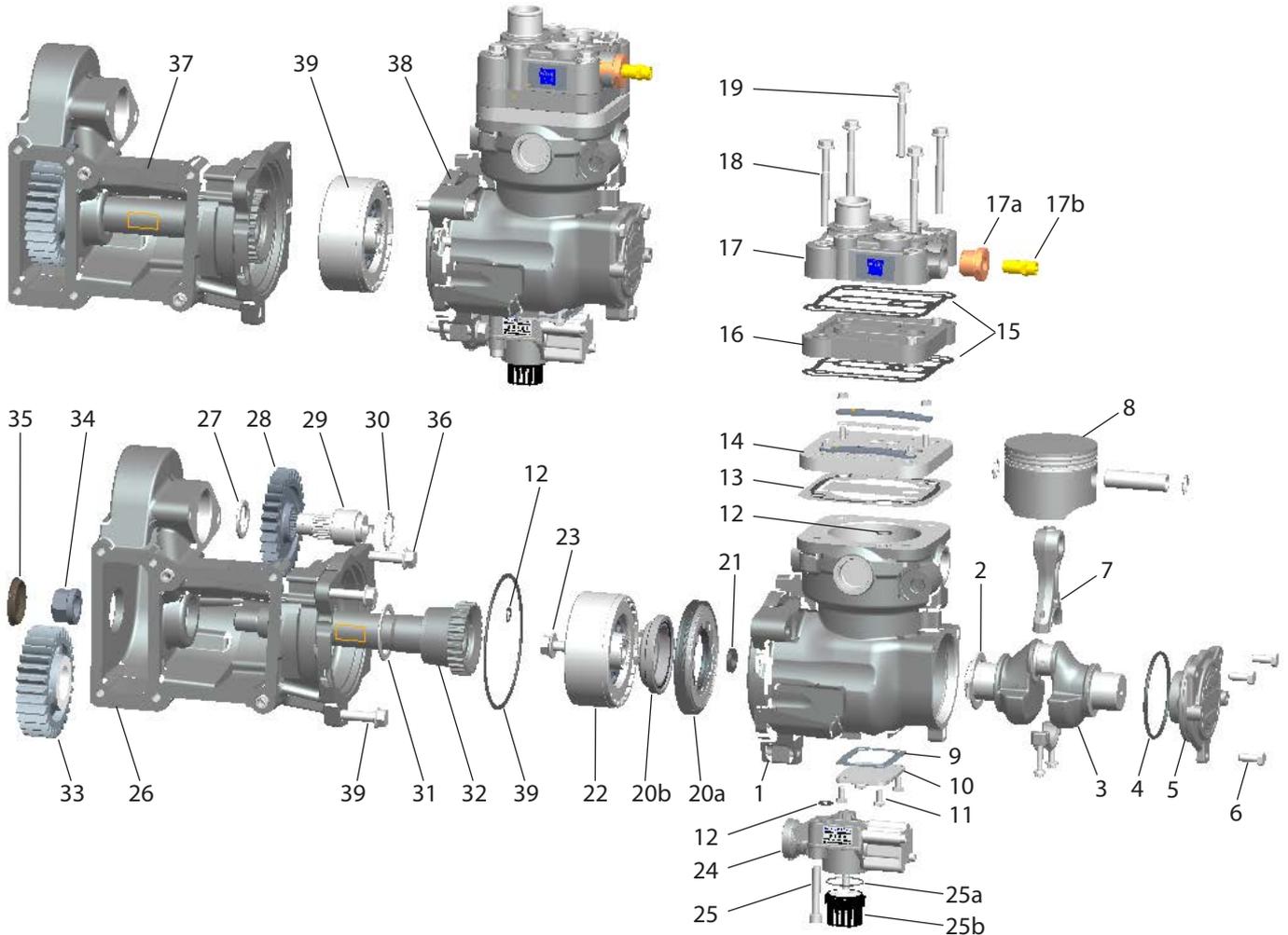
The function of the clutch (22) is checked by filling the system until the cut-out pressure is reached. After the compressor drive is disconnected at the clutch and regeneration is complete, no compressed air should emerge from the ventilation of the air dryer.

Follow the specifications of the vehicle manufacturer for the cut-in and cut-out pressure.

2.2 Identification



2.3 Service kits



Legend

- | | | |
|---------------------------|-------------------------|---|
| 1 Compressor Crankcase | 17a Adaptor | 30 Sensing ring |
| 2 Thrust washer | 17b Safety valve | 31 Thrust washer |
| 3 Crankshaft | 18 Hex screw (4/5x) | 32 Driveshaft |
| 4 O-ring (bearing cover) | 19 Hex screw (1x) | 33 Drive gear |
| 5 Bearing cover | 20a Actuation piston | 34 Flanged nut |
| 6 Hex screw (3x) | 20b Release bearing | 35 Plug |
| 7 Connecting rod | 21 Sealing ring | 36 Hex screw (3x) |
| 8 Piston | 22 Clutch | 37 Drive unit |
| 9 Crankcase seal | 23 Hex screw | 38 Compressor unit |
| 10 Crankcase cover | 24 Solenoid valve | 39 Clutch pack |
| 11 Hex screw (4x) | 25 Inner hex screw (2x) | 42 Pressure switch (not shown in drawing) |
| 12 O-ring (3x) | 25a O-ring) | 43 Air dryer (not shown in drawing) |
| 13 Intake reed | 25b Silencer | 44 Power steering pump (not shown in drawing) |
| 14 Valve plate | 26 Drive unit case | 45 Engine (not shown in drawing) |
| 15 Steel bead gasket (2x) | 27 Thrust washer | |
| 16 Cooling plate | 28 Output gear | |
| 17 Cylinder cover | 29 Ouput shaft | |

2 GENERAL SPECIFICATIONS

Compressor unit module

No.	Designation	Content (item no.)
1.0	Compressor unit complete	38
1.1	Cylinder head	12, 13, 15 (2x), 16, 17, 17a, 17b, 18 (4/5x), 19
1.2	Piston	8, 9, 11, 12 (2x), 13, 15 (2x), 18 (4/5x), 19
1.3	Valve plate	12, 13, 14, 15 (2x), 18 (4/5x), 19
1.4	Safety valve	17a, 17b

Solenoid valve / pressure switch for LS3907 only

No.	Designation	Content (item no.)
3.1	Solenoid valve	12, 24, 25(x2), 25a, 25b
3.2	Pressure switch	42
3.3	Silencer	25a, 25b

Drive unit module

No.	Designation	Content (item no.)
2.1	Drive unit with clutch complete	12, 20, 21, 22, 23, 37, 39
2.2	Gear kit	12 (x1), 27, 28, 29, 30, 33, 34, 35, 36(x3), 39
2.3	Clutch pack kit	20, 21, 22, 23

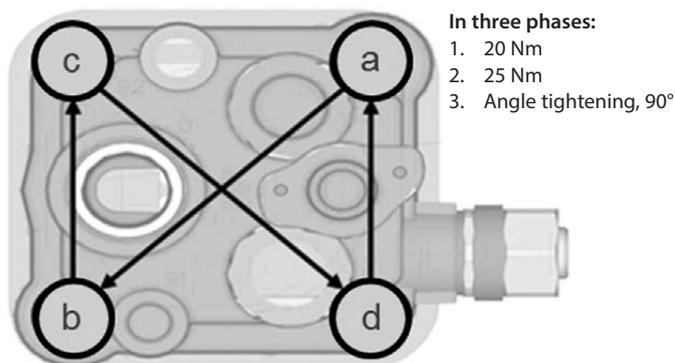
Seals

No.	Designation	Content (item no.)
4	Seal set complete	04, 06 (3x), 09, 11 (4x), 12 (3x), 13, 15 (2x), 18 (4x), 19, 25 (2x), 30, 35, 36 (3x), 39

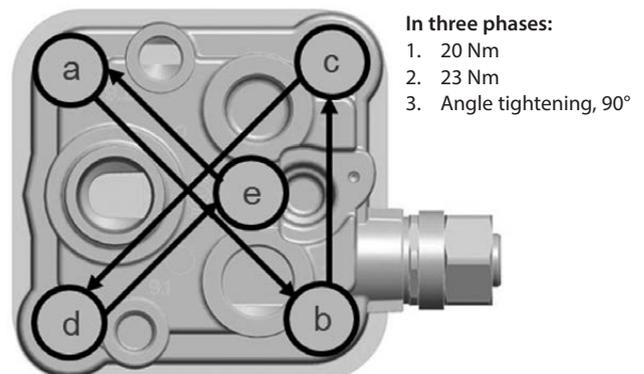
2.4 Tightening torques

Item no.	Quantity	Installation location	Tightening torque	Wrench size
18 + 19	4+1	Cylinder cover	See figures below *	13 mm (hexagon)
17a + 17b	1+1	Safety valve on cylinder cover	65Nm / 23Nm	32mm/15mm(hexagon)
25	2	Solenoid valve	25Nm	6 mm (inner hex)
7	2	Connecting rod	13Nm	8 mm (outer star)
36	3	Connection between compressor and drive housing	50Nm	16 mm (hexagon)
34	1	Nut for drive gear	40Nm +90°	30 mm (hexagon)
23	1	Clutch fastening	15Nm +60°	18 mm (hexagon)
11	4	Crankcase cover	12Nm	10 mm (hexagon)

Tightening sequence for cylinder head with 4 hex bolts



Tightening sequence for cylinder head with 5 hex bolts



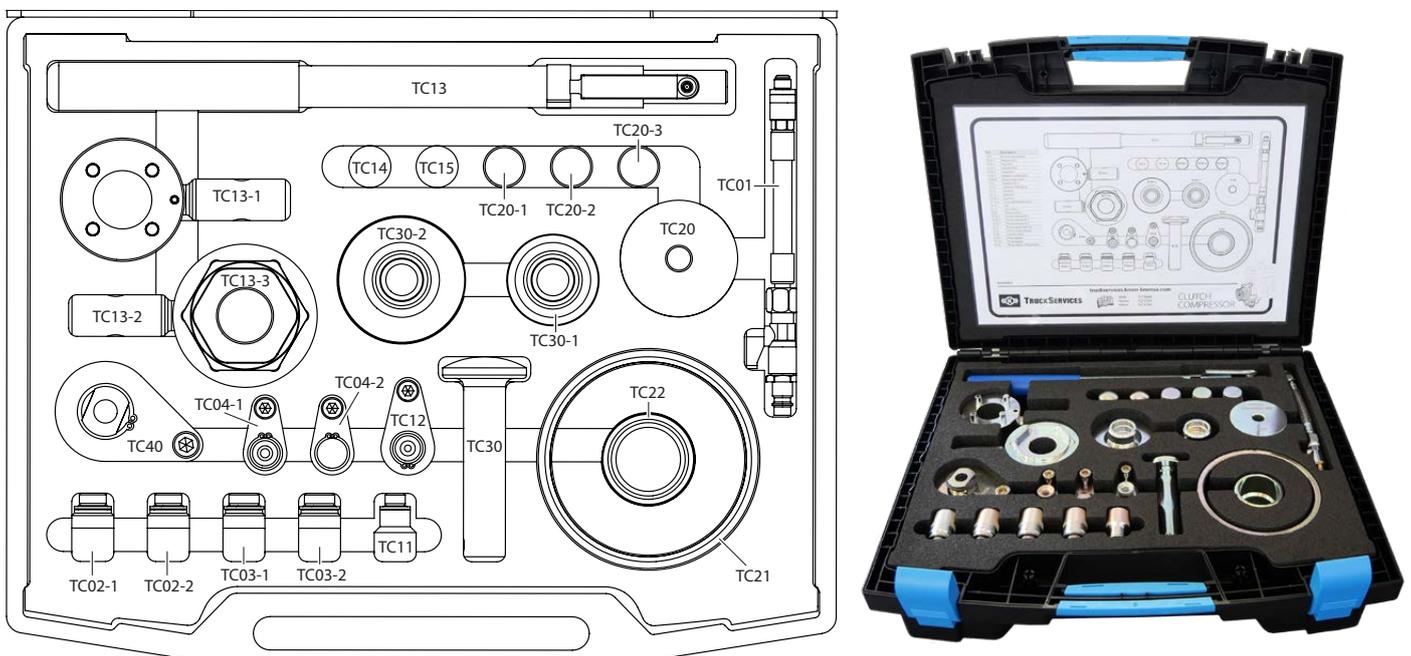
2.5 Lubricants and sealants

Additional recommendation

Product	Purpose of usage
Loctite 5900	To seal the connection between the compressor with clutch and the engine

2.6 Special tools

Compressor Tool Case: K052066K50



TC02-1 / TC02-2 / TC03-1 / TC03-2 / TC11 / TC04-1 / TC04-2: Adaptors to test the tightness of the Compressor

TC12: Adaptor for ventilating the clutch

TC40: Pressing-in tool for installing the retaining ring including backing plate for fastening the drive gear

TC30 / TC30-1 / TC30-2: Pressing-in tool for housing cover

TC21 / TC22: Installation aid for actuation piston

TC01: Ventilating hose

TC20 / TC20-1 / TC20-2 / TC20-3: Protective mechanism for pressing out the actuation piston

TC14: Pressing-out tool for gear support

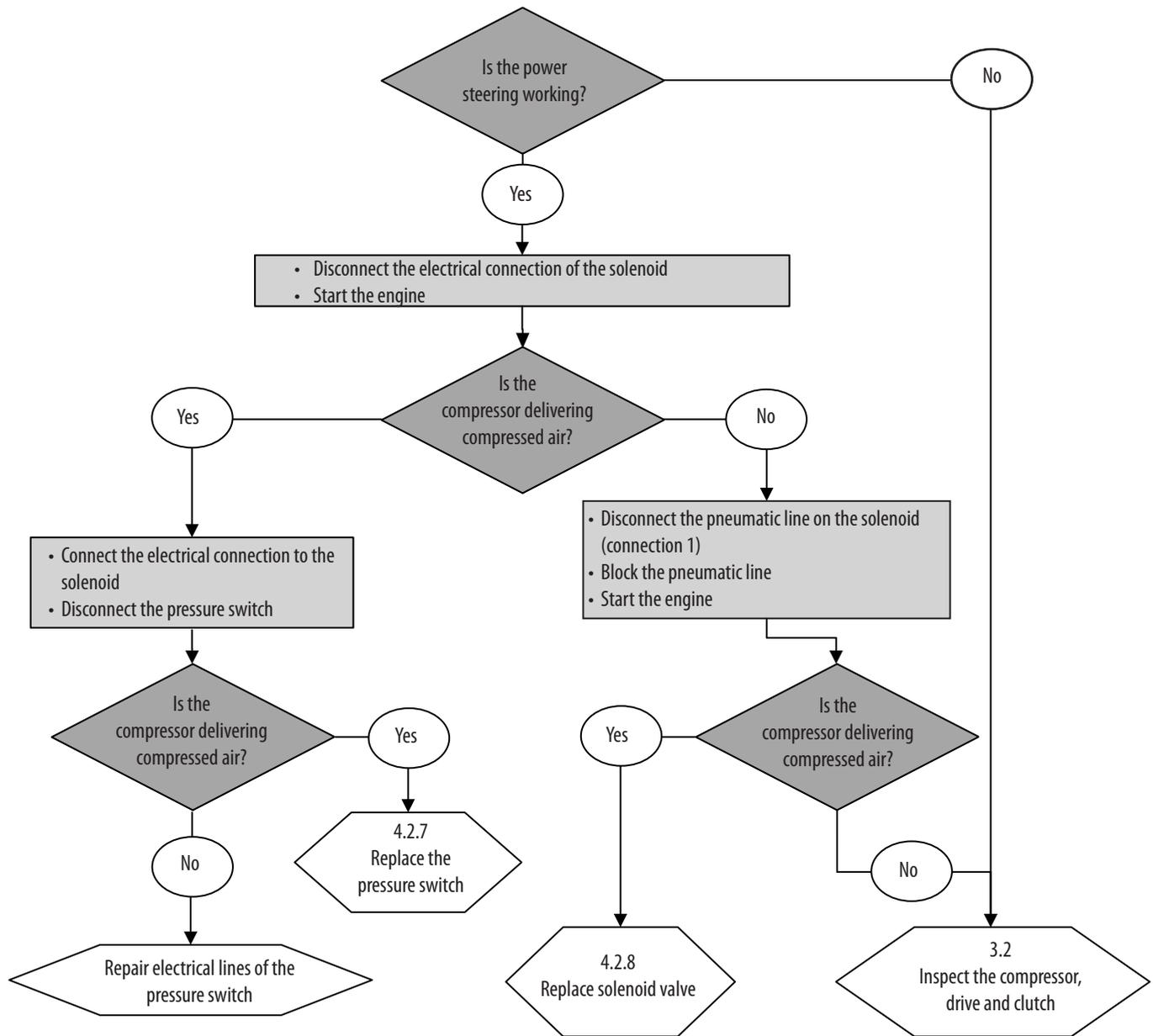
TC13 / TC13-1 / TC13-2 / TC13-3: Socket wrench for installation of the clutch

TC15: Pin punch

3 SERVICE PROCEDURE FLOW DIAGRAMS

3.1 Problem causes

3.1.1 Compressor isn't delivering compressed air



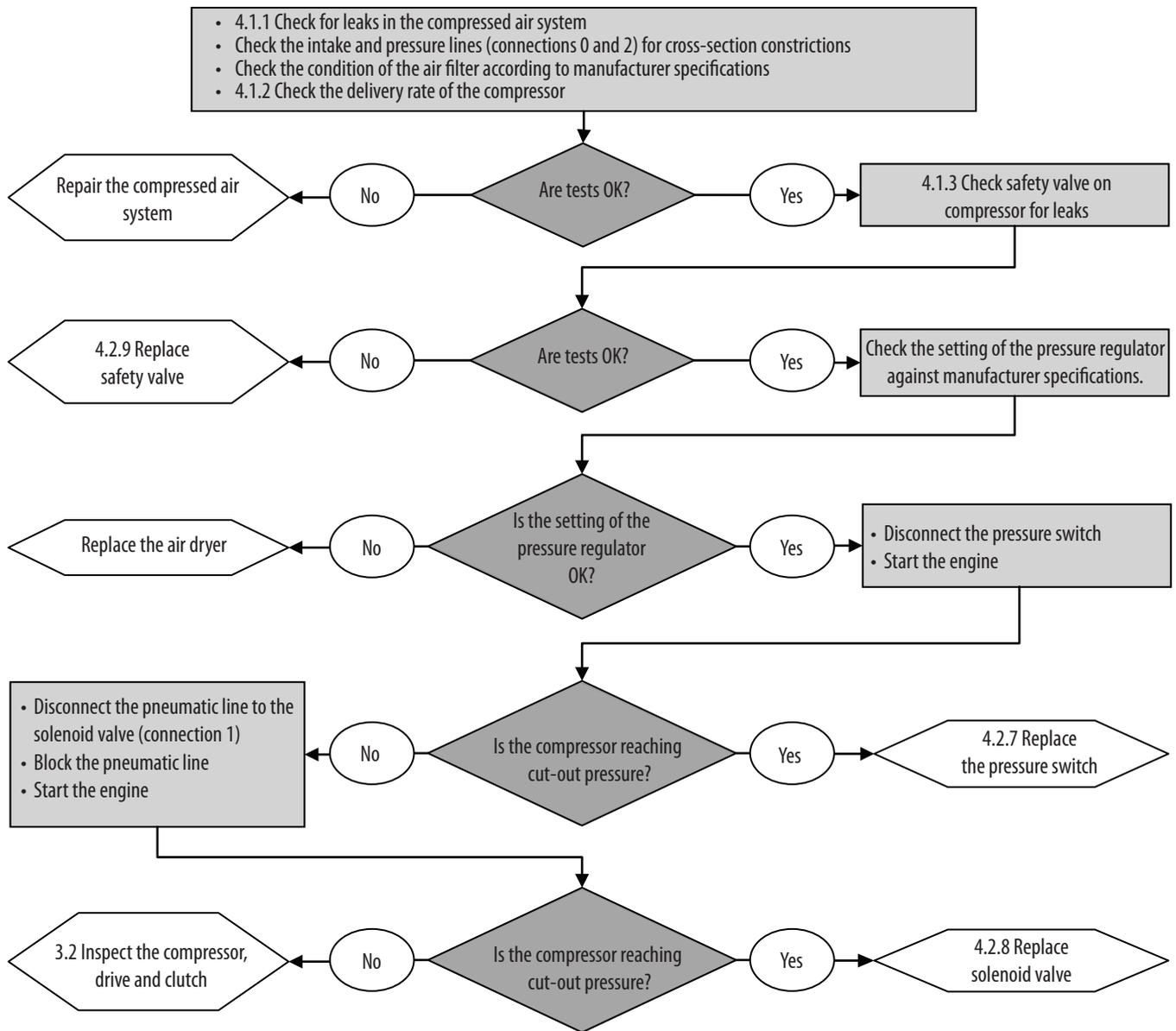
References:

- 3.2 Troubleshooting – inspection of compressor, drive and clutch. Page 25
- 4.2.7 Replacing the pressure switch – **Service kit 3.2.** Page 36
- 4.2.8 Replacing the solenoid valve – **Service kit 3.1** Page 36

Possible causes:

- Solenoid valve leaking
- Pressure switch defective
- Short circuit in line
- Mechanical failure

3.1.2 Compressor delivers air but cut-off pressure is not reached



References:

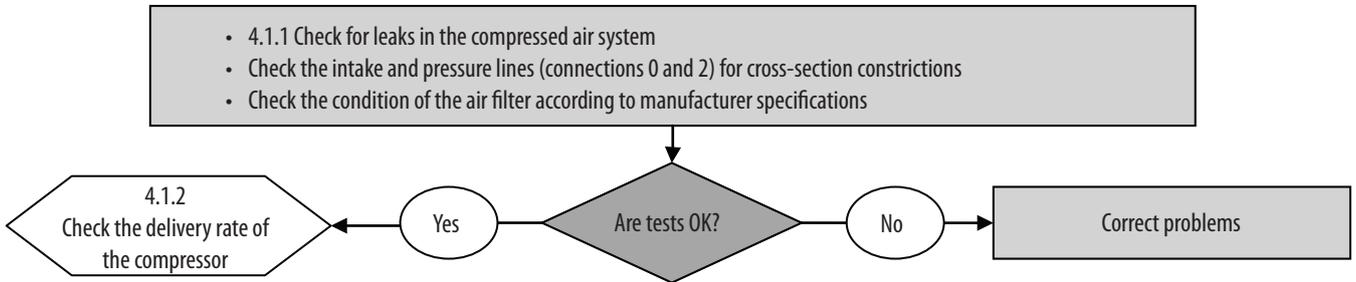
- 3.2 Troubleshooting – inspection of compressor, drive and clutch. . . Page 25
- 4.1.1 Check for leaks in the compressed air system. Page 26
- 4.1.2 Check the delivery rate of the compressor Page 26
- 4.1.3 Check the safety valve on compressor for leaks Page 27
- 4.2.7 Replacing the pressure switch – Service kit 3.2. Page 36
- 4.2.8 Replacing the solenoid valve – Service kit 3.1 Page 36
- 4.2.9 Replacing the safety valve – Service kit 1.4 Page 37

Possible causes:

- Compressed Air System Leaking
- Cross-Section Constriction In The Intake Or Pressure Line Of The Compressor
- Safety Valve On Cylinder Head Of The Compressor Leaking
- Air Dryer (Pressure Regulator) Defective
- Pressure Switch Defective
- Solenoid Valve Defective
- Mechanical Failure

3 SERVICE PROCEDURE FLOW DIAGRAMS

3.1.3 Filling the system from pressure-free state takes too long



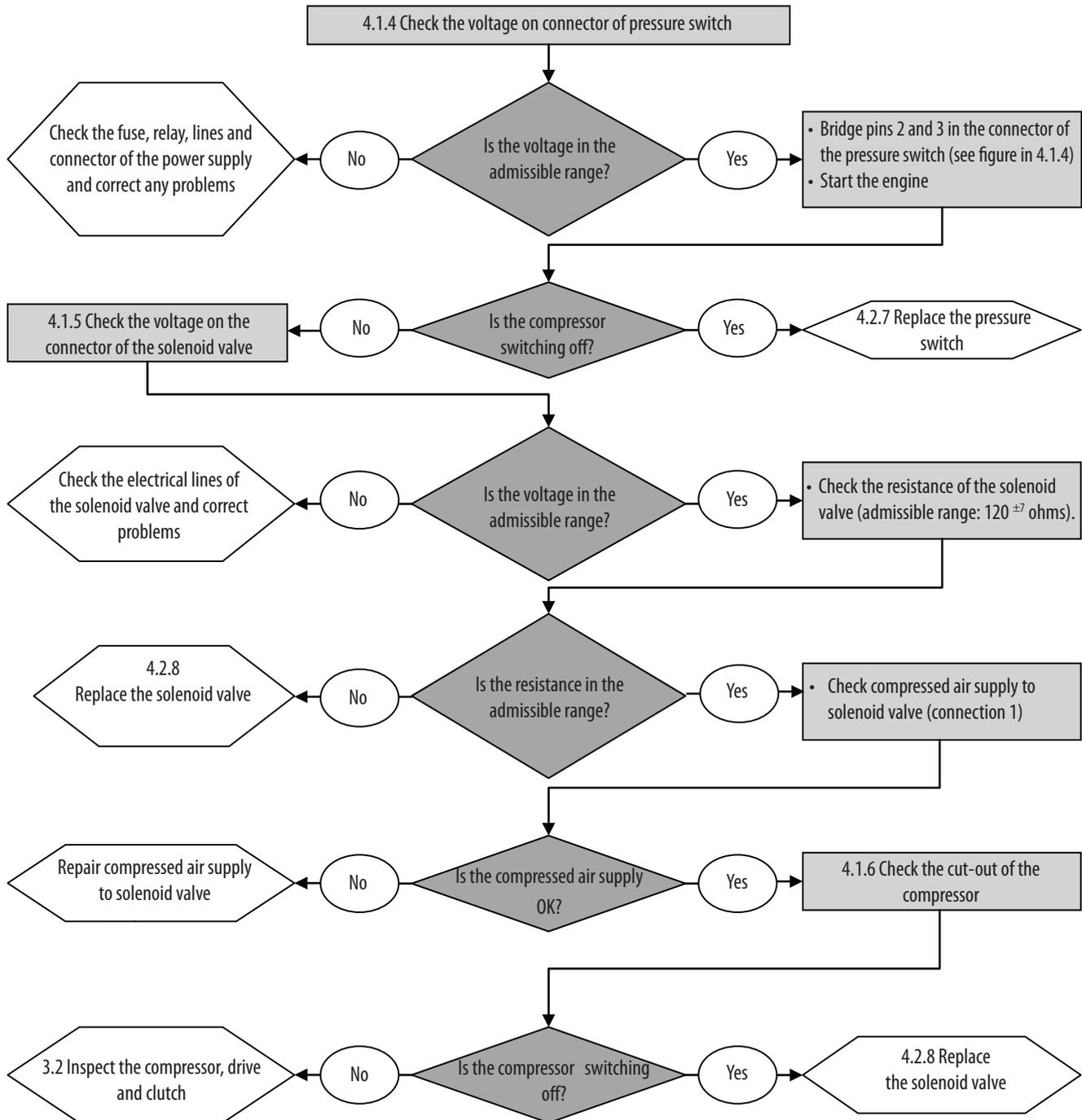
References:

- 4.1.1 Check for leaks in the compressed air system. . . . Page 26
- 4.1.2 Check the delivery rate of the compressor Page 26

Possible causes:

- Compressed air system leaking
- Cross-section constriction in the intake or pressure line of the compressor
- Safety valve on cylinder head of the compressor leaking
- Mechanical failure

3.1.4 Compressor continues to deliver compressed air even after cut-out pressure reached



References:

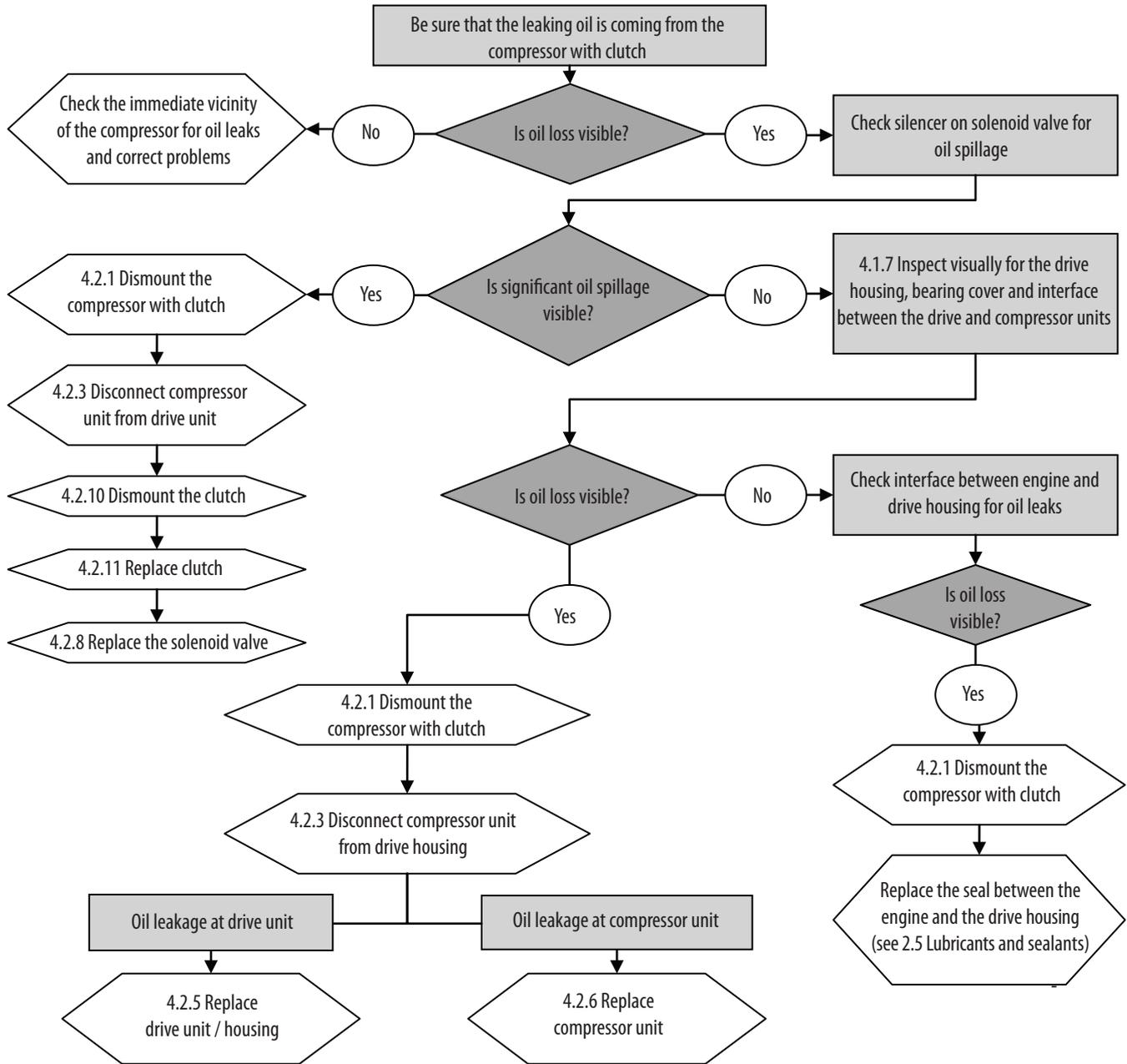
- 3.2 Troubleshooting – inspection of compressor, drive and clutch. . . .Page 25
- 4.1.4 Check the voltage on connector of pressure switchPage 27
- 4.1.5 Check the voltage on the connector of the solenoid valvePage 28
- 4.1.6 Check the cut-out of the compressorPage 28
- 4.2.7 Replacing the pressure switch – Service kit 3.2.Page 36

Possible causes:

- Power supply defective
- Pressure switch defective
- Solenoid valve defective
- Compressor air supply defective
- Mechanical failure

3 SERVICE PROCEDURE FLOW DIAGRAMS

3.1.5 Oil leakage at the compressor



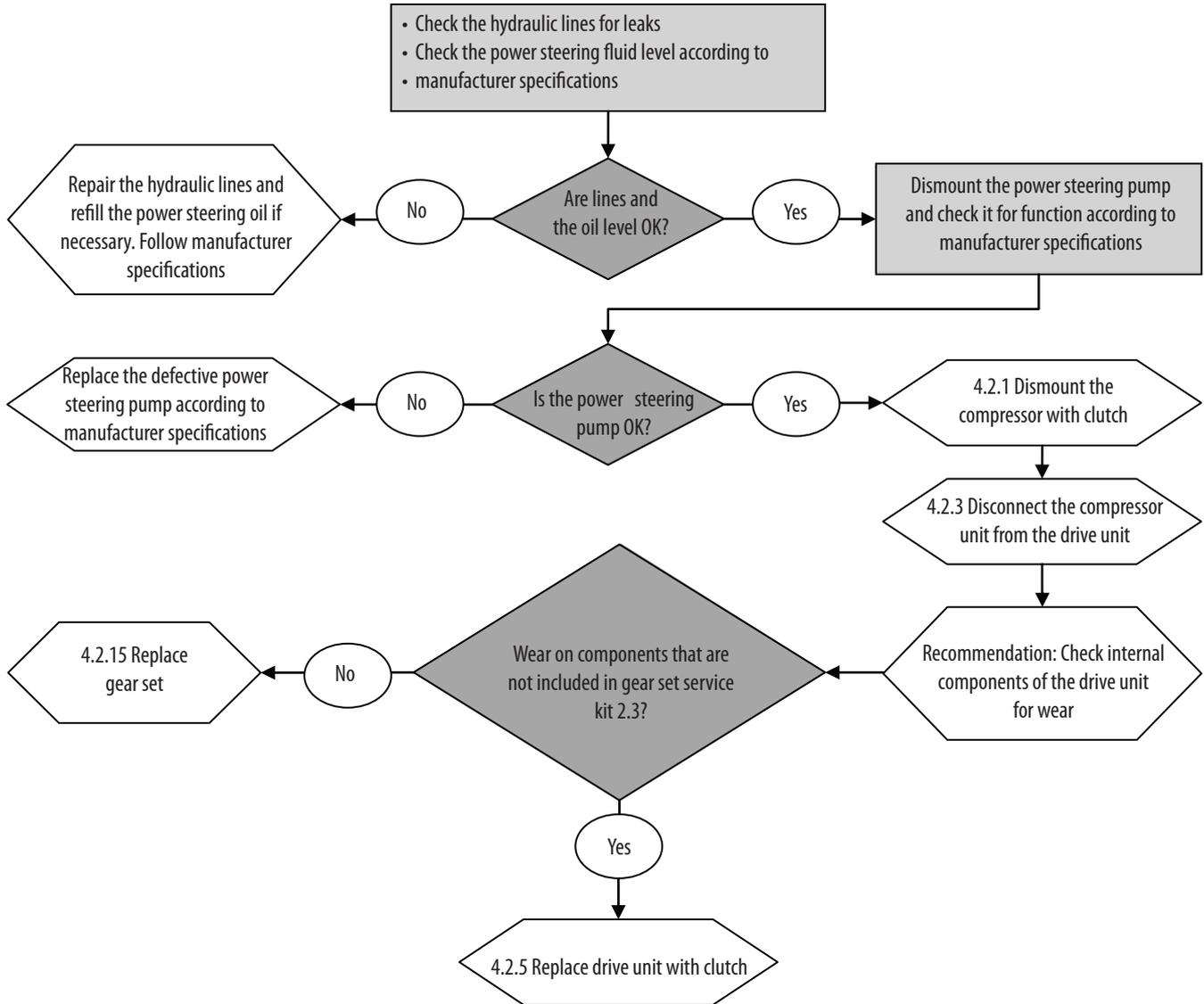
References:

- 4.1.7 Inspect visually for the drive housing, bearing cover and interface between drive housing and compressor unitPage 29
- 4.2.1 Dismount the compressor with clutchPage 32
- 4.2.3 Disconnect compressor unit from drive housingPage 33
- 4.2.5 Replacing the drive unit / housing – **Service kit 2.1**Page 35
- 4.2.6 Replacing the compressor unit – **Service kit 1.0**Page 35
- 4.2.8 Replacing the solenoid valve – **Service kit 3.1**Page 36
- 4.2.10 Dismount the clutchPage 37
- 4.2.11 Mounting (replacing) the clutch – **Service kit 2.3**Page 39

Possible causes:

- Actuation piston leaking
- Bearing cover O-ring leaking
- Leaks in engine/compressor interface
- O-ring between drive housing and compressor unit leaking
- Oil duct sleeve

3.1.6 System reaches cut-out pressure but there is no power steering support



References:

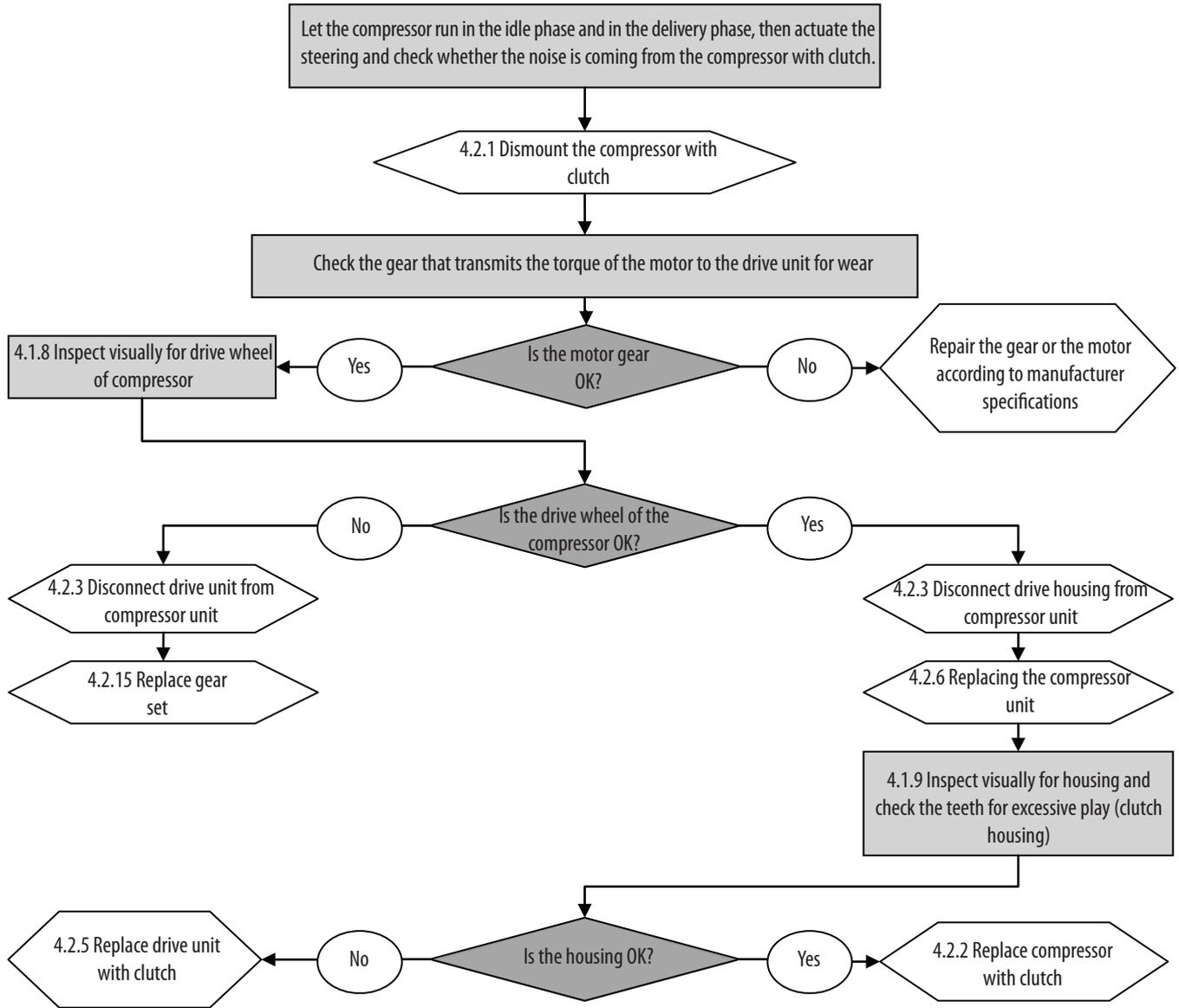
- 4.2.1 Dismount the compressor with clutchPage 32
- 4.2.3 Disconnect compressor unit from drive housingPage 33
- 4.2.5 Replacing the drive unit with clutch – **Service kit 2.1**Page 35
- 4.2.15 Replacing the gear set – **Service kit 2.2**Page 48

Possible causes:

- Hydraulic line defective
- Power steering pump defective
- Wear in internal components of the drive unit
- Drive unit defective

3 SERVICE PROCEDURE FLOW DIAGRAMS

3.1.7 Noise (mechanical)



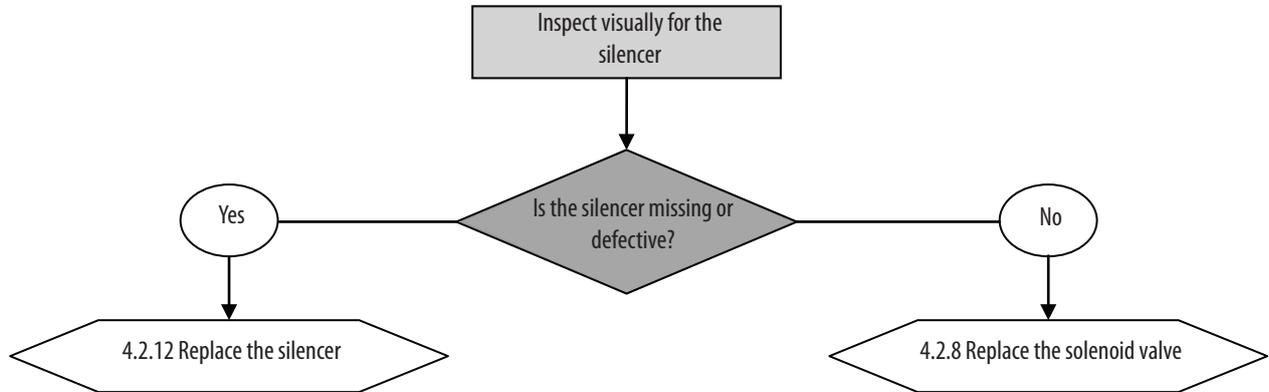
References:

- 4.1.8 Inspect visually for drive wheel of compressorPage 29
- 4.1.9 Inspect visually for housing and check the teeth for excessive play (clutch housing)Page 30
- 4.2.1 Dismount the compressor with clutchPage 32
- 4.2.2 Mount (replace) compressor with clutchPage 32
- 4.2.3 Disconnect drive housing from compressor housing.Page 33
- 4.2.5 Replacing the drive unit with clutch – **Service kit 2.1**Page 35
- 4.2.6 Replacing the compressor unit.Page 35
- 4.2.15 Replacing the gear set – **Service kit 2.2**Page 48

Possible causes:

- Gear fastening defective or increased play in gear on driveshaft with clutch housing
- Contact between housing and clutch (increased bearing play)
- Increased play in clutch

3.1.8 Noise (pneumatic; loud ventilation)



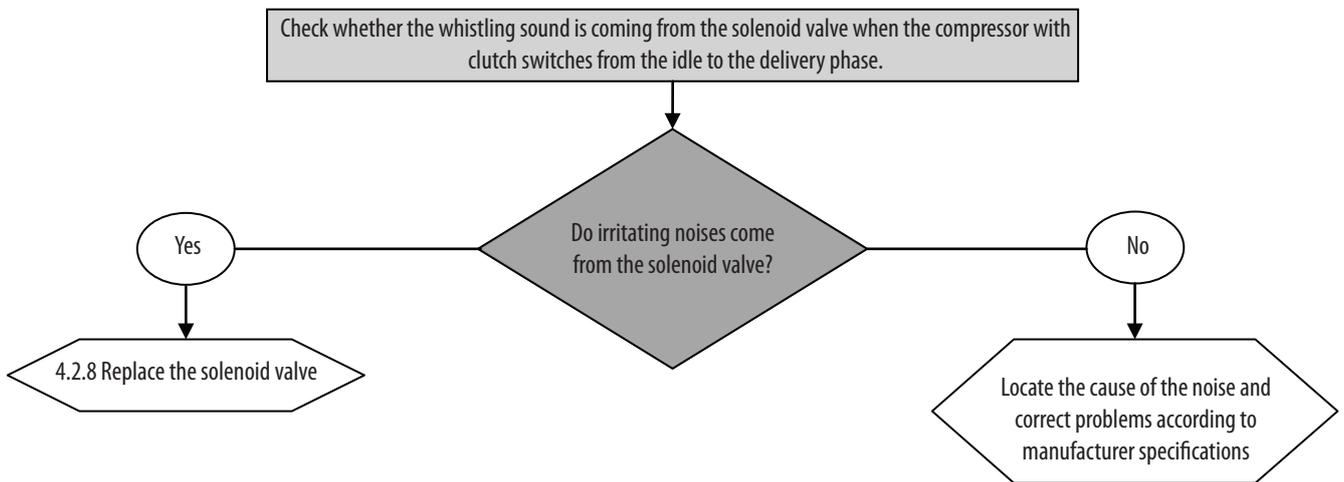
References:

- 4.2.8 Replacing the solenoid valve – Service kit 3.1Page 37
- 4.2.12 Replacing the silencer – Service kit 3.3Page 43

Possible causes:

- Silencer on solenoid valve missing or
- Solenoid valve defective

3.1.9 Noise (pneumatic; whistling)



References:

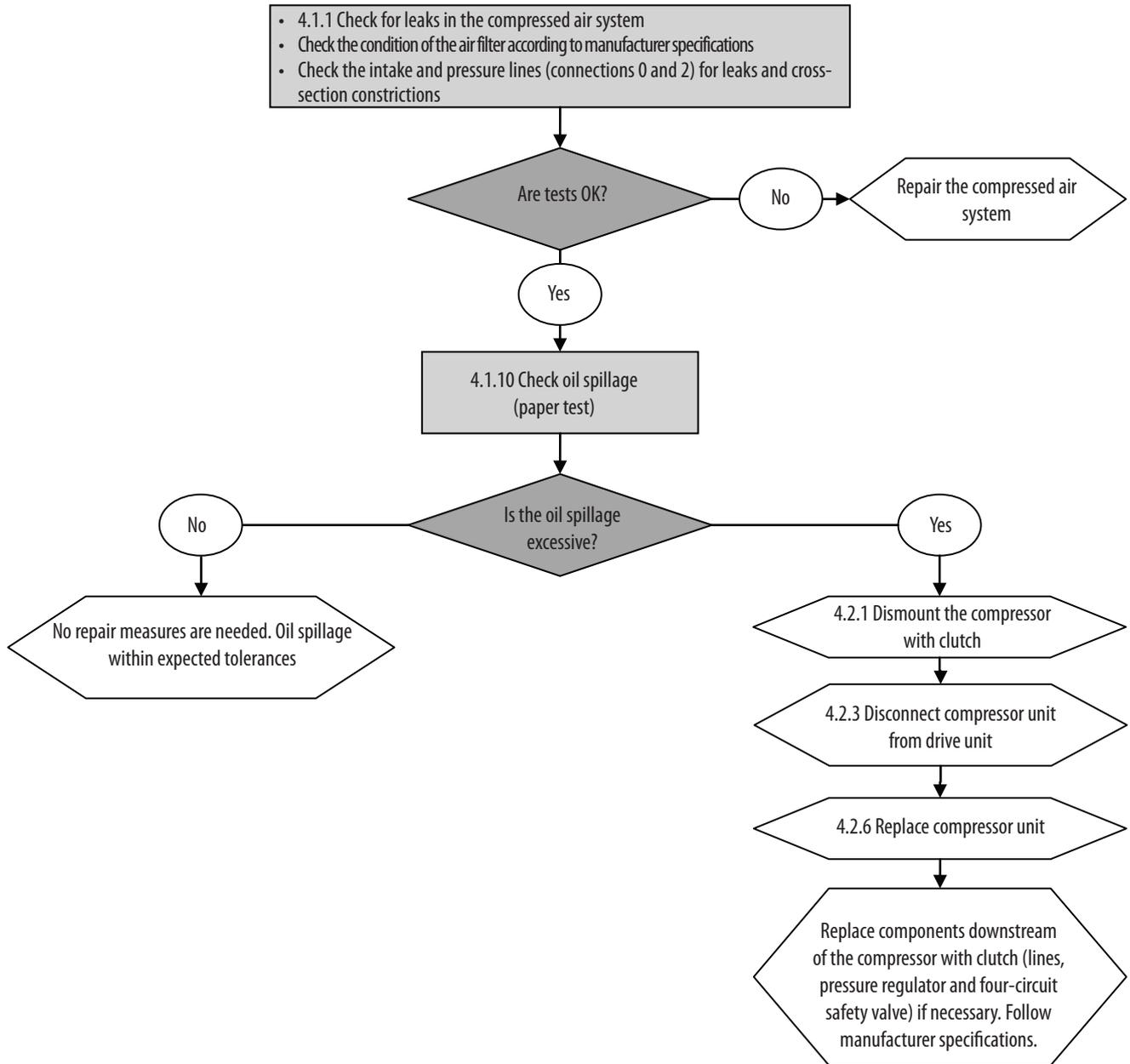
- 4.2.8 Replacing the solenoid valve – Service kit 3.1Page 36

Possible causes:

- Solenoid valve defective

3 SERVICE PROCEDURE FLOW DIAGRAMS

3.1.10 Excessive oil emerging from silencer of air dryer



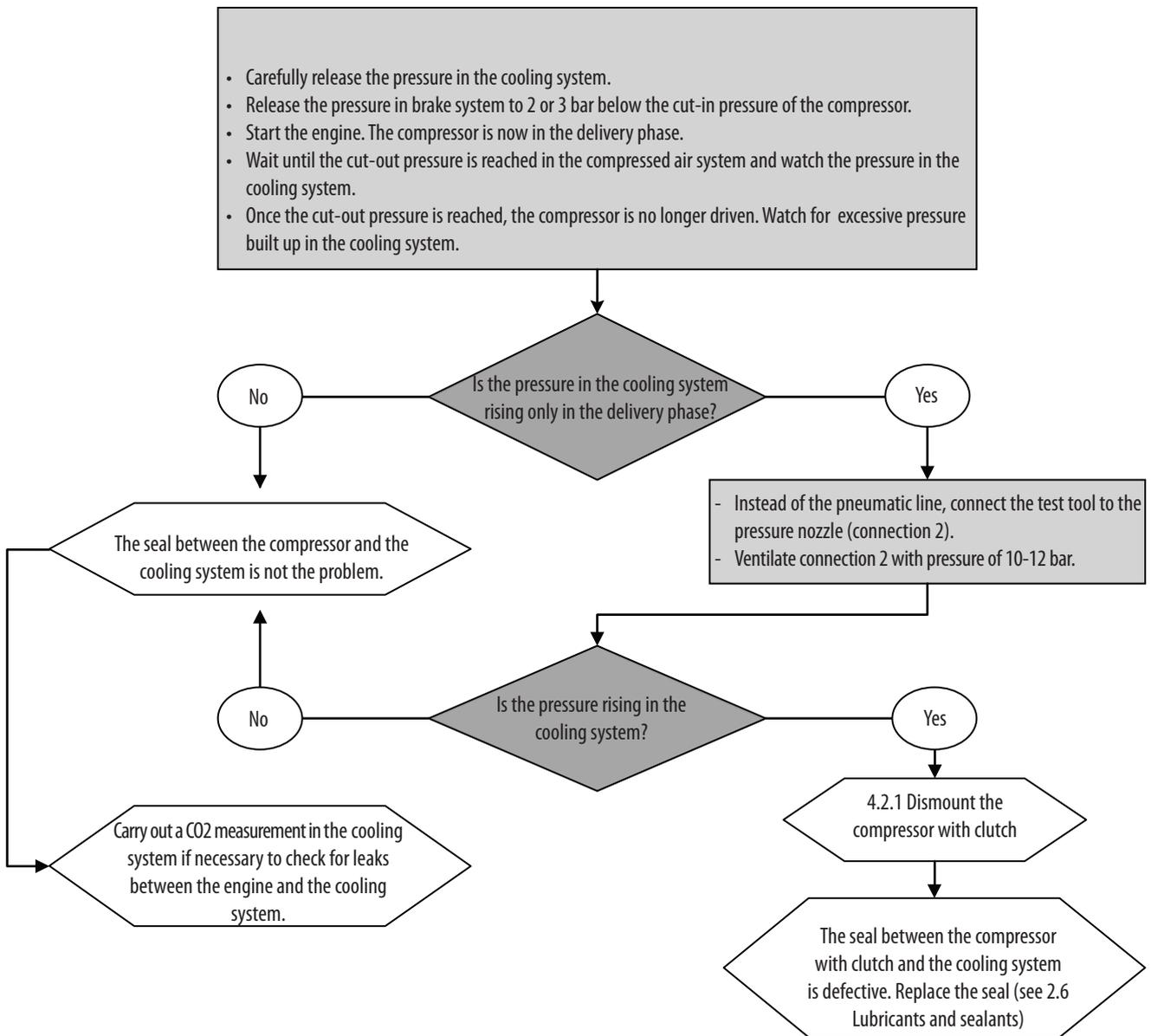
References:

- 4.1.1 Check for leaks in the compressed air system.Page 26
- 4.1.10 Check oil spillage (paper test)Page 30
- 4.2.1 Dismount the compressor with clutchPage 32
- 4.2.3 Disconnect compressor unit from drive unitPage 33
- 4.2.6 Replacing the compressor unit – **Service kit 1.0**Page 35

Possible causes:

- Cross-section constriction in the intake or pressure line of the compressor
- Compressed air system leaking
- Mechanical problem in compressor (wear)

3.1.11 Excessive pressure built up in the cooling system



References:

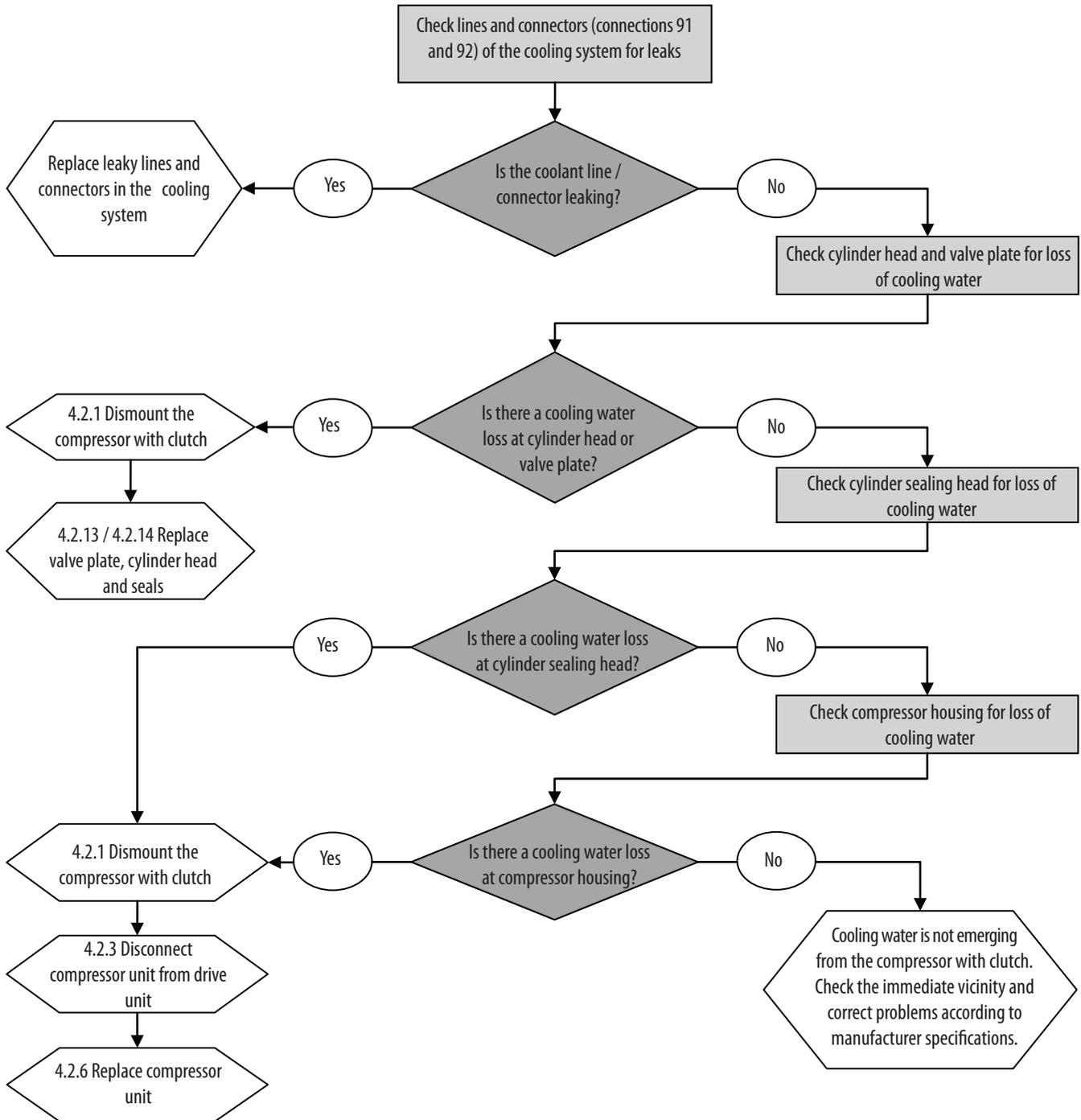
4.2.1 Dismount the compressor with clutch Page 32

Possible causes:

- Seals defective
- O-ring between drive housing and compressor unit leaking

3 SERVICE PROCEDURE FLOW DIAGRAMS

3.1.12 Loss of cooling water in the compressor



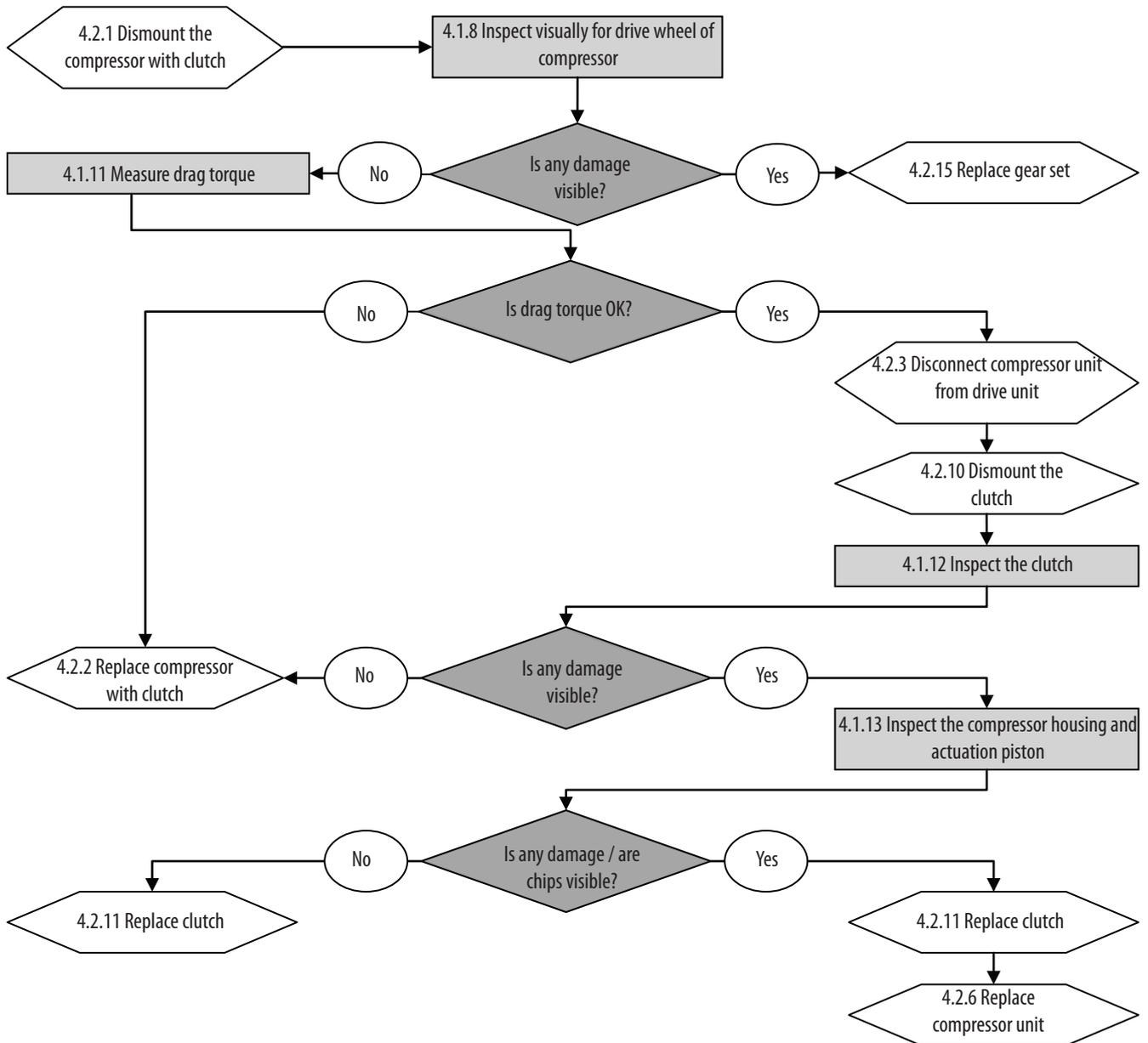
References:

- 4.2.1 Dismount the compressor with clutchPage 32
- 4.2.3 Disconnect compressor unit from drive unitPage 33
- 4.2.6 Replacing the compressor unit – **Service Kit 1.0**Page 35
- 4.2.13 Replace valve plate, cylinder head and seals - **Service kit 1.1; 1.3; 4**Page 43
- 4.2.14 Replace valve plate, cylinder head and seals - **Service kit 1.1; 1.3; 4**Page 45

Possible causes:

- Coolant line / connector leaking
- Valve plate / cylinder head leaking
- Cylinder sealing head leaking
- Fluid dripping onto housing from outside

3.2 Troubleshooting – inspection of compressor, drive and clutch



References:

4.1.8	Inspect visually for drive wheel of compressor	Page 29
4.1.11	Measure drag torque	Page 30
4.1.12	Inspect the clutch	Page 31
4.1.13	Inspect the compressor housing and actuation piston	Page 31
4.2.1	Dismount the compressor with clutch	Page 32
4.2.2	Mount (replace) compressor with clutch	Page 32
4.2.3	Disconnect drive unit from compressor	Page 33
4.2.6	Replacing the compressor unit – Service kit 1.0	Page 35
4.2.10	Dismount the clutch	Page 37
4.2.11	Mounting (replacing) the clutch – Service kit 2.3	Page 39
4.2.15	Replacing the gear set – Service kit 2.2	Page 48

Possible causes:

- Piston seizure
- Broken connecting rod
- Clutch slipping
- Weld break, broken housing
- Running surface of actuation piston damaged at compressor housing

4 SERVICE PROCEDURE REFERENCES

4.1 Tests / checks

4.1.1 Checking for leaks in the compressed air system

Secure the vehicle so that it cannot roll away. Then release the parking brake.

Fill the air system until it reaches the cut-out pressure.

In the delivery phase, check for leaks in the line between the compressor and the air dryer.

Turn off the engine.

Check the pressure in the compressed air reservoirs.

Carry out a braking action with the service brake until a brake cylinder pressure of about 3 bar is reached.

After one minute, measure the pressure in the compressed air reservoirs.

After another 3 minutes, this pressure may not have dropped more than 0.4 bar.

4.1.2 Checking the delivery rate of the compressor

Before measuring the delivery rate, you should first carry out the objective evaluation.

If the objective evaluation shows a defective delivery rate from the compressor, measure the delivery rate.

Objective evaluation:

- Depressurize the system
- At the rated speed, the pressure must clearly rise in the reservoir of the service brake

Measuring the delivery rate:

The following material is recommended for this test method:

- A 40 l compressed air reservoir with test connection
- 5 m line with 15 mm inner diameter
- Manometer (0-16 bar)
- Safety valve (12 bar)
- Valve to release pressure (e.g. a way valve)
- Stopwatch



Before removing a pressure line, release the pressure in the system. Even then, there can still be residual pressure in the pressure line.

Disconnect the pressure line from the compressor and connect the compressed air reservoir to the compressor with clutch using a 5 m long line of at least 15 mm inner diameter (see schematic).

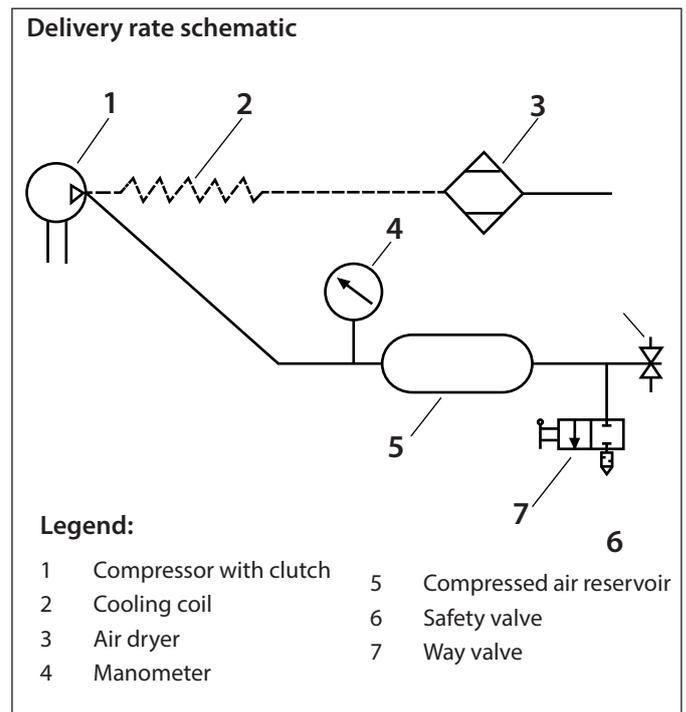


Fig. 4.1.2

Connect a manometer to the compressed air reservoir (see schematic).

The compressed air container should also have a safety valve and a way valve downstream (to release the pressure – see schematic).

Start the engine and let it run at a constant engine speed of 700 rpm. Close the way valve.

Measure the time the compressor with clutch requires to increase the pressure in the reservoir from 5 to 10 bar.

The measured value must be under 70 sec (if using a 4 m x 12 mm manometer line; about 450 cm³).

To repeat or finish the test, the reservoir should be depressurized using the two-way valve.

4.1.3 Checking safety valve on compressor for leaks

Be sure that the brake system is pressurized and that the compressor is in the delivery phase.

Check the safety valve (17b) for leaks by treating the entire valve with leak test spray (see figure).

Note: No air bubbles should form!

In normal use, the safety valve should have an opening pressure of 17 bar.

Different models can be found on different positions

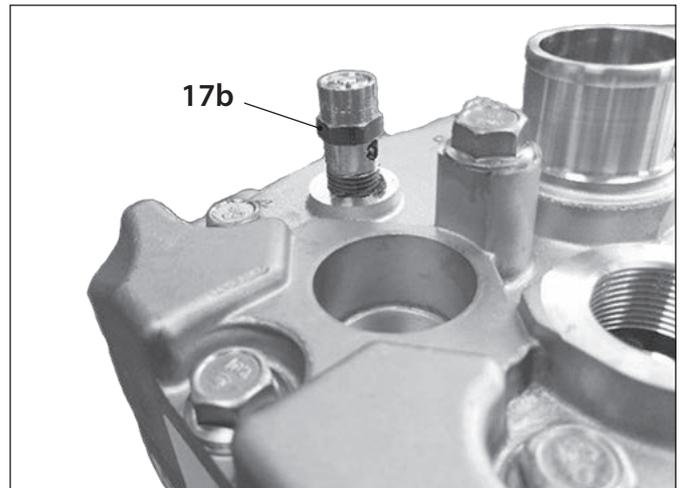
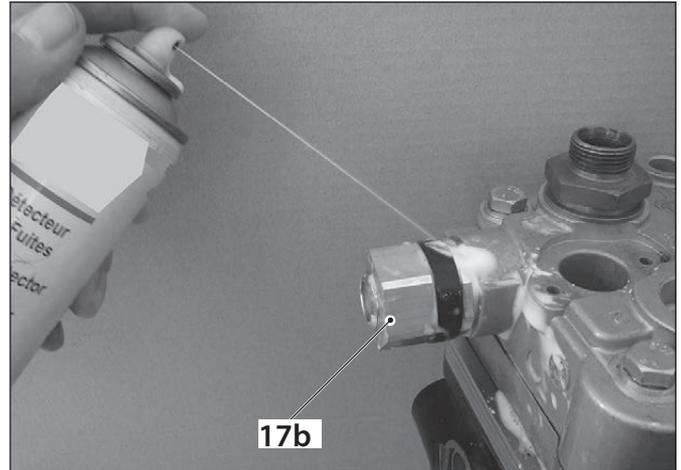


Fig. 4.1.3

4.1.4 Checking voltage on connector of pressure switch (LS3907 only)

Pull the connector from the pressure switch (42).

Start the engine.

Test the voltage in the connector for the pressure switch (42) between pin 1 (power supply) and pin 2 (ground).

Expected value: 22 - 36 Volt

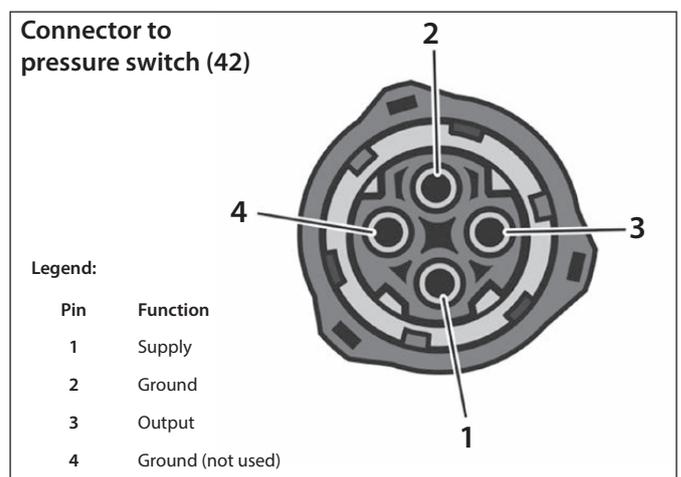


Fig. 4.1.4

4 SERVICE PROCEDURE REFERENCES

4.1.5 Checking voltage on the connector of the solenoid valve (LS3907 only)

Bridge pin 2 (ground) and pin 3 (output) in the connector of the pressure switch (42).

Pull the connector of the solenoid valve (24). Start the engine.

Test the voltage in the connector for the solenoid valve (24) between pin 1 (power supply) and pin 2 (ground).

Expected value: **22 - 36 Volt.**

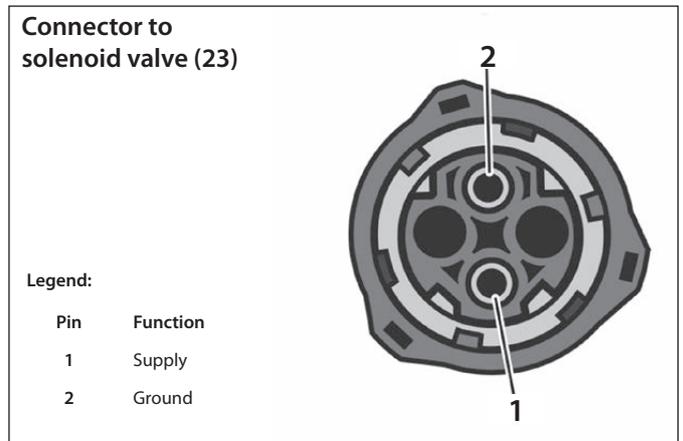


Fig. 4.1.5

4.1.6 Checking cut-out of the compressor

4.1.6.1 Remove the solenoid valve (24). (LS3907 only)

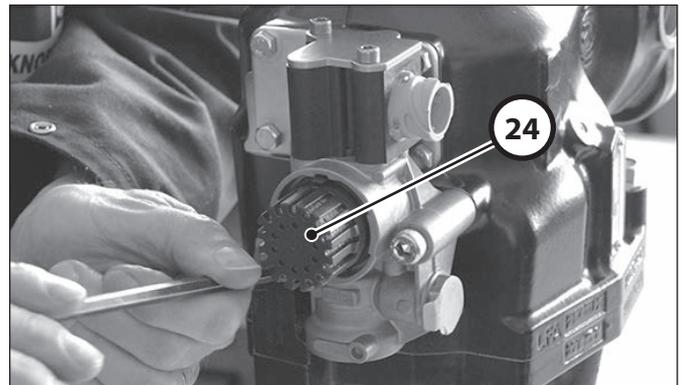


Fig. 4.1.6.1

4.1.6.2 Connect the adaptor (TC12) at the clutch actuation port.

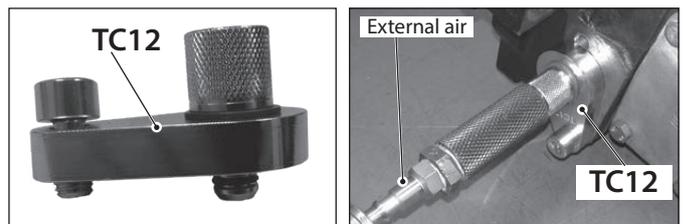


Fig. 4.1.6.2

4.1.6.3 Start the engine and ventilate the clutch (22) with external air (8 -10 bar).

Note: Ventilating the clutch with the engine running must be carried out in significantly less time than one second to avoid the clutch slipping.

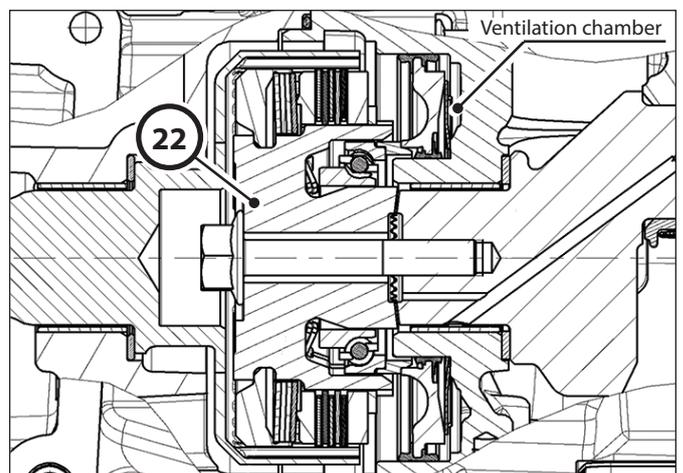


Fig. 4.1.6.3

4.1.7 Visual inspection of drive housing, bearing cover and interface between the drive unit and the compressor unit

Check components bearing cover (5), drive housing (26), housing cover (10) and the interface (drive unit 37 and compressor unit 38) for oil leaks – see also Section 2.4.

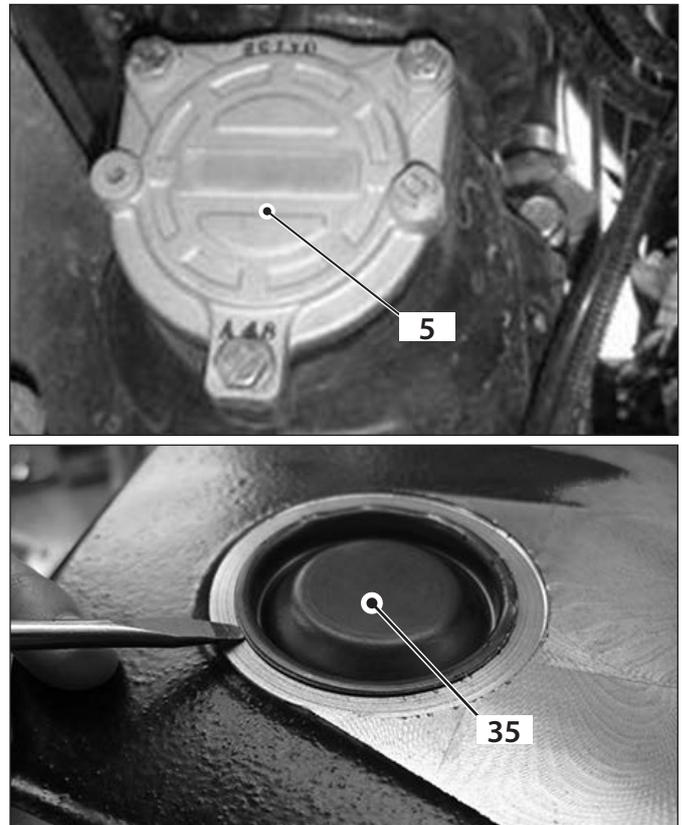


Fig. 4.1.7

4.1.8 Visual inspection of drive wheel of compressor

Examine the gears (28 and 33) of the compressor. Inspect the gears (28 and 33) for excessive axial or radial play when turning. During this process, check the fastening of the drive gear (33).

Check for excessive wear.

If excessive wear is found, the available service kit should be considered - **Service Kit 2.2**

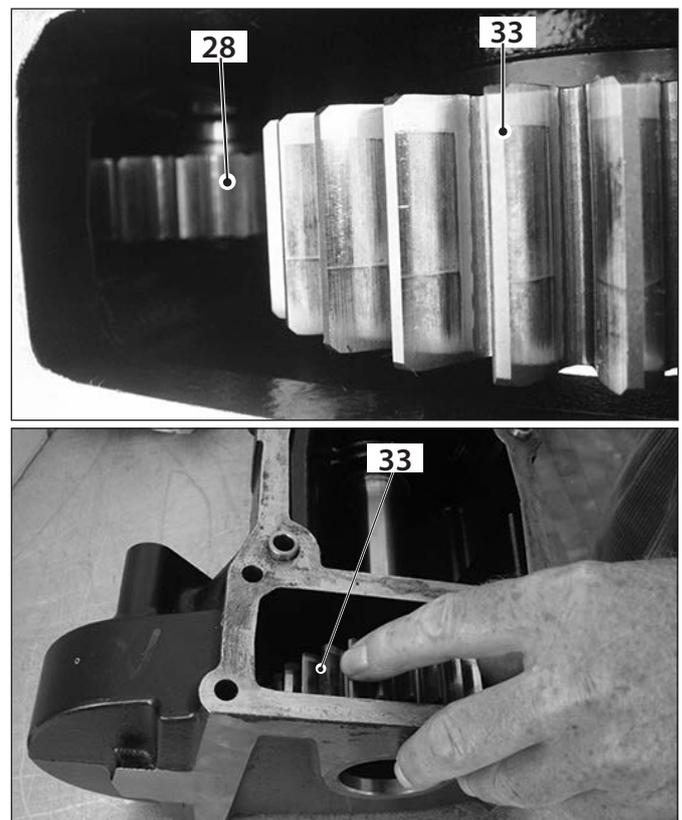


Fig. 4.1.8

4 SERVICE PROCEDURE REFERENCES

4.1.9 Visual inspection of housing and check for play in the teeth (clutch housing)

For the housing (37) to be further inspected, disconnecting the drive unit from compressor unit with clutch - see Section 4.2.3.

Check the teeth of the driving shaft (32) for excessive wear. If excessive wear is found, the available service kits should be considered - **Service Kit 2.1**

Also check whether the play between the clutch teeth (22) and the shaft (32) is excessively large.



Fig. 4.1.9

4.1.10 Checking oil spillage

Check the oil spillage.

To do this, download the document “Compressor oil carry over” from our website and carry out the test described in point “Test 11”(paper test).

Document number: Y037387 truckservices.knorr-bremse.com

4.1.11 Measuring drag torque

Check the ease of movement of the gears (28 and 33) and the driveshaft (32).

To do this, remove the housing plug (35) as shown in the figure.

Note: the housing plug (35) will be damaged during opening, service kit 4 is needed.

Turn the nut fastener (34) using a suitable drag torque gauge.

While turning, listen for any sounds of friction or other unusual sounds that could indicate damage.

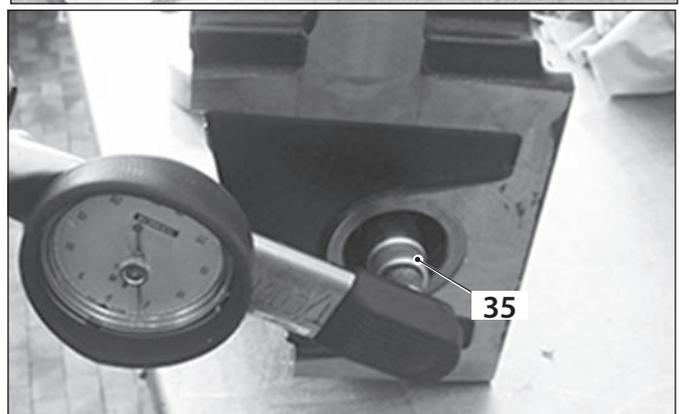


Fig. 4.1.11

4.1.12 Inspecting the clutch

Carry out a visual inspection of the clutch driving shaft (32), looking for metal chips that may have lodged on the spline teeth.

For the clutch (22) to be further inspected, it must be removed – see Section 4.2.10.

Carry out a visual inspection of the clutch (22). Look for damage in the form of thermal overloads (discoloration), deformations, scratches, chips, etc.

The depth between the top of the spring and the hub increases while clutch wear. As soon as the dimension of **9.3 mm** or over is reached, excessive wear is found, the available service kit should be considered - **Service Kit 2.3**

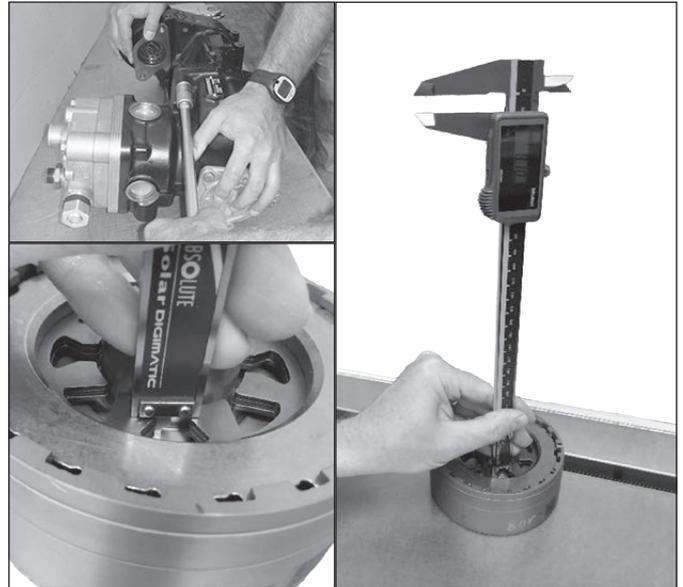


Fig. 4.1.12

4.1.13 Inspecting compressor housing and actuation piston

After dismantling the clutch (22), the compressor housing (1) and the actuation piston (20) can be inspected – see Section 4.2.10.

Clean the compressor housing and the actuation piston. Check the area of the running surface of the compressor housing (1) as well as the sealing surface of the actuation piston (20a).

Look for damage in the form of scratches and residue of metal chips.

The pre-load spring should remain crimped when pulling manually

If excessive wear is found, the available service kits should be considered - **Service Kit 2.3**

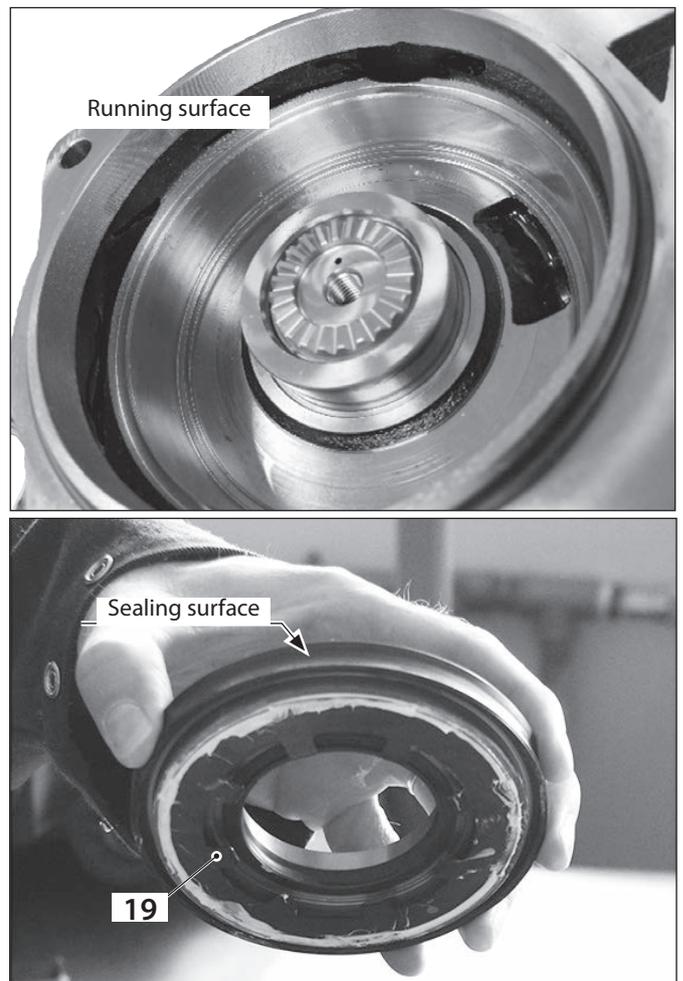


Fig. 4.1.13

4 SERVICE PROCEDURE REFERENCES

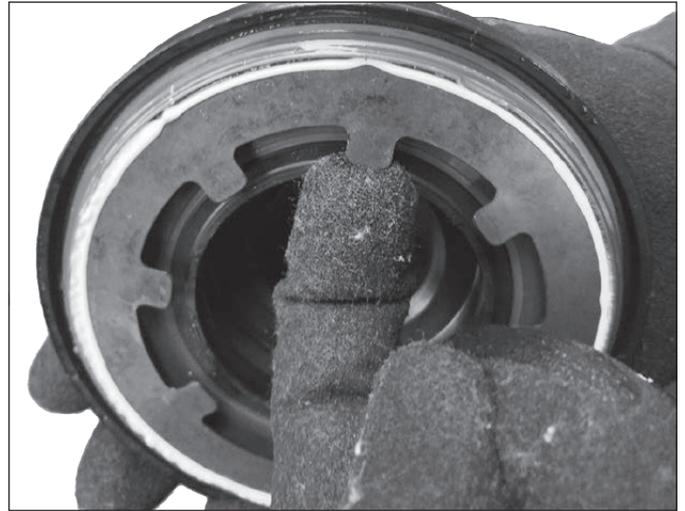


Fig. 4.1.13

4.2 Repair measures

4.2.1 Dismounting the compressor with clutch from the vehicle

Depending on the vehicle equipment, it may be necessary before removing the compressor with clutch to dismount other components from the vehicle. Follow the manufacturer's instructions.



To prevent damage to the component, the compressor with clutch should not be placed on the solenoid valve (24) or the silencer (25b) after dismounting.

Dismount the compressor with clutch. Follow the manufacturer's instructions.

4.2.2 Mounting (replacing) compressor with clutch

Before installing the compressor unit (38) with clutch (39) and drive unit (37), be sure that the flange surfaces are clean and undamaged.

Apply sealant to the area shown

Mount the compressor with clutch.

Be sure that the connection to the engine is sealed.

For installation into the vehicle, follow the manufacturer's instructions.

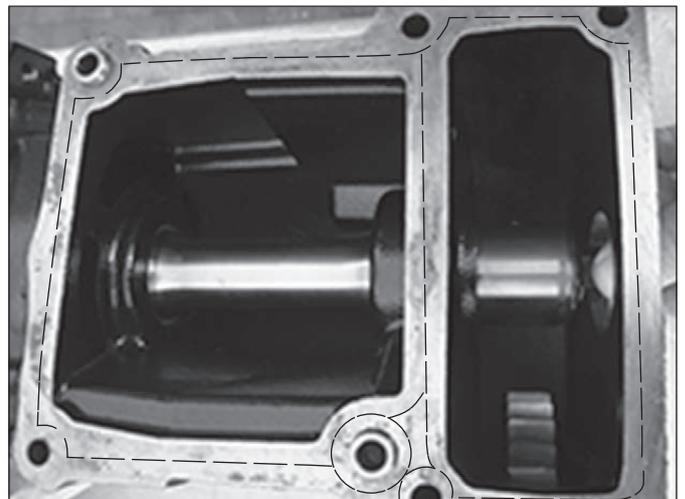


Fig. 4.2.2

4.2.3 Disconnecting the drive unit from compressor unit with clutch

Loosen the 3 hex bolts (36) and disconnect the compressor unit (38) with clutch (39) and the drive unit (37) as shown in the figures.

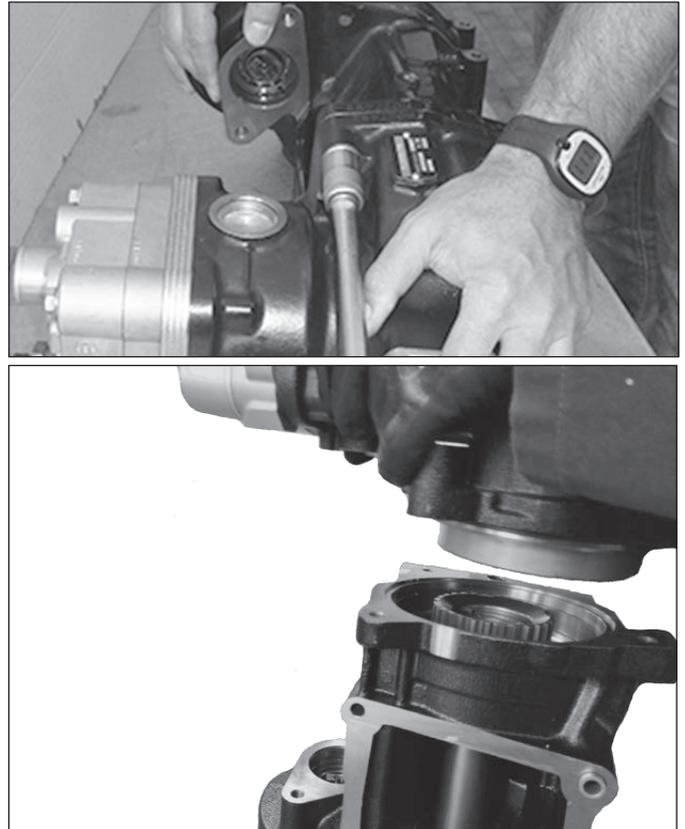


Fig. 4.2.3

4.2.4 Mounting the drive unit and compressor unit with clutch

Clean the installation space.

Examine the teeth on the splines of the driveshaft (32).

If marks from the clutch teeth can be seen, the driveshaft with clutch housing (37) must be replaced – see Section 4.2.5 and Section 4.2.10. – **Service kit 2.1.**

In general: To avoid damage when joining the two units due to an inaccurate fit of the clutch teeth into the clutch housing, proceed as follows:

Before installing the compressor unit (38) with clutch (39) and drive unit (37), be sure that the flange surfaces are clean and free of damage.

4 SERVICE PROCEDURE REFERENCES

4.2.4.1 Apply a little grease to the two O-rings (12) and (39) and be sure that they are correctly mounted.

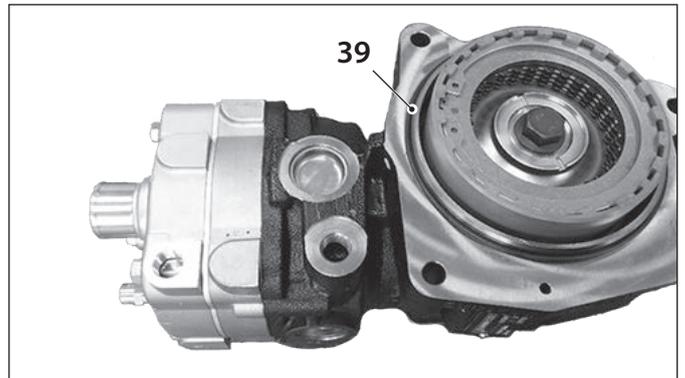
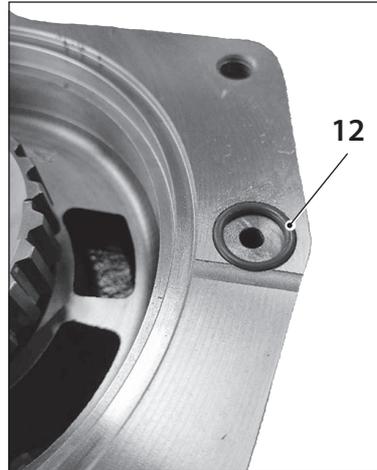


Fig. 4.2.4.1

4.2.4.2 Join the drive unit (37) and compressor unit (38) with clutch (39).



Align the two units with one another and screw together using the 3 screw fasteners (36) - torque **50 Nm**.

To install the compressor with clutch – see Section 4.2.2.

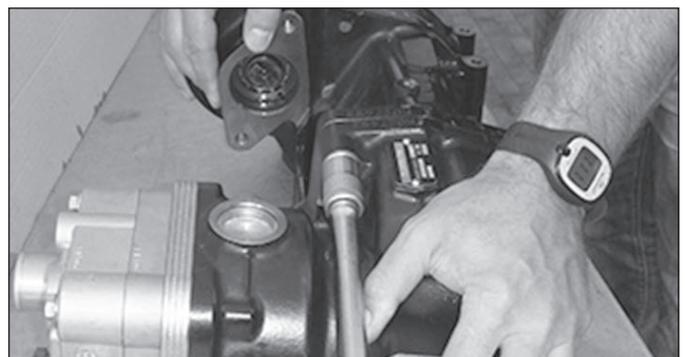


Fig. 4.2.4.2

4.2.5 Replacing drive unit / housing – Service kits 2.1 / 2.2

If the complete drive unit (37) with clutch (39) should be replaced, the used clutch (39) must be removed from the compressor and the new clutch installed – see Section 4.2.10 and Section 4.2.11.

4.2.6 Replacing the compressor unit – Service kit 1.0

Remove the clutch (39) from the dismantled compressor unit (38) and install it on the new compressor unit.

Continue with Section 4.2.10 and Section 4.2.11.

4.2.6.1 Block the drive gear (33) using special tool (TC40) over the output drive gear (28). The driver of the output shaft (29) must be engaged in the special tool (TC40).

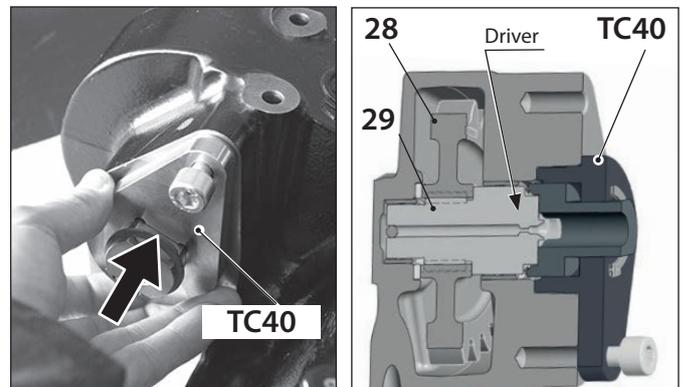


Fig. 4.2.6.1

4.2.6.2 Loosen the fastening screw (35) enough to be able to remove the special tool (TC40).

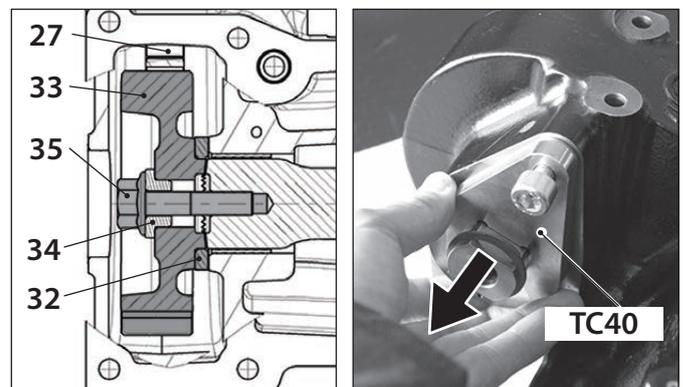


Fig. 4.2.6.2

4.2.6.3 Remove the fastening screw (35), drive gear (33) and spacer ring (32).

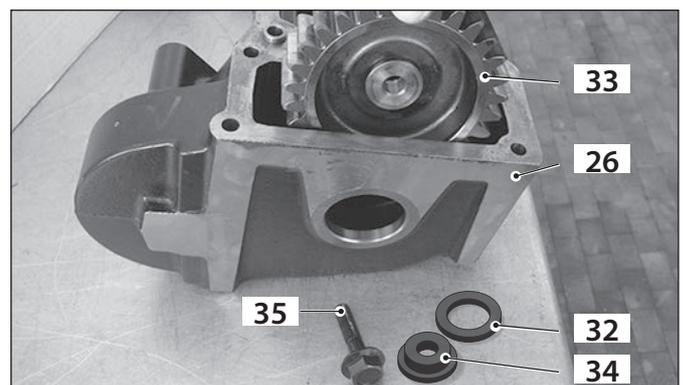


Fig. 4.2.6.3

4 SERVICE PROCEDURE REFERENCES

4.2.6.4 Block the gear again with the special tool (TC40).

4.2.6.5 The fastening Nut (34) can now be tightened with a torque value of **40 Nm + 90°**.

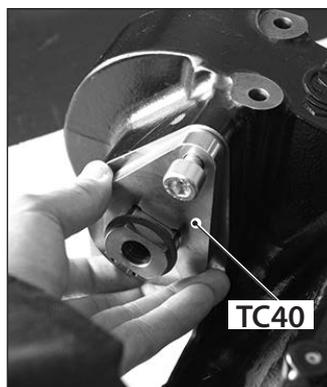


Fig. 4.2.6.4

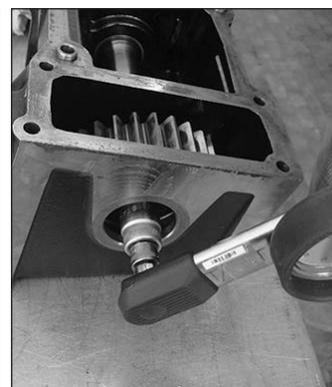


Fig. 4.2.6.5

4.2.6.6 Press in the new housing cover (35) as far as it will go using tool (TC30).

To mount the drive unit and compressor unit – see Section 4.2.4.

To mount the complete unit on the engine – see Section 4.2.2.

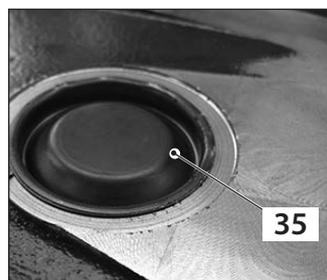


Fig. 4.2.6.6



4.2.7 Replacing the pressure switch – Service kit 3.2

4.2.7.1 Remove the electrical connection to the pressure switch (42).

4.2.7.2 Replace the pressure switch (42).

The tightening torque for the pressure switch (42) is 45 Nm. Reconnect the electrical connection.

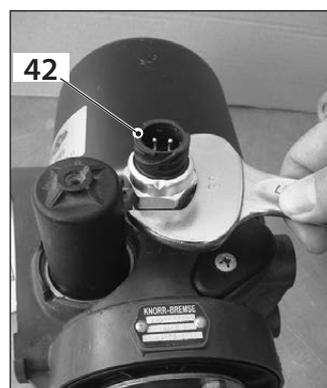


Fig. 4.2.7.1



Fig. 4.2.7.2

4.2.8 Replacing the solenoid valve – Service kit 3.1

If there is enough room, the solenoid valve can also be replaced directly on the vehicle.

Ventilate the compressed air system and remove the ignition key. Disconnect connection 1. Disconnect the electrical connection. When working on the vehicle, also follow the manufacturer's instructions.

Undo both fastening screws (25) and replace the solenoid valve (24).

The tightening torque for both fastening screws (25) of the solenoid valve (24) is **25 Nm**.

After replacing the solenoid valve (24) on the vehicle, reconnect the electrical and pneumatic connections (connection 1).

Start the engine and check for leaks.

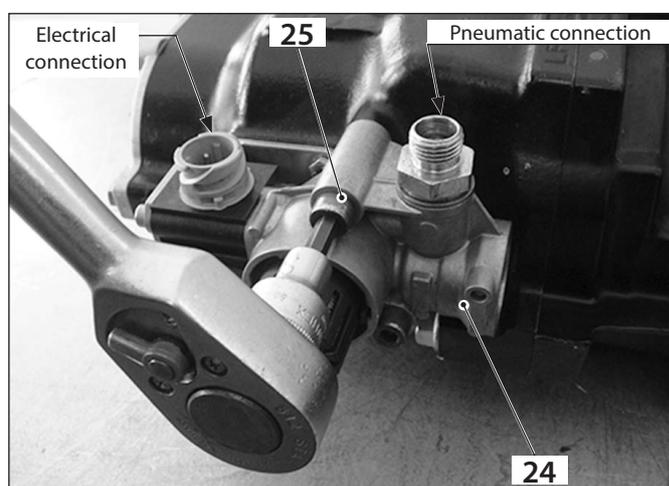


Fig. 4.2.8

4.2.9 Replacing the safety valve – Service kit 1.4



Before removing the safety valve (17b), depressurize the compressed air system.

Replace the safety valve (17b) and sealing ring (17a) by the new safety valve and adaptor 17a when needed.

The tightening torque of the safety valve (17b) is **22 Nm**.
The tightening torque of the adaptor (17a) is **65Nm**

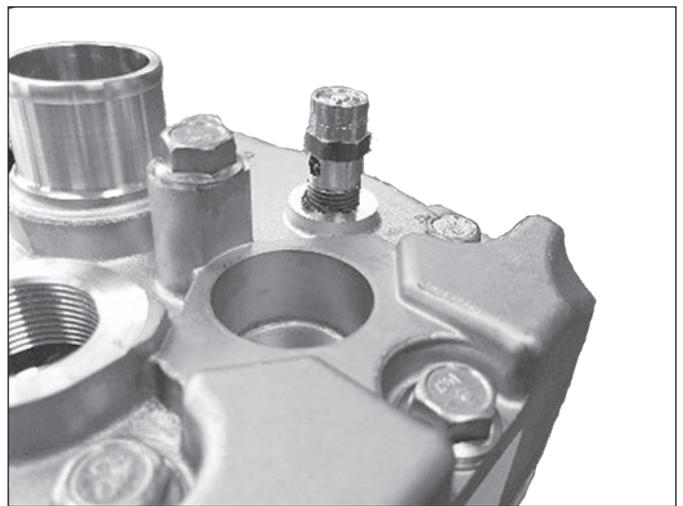
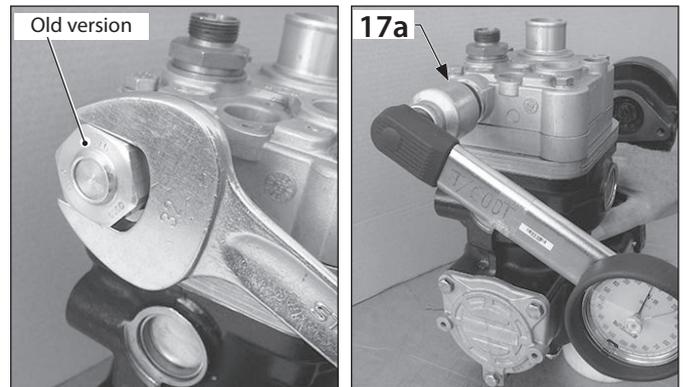


Fig. 4.2.9

4.2.10 Clutch (22) and Actuation Piston (20) removal

Tools required for clutch replacement

TC13 / TC13-1: Tool combination for clutch assembly/disassembly

TC20: Protective mechanism for pressing out the actuation piston

TC21 / TC22: Installation aid for actuation piston

TC40: Pressing-in tool for installing the retaining ring including backing plate for fastening the drive gear

Torque wrench: For clutch assembly (Note, not included in the special tool case)

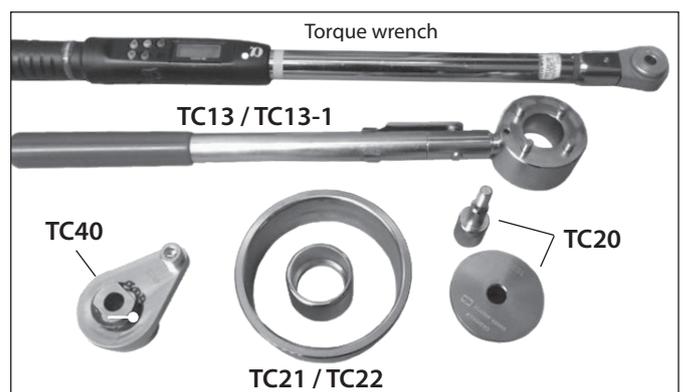


Fig. 4.2.10

4 SERVICE PROCEDURE REFERENCES

4.2.10.1 Place the special tool combination (TC13 / TC13-1) into the slots of the clutch (21) as shown

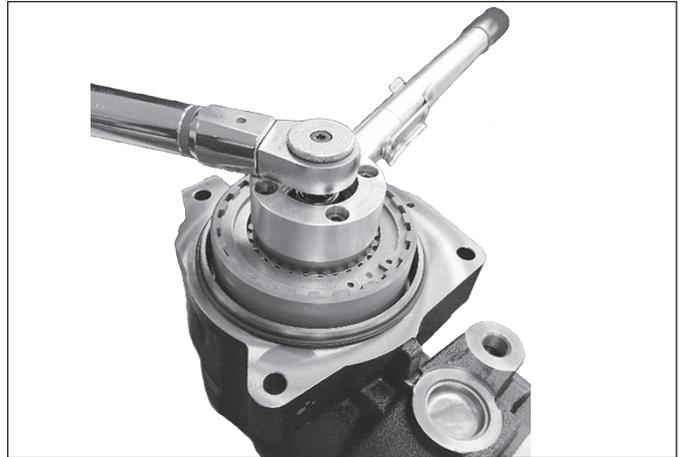


Fig. 4.2.10.1

4.2.10.2 Whilst holding tool combination (TC13 / TC13-1) in position, unscrew the fastening bolt (22) using a suitable torque wrench (18 mm).

4.2.10.3 Remove the clutch (22).

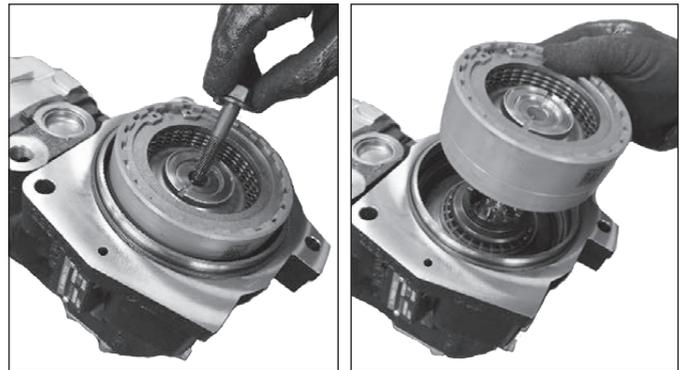


Fig. 4.2.10.3

Actuation Piston (20) replacement

At this point the actuation piston (20) can be replaced if necessary:

4.2.10.4 Place tool (TC20) onto the crankshaft (3) and hand-tighten in place using tool (TC20-1).

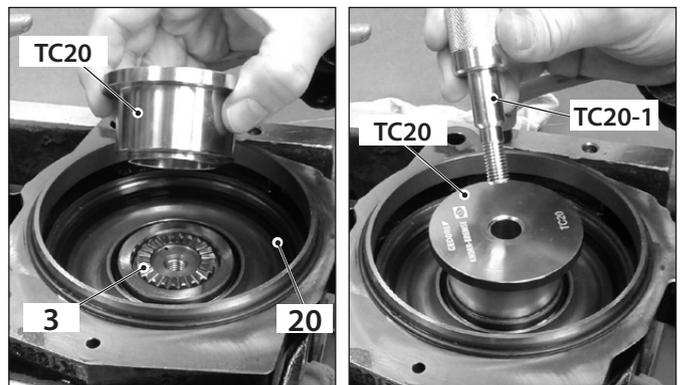


Fig. 4.2.10.4

4.2.10.5 Dismount the solenoid valve (24) – see Section 4.2.8.

4.2.10.6 Gradually and carefully press out the actuation piston (20) by repeatedly ventilating and turning tool (TC20).

The actuation piston (20) can only be dismounted vertically via tool (TC20)

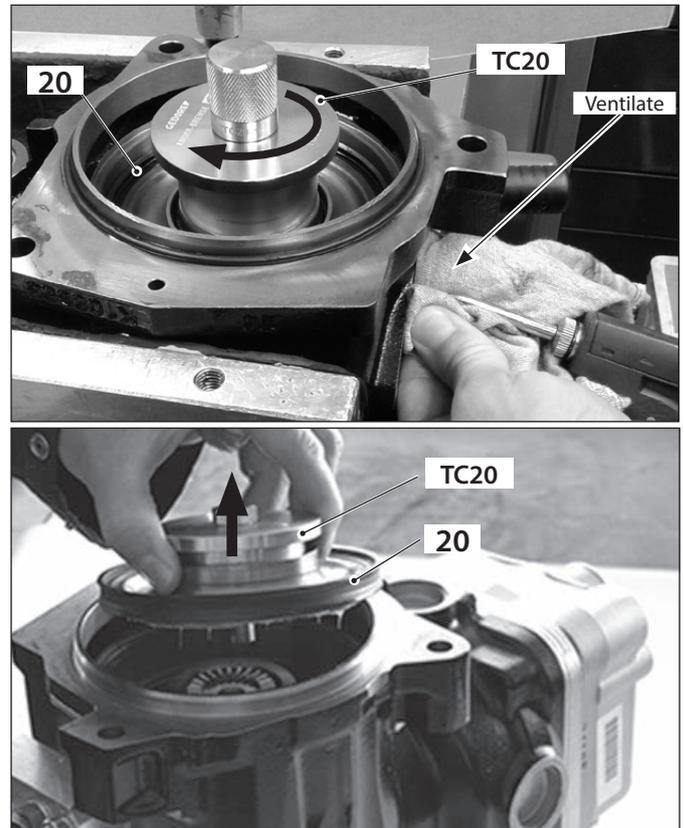


Fig. 4.2.10.6

 **Carefully remove actuation piston (20) without causing damage to other surfaces. Do not tip it!**

4.2.10.7 Re-mount the solenoid valve (24) – see Section 4.2.8.

4.2.11 Mounting (replacing) the clutch – Service kit 2.3

For installation, tools (TC21) and (TC22) are required.

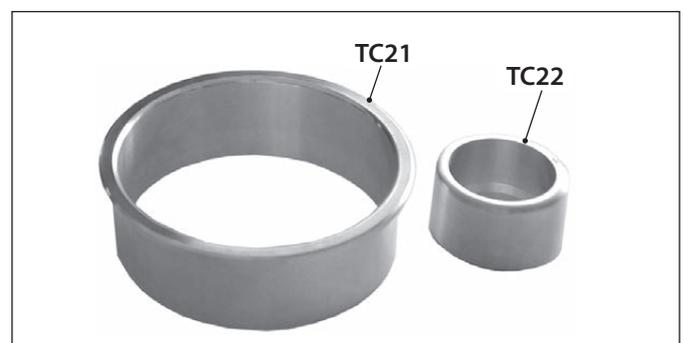


Fig. 4.2.11

4 SERVICE PROCEDURE REFERENCES

4.2.11.1 Insert tools (TC21) and (TC22) as shown.



Disassemble the bearing by separating the inner ring with balls from the outer ring



Fig. 4.2.11.1

4.2.11.2 Clean the running surface of the actuation piston (20) in the compressor crankcase. Apply a little motor oil to both the running surface of the compressor and the seal on the actuation piston (20) to ease installation.

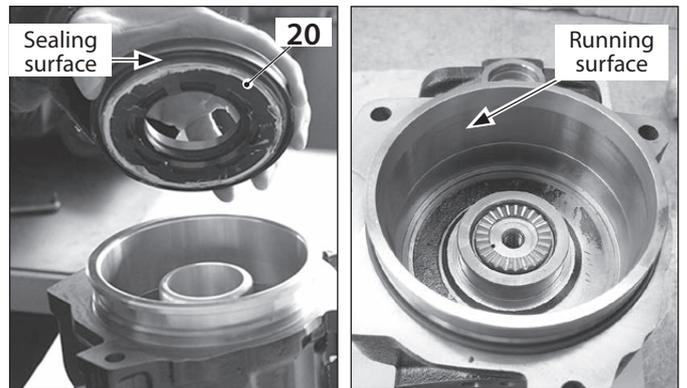


Fig. 4.2.11.2

4.2.11.3 Grease the actuation piston with the lubricant included as shown.

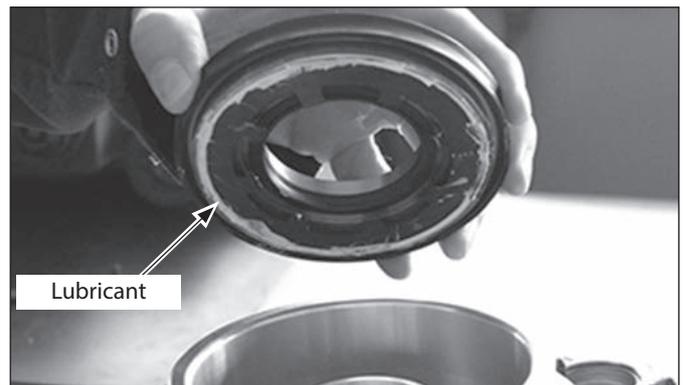


Fig. 4.2.11.3



The actuation piston (20) can only be mounted vertically without damage. Do not tip it.



4.2.11.4 Carefully mount the actuation piston (20) as far as it will go by hand

Remove tools TC21 and TC22

and then Insert the release bearing (20a).

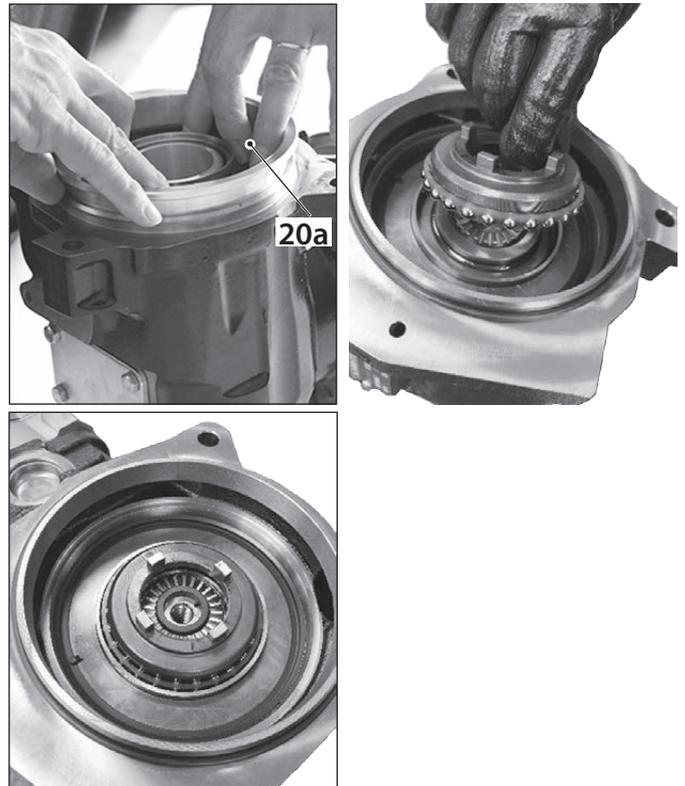


Fig. 4.2.11.4

4.2.11.5 Refit the clutch (22) and hand-tighten in place using bolt (23).



Fig. 4.2.11.5

4.2.11.6 Insert special tool combination (TC13 / TC13-1) into the groves of the clutch (22) and tighten to a torque of $15 \text{ Nm} + 60^\circ$.

To mount the drive and compressor unit – see Section 4.2.4.

To mount the complete unit on the engine – see Section 4.2.2.

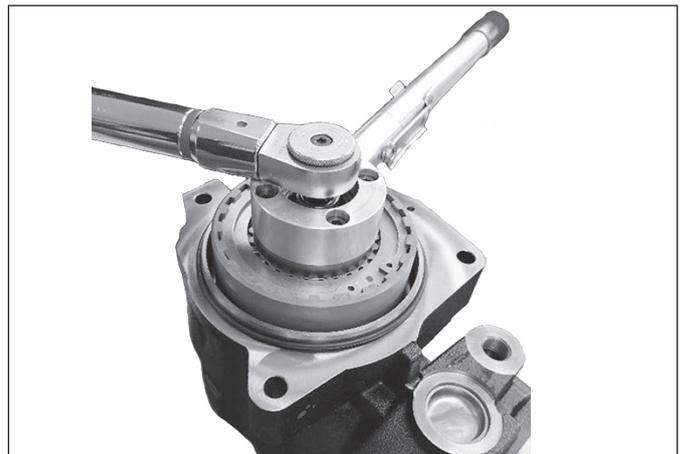


Fig. 4.2.11.6

4 SERVICE PROCEDURE REFERENCES

4.2.12 Replacing the silencer – Service kit 3.3

4.2.12.1 Disconnect the electrical and pneumatic line (connection 1) from the solenoid valve (24).

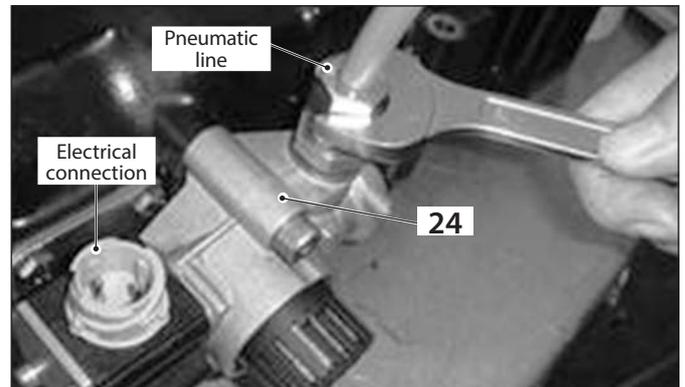


Fig. 4.2.12.1

4.2.12.2 Loosen both fastening screws (25) of the solenoid valve (24) and dismount the solenoid valve.

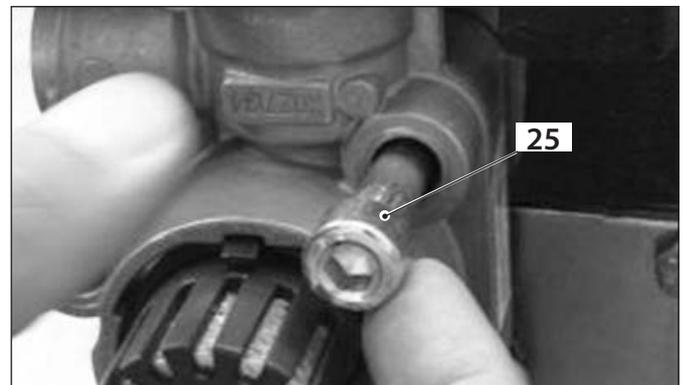


Fig. 4.2.12.2

4.2.12.3 Carefully clamp the silencer (25b) into a vice in the place provided and press the opposing tabs on the silencer. Turn the solenoid valve (24) to open the bayonet closure. Disconnect the silencer (25b) from the solenoid valve

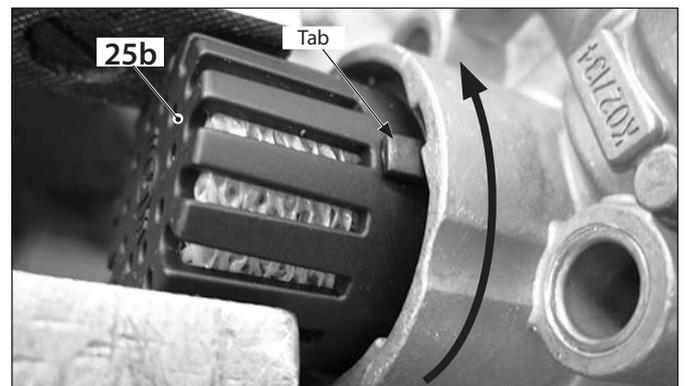


Fig. 4.2.12.3

4.2.12.4 After the new silencer (25b) has been inserted into the solenoid valve (24), turn the silencer in the counterclockwise direction until the bayonet closure engages.

Grease the O-ring (12) and insert it as shown into the solenoid valve (24). The groove (see arrow) can be used after installation of the solenoid valve (24) to check whether the O-ring (12) is in the correct position.

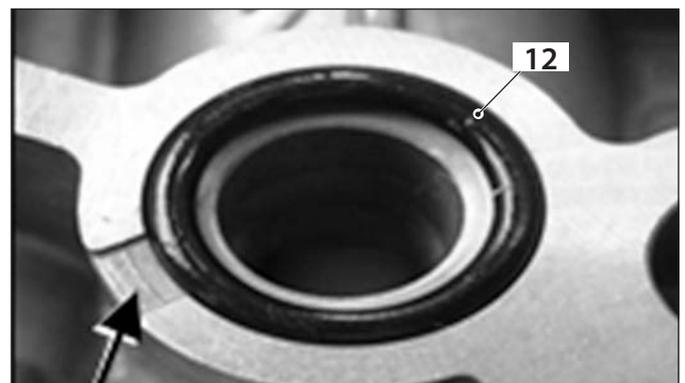


Fig. 4.2.12.4

4.2.12.5 Mount the solenoid valve (24) onto the compressor with clutch and fix in place with screws (25) to a torque of 25 Nm.

Connect the solenoid valve (24) electrically and pneumatically (connection 1).

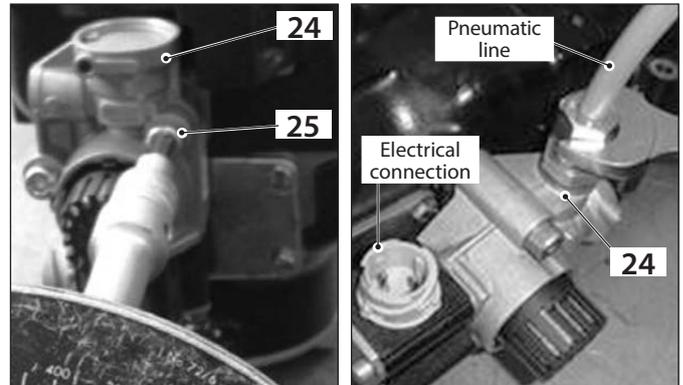


Fig. 4.2.12.5

4.2.13 Repairing the valve plate, cylinder cover and seals (LS3907) – Service kits 1.1 / 1.3 / 4

Depending on the damage, one or more of these service kits will be required – see Section 2.3:

- **Service kit 1.1** (damage to the cylinder head (17))
- **Service kit 1.3** (damage to the valve plate (14))
- **Service kit 4** (new seals)

4.2.13.1 Loosen the four outside hex screws (18) and remove the cylinder cover (17) as well as the intake vane (13).

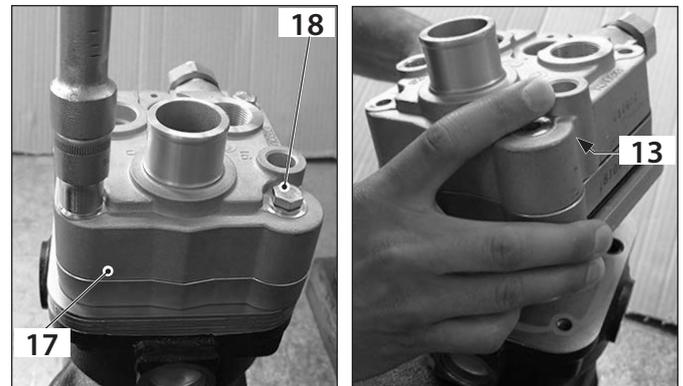


Fig. 4.2.13.1

4.2.13.2 Clean the surface of the crankcase using a suitable tool, without damaging the sealing surface.



Fig. 4.2.13.2

4 SERVICE PROCEDURE REFERENCES

4.2.13.3 Mount the new intake vane (13) and valve plate (14).

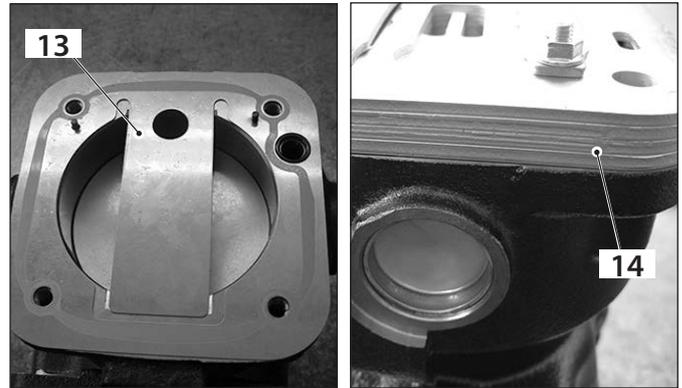


Fig. 4.2.13.3

4.2.13.4 If the gap between the intake vane (13) and valve plate (14) is inadmissibly large (see arrow), then the fastening pins in the crankshaft must be checked for deformation. If no deformation of the fastening pins can be seen, drive these carefully in a little further.

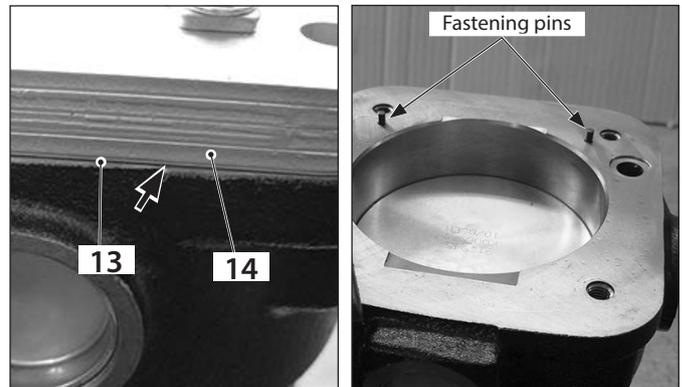


Fig. 4.2.13.4

4.2.13.5 Mount one of the two steel bead gaskets (15) onto the valve plate (14).

Mount the intermediate plate (16) and the second steel bead gasket (15).

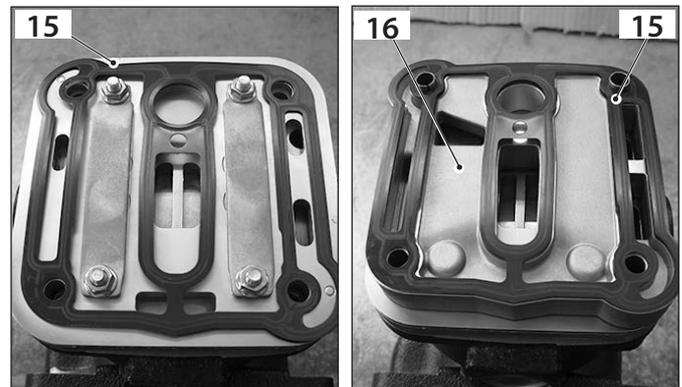


Fig. 4.2.13.5

4.2.13.6 Mount the cylinder head (17) and its hex screws (18). Tighten the hex screws (18) – see Section 2.4.

To install the compressor with clutch – see Section 4.2.2.

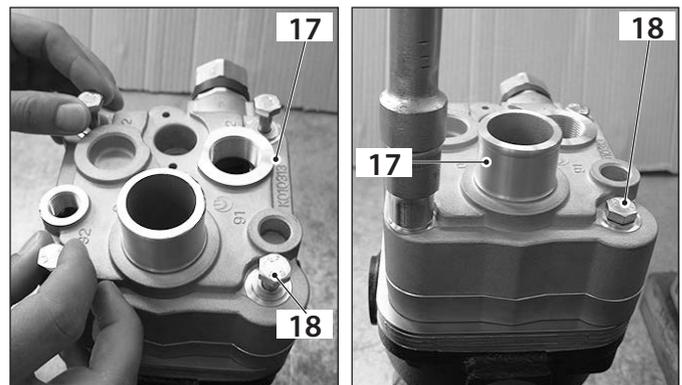


Fig. 4.2.13.6

4.2.14 Repairing the valve plate, cylinder cover and seals (LS3909) – Service kits 1.1 / 1.3 / 4

Depending on the damage, one or more of these service kits will be required – see Section 2.4:

- Service kit 1.1 (damage to the cylinder head (17))
- Service kit 1.3 (damage to the valve plate (14))
- Service kit 4 (new seals)

4.2.14.1 Loosen the four outside hex screws (18) and remove the cylinder head (17) as well as the intake vane (13).

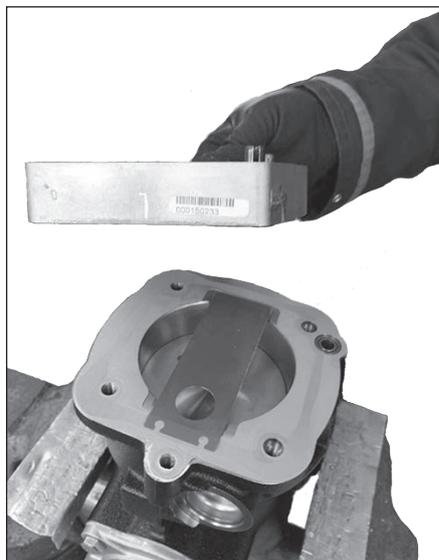
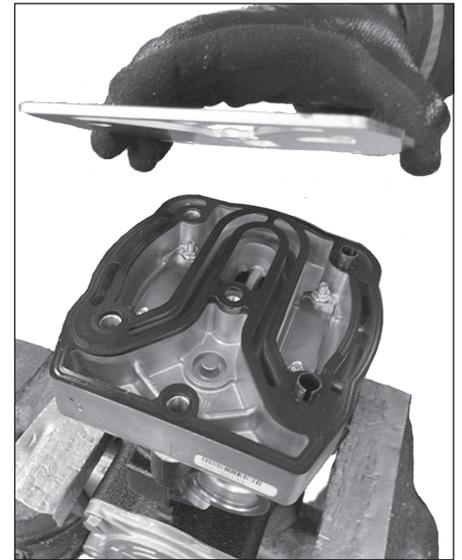
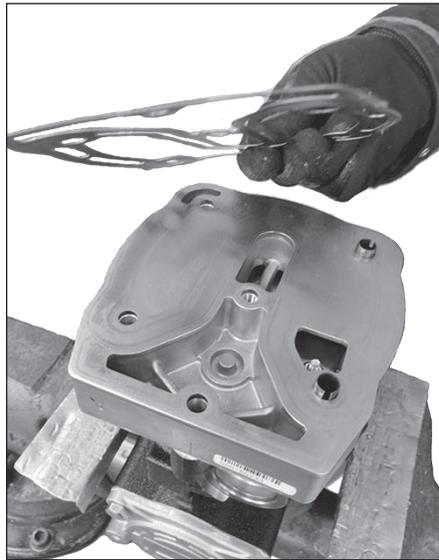
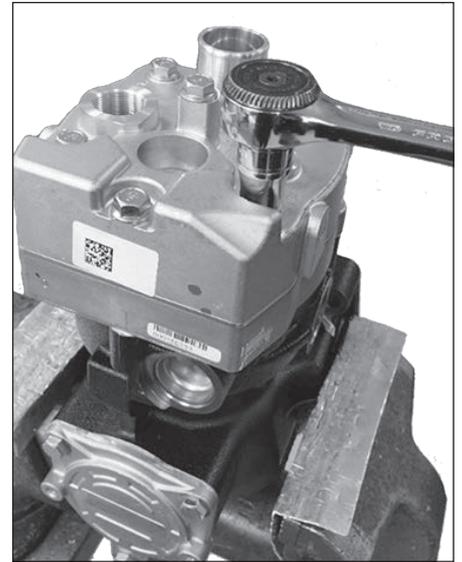


Fig. 4.2.14.1

4 SERVICE PROCEDURE REFERENCES

4.2.14.2 Clean the surface of the crankcase using a suitable tool, without damaging the sealing surface.

Ensure the O-ring is in place on the coolant channel on the top of the crankcase

Mount the new intake vane (13) and valve plate (14)

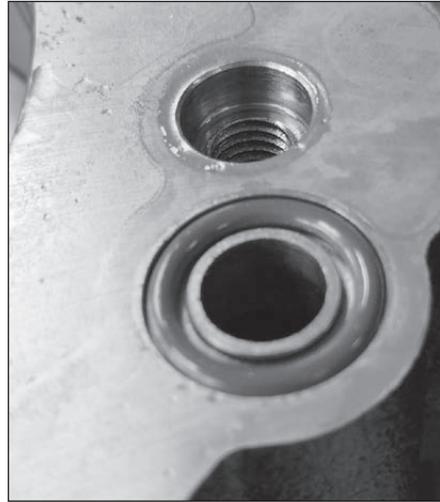


Fig. 4.2.14.2

4.2.14.3 If the gap between the intake vane (13) and valve plate (14) is inadmissibly large then the fastening pins in the crankshaft must be checked for deformation. If no deformation of the fastening pins can be seen, drive these carefully in a little further.

4.2.14.4 Mount one of the two steel bead gaskets (15) onto the valve plate (14).

Mount the intermediate plate (16) and the second steel bead gasket (15).

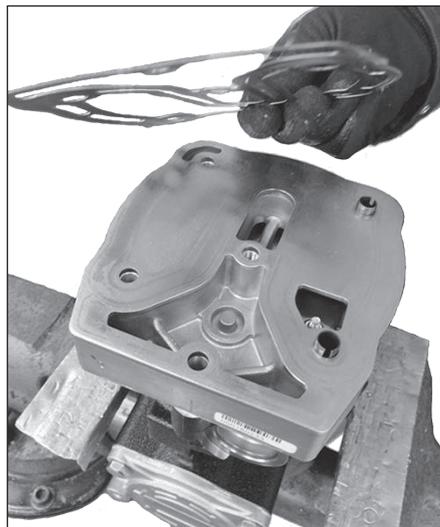


Fig. 4.2.14.4

4.2.14.5 Mount the cylinder head (17) and its hex screws (18).

Tighten the hex screws (18) – see Section 2.4.

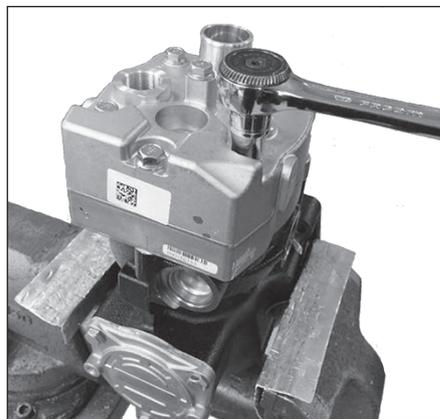


Fig. 4.2.14.5

4 SERVICE PROCEDURE REFERENCES

4.2.14.6 Any leakage from the water cooling system can be checked using adapters (F1) and (K1) and a calibrated pressure gauge to carry out a 'pressure drop test'.

Pressurise the water circuit to **5 bar** using an external air supply through the adapter (K1). Allow the pressure to settle then shut off the air supply. There must be no pressure drop over a period of **60 seconds**.

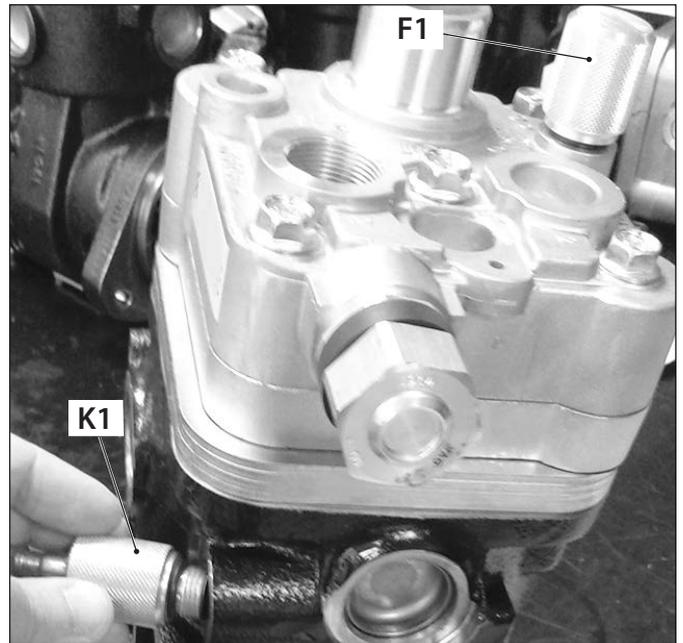


Fig. 4.2.14.6

4.2.15 Replacing the gear set – Service kit 2.2

4.2.15.1 Dismount the driveshaft with clutch housing (32) – see Section 4.2.5.

4.2.15.2 Use a suitable screwdriver to lever out the retaining ring (30) from the output shaft (29).

Carefully dismount the output shaft (29) to avoid damaging the bearing points.

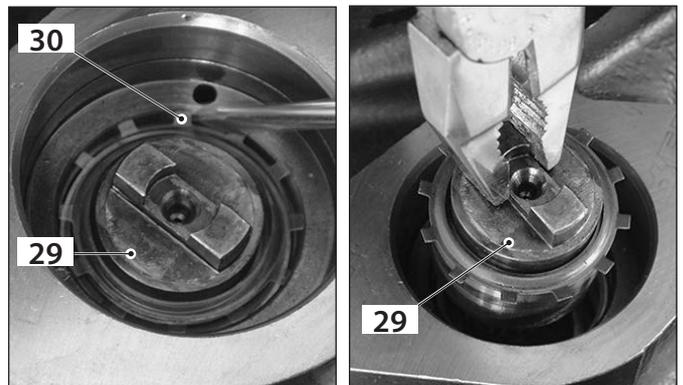


Fig. 4.2.15.2

4.2.15.3 Dismount the output drive gear (28) and the thrust washer (27).

Clean the drive housing (26) thoroughly and oil the bearing points with a little motor oil.

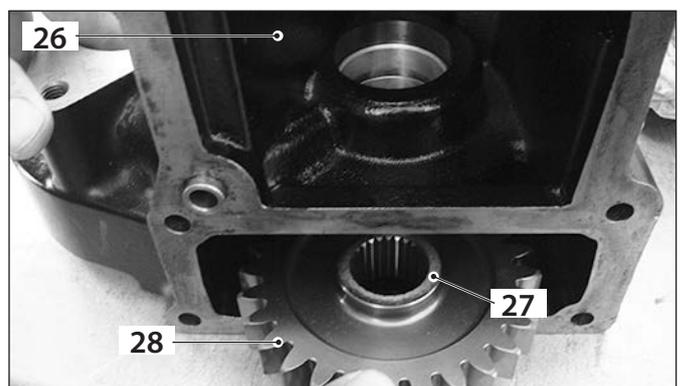


Fig. 4.2.15.3

Mount **Service kit 2.2** in the reverse order – as shown in the following figures.

4.2.15.4 Insert the output drive gear (28) and thrust washer (27) into the driveshaft housing (26).

Oil the output shaft (29) slightly and install it.

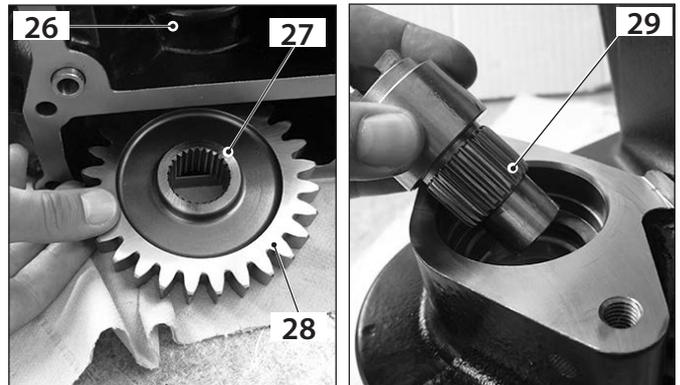


Fig. 4.2.15.4

4.2.15.5 Place the retaining ring (30) with the points of the ring directed upwards as shown.

Mount the special tool (TC40) in place.

The driver of the output shaft (29) must engage into the special tool (TC40).

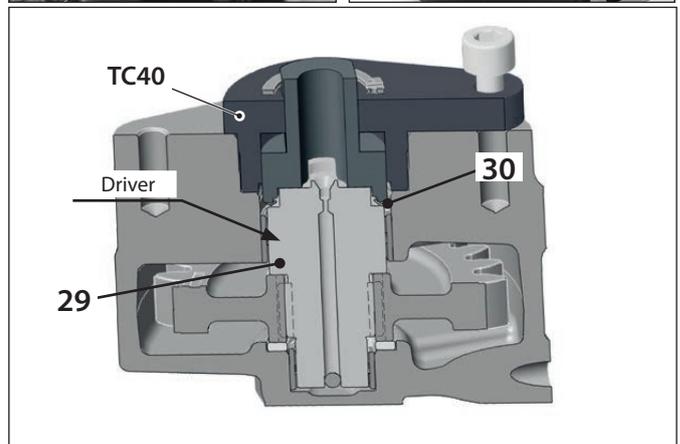


Fig. 4.2.15.5

4.2.15.6 Use special tool (TC40) to insert the retaining ring (30) pushing down by hand as far as it will go.

Remove tool (TC40)



Fig. 4.2.15.6

4.2.15.7 The pressing-in process is complete.

Check for the correct seating of the output shaft (29) and the output drive gear (28).

To mount the driveshaft – see Section 4.2.6.

To mount the drive unit and compressor unit – see Section 4.2.4.

To mount the complete unit on the engine – see Section 4.2.2.

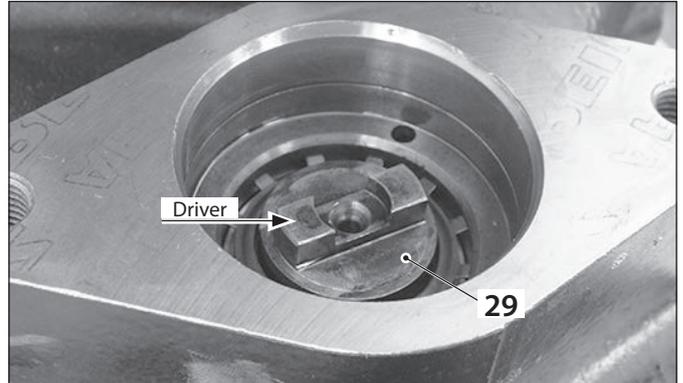


Fig. 4.2.15.7

4.2.16 How to change the clutch without specific tool

4.2.16.1 Disassemble the solenoid valve (see 4.2.8).

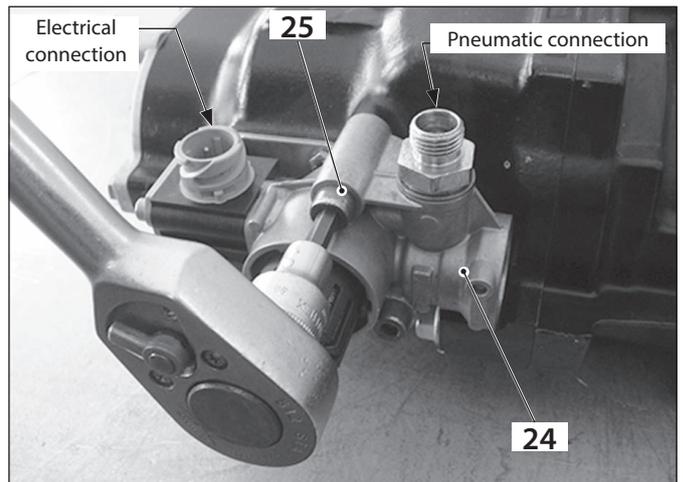


Fig. 4.2.16.1

4.2.16.2 Disassemble the sump plate (4 screws).



Fig. 4.2.16.2

4.2.16.3 Block the crankshaft with a clean stick. Take care that no chip or particle can fall into the crankcase



Fig. 4.2.16.3

- 4.2.16.4 Unscrew the main screw using a suitable torque wrench (18 mm)
- 4.2.16.5 Continue from 4.2.11.3 to 4.2.11.5
- 4.2.16.6 Block the crankshaft with a clean stick and tighten the main screw to a torque of **15 Nm + 60°**.

4.2.16.7 Reassemble the sump plate with a new gasket 9 available in the complete seal set 4.



Fig. 4.2.16.7

4.2.16.8 Reassemble the clutch control valve with a new O-ring 12.

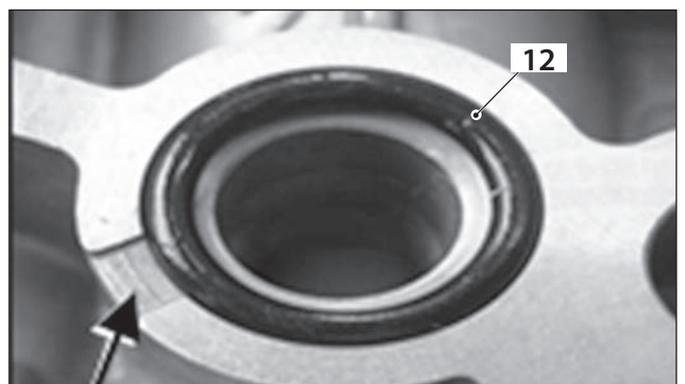


Fig. 4.2.16.8

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