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# 3. BRAKE SYSTEM

## 3.1 GENERAL

**Coding of components**

All components have been provided with number codes.

**Structure of the code**

**1st digit**:
0 Suction connection
1 Energy supply (pressure)
2 Energy outlet
3 Exhaust
4 Control connection
5 Not used
6 Not used
7 Anti-freeze connection
8 Lubricant connection
9 Coolant connection

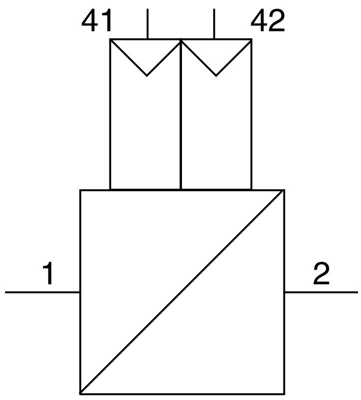
When one connection performs several functions, additional first digits will be allocated. These are separated by a hyphen.
If several connections perform the same function, a second digit will be added behind the first.

Example

Empty/load relay valve

Meaning:

1 energy supply from air compressor
2 energy discharge to the next component
41 control connection
42 control connection

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## COMPRESSOR

| | |
|---|---|
| **Design** | |
| Make: | Wabco 911 504 500 0 |
| Version: | 2-cylinder, water-cooled |
| | |
| **Reject sizes Wabco W 911 504 500 0 compressor** | |
| Cylinder bore at return point of first piston ring | 75.022 mm |
| Piston-ring groove height: | |
| first groove | 2.035 mm |
| second groove | 2.035 mm |
| third groove | 4.047 mm |
| Piston-pin bore diameter | 15.018 mm |
| Piston pin diameter | 14.992 mm |
| Piston diameter, measured in longitudinal direction from piston pin to bottom of piston skirt | 74.962 mm |
| Piston pin bearing in connecting rod | 15.047 mm |
| Crankshaft bearing diameter, non-driving end | 35.070 mm |
| Crankshaft main bearing, non-driving end | 34.963 mm |
| Diameter of crankshaft local to connecting rod | 32.963 mm |
| Anti-friction bearing at driving end | replace always |

## SERVICE-BRAKE VALVE

| | |
|---|---|
| **Design** | |
| Make: | Knorr MB 4694 II/14119 |
| Differential pressure between circuits 1 and 2 | 0.25 - 0.35 bar |
| | |
| **Connections** | |
| Circuit distribution | circuit 1: rear axle<br>circuit 2: front axle |
| Connection 11 | circuit 1 supply |
| Connection 12 | circuit 2 supply |
| Connection 21 | circuit 1 braking pressure |
| Connection 22 | circuit 2 braking pressure |


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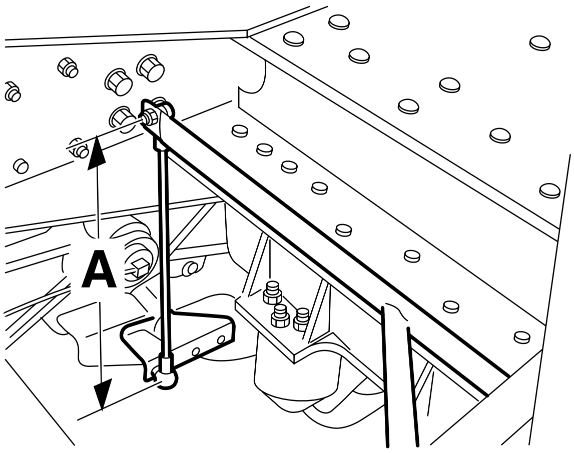
## LOAD-SENSING VALVE, LEAF-SPRING SUSPENSION

| Size | Length |
|---|---|
| Size A | 350 mm |

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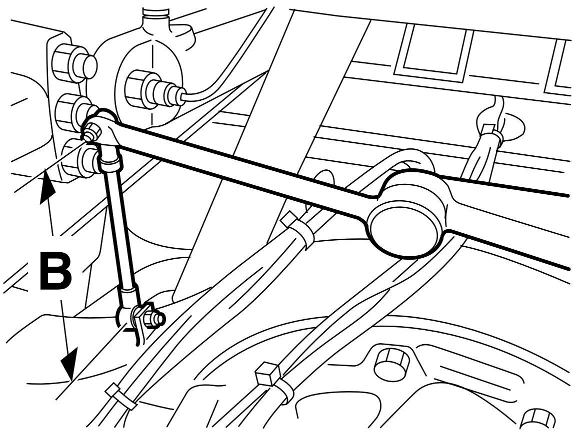
| Size | Axle type | Length |
|---|---|---|
| B | 1355 | 210 mm |
| B | 1347 | 173 mm |
| B | 1354 | 220 mm |

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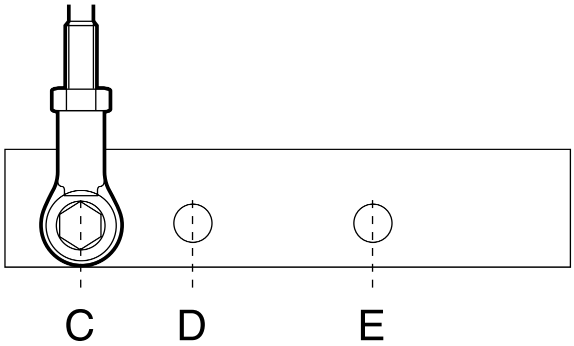
| Adjustment | Axle-load ratio |
|---|---|
| C | 10 tonnes - 10 tonnes |
| E | 11 tonnes - 7 tonnes |

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## BRAKE-LIGHT SWITCH

**Design**

| | |
|---|---|
| Make: | Messmer 131 733 |
| Cut-in pressure brake-light switch | approx 0.5 bar |

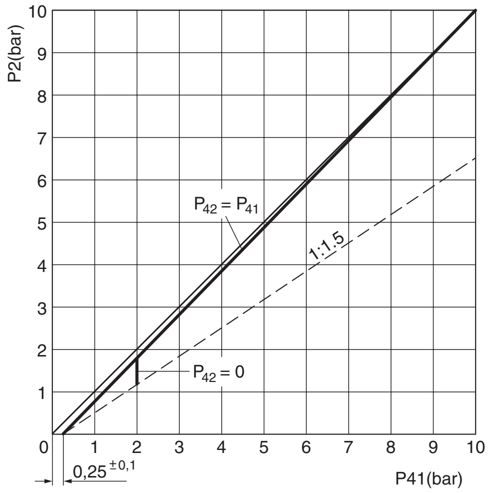
## LOW-PRESSURE SWITCH

**Design**

| | |
|---|---|
| Make: | Wabco 441 014 032 0 |
| Cut-out pressure, low-pressure switch | approx. 5.2 ± 0.5 bar |

## IDLE RELAY VALVE WITHOUT INCREASE OF CONTROL PRESSURE

**Design**
Merk: WABCO 973 011 106 0
Maximum reduction ratio 1: 1.5
Fitted with internal filter and silencer

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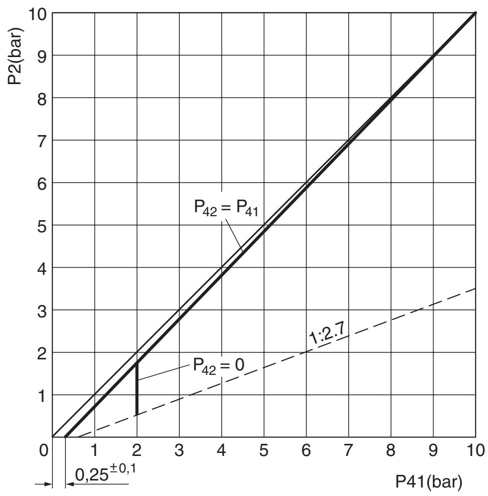
**Design**
Make: WABCO 973 011 107 0
Maximum reduction ratio 1: 2.7
Fitted with internal filter and silencer

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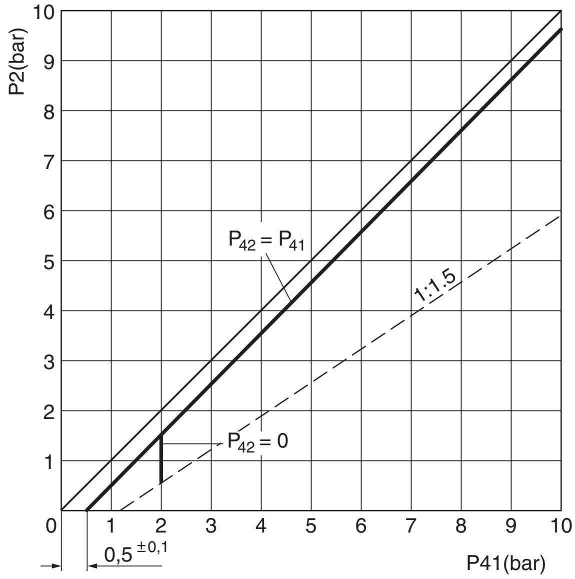
## IDLE RELAY VALVE WITH INCREASE OF CONTROL PRESSURE

**Design**
Make: WABCO 973 011 109 0
Maximum reduction ratio 1: 1.5
Fitted with internal filter and silencer

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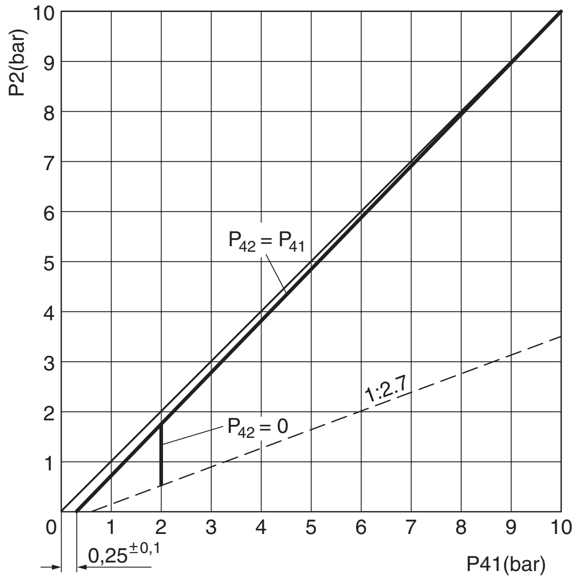
**Design**
Make: WABCO 973 011 110 0
Maximum reduction ratio 1: 2.7
Fitted with internal filter and silencer

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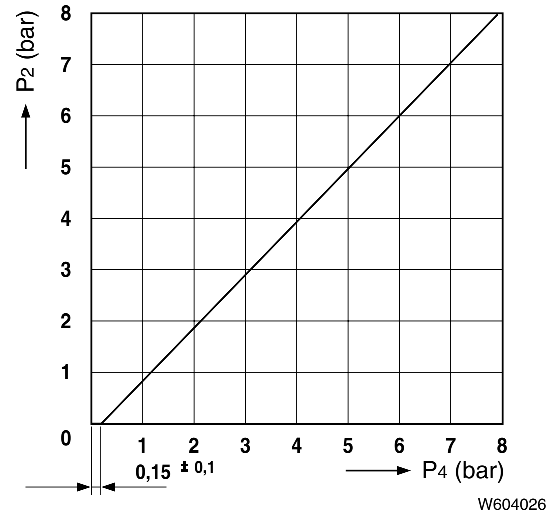
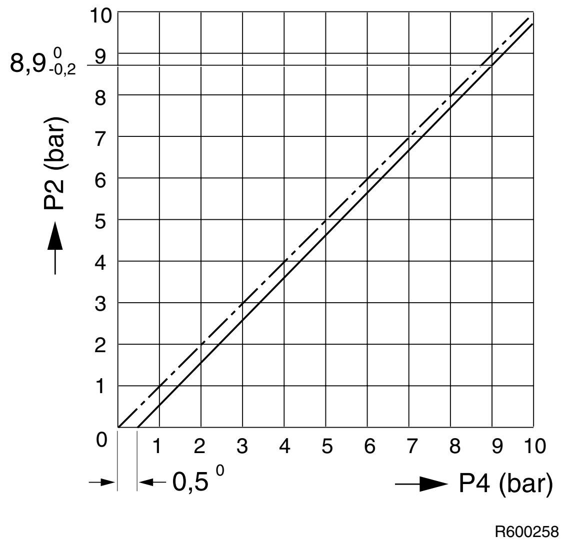
## RELAY VALVE WITHOUT INCREASE OF CONTROL PRESSURE

**Design**
Make: Wabco 973 011 008 0
Fitted with internal filter and silencer




## RELAY VALVE WITH INCREASE OF CONTROL PRESSURE

**Design**
Make: Wabco 973 011 009 0
Fitted with internal filter and silencer



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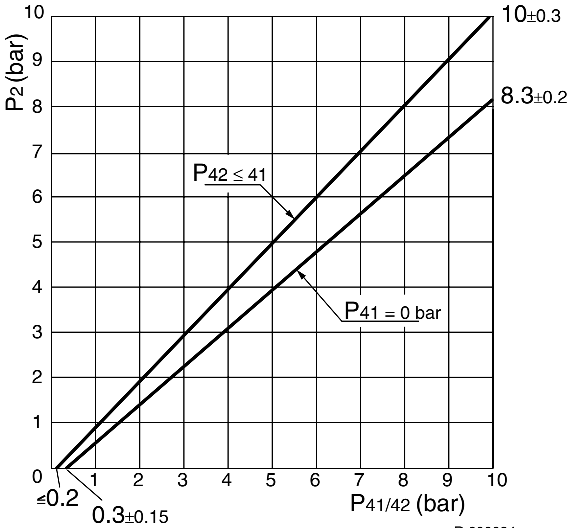
## DOUBLE CHECK/RELAY VALVE

**Design**
Make: Wabco 973 011 205 0
Fitted with internal filter and silencer

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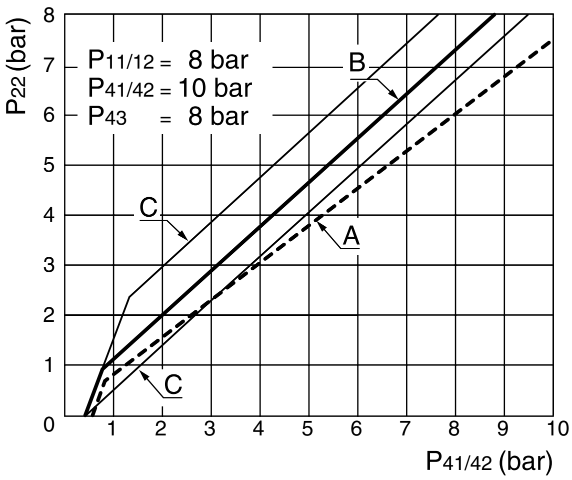
## (SEMI-)TRAILER REACTION VALVE

**Design**
Make: Wabco 973 009 300 0

**Advance**
Input pressure: 3 bar
Output pressure: 3 bar
(comes down to 0.6 bar advance = manufacturer's setting)

**Advance adjustment**
Adjusting bolt (cross head type)
Turning clockwise, advance is decreased
Turning counterclockwise, advance is increased

Explanation of graph
A Curve of failure in circuit 1
B Curve of intact circuit 1 and circuit 2, or failure in circuit 2
C Advance adjustment phase

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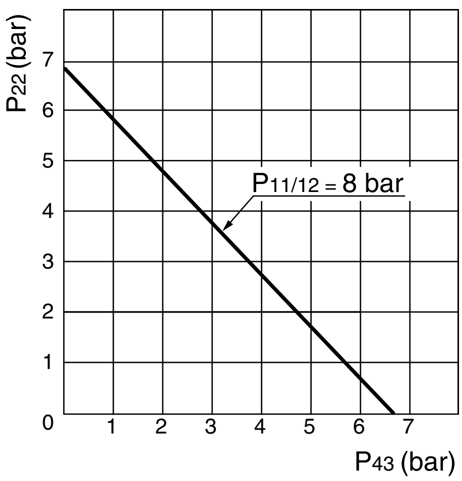


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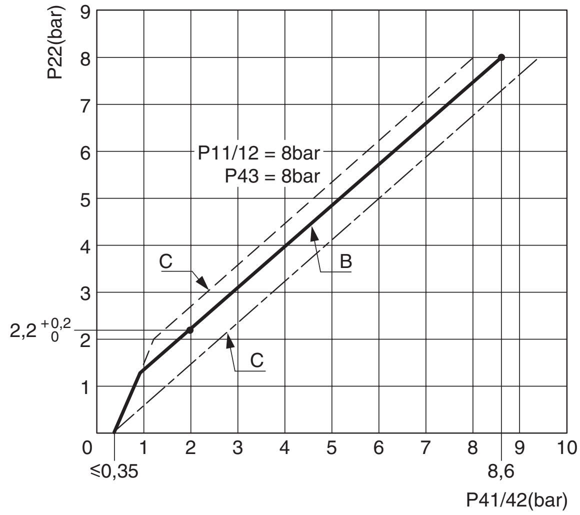
**Design**
Make: Knorr AC 599 A

**Advance**
Input pressure: 3 bar
Output pressure: 3 bar
(comes down to 0.6 bar advance = manufacturer's setting)

**Advance adjustment**
Adjusting bolt (Phillips type)
Turning clockwise, advance is increased
Turning counterclockwise, advance is decreased

Explanation of graph
B Curve of intact circuit 1 and circuit 2, or failure in circuit 1 or circuit 2
C Advance adjustment phase

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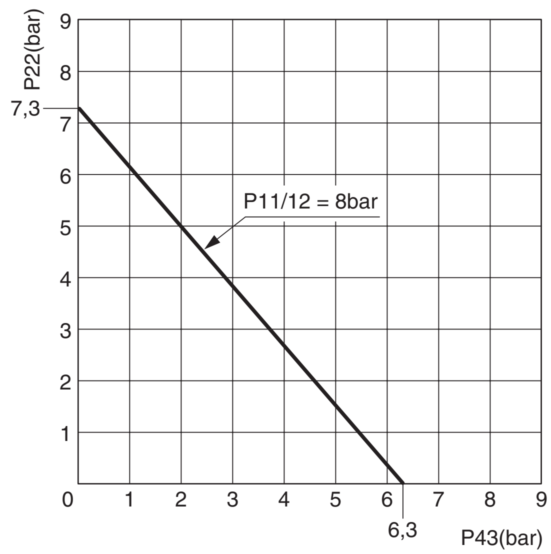


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## PRESSURE-LIMITING VALVE WITH INTEGRATED NON-RETURN VALVE

**Design**

| | |
|---|---|
| Make: | Wabco 475 010 400 0 |
| Setting | 8.0 bar |

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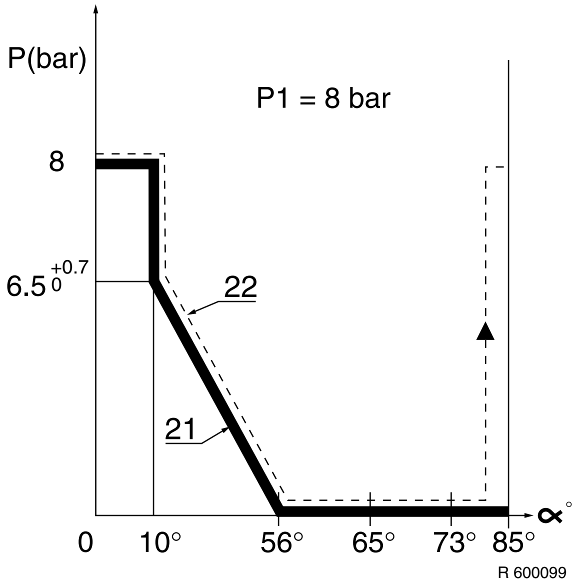
## PARKING-BRAKE VALVE WITH (SEMI-)TRAILER CONNECTION

**Design**
Make: Wabco 961 723 130 0
Knorr DPM90DA
Knorr DPM93DA (without test position)
Max. output pressure
in driving position approx. 8 bar




## FOUR-CIRCUIT SAFETY VALVE

**Version without circuit 3 reverse flow function**

| | |
|---|---|
| Make: | Knorr AE 4437-II/17189 |
| Opening pressure of circuits 1, 2 and 4 | approx 6.5 bar |
| Opening pressure of circuit 3 | approx 67.3 bar |
| Static closing pressure, all circuits | ≥ 4.5 bar |

**Version with circuit 3 reverse flow function**

| | |
|---|---|
| Make: | Knorr AE 4610-II/37462 |
| Opening pressure of circuits 1, 2 and 4 | approx 6.5 bar |
| Opening pressure of circuit 3 | approx 7.3 bar |
| Static closing pressure, all circuits | ≥ 4.5 bar |
| Start reverse flow circuit 3 | pressure circuit 1 < approx. 4 bar |

## SAFETY VALVE

**Design**

| | |
|---|---|
| Make: | Voss 0 268 874 200 |
| Opening pressure | approx. 16 bar |

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## AIR DRYER

**BOSCH design**

| | |
|---|---|
| Type: | RB 0484 460 195 |
| Cut-out pressure of pressure regulator | 9.8 ± 0.2 bar |
| Cut-in pressure of pressure regulator | 8.6 - 9 bar |
| Cut-in temperature heating element | 1°C |
| Cut-out temperature heating element | approx 22°C |

**KNORR design**

| | |
|---|---|
| Type: | LA 8284-II/37663 |
| Cut-out pressure of pressure regulator | approx 9.8 bar |
| Cut-in pressure of pressure regulator | approx 8.8 bar |
| Cut-in temperature heating element | approx 7°C |
| Cut-out temperature heating element | approx 29°C |

## AUTOMATIC SLACK ADJUSTER

**Design**

| | |
|---|---|
| Make: | Haldex |
| Basic brake travel | 35 - 40 mm |
| Reverse torque adjusting bolt | > 18 Nm |
| Axial play on brake camshaft | 0.5 - 1 mm |


DAF © 0006

## BRAKE LININGS

| TYPE | NOTES |
|---|---|
| **DAF 2100** | Installed on LHD vehicles |
| **DAF 3100** | Installed on RHD vehicles |

The bearing pattern of the brake lining can be improved by turning down the brake lining to a diameter which is max. 1 mm smaller than the drum diameter.

## BRAKE DRUM

**General**
A brake drum may be used until the inside diameter has reached the maximum permissible value, as specified in the table below.
As soon as this diameter is exceeded, the brake drum must be replaced.

| Brake diameter | Brake drum standard diameter in mm | Maximum in mm | Maximum turning dimensions |
|---|---|---|---|
| 12 $^3/_8$″ | Out-of-roundness<br>314 + 0.127 | 317.3 | 316.3 |
| 13″ | 330.2 + 0.127 | 333.2 | 332.3 |
| 15 $^1/_2$″ | 393.7 + 0.127 | 396.7 | 395.7 |
| 16″ | 406.6 + 0.250 | 409.6 | 408.6 |
| 16 $^1/_2$″ | 420 + 0.250 | 425 | 423 |
| 310 mm | 310 + 0.210 | 313 | 312 |
| 325 mm | 325 + 0.230 | 328 | 327 |
| 360 mm | 360 + 0.230 | 363 | 362 |
| 375 mm | 375 + 0.230 | 378 | 377 |
| 420 mm | 420 + 0.250 | 425 | 423 |

The out-of-roundness (deformation) of the brake drum is checked with the drum in position on the hub, or on a brake dynamometer.

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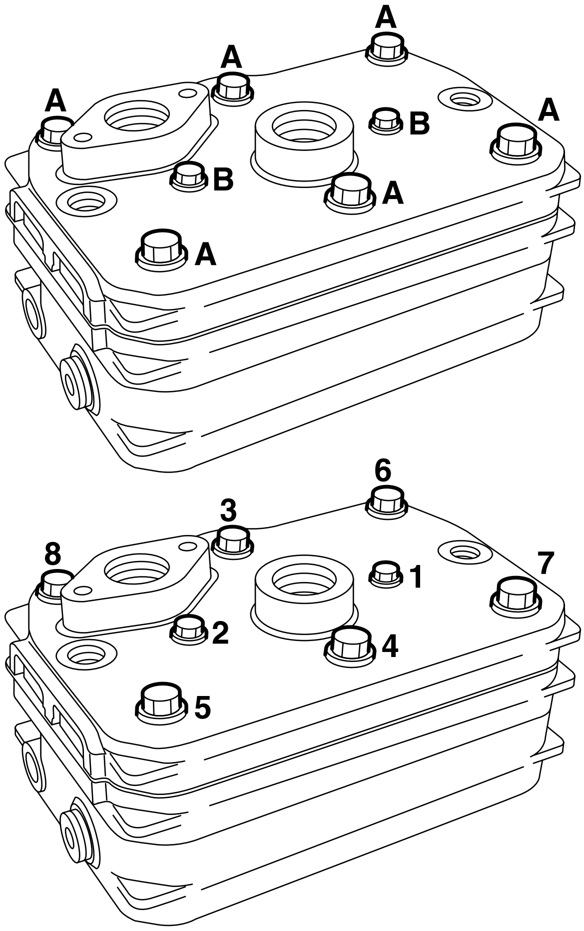
## 3.2 TIGHTENING TORQUES

## COMPRESSOR

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**Cylinder-head bolts:**

| | | |
|---|---|---|
| Phase 1 | | |
| Attachment bolts B | 6 Nm | + 90° angular rotation |
| Attachment bolts A | 30 Nm | + 90° angular rotation |
| Phase 2 | | |
| Attachment bolts B | 10 Nm | + 90° angular rotation |
| Delivery valve fixing nuts | 5 Nm | + 90° angular rotation |
| Connecting rod bolts | 6 Nm | + 70° angular rotation |

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## BRAKE CYLINDER

| | |
|---|---|
| Brake cylinder fixing nuts | 120 Nm |

## SPRING-BRAKE CYLINDER

| | |
|---|---|
| Fixing bolts of spring-brake chamber | 20 Nm |
| Fixing bolts of the brake chamber clamping strip | 10 Nm |
| Release bolt (pressure at least 5.1 bar) | 30 Nm |
| Fixing nuts of spring-brake cylinder | 180 - 210 Nm |

## SAFETY VALVE

| | |
|---|---|
| Attachment | 70 - 75 Nm |

## BRAKE BACK PLATE, FRONT AXLES

| | |
|---|---|
| **Diameter securing hole 14.1 mm** | |
| Flange bolt M14, 12.9 | 178 ± 14 Nm |
| Torx bolt M14, 12.9 | 170 ± 15 Nm + 60° angular rotation * |
| **Diameter securing hole 14.5 mm** | |
| Torx bolt M14, 12.9 | 170 ± 15 Nm + 60° angular rotation * |

## BRAKE BACK PLATE, REAR AXLES

| | |
|---|---|
| **Diameter securing hole 14.1 mm** | |
| Flange bolt M14, 8.8 | 116 ± 9 Nm |
| Torx bolt M14, 10.9 | 170 ± 15 Nm + 60° angular rotation * |
| **Diameter securing hole 14.5 mm** | |
| Torx bolt M14, 10.9 | 170 ± 15 Nm + 60° angular rotation * |

*
- When assembling, always use new bolts, unless an appropriate new nut can be screwed by hand over the entire length of the bolt thread.
- First tighten to the specified torque, and then apply the angular rotation.
- Always achieve full angular displacement, even if the bolt starts to yield.

## QUICK-RELEASE COUPLINGS

| | |
|---|---|
| Socket (VOSS 230 design) | 10 Nm |
| Socket (VOSS 232 design) | 12 Nm |

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# 1. BRAKE SYSTEM

## 1.1 FAULT-FINDING TABLE

| FAULT: RATTLING OF THE BRAKES | |
|---|---|
| **Possible cause** | **Remedy** |
| Loose brake shoes | Check brake shoe attachment |
| Loose brake lining on brake shoe | Check brake lining/lining rivets |
| Poorly machined brake linings, brake lining has poor contact with brake drum | Check brake lining bearing pattern |
| Poor quality of brake linings | Check brake linings |
| Brake drums not or insufficiently reconditioned | Check brake drums |
| Different or non-standard quality brake drums | Check brake drums |
| Maximum grinding tolerance exceeded | Check brake drums |
| Cracked brake drums | Check the length and depth on cracks of brake drums |
| Loose S-camshaft bearing | Check S-camshaft bearing |
| Worn roller-cam/roller-cam bearing | Check/replace roller-cam/roller-cam bearing |
| Incorrect vehicle combination setting | Check vehicle combination setting |
| Incorrect brake pressure setting front axle/rear axle | Check front axle/rear axle setting |

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| FAULT: VEHICLE PULLS TO ONE SIDE DURING BRAKING | |
|---|---|
| **Possible cause** | **Remedy** |
| Worn brake lining/drum | Check brake lining/drum |
| Difference in tyre pressure | Check/correct tyre pressure |
| Difference in tyre size | Check tyres |
| Different quality of brake linings | Check brake linings |
| Poorly machined brake linings, brake lining has poor contact with brake drum | Check brake lining bearing pattern |
| Different, too weak brake-return springs on brake shoes. | Check brake shoe return springs |
| Brake linings contaminated by grease or oil | Check for excess of grease or oil on sealing rings and/or cam rollers |
| Damaged brake lining surface | Check brake linings |
| Brake linings without taper | Check brake linings |
| Different diameters of brake cylinders | Check brake cylinder diameter |
| Broken springs on brake cylinders | Check brake cylinders |
| Leaking brake cylinders | Check brake cylinders |
| Contaminated brake cylinders | Check brake cylinders for contamination |
| Defective brake slack adjuster(s) | Check automatic slack adjuster |
| Wrong slack adjuster stroke | Check slack adjuster stroke |
| Movement of S-camshaft | Check S-camshaft movement |
| Excessive play of swivel-axle bearing | Check play on swivel-axle bearing |
| Excessive play on steering ball joint | Check play on steering ball joint |
| Excessive play of shackle pins | Check play on shackle pins |
| Incorrect vehicle combination setting | Check vehicle combination setting |
| Incorrect ABS operation | Check ABS operation |

| FAULT: POOR BRAKING DECELERATION | |
|---|---|
| **Possible cause** | **Remedy** |
| Overloading due to too heavy load | Check vehicle load conditions |
| System pressure too low | Check pressure regulator setting |
| Air leakage in braking system | Check braking system for leaks |
| Insufficient braking power/wrong (semi-)trailer braking system conditions | Check (semi-)trailer |
| Heavy brake pipe bending | Check/replace brake pipes |
| Excessive brake cylinder stroke | Check automatic slack adjuster |
| Frozen braking system | Check braking system |
| Excess of pollution on brake components | Check brake components for contamination |
| Contaminated brake cylinders | Check brake cylinders for contamination |
| Incorrect brake cylinder diameter | Check brake cylinders |
| Brake linings contaminated by grease or oil | Check for excess of grease or oil on sealing rings and/or cam rollers |
| Poorly machined brake linings, brake lining has poor contact with brake drum | Check brake lining bearing pattern |
| Damaged brake lining surface | Check brake linings |
| Poor quality of brake linings | Check brake linings |
| Hardened brake linings | Check brake linings |
| Damaged brake shoes | Check brake linings |
| Jammed brake shoe bearings | Check brake shoes |
| Loose S-camshaft bearing | Check S-camshaft bearing |
| Worn roller-cam/roller-cam bearing | Check roller-cam/roller-cam bearing |
| Incorrect operation/setting of load-sensing adjustment valve | Check operation/setting of load-sensing adjustment valve |
| Incorrect vehicle combination setting | Check vehicle combination setting |
| Incorrect ABS operation | Check ABS operation |

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| FAULT: VIBRATIONS DURING BRAKING | |
|---|---|
| **Possible cause** | **Remedy** |
| Wrong tightening method when fitting the wheels | Tighten the wheels according to the appropriate procedure |
| Non-standard wheel fitting | Use only standard wheels |
| Overloading due to too heavy load | Check vehicle load conditions |
| Incorrect brake pressure setting front axle/rear axle | Check front axle/rear axle setting |
| Poor quality of brake linings | Check brake linings |
| Poor machining of brake linings Use of a blunt chisel during machining | Check brake linings |
| Loose brake lining on brake shoe | Check brake lining/lining rivets |
| Loose brake shoes | Check brake shoe attachment |
| Brake drums not or insufficiently reconditioned | Check brake drums |
| Different or lesser quality brake drums | Check brake drums |
| Cracked brake drums | Check the length and depth on cracks of brake drums |
| Deformed/oval brake drums | Check brake drums |
| Hardened parts on brake drum due to overheating | Check/replace brake drums |
| Play in cab suspension | Check cab suspension |
| Incorrect vehicle combination setting | Check vehicle combination setting |


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| FAULT: BRAKE LOCKING | |
|---|---|
| **Possible cause** | **Remedy** |
| Incorrect setting of load-sensing adjustment valve | Check setting of load-sensing adjustment valve |
| Overheating of brake linings on the non-locking axle | Check brake linings on non-locking axle |
| Poor machining or no machining of brake linings | Check brake linings |
| Use of a blunt chisel during machining of brake linings | Check brake linings |
| Different or lesser quality brake drums | Check brake drums |
| Hardened parts on brake drum due to overheating | Check/replace brake drums |
| Loose S-camshaft bearing | Check S-camshaft bearing |
| Worn roller-cam/roller-cam bearing | Check roller-cam/roller-cam bearing |
| Wrong system pressure due to incorrect setting of pressure regulator | Check pressure regulator setting |
| Defective (semi-)trailer braking system | Check (semi-)trailer braking system |
| Incorrect vehicle combination setting | Check vehicle combination setting |
| Incorrect ABS operation | Check ABS operation |
| Insufficient tyre tread | Check tyre tread |

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| FAULT: EXCESSIVE WEAR OF BRAKE LININGS | |
|---|---|
| **Possible cause** | **Remedy** |
| Overloading due to too heavy load | Check vehicle load conditions |
| Incorrect setting of service-brake valve stop bolt (residual pressure) | Check service-brake valve setting |
| Incorrect setting of load-sensing adjustment valve | Check setting of load-sensing adjustment valve |
| Incorrect vehicle combination setting on front axle/rear axle | Check vehicle combination setting on front axle/rear axle |
| Defective (semi-)trailer braking system | Check (semi-)trailer braking system |
| Heavily polluted brakes, jamming pivoting points on brake shoes | Check free movement of brake shoes, clean brakes |
| Different /poor quality of brake linings | Check brake linings |
| Too loose or broken return spring | Check return spring |
| Defective brake slack adjuster | Check automatic slack adjuster |
| Cracked brake drums | Check the length and depth on cracks of brake drums |
| Insufficient air pressure on brake cylinders when driving, brake dragging | Check air pressure in brake cylinders when the parking brake valve is in driving position |
| Dragging brakes, since parking brake is not released | Check parking brake release |
| Dirt on foot valve/floor mat too high | Check foot valve free movement |
| Dirty/clogged breathers of brake valves | Check breathers of brake valves |


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| FAULT: DAMAGED BRAKE DRUMS | |
|---|---|
| **Possible cause** | **Remedy** |
| Overloading due to too heavy load | Check vehicle load and use conditions |
| Brake drums of lesser quality | Check quality/make of brake drums |
| Wrong tightening method when fitting the wheels | Tighten the wheels according to the appropriate procedure |
| Heavily contaminated brakes | Clean brakes |
| Poor quality of brake linings | Replace brake linings |
| Poorly machined brake linings, brake lining has poor contact with brake drum | Check brake linings |
| Loose S-camshaft bearing | Check S-camshaft bearing |
| Reconditioned brake drums larger than maximum diameter allowed | Replace brake drums |
| Incorrect operation of non-increment function of braking system | Check non-increment function of braking system |

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| FAULT: DAMAGED BRAKE LININGS | |
|---|---|
| **Possible cause** | **Remedy** |
| Overloading due to too heavy load | Check vehicle load and use conditions |
| Heavily contaminated brakes | Clean brakes |
| Poor quality of brake linings | Check quality/make of brake linings |
| Frozen or rusted brakes released by force | Replace brake linings |
| Wrong brake lining machining, use of a blunt chisel during machining | Check/replace brake linings |
| Too high pressure on rivets when fitting brake linings on brake shoes | Apply right pressure on rivets when fitting brake linings on brake shoes |
| Too low pressure on rivets when fitting brake linings on brake shoes | Apply right pressure on rivets when fitting brake linings on brake shoes |
| Wrong order of placing rivets when fitting brake lining on brake shoe | Follow the right procedure during brake lining fitting |
| Worn and/or damaged brake shoes | Check/replace brake shoes |
| Damaged lining due to broken return spring | Check return spring |


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| FAULT: DRAGGING BRAKES | |
|---|---|
| **Possible cause** | **Remedy** |
| Incorrect setting of service-brake valve stop bolt (residual pressure) | Adjust stop bolt |
| Leakage of foot valve to circuit 1 and/or 2 | Check foot valve for leaks |
| Insufficient air pressure on brake cylinders when driving | Check the non-increment relay valve output pressure<br><br>Check four-circuit safety valve for contamination<br><br>Check the parking brake valve output pressure |
| Heavily polluted brakes, jamming brake shoes | Check free movement of brake shoes, clean brakes |
| Broken or too loose return spring between the brake shoes | Check return spring |
| Wrong type of brake lining | Check type and clearance of brake lining |
| Movement of S-camshaft | Check S-camshaft motion |
| Defective brake slack adjuster | Check automatic slack adjuster |
| Too low output pressure from trailer control valve to trailer or semi-trailer | Check trailer control valve output pressure |
| Dirt on foot valve/floor mat too high | Check foot valve free movement |
| Dirty/clogged breathers of brake valves | Check breathers of brake valves |

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# 1. BRAKE DIAGRAMS

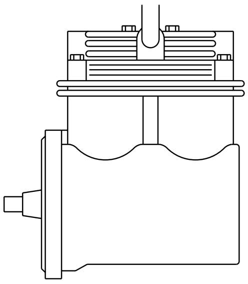
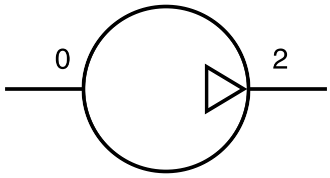
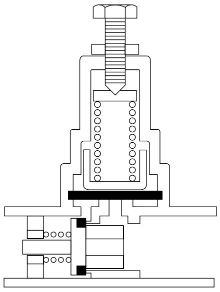
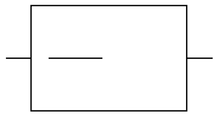
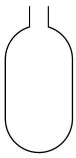
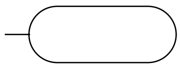
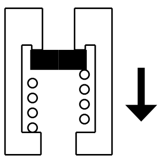
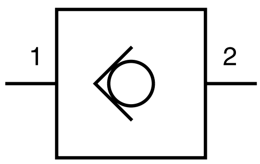
## 1.1 INTRODUCTION

Because of the large number of brake system versions per vehicle series and per country, it is not feasible to include all the different brake system diagrams in the Workshop Manual.

To explain the operation of the brake systems, basic diagrams of the various brake systems have been included, and reference is made to these diagrams in the instructions.

Other vehicle series and country versions can be derived from these basic diagrams.

## 1.2 OVERVIEW OF FUNCTION AND DIN SYMBOLS

| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 1. | **Compressor** |  W603020 |   W603051 |
| 2. | **Pressure-relief valve (with full reverse flow)** |  R600067 |  R600066 |
| 3. | **Regeneration reservoir** |  R600064 |  R600065 |
| 5. | **Non-return valve** |  W603021 |   W603052 |

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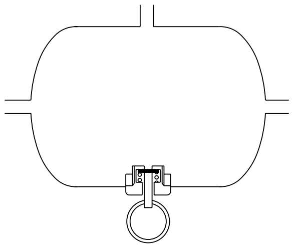
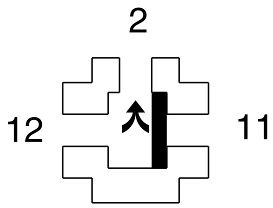
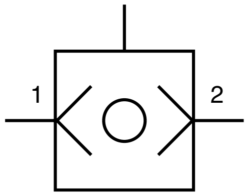
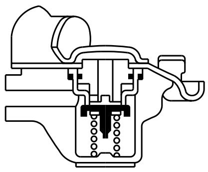
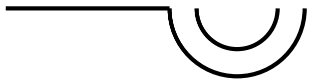
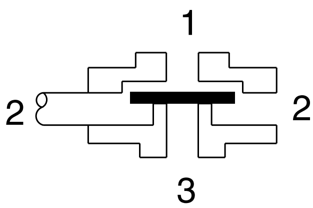
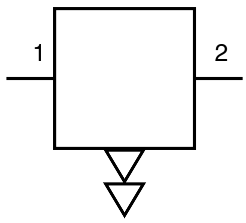
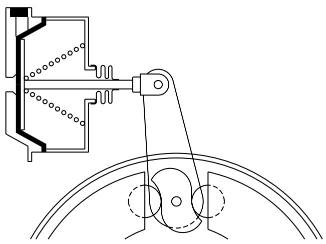
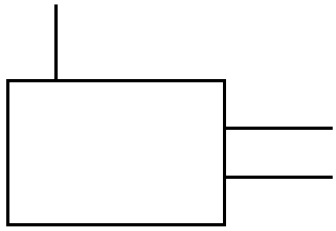
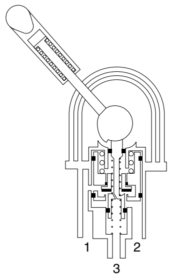
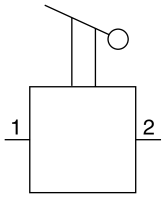
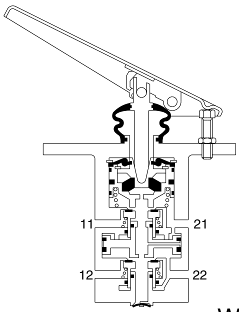
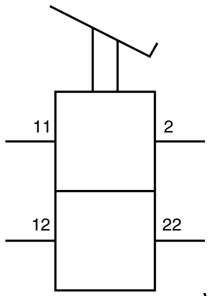
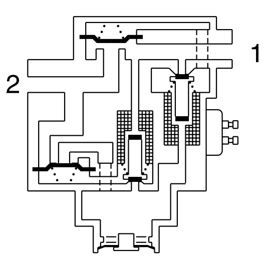
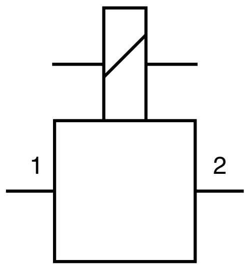
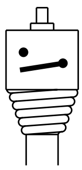
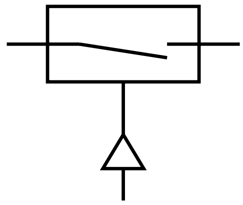
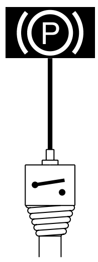
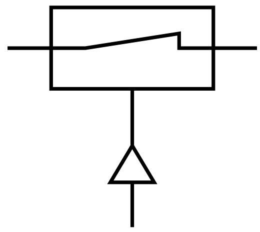
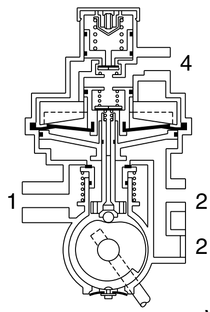
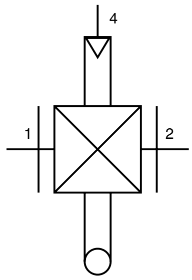
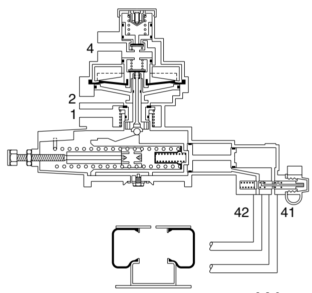
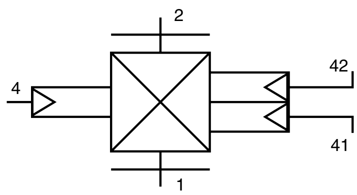
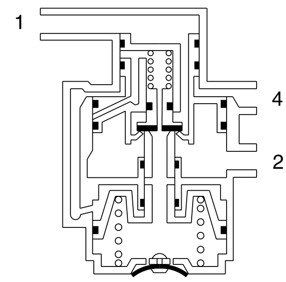
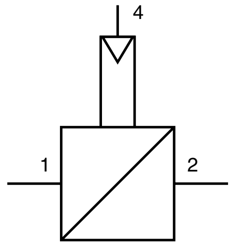
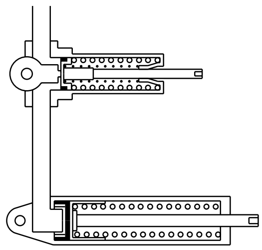
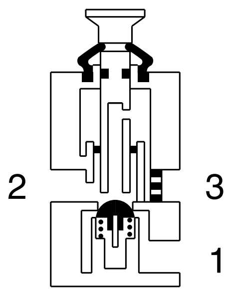
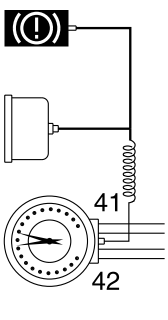
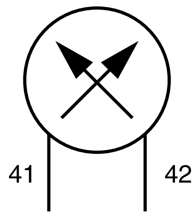
| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 7. | **Air reservoir** |  W603023 |  W603053 |
| 10. | **Two-way valve** |   W603024 |   W603054 |
| 12. | **Coupling head** |  W603025 |  W603055 |
| 13. | **Quick-release valve** |   W603026 |   W603056 |

| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 14. | **Brake chamber** |  W603027 |  W603057 |
| 15. | **Independent (semi-)trailer brake valve** |   R600068 |   R600071 |
| 16. | **Service-break valve** |   W603028 |   W603058 |
| 17. | **Electropneumatic valve** |   W603029 |   W603059 |

| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 18. | **Brake-light switch** |  W603032 |  W603060 |
| 19. | **Low-pressure switch** |   W603033 |  W603061 |
| 21. | **Load-sensing valve, leaf-spring suspension** |   W603034 |   W603062 |
| 22. | **Load-sensing valve, air suspension** |   W603035 |   W603063 |

| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 23. | **Empty/load valve** |   W603036 |   W603064 |
| 24. | **Exhaust-brake air cylinders** |  W603037 | |
| 26. | **Engine-brake control valve** |   W603038 | |
| 28. | **Pressure gauge** |   W603039 |   W603065 |



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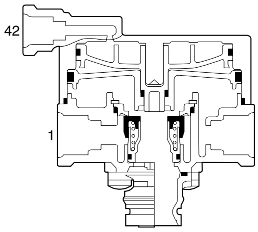
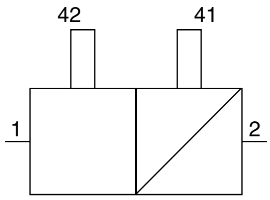
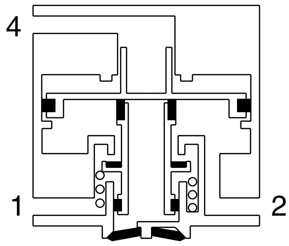
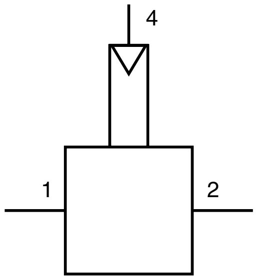
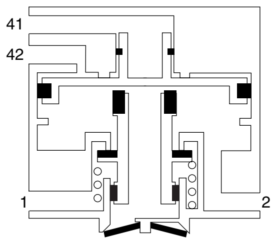
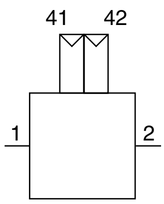
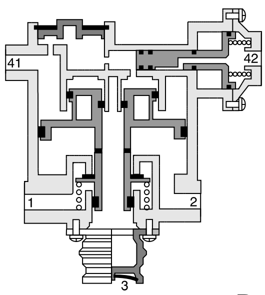
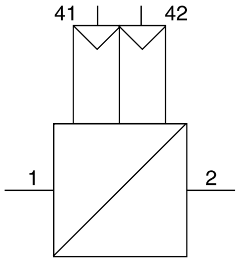
| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 32. | **Double check/relay valve** | <br>R600085 | <br>R600063 |
| 33. | **Relay valve** | <br>W603040 | <br>W603066 |
| 34. | **Trailing axle relay valve** | <br>R600070 | <br>R600069 |
| 35. | **Empty/load relay valve** | <br>R600037 | <br>R600036 |

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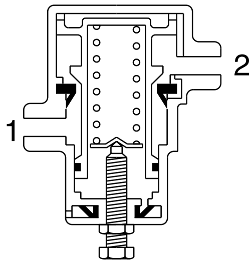
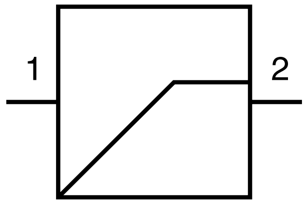
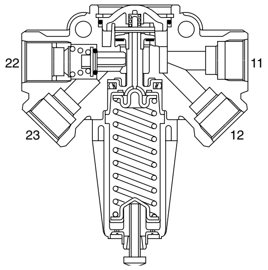
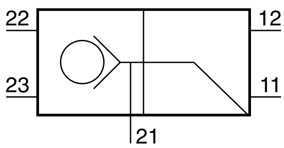
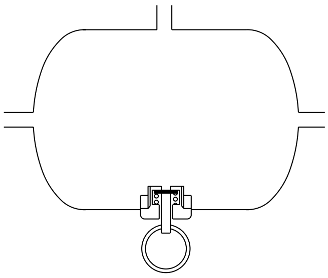
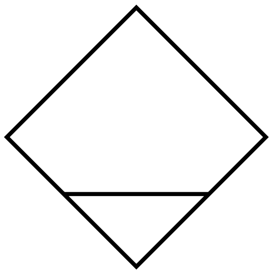
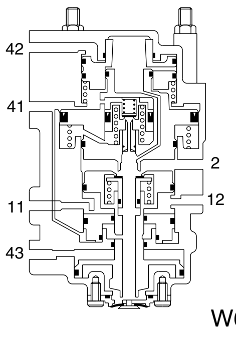
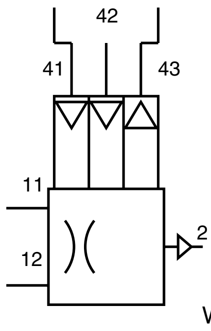
| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 40. | **Pressure limiting valve** |   W603041 |   W603067 |
| 41. | **Pressure-relief valve with integrated non-return valve** |   R600227 |   R600228 |
| 44. | **Water blow-off valve** |  W603023 |  W603068 |
| 46. | **(semi-)trailer-reaction valve** |   W603042 |   W603069 |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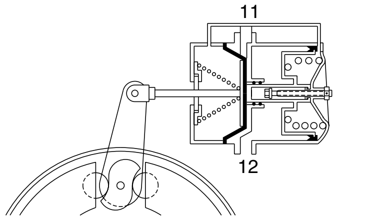
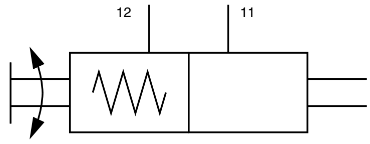
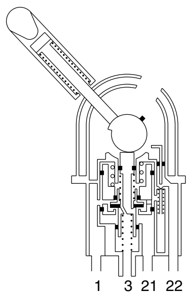
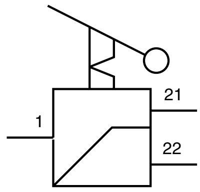
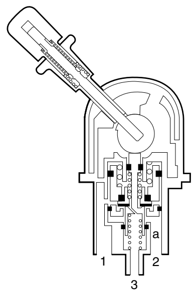
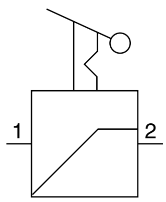
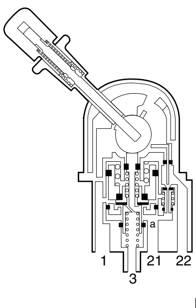
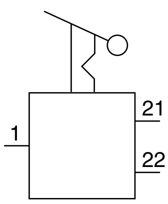
| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 49. | **Spring-brake cylinder** |   W603043 |   W603070 |
| 50. | **Parking-brake valve with pressure-relief and (semi-)trailer reaction valve** |   W603044 |   W603071 |
| 51. | **Parking-brake valve with pressure-relief and without (semi-)trailer reaction valve** |   R600096 |   R600061 |
| 52. | **Parking-brake valve with (semi-)trailer reaction valve** |   R600094 |   R600062 |

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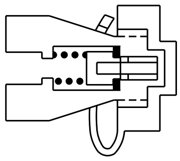
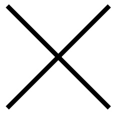
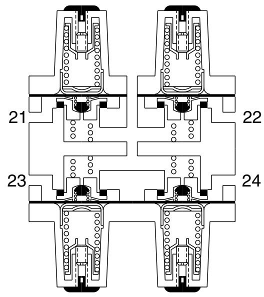
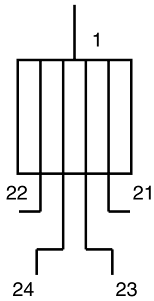
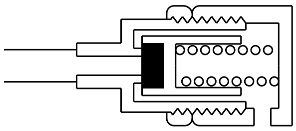
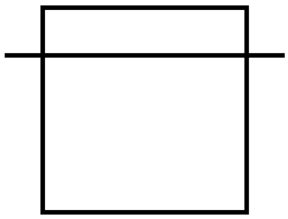
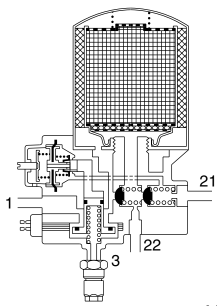
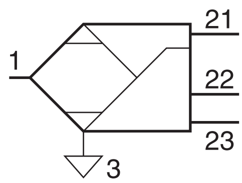
| No. | Designation | Function symbol | DIN symbol |
|---|---|---|---|
| 62. | **Emergency filling/test connection** |  W603046 |  W603072 |
| 63. | **Four-circuit safety valve** |  W603047 |  W603073 |
| 64. | **Safety valve** |  W603048 |  W603074 |
| 66. | **Air dryer** |  W603049 |  R600342 R600342 |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## 1.3 BRAKE-DIAGRAM LEGEND

1. Compressor
2. Pressure-relief valve (with full reverse flow)
3. Regeneration reservoir
4. Non-return valve
5. Air reservoir
6. Two-way valve
7. Coupling head
8. Quick-release valve
9. Brake chamber
10. Independent (semi-)trailer brake valve
11. Service-break valve
12. Electropneumatic valve
13. Brake-light switch
14. Low-pressure switch
15. Load-sensing valve, leaf-spring suspension
16. Load-sensing valve, air suspension
17. Empty/load valve
18. Exhaust-brake air cylinders
19. Engine brake control valve
20. Pressure gauge
21. Double check/relay valve
22. Relay valve
23. Trailing axle relay valve
24. Empty/load relay valve
25. Pressure limiting valve
26. Pressure-relief valve with integrated non-return valve
27. Water blow-off valve
28. (semi-)trailer-reaction valve
29. Spring-brake cylinder
30. Parking-brake valve with pressure-relief and (semi-)trailer reaction valve
31. Parking-brake valve with pressure-relief and without (semi-)trailer reaction valve
32. Parking-brake valve with (semi-)trailer reaction valve
33. Emergency filling/test connection
34. Four-circuit safety valve
35. Safety valve
36. Air dryer

2

## 1.4 BRAKE DIAGRAMS

| BRAKE DIAGRAM NUMBER | VEHICLE TYPE | NOTES |
|---|---|---|
| R600235 | FA | Leaf-spring suspension |
| R600237 | FTG | Air suspension |
| R600239 | FT | Leaf-spring suspension |
| R600241 | FAS | Leaf-spring suspension |


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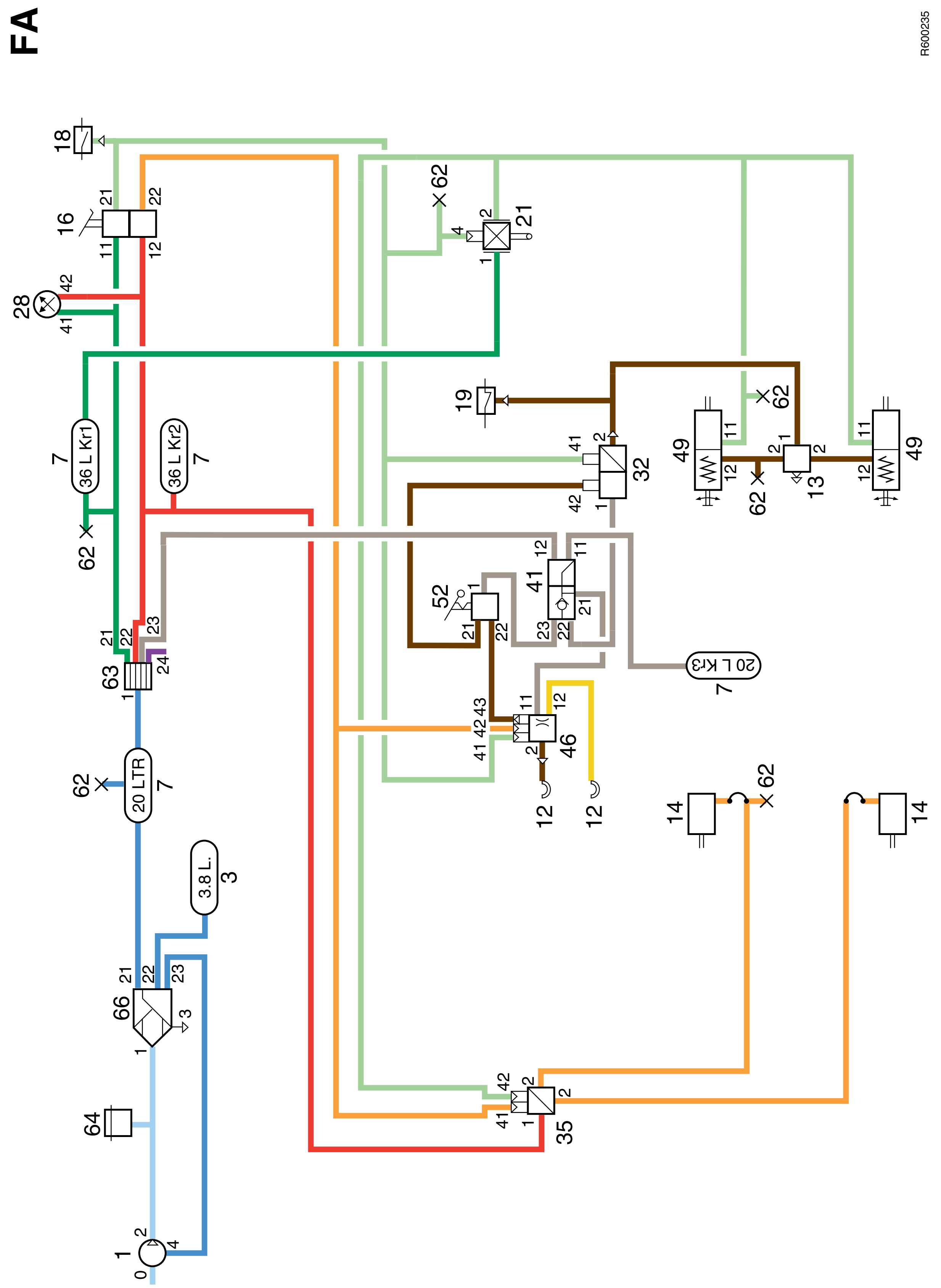
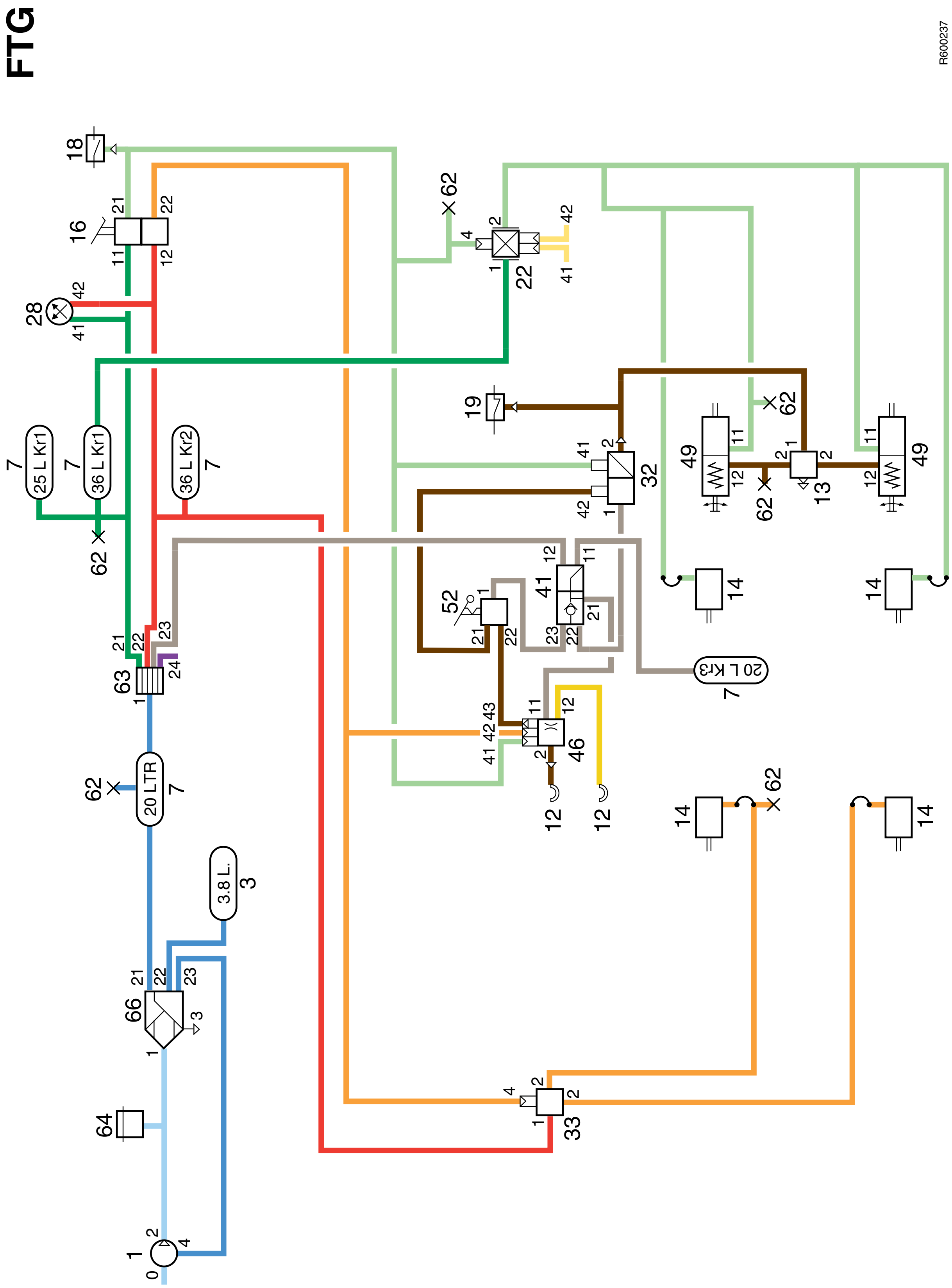
## BRAKE DIAGRAM R600235



2

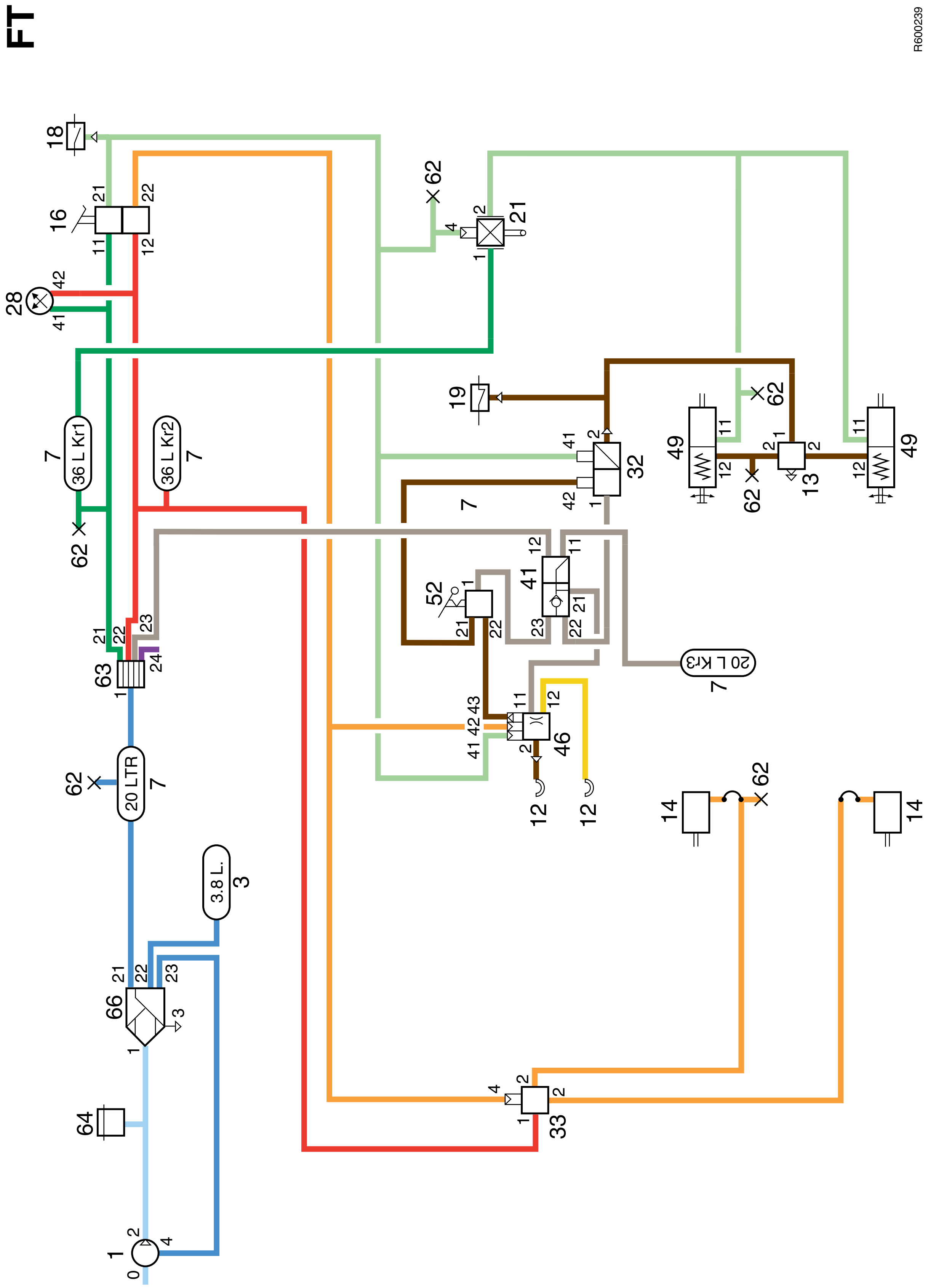
## BRAKE DIAGRAM R600237



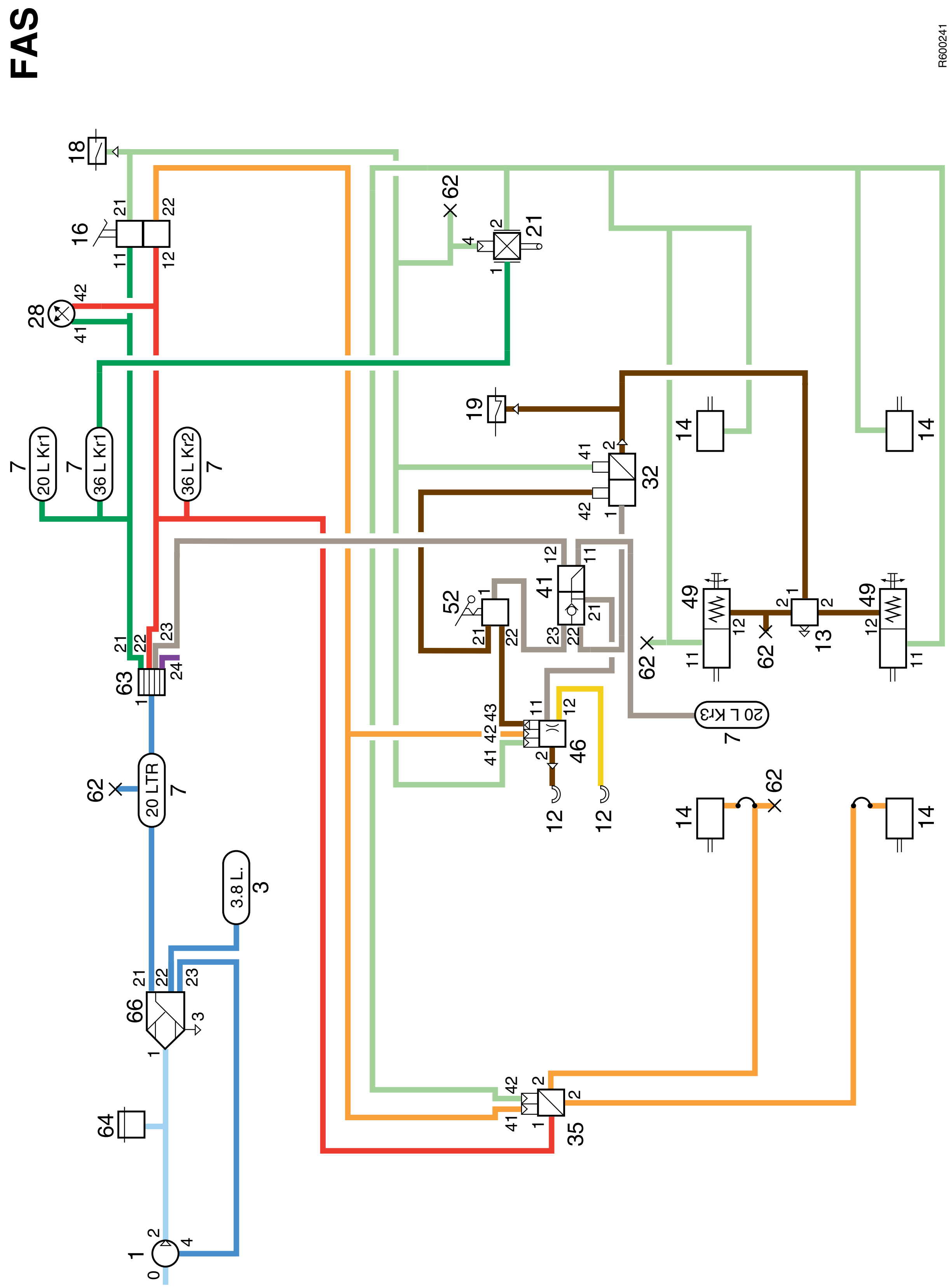



© 0006

## BRAKE DIAGRAM R600239



## BRAKE DIAGRAM R600241

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# CONTENTS



3

3

# 1. DESCRIPTION OF COMPONENTS

## 1.1 COMPRESSOR

The compressor in a two-cylinder version with water-cooled cylinder head.
The compressor is driven by the camshaft gear via a gear wheel.

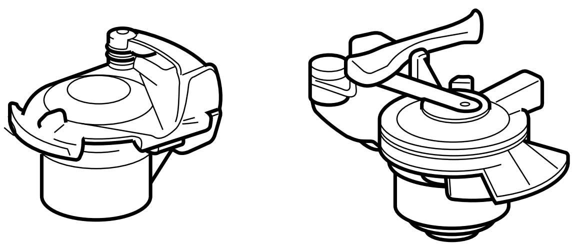
The compressor has a so-called energy-saving function.
When the air-pressure system has reached the set pressure, the air dryer will send a pressure signal back to the compressor.
In the compressor a plunger operates two valves, which connect the inlet and exhaust valve inside the compressor.
The compressed air is then constantly pumped from one cylinder to the other.
This energy-saving function has a positive effect on the engine efficiency.
If the controller switches off to fill up the air-pressure system, the plunger will move the two valves into their initial position, thus making it possible for the compressor to supply pressure again.

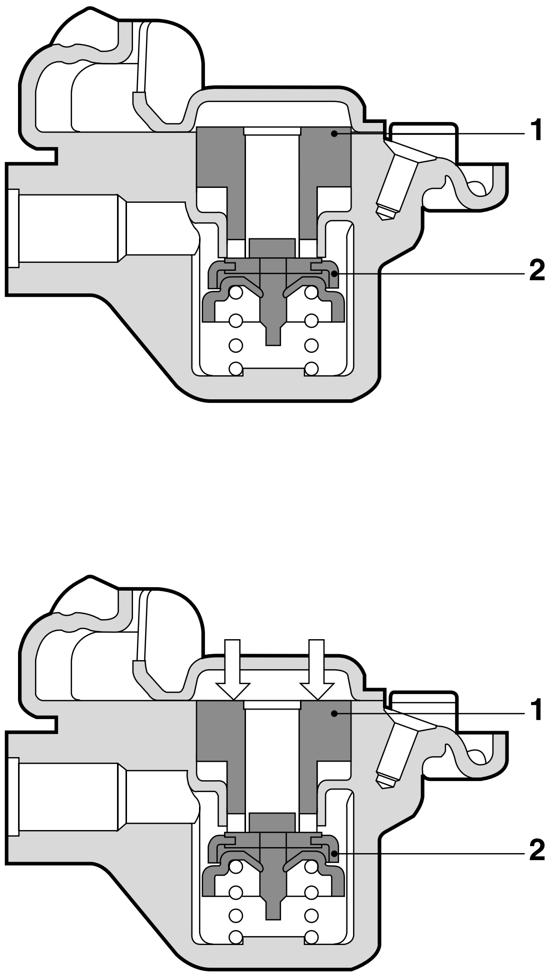
## 1.2 COUPLING HEAD

**Application**
With spring-loaded valve. Fitted in the dual-circuit system of versions with (semi-)trailer connections.
If these automatic coupling heads are applied there is no need for an air cock.

**Purpose**
To interconnect the air-brake system of the tractive vehicle with that of the (semi-)trailer.

**Operation**
The spring-loaded valve (2) in the coupling head ensures that the system is isolated from the atmosphere.
When coupling, turn the counter head until the claws of the two heads rest against the stop under the locking plates. This will prevent the coupling head from disengaging spontaneously.
Because the two sealing rings (1) are pressed against each other, the spring-loaded valve remains open so that an air-tight connection is achieved. When the heads are uncoupled, the spring-loaded valve on the towing vehicle will seal off the pipe.
The coupling head is equipped with a fool-proof safety cam. This is to prevent different coupling heads being coupled to one another.
If no (semi-)trailer is hooked up, the cover of the coupling head must be closed, to avoid fouling.



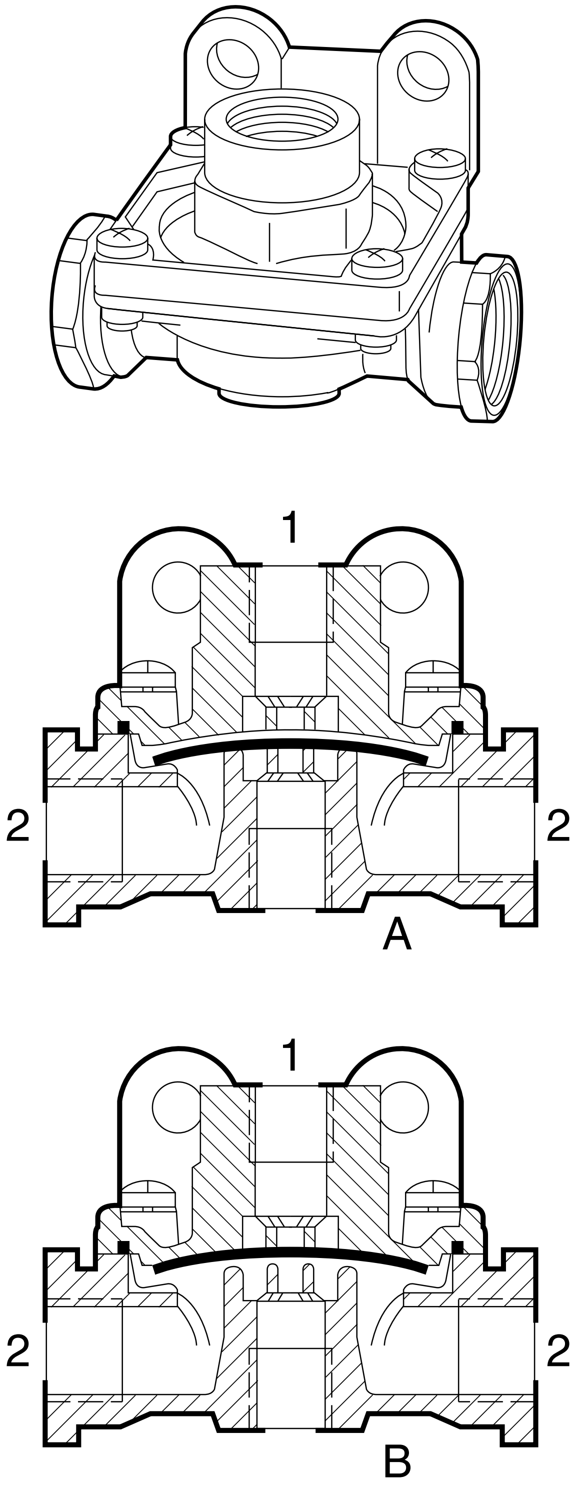



R600101

## 1.3 QUICK-RELEASE VALVE

**Purpose**
The purpose of the quick-release valve is to quickly vent compressed air from the brake chambers and the spring-brake cylinders.

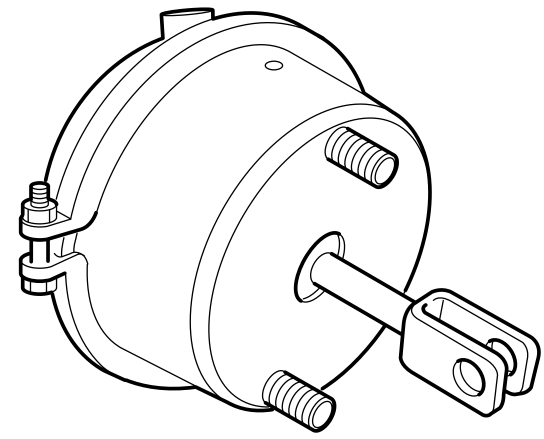
**Operation**
In the brakes-released position of the service brake, all ports have atmospheric pressure. Applying the brake will supply compressed air to port 1. This will press the diaphragm onto the seat, whilst the outer edge deflects to the ridges in the housing (see illustration A).
Compressed air can now flow around the diaphragm to port 2, and to the brake chambers, so that the brakes are applied against the drums. When the brakes are released, the air pressure at port 1 falls away, and the pressure at port 2 forces the diaphragm upwards, so that it forms a seal against the cover. The connection with the exhaust port is now free because the diaphragm is also released from its seating. The compressed air at port 2 can be vented to the atmosphere (see illustration B).




R600051

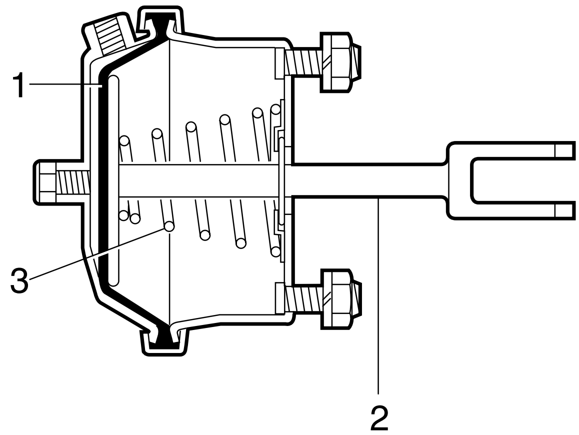
## 1.4 BRAKE CHAMBER

**Purpose**
The purpose of the brake chamber is to apply the brake shoes against the drum.



R600243

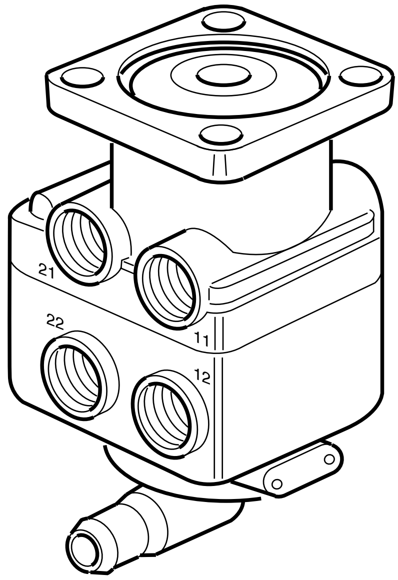
**Operation**
When the service-brake valve is operated, compressed air is admitted at the pressure side of the diaphragm (1). The diaphragm (1) and push rod (2) are pushed outwards against the pressure of the spring. As a result, the brake shoes are forced against the brake drum via a linkage. The air on the other side of the diaphragm can escape via vent holes, and the clearance around the push rod.
When the brakes are released, the coil spring (3) will force the push rod and the diaphragm back to their initial position.
The brake chamber will always draw in outside air on the non-pressure side. When the brakes are released the push rod should return fully to its initial position. The set pressure should not exceed 0.5 bar.




R600244

## 1.5 SERVICE-BREAK VALVE

Differential pressure between circuits 1 and 2 approx. 0.25 - 0.35 bar.




R600103

**Purpose**
The purpose of the service-brake valve is to enable very precise bleeding and venting of air to and from the service-brake circuits, independently of each other.

**Connection points**
The circuit distribution is as follows:
Circuit 1: rear axle
Circuit 2: front axle

| | |
|---|---|
| Connection 11 | Circuit 1 supply |
| Connection 12 | Circuit 2 supply |
| Connection 21 | Circuit 1 braking pressure |
| Connection 22 | Circuit 2 braking pressure |

**Operation**
The service-brake valve consists of an upper part (circuit 1) and a lower part (circuit 2); both parts are provided with a connection for the supply line (11 or 12) and the brake line (21 or 22).
If the pedal is depressed, push rod (1), spring retainer (2) and rubber regulating spring (3) will exert force on regulating piston (4). The regulating piston moves downwards, closes off exhaust (5) and opens inlet (10). The reservoir pressure at port 11 flows via chamber (A) and port 21 to the brake chambers of circuit 1.
At the same time, compressed air flows via bore (D) into chamber (B) above regulating piston (7), which is forced downwards as a result. Exhaust (9) is closed and inlet (8) opened. Via chamber (C) and port 22, the reservoir pressure at port 12 flows to the brake chambers in circuit 2.

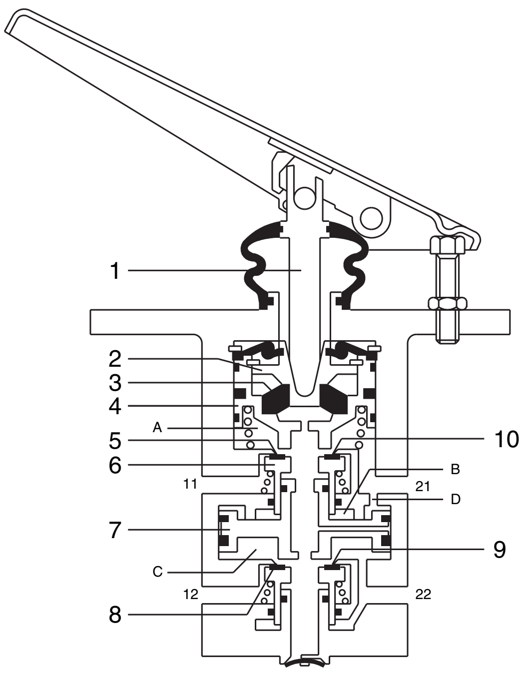



Fig.2

W604033

The pressure being built up in chamber (A) is also applied to the underside of regulating piston (4), which is forced upwards against the pressure of the rubber regulating spring (3), until a state of balance is achieved. In this state of balance, both exhaust (5) and inlet (10) are closed. In the same way, a state of balance is achieved in circuit 2.
As the pedal is depressed further, the above described cycle will be repeated, thus enabling the brakes to be applied in stages, until the maximum braking force has been applied. If the pedal force is reduced, rubber regulating spring (3) will expand so that regulating pistons (4) and (7) move upwards. The brake pipes are vented and the pressure in the brake chambers falls, correspondingly. If a leak occurs in the lower circuit (circuit 2), the upper circuit will operate as described above. If a leak occurs in the upper circuit, no compressed air will flow to chamber (B) above regulating piston (7). Piston (4) should now be depressed deep enough that the underside of the piston tube (6) comes into contact with regulating piston (7). The adjustment is done in the same way as described above. Regulating piston (7) is fitted with two O-rings, to ensure a thorough and safe separation between the two circuits. The space between these two seals is connected to the venting system. A leak can be heard immediately as the blowing-off sound of the service-brake valve during braking.

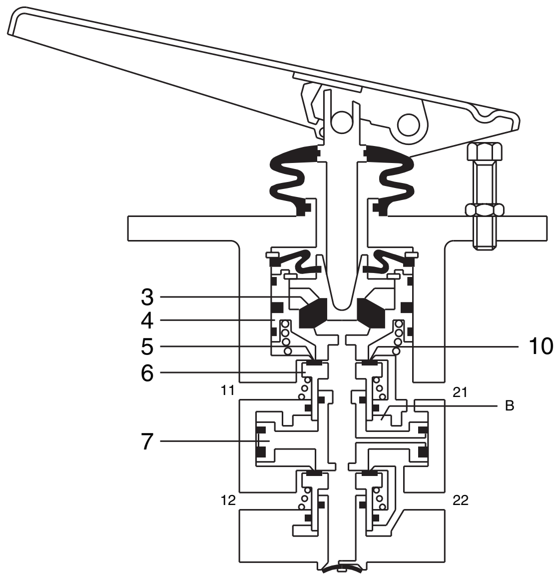


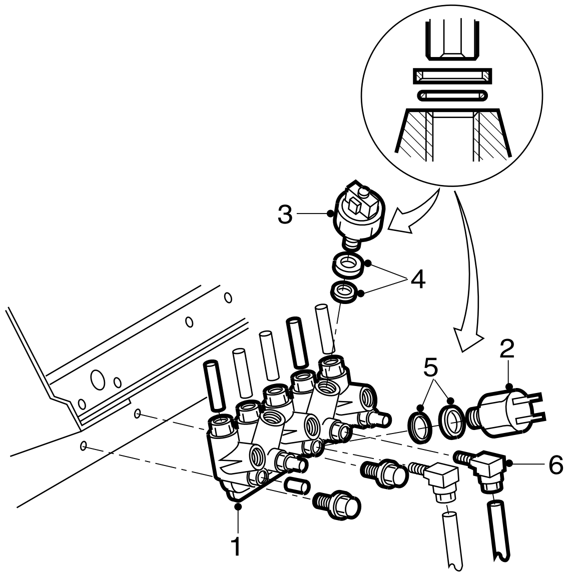

Fig.3

W604034

## 1.6 BRAKE-LIGHT SWITCH

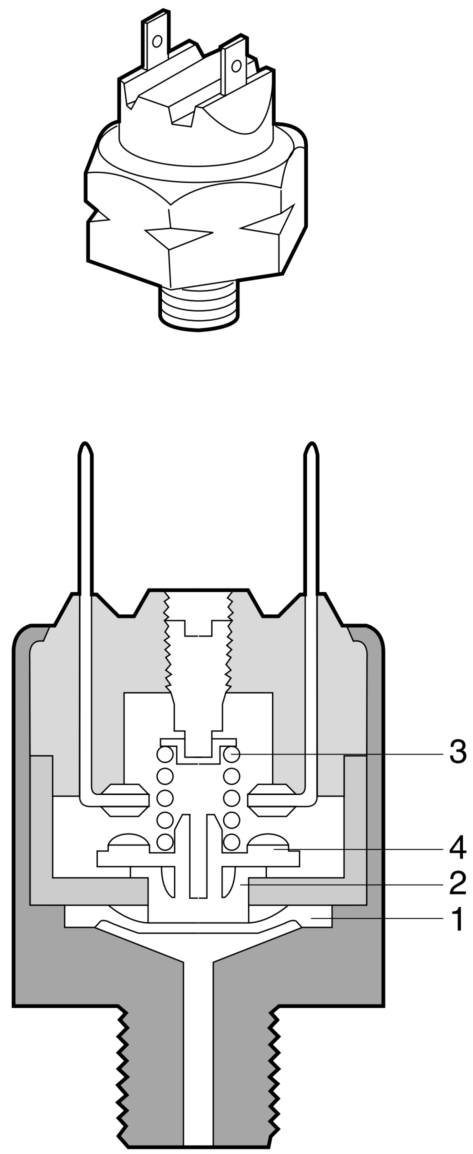
**Purpose**
The purpose of the brake-light switch is to operate the braking lights when braking. The switch-on pressure is approx. 0.5 bar.

1. Coupling piece
2. Brake-light switch
3. Pressure switch for parking-brake valve
4. Sealing rings
5. Sealing rings




R 600104

**Operation**
The brake-light switch is mounted in the air pipe (see brake-system diagrams).
The brake-light switch consists of a diaphragm (1) with a fixed core (2), which in the rest position is kept in its lower position by spring (3). In the rest position, the spring also forces movable contact (4) downwards. As soon as the brakes are applied, pressure beneath the diaphragm forces the diaphragm with the fixed core upwards, against the pressure of the spring. The movable contact also moves upwards, and the switch is activated.
If the pressure beneath the diaphragm falls away, spring (3) ensures that the initial position is restored. The switch must be installed in a vertical position, with the terminals uppermost.

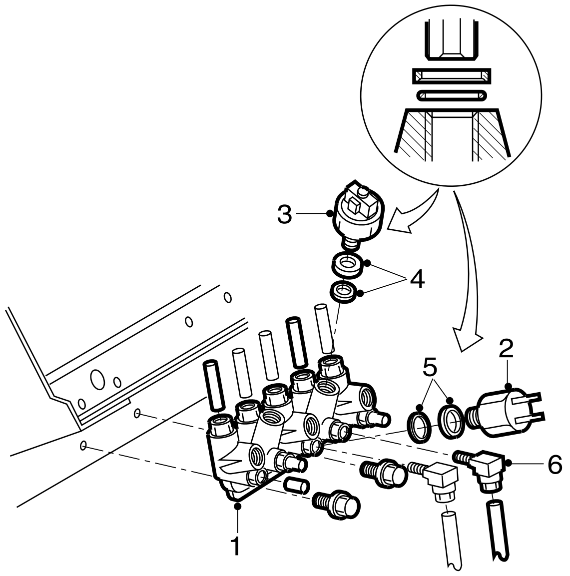



R 600105

## 1.7 LOW-PRESSURE SWITCH

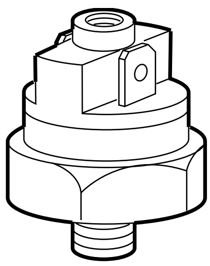
**Purpose**
The purpose of the low-pressure switch is to switch off the warning lights when a preset pressure is reached. The switch-off pressure is 5 - 5.5 bar.

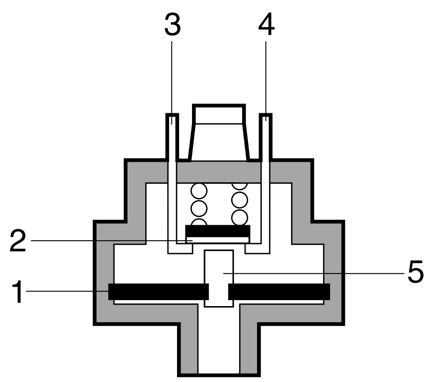
1. Coupling piece
2. Brake-light switch
3. Pressure switch for parking-brake valve
4. Sealing rings
5. Sealing rings




R 600104

**Operation**
If the preset pressure in the air pipe is reached, the existing connection of both contacts (3) and (4) is cut off by the diaphragm (1). If the pressure falls below the preset value, both contacts are connected again.



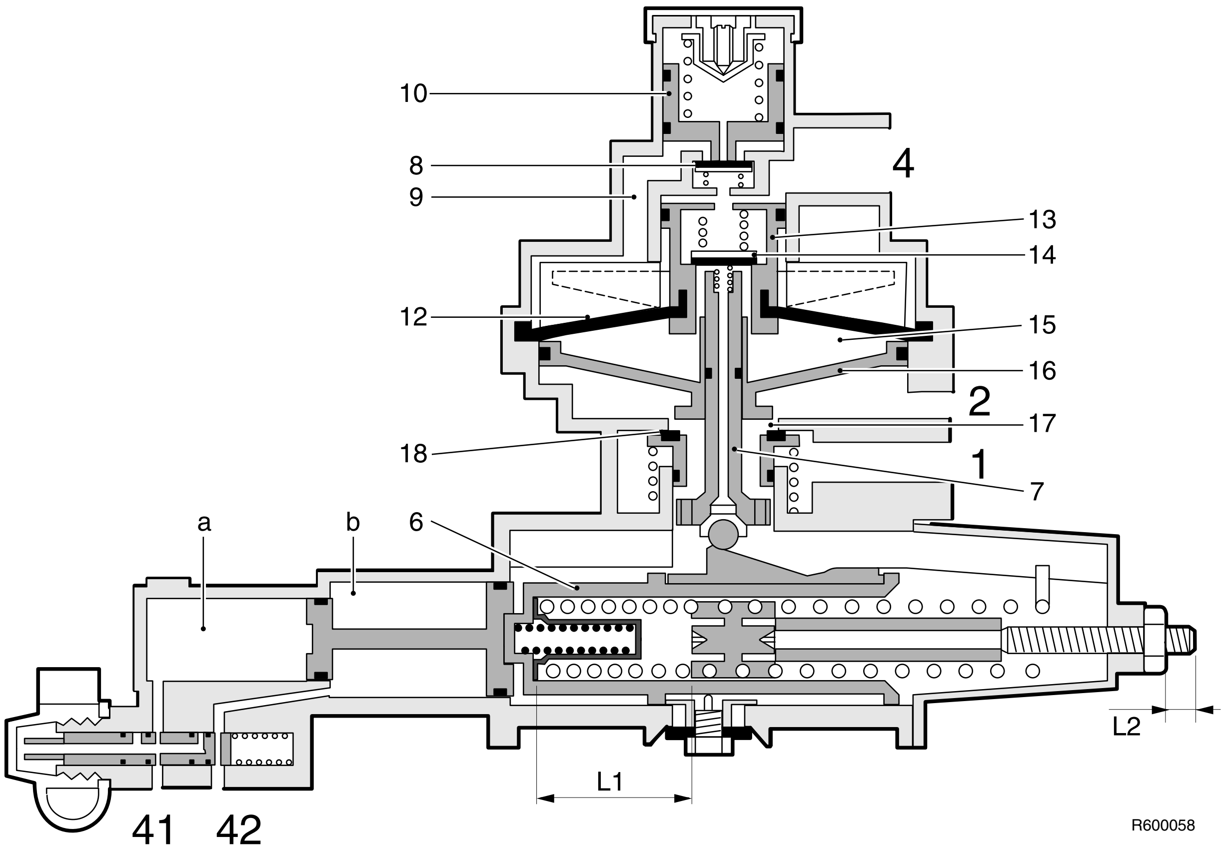



R 600106

## 1.8 LOAD-SENSING VALVE, AIR SUSPENSION

**Application**
For vehicles equipped with air suspension.

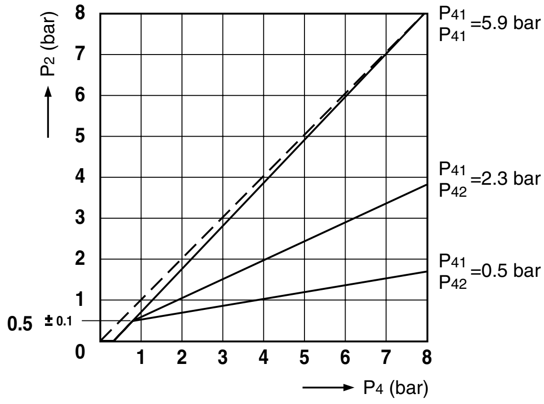
**Purpose**
The purpose of the load-sensing valve is to govern the braking force of air-suspended vehicles, depending on the pressure in the bellows and therefore on the load being carried.





© 0006

**Operation**
The load-sensing valve is attached to the chassis frame and is not connected to the rear axle.
Ports 41 and 42 are both connected to one of the bellows on the rear axle. When the vehicle is being loaded the pressure in the bellows and therefore at ports 41 and 42 will rise. This pressure rise in chambers (a) and (b) will force cylinder bushing (6) with cam to move against the spring pressure from the “unloaded” into the “fully-loaded” position. The cam at cylinder bushing (6) serves as a resting point for cylinder sleeve (7). In this way the position of cylinder sleeve (7) is determined, depending on the loaded condition of the vehicle. When the brakes are applied, compressed air enters at port (4) and arrives via open valve (8) at chamber (9) above diaphragm (12). If this pressure exceeds a value of 0.5 bar, piston (10) is pushed upwards against the pressure of the spring above piston (10) and closes small valve (8). At the same time this pressure is also exerted on piston (13), which will be pushed downwards. Valve (14) will abut piston sleeve (7). When piston (13) moves downwards even further, valve (14) will be lifted from its seating, thus enabling braking air to flow into chamber (15) above relay piston (16). The relay piston will move downwards and close off exhaust (17). Inlet (18) is subsequently opened.



W604025

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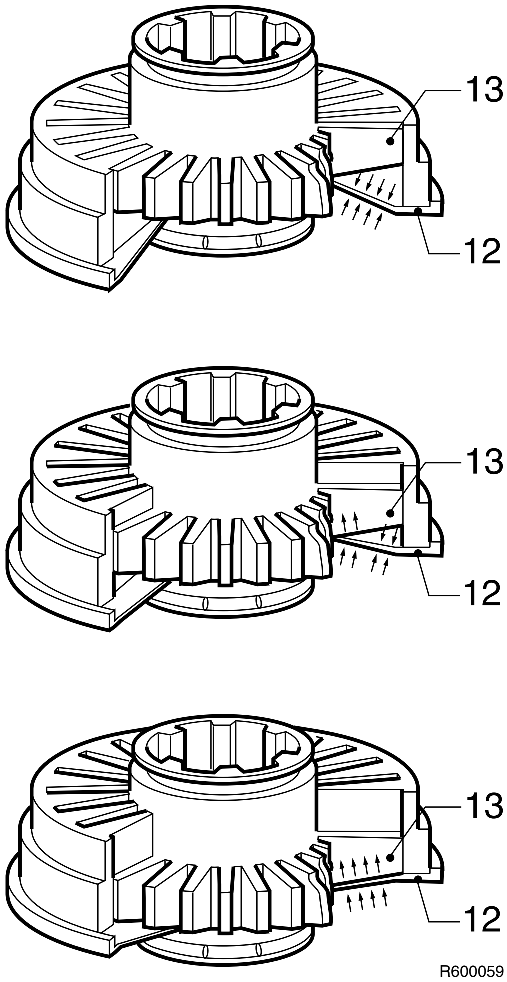
The reservoir pressure at port (1) can now pass through inlet (18) to the ports (2) and to the chamber below relay piston (16). When the pressure in this chamber is equal to that in chamber (15), relay piston (16) will be moved upwards again and close inlet (18). The state of balance has now been achieved.

Depending on the loaded condition of the vehicle the input pressure will be reduced at port (4) and increased at port (2). This pressure reduction is achieved as follows:

In the case of a fully loaded (not overloaded) vehicle, piston sleeve (7) is forced upwards by the cam until it almost touches valve (14). Piston (13) has to be moved only a little by the input pressure at port (4) before inlet valve (14) contacts piston sleeve (7). Because of this small movement, diaphragm (12) continues to abut the valve body. Since the surfaces of piston (13) on either end are equal now, the pressure required to force this piston upwards and to close inlet valve (14) is the same as the pressure entering at port (4). In other words, there will be no more pressure reduction.

As the vehicle is loaded, the bellows pressure increases. The input pressure at port (4) forces piston (13) downwards again, until valve (14) makes contact with piston sleeve (7). Because the downward movement of piston (13) is smaller (higher position of the piston sleeve), more than one section of the diaphragm (12) will be released from the ridges in the valve body. As a result, the effective surface of the diaphragm remains smaller, so that in chamber (15) a higher pressure is required to move the diaphragm with piston (13) upwards and to close inlet valve (14).
If the pressure at port (4) is released (due to releasing the brakes), the pressure under valve (8) and above piston (13) will also be released. The force of the spring above piston (10) pushes piston (10) downwards and opens valve (8). Chamber (9) can now be vented via port (4).




R600059

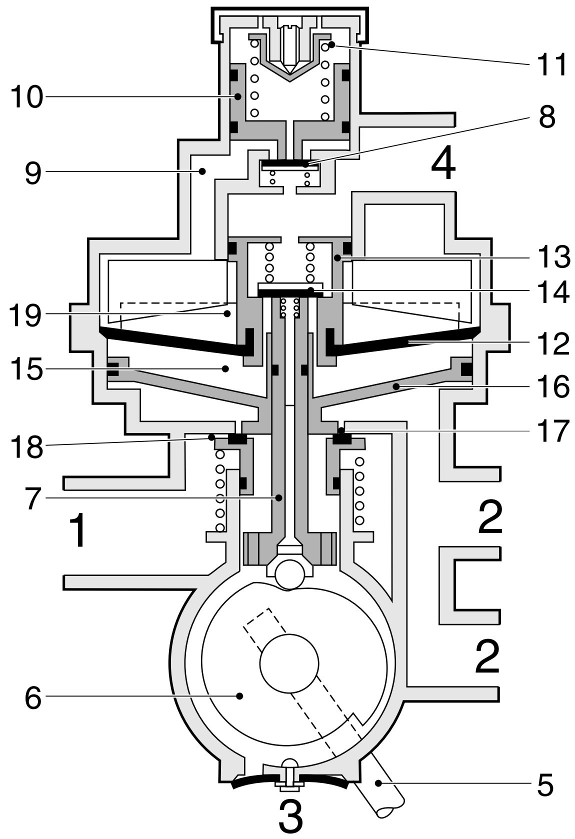
At the same time the pressure in chamber (15) will push diaphragm (12) with piston (13) upwards, thus causing valve (14) to be released from piston sleeve (7). Chamber (15) can now be vented via port 7. The pressure in port (2) moves relay piston (16) upwards, thus releasing exhaust (17) and providing an escape for this pressure via the valve vent.

When a vehicle carries no load, piston sleeve (7) is in its lowest position. The input pressure at port (4) forces piston (13), which is rigidly connected to diaphragm (12), off the ridges in the valve body so that the effective surface of the diaphragm is gradually enlarged. Since in this position the effective surface of the diaphragm is larger than that of piston (13), piston (13) will move upwards and close inlet valve (14).

## 1.9 LOAD-SENSING VALVE, LEAF-SPRING SUSPENSION

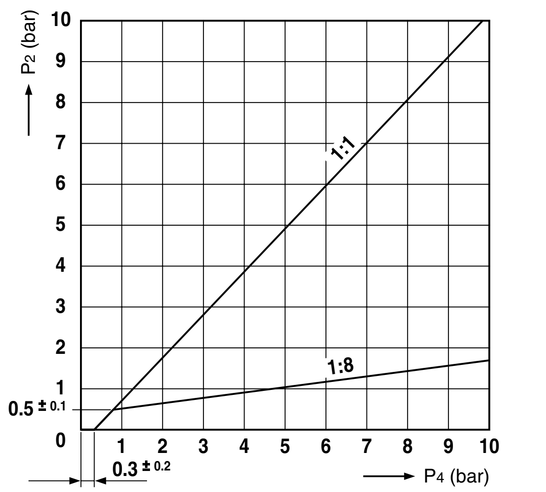
**Application**
For vehicles equipped with leaf-spring suspension.

**Purpose**
The automatic load-sensing valve is used to govern the braking pressure to the brake chambers, depending on the load being carried.




R 600107

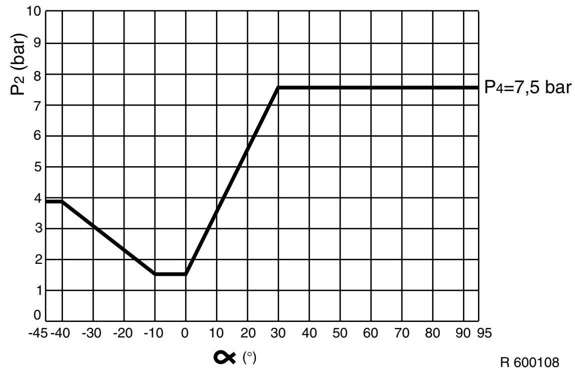
**Operation**
These valves have a built-in relay function (load-sensing valve with built-in relay valve). In addition, the valve will permit the first 0.5 bar input braking pressure to pass, unreduced, whilst the control ratio can vary from 1:1 (fully loaded) to 8:1 (empty). In the event of fracturing of the vertical tie rod, the valve is automatically placed in the “half loaded” position ($\alpha = -40°$).




W604027

The control valve is connected to the chassis frame, while control lever (5) is connected with the rear axle by means of a linkage. If the vehicle is loaded, the distance between chassis and axle is reduced. This will cause the control lever to move from the position “empty” to the position “fully-loaded”. Within the valve control lever (5) is connected to a disk (6) with a special form, serving as a support for piston sleeve (7). In this way the position of piston sleeve (7) is determined, depending on the loaded condition of the vehicle. When the brakes are applied, compressed air enters at port 4 and arrives via open valve (8) at chamber (9) above diaphragm (12). If this pressure exceeds a value of 0.5 bar, piston (10) is pushed upwards against the pressure of spring (11) and closes small valve (8). At the same time this pressure is also exerted on piston (13), which will be pushed downwards.

Valve (14) will abut piston sleeve (7). When piston (13) moves downwards even further, valve (14) will be lifted from its seating, thus enabling braking air to flow into chamber (15) above relay piston (16). This causes the relay piston to move downwards, close exhaust (17) and open inlet (18). The reservoir pressure at port 1 can now pass through inlet (18) to port 2 and also to the chamber below relay piston (16). When the pressure in this chamber is equal to that in chamber (15), relay piston (16) will be moved upwards again and close inlet (18).
The state of balance has now been achieved.



R 600108

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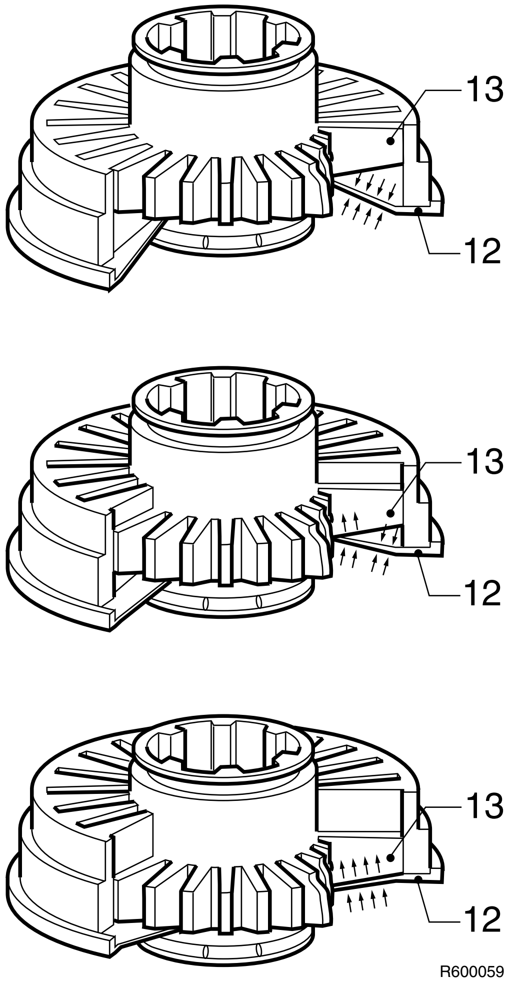
Depending on the loaded condition of the vehicle the input pressure will be reduced at port (4) and increased at port (2) This pressure reduction is achieved as follows:

In the case of a fully loaded (not overloaded) vehicle, piston sleeve (7) is forced upwards by disc (6) until it almost touches valve (14). Piston (13) has to be moved only a little by the input pressure at port 4 before inlet valve (14) contacts piston sleeve (7). Because of this small movement, diaphragm (12) continues to abut the ridges (20) in the valve body. Since the surfaces of piston (13) on either end are equal now, the pressure required to force this piston upwards and to close inlet valve (14) is the same as the pressure entering at port 4.
In other words, there will be no more pressure reduction. If the pressure at port 4 is released (due to releasing the brakes), the pressure under valve (8) and above piston (13) will also be released. The force of spring (11) pushes piston (10) downwards and opens valve (8). Chamber (9) can now be vented via port 4. At the same time the pressure in chamber (15) will push diaphragm (12) with piston (13) upwards, thus causing valve (14) to be released from piston sleeve (7). Chamber (15) can now be vented via piston sleeve (7) and port (3). The pressure in port (2) moves relay piston (16) upwards, thus releasing exhaust (17) and providing an escape for this pressure via port (3). In the event of a fracture of the connecting rod, the control lever will shift to a slanting position. Due to the special shape of the disc, the valve will reduce the input pressure in the same way as in the half loaded position.



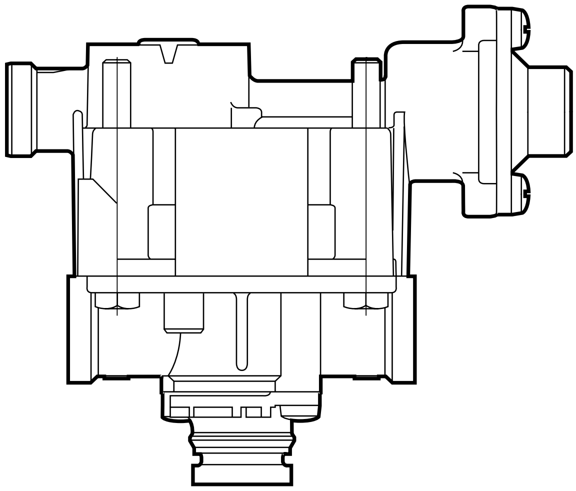
When the vehicle is loaded, the distance between the chassis frame and the axle is reduced, so that control lever (5) is twisted. That is why the specially shaped disc (6) forces piston sleeve (7) upwards. The input pressure at port 4 forces piston (13) downwards again, until valve (14) makes contact with piston sleeve (7). Because the downward movement of piston (13) is smaller (higher position of the piston sleeve), more than one section of the diaphragm (12) will be released from the ridges (20) in the valve body. As a result, the effective surface of the diaphragm remains smaller, so that in chamber (15) a higher pressure is required to move the diaphragm with piston (13) upwards and to close inlet valve (14).

When a vehicle carries no load, piston sleeve (7) is in its lowest position. The input-braking pressure at port (4) forces piston (13), which is attached to diaphragm (12) and wings (19), downwards until valve (14) comes into contact with piston sleeve (7). The movement of piston (13) causes diaphragm (12) to become released from the ridges (20) in the valve body, thus increasing the effective surface of the diaphragm. Since in this position the effective surface of the diaphragm exceeds the effective surface of piston (13), even a slight pressure in chamber (15) will suffice to move the diaphragm with piston (13) upwards, and to close the inlet valve.

## 1.10 EMPTY/LOAD RELAY VALVE

**Purpose**
The purpose of this valve is to adjust the braking pressure to the front axle depending on the output pressure from the load-sensing valve on the rear axle.

**Connection points**
1 reservoir
2 output pressure
3 venting
41 control signal, from service-brake valve
42 control signal, from load-sensing valve



R600049

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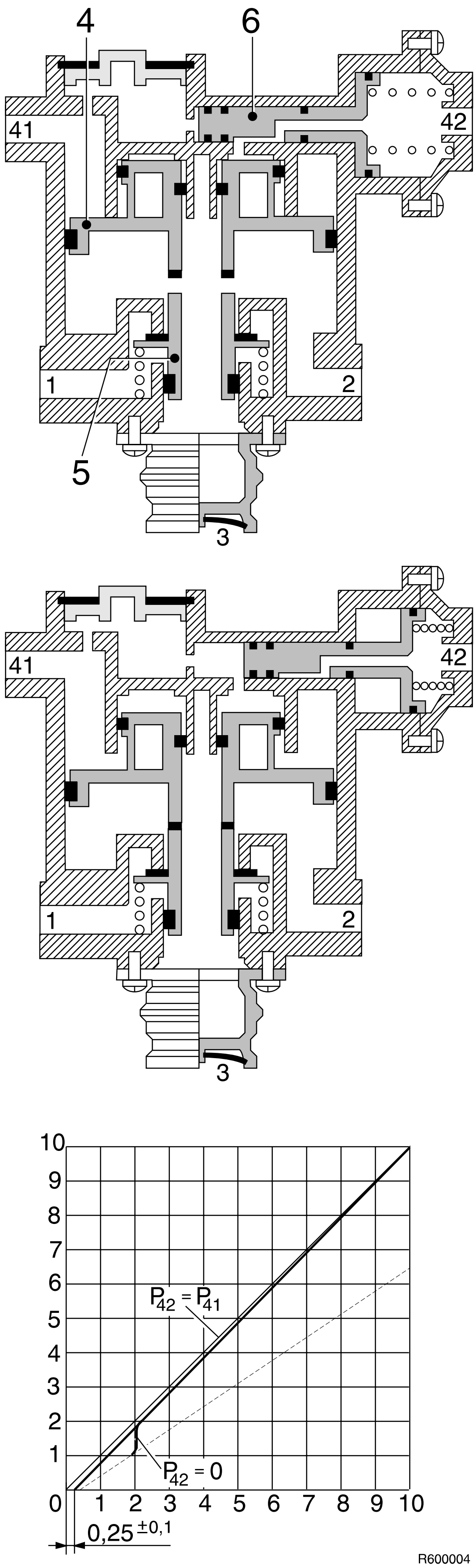
**Models with idle relay valve without increase of control pressure**
In the brakes-released position, relay piston (4) is in its upper position and port (2) (brake cylinders on front axle) are vented via port 3.

When the service brake is applied, the relay piston is forced downwards via port 41 thus opening reservoir valve (5). At port 2 pressure is built up until a set value is reached. The relay piston is then once again forced upwards, until a state of balance has been achieved.
Air has also entered simultaneously via port 42 (load-sensing valve). This will force piston (6) to the left. Through a bore in piston (6) the pressure now also reaches the central surface of the relay piston. This pressure will depend on the loading of the rear axle. As a consequence, the output pressure of this valve is in part dependent on the braking pressure of the rear axle.

The input pressure at port 41 is also applied to the left-hand side of piston (6), via two openings. If no pressure enters via port 42, due to a fault, piston (6) will be forced to the right. The pressure at port 41 will now also reach the central surface of the relay piston. In this situation, the valve simply operates as a relay valve, and will no longer reduce.

When the service brake is released, the pressure at ports 41 and 42 will drop. The relay piston will be forced upwards by the pressure beneath it, thus reopening the exhaust.




R600004

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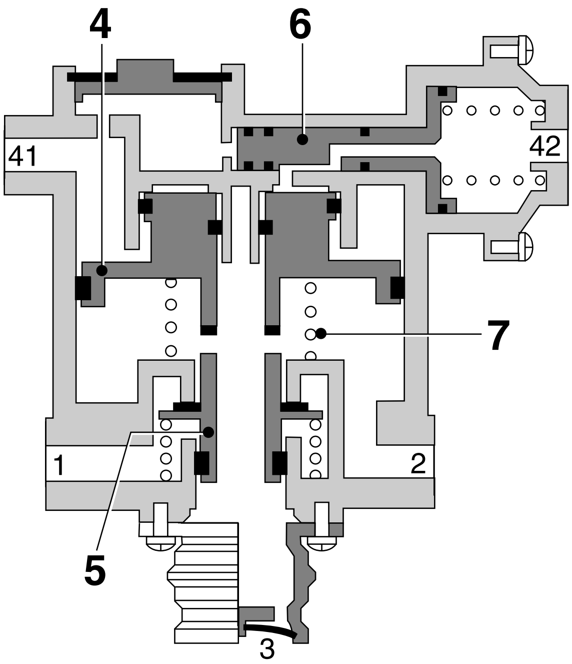
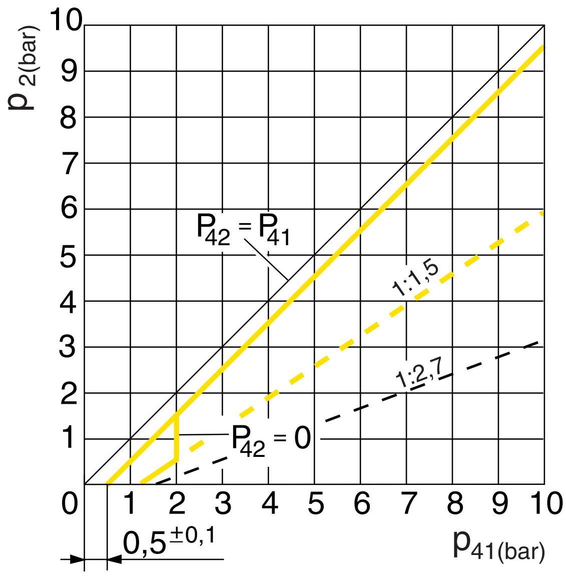
**Models with idle relay valve with increase of control pressure**
The valve may be equipped with a spring under piston (4), depending on the vehicle type. This will slightly lower the front axle braking pressure in relation to the rear axle braking pressure.




R600338




R600339

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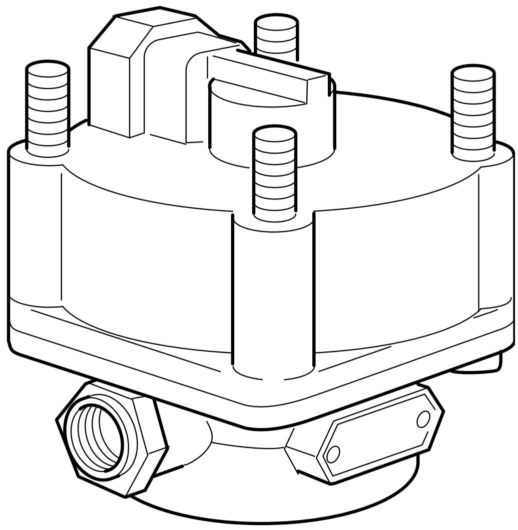
## 1.11 RELAY VALVE

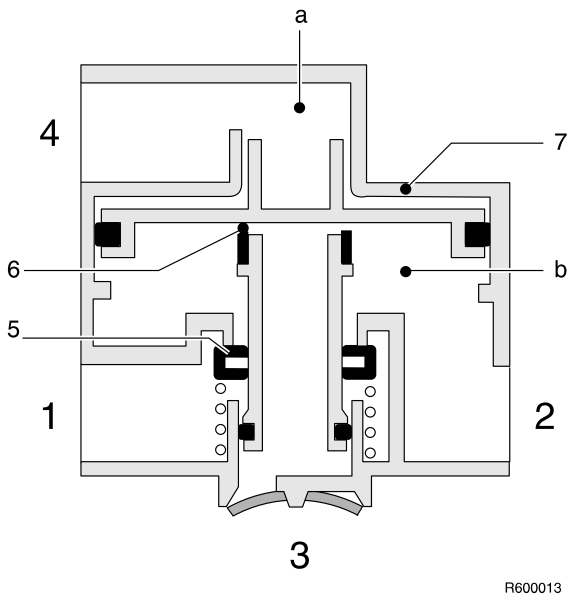
**Purpose**
The purpose of the relay valve is to speed up the reaction time and release speed of the brakes by minimising the time required for pressurising and venting the brake chambers.



**Models without increase of control pressure**
Port (1) is connected to the air reservoir. When port (4) is pressureless, inlet (5) is closed and exhaust (6) opened. The brake chambers connected to port (2) are now vented.

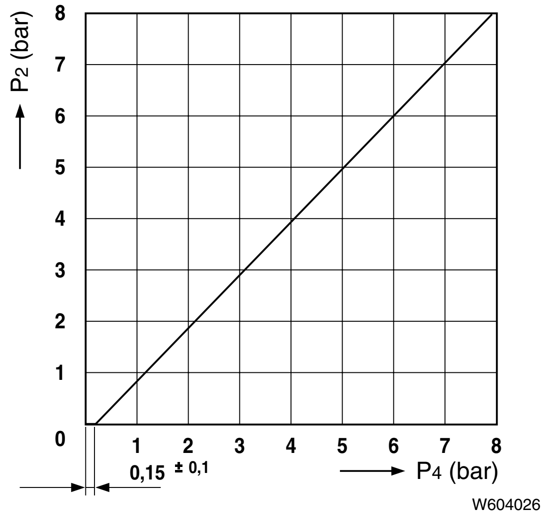
When compressed air passes through port (4) into chamber (a) above piston (7), the piston is forced downwards. Exhaust (6) is closed and inlet (5) opened. The compressed air now passes from the air reservoir to the brake chambers.

A state of balance is achieved when the pressures on both sides of piston (7) are equal. Then, both inlet and exhaust are closed.



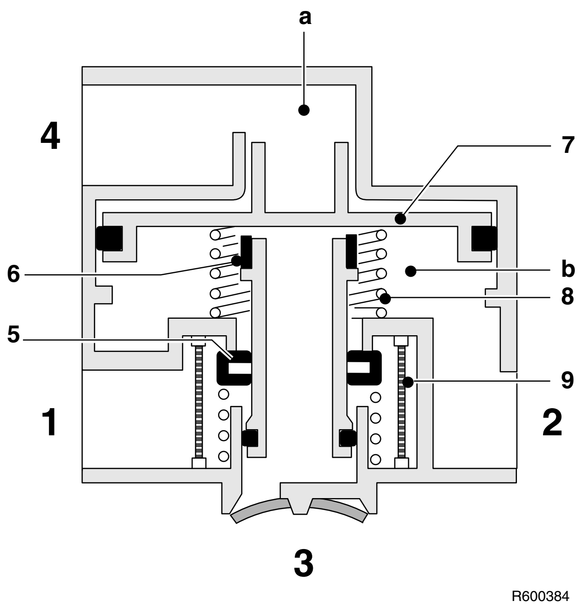
When the pressure in port (4) and consequently in chamber (a) drops, piston (7) is forced upwards. Inlet (5) is closed and outlet (6) opened and as a consequence the brake chambers are vented through vent opening (3).

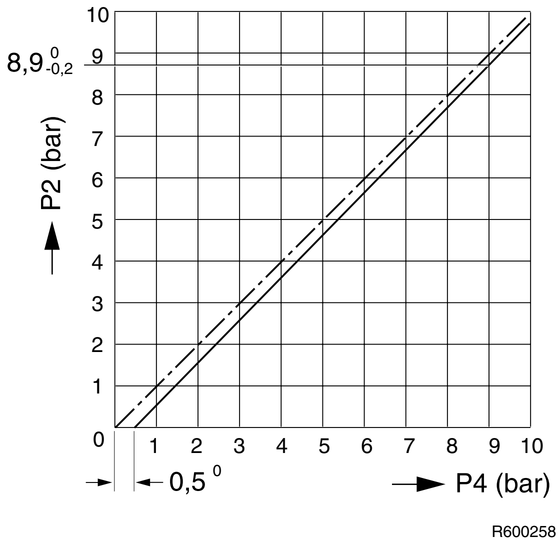
The rubber flap in opening (3) prevents dirt from entering, whilst providing a large opening for air to be vented.




**Models with idle relay valve with increase of control pressure**

The valve may be equipped with a spring under piston (7), depending on the vehicle type. This will hold back front axle brake pressure in the lower pressure range.

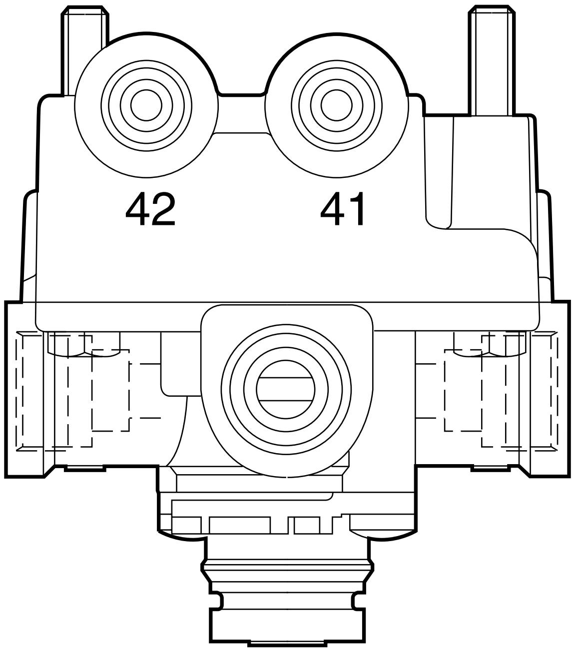


## 1.12 DOUBLE CHECK/RELAY VALVE

**Purpose**

9. Firstly, bleeding and venting the spring-brake chamber of the spring-brake actuator.
10. Secondly, bleeding the spring-brake chamber as the parking-brake valve is in the parking-brake position and the service-brake valve is operated in this situation (double-check function).

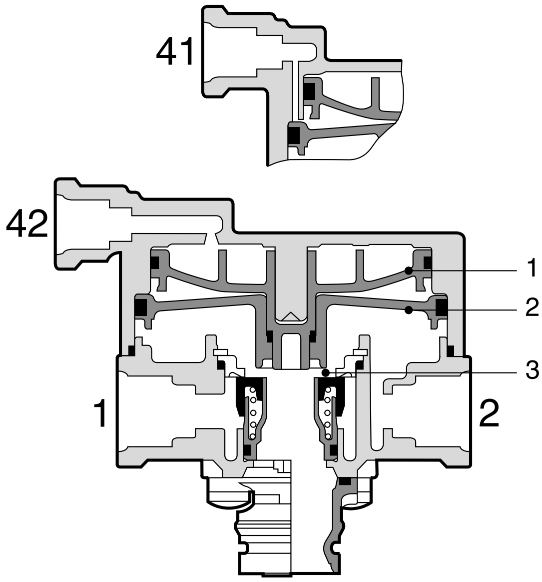



R600083

**Operation**

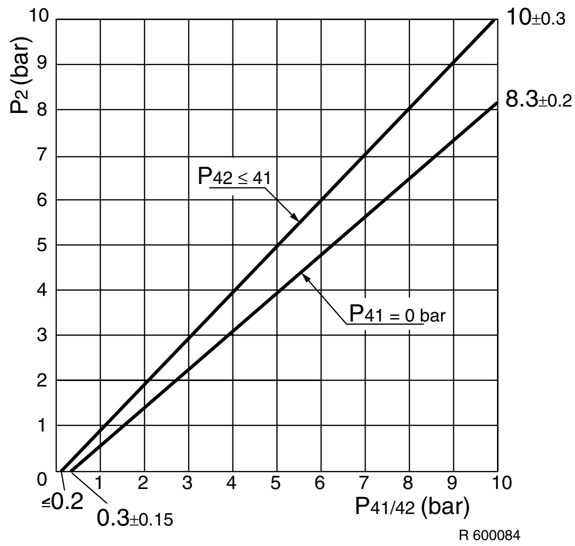
Port (1) is connected to the air reservoir.
Port (2) is connected to the spring-brake chamber of the spring-brake actuator.
When the parking-brake is in the “Driving” position, port (42) will show an input pressure originating from the parking-brake valve.
As a result, piston (1) is pushed downwards, the exhaust (3) is sealed off, and the output pressure is applied to port (2) of the double check/relay valve.
This output pressure is also present below piston (2) which has a larger effective surface than (1). As a consequence, the output pressure at port (2) is reduced to a certain value (see graph).

With the parking-brake valve in the parking-brake position, no pressure is applied to port (42). As a result, port (2) is connected to the exhaust (3). The spring-brake chamber of the spring-brake actuator is now vented, placing the vehicle on the parking brake.




R600082

If during this situation the service-brake valve is operated, port (41) of the double check/relay valve is vented. As a result, piston (2) is pushed downwards resulting in an output pressure at port (2) of the double check/relay valve.
The spring-brake chamber of the spring-brake actuator is then provided with the same pressure as the input pressure at port (41) of the double check/relay valve.
In other words, the pressure in the brake chamber of the spring-brake actuator is now equal to the pressure in the spring-brake chamber of the spring-brake actuator (double-check function of the relay valve is operational).

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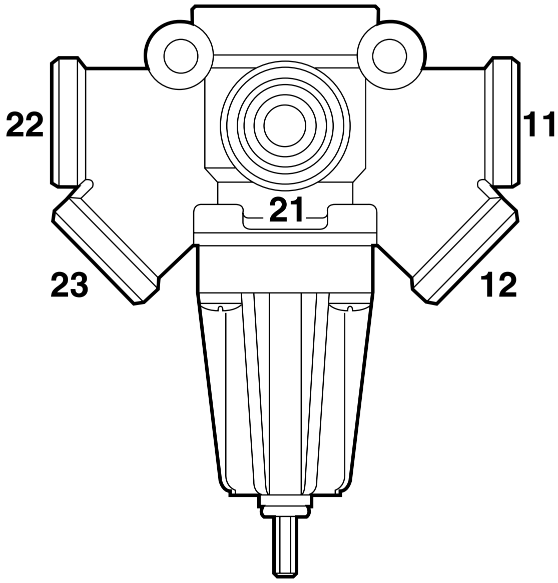
## 1.13 PRESSURE-RELIEF VALVE WITH NON-RETURN VALVE

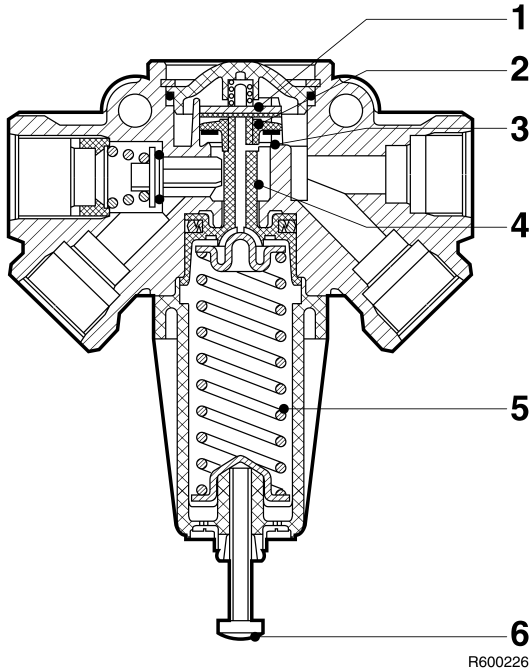
**Purpose**
The purpose of the pressure-limiting valve with non-return valve is to limit the output pressure to a specified preset value (8 bar).
Lower pressures are passed unreduced. This valve also includes a non-return valve for circuit 3 of the brake system.

**Operation**
Compressed air is input at connection number 12 (maximum system pressure).
The storage reservoir for circuit 3 is filled via port 11.
At port numbers 21, 22 and 23, the pressure-limited air is once again bled. If the exhaust air has not yet reached the limit value, piston-shaped valve (2) is open.

When the pressure at the piston-shaped valve (2) reaches the limit set by the adjusting screw (6), valve (2) will be forced downwards against the pressure of spring (5), until it contacts seat (3).
No air can now pass.

If pressure at ports (21), (22) and (23) exceeds that at ports 11 and 12, via an opening in piston (4), the pressure will raise spring-loaded seal (1), from piston-shaped valve (2). As a result the air can flow back to ports (11) and (12).

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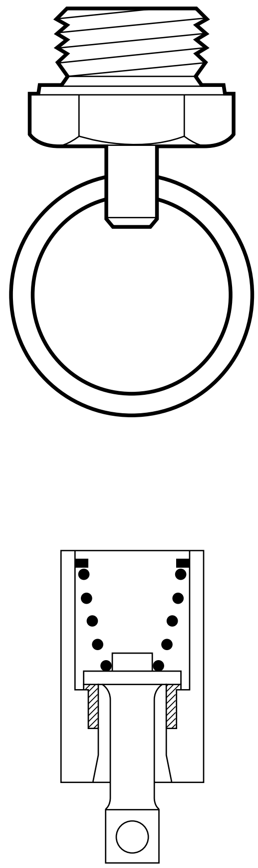
## 1.14 WATER BLOW-OFF VALVE

**Purpose**
The purpose of the water blow-off valve is to enable any condensate in the air reservoir or air lines to be drained and, if necessary, to vent the system.

**Operation**
The valve is kept closed by the spring and the reservoir pressure. By pushing the pin sideways, the valve is lifted off the seat, allowing condensate and compressed air to escape. When the pin is released, the valve is closed.

Check that no other components are present under the blow-off plug, as these could be fouled during the blow-off process.



R600046

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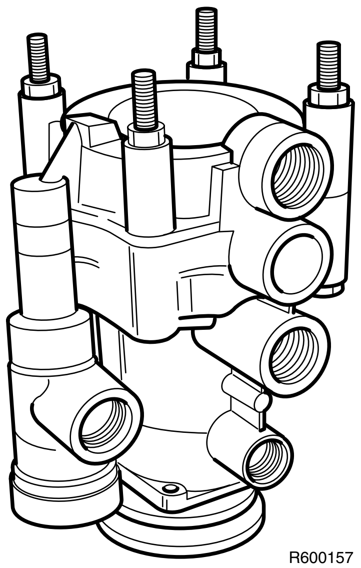
## 1.15 (SEMI-)TRAILER-REACTION VALVE

**WABCO design**

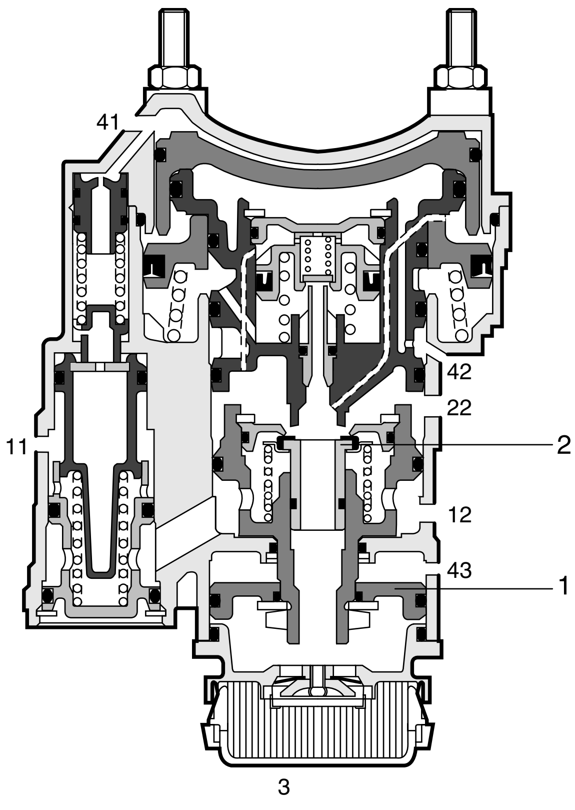
**Purpose**
The purpose of the trailer-reaction valve is to pass on the brake commands from the tractor to the (semi-)trailer.



R600157

**Operation**

**Driving**
Port (11) is connected with a reservoir, and port (43) with the parking-brake valve. Both are pressurised and in a state of balance. The service -coupling head is connected via port (22) and exhaust valve (2), and vent (3), to the atmosphere.



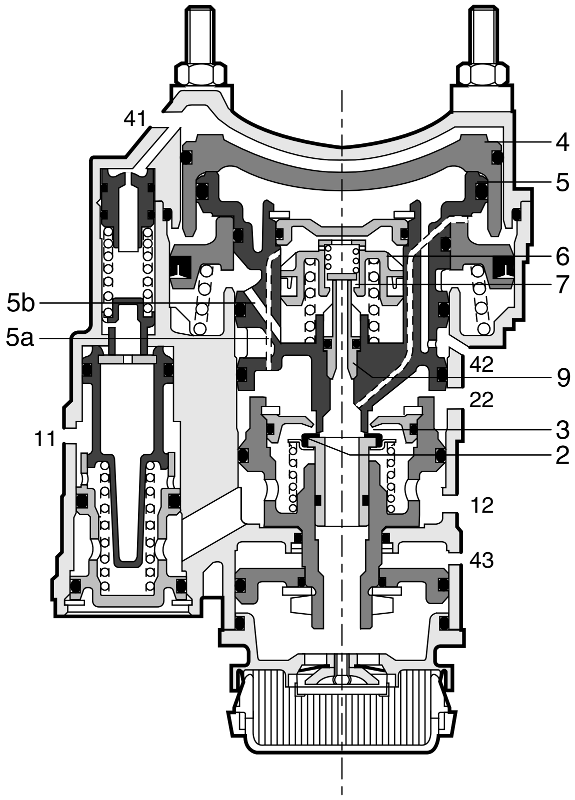

R600122

**Braking with the service brake**

**Pressure build-up**
With the service-brake valve, circuit 1, port (41), and circuit 2, port (42), are pressurised.
This will force pistons (4) and (5) downwards, closing exhaust valve (2) and opening inlet valve (3). The reservoir pressure at port (11) can now flow via inlet valve (3) to port (22), (yellow) (semi-)trailer service-coupling head, and will cause the (semi-)trailer to brake.

**Regulating**
When a preset value has been reached in the output pressure at port (22), this pressure will once again force pistons (4) and (5) upwards, thus closing inlet valve (3).
There is now a state of balance between the input pressure at port (41), and output pressure at port (22).

**Releasing**
When the service-brake valve is released, the input pressure at ports (41) and (42) falls away. Pistons (4) and (5) are forced upwards, by the output pressure at port 22.
As a result, inlet valve (3) is closed, and exhaust valve (2) opened, thus linking port (22) with the exhaust.



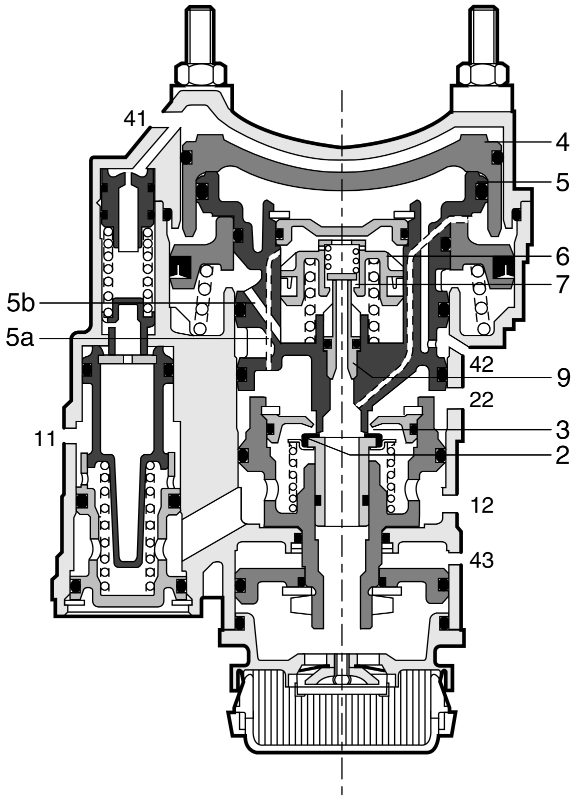

R600123

**Advance**

**Pressure build-up**
When the foot valve is operated, pressure will be built up at ports (41) and (42), the output pressure at port (22) will also force piston (6) downwards via bore (5a), and as a result inlet (7) is opened.
Via bore (5b), braking pressure enters the circular channel beneath pistons (4) and (5).
Zuigers (4) en (5) worden teruggedrukt, totdat er een evenwichtssituatie is ontstaan, waardoor inlaatventiel (3) wordt afgesloten.

**Changing**
If adjusting screw (9) is turned counter-clockwise, some pressure will escape from the circular channel beneath pistons (4) and (5).
As a result of this reduced pressure, the output pressure (port 22) must become higher, in order to maintain the state of balance.

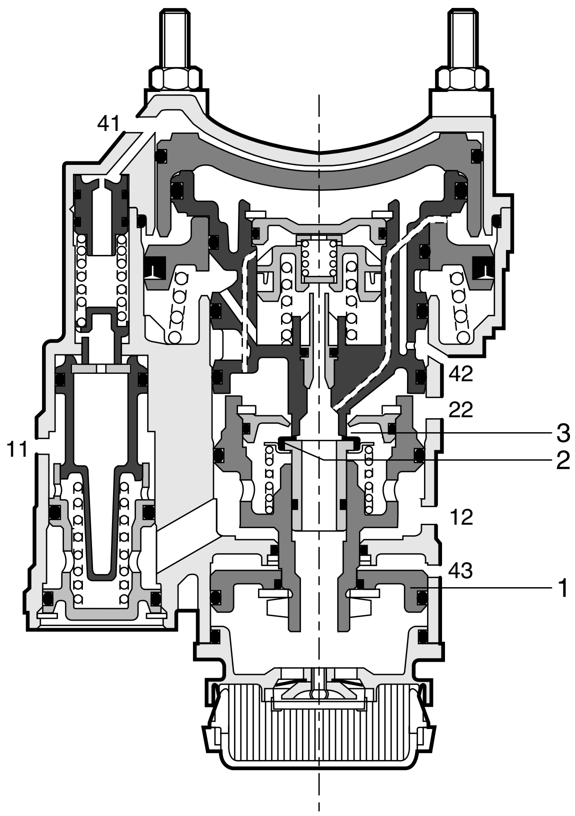
This service-pressure increase to the (semi-)trailer as compared to the braking pressure from the tractor is called braking-pressure advance.
For the setting procedure, refer to the chapter “Inspection and adjustment”.




R600123

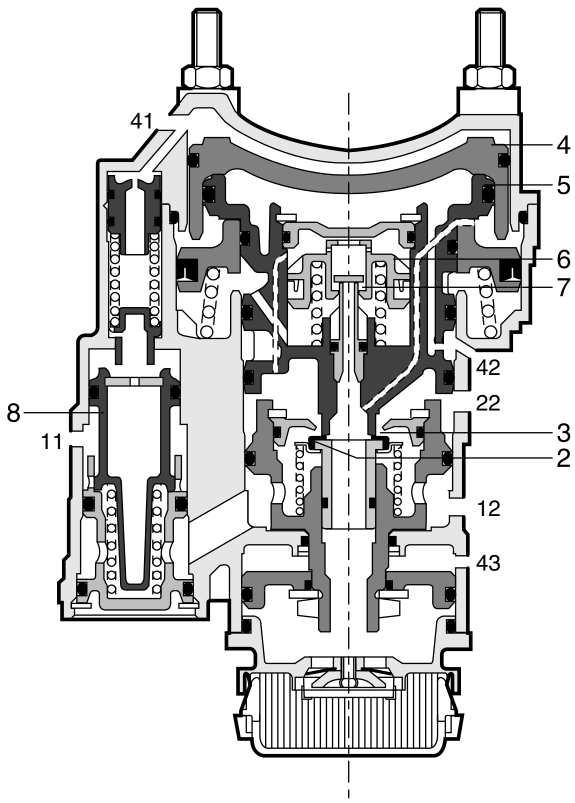
**Emergency brake**
When the parking-brake valve is moved into the locking position, port (43) will be gradually vented.
Piston (1) moves upwards, and inlet valve (3) is opened.
Depending on the drop in pressure at port (43), a pressure build-up will occur at port (22). When a preset value has been reached, inlet valve (3) will close, and a state of balance will be achieved.

**Parking brake**
When the parking-brake valve is in its maximum position, i.e. the position at which the lever is blocked, port (43) is bled. As a consequence, there still is an output pressure at port (22).




R600124

**Safeguarding against fracture of the service line**
Braking will cause a pressure build-up at port (22). The air required will be provided via port 11. In case of a fracture of the service line occurring, port (12) will be vented via port (22). This will cause a pressure reduction beneath piston (8).
Piston (8) will shut off the air reserve from port (11), so that the (semi-)trailer reaction valve no longer receives any pressure.
The pressure in the reservoir line drops, and the (semi-)trailer brakes are applied.




R600125


DAF
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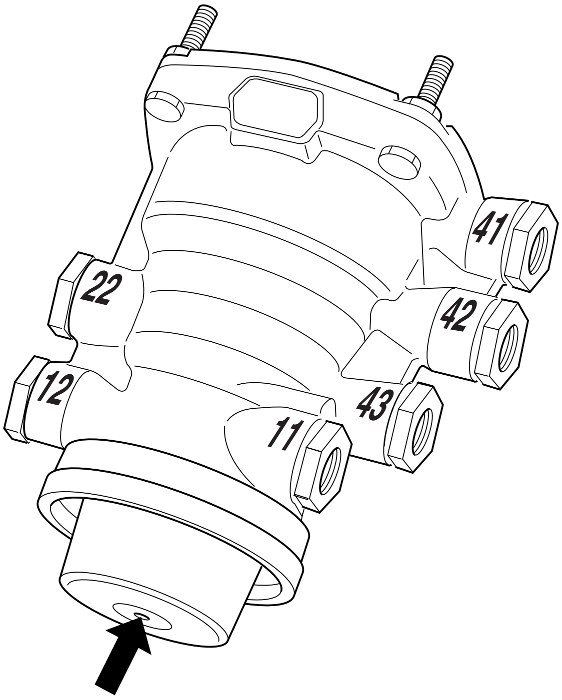
**KNORR design**

**Purpose**
The purpose of the trailer-reaction valve is to pass on the brake commands from the tractor to the (semi-)trailer.

**Operation**

**Driving**
Port 11 is connected with a reservoir, and port 43 with the parking-brake valve. Both are pressurised and in a state of balance. The service-coupling head is connected via port 22, valve (8), valve exhaust port and damper to the atmosphere.

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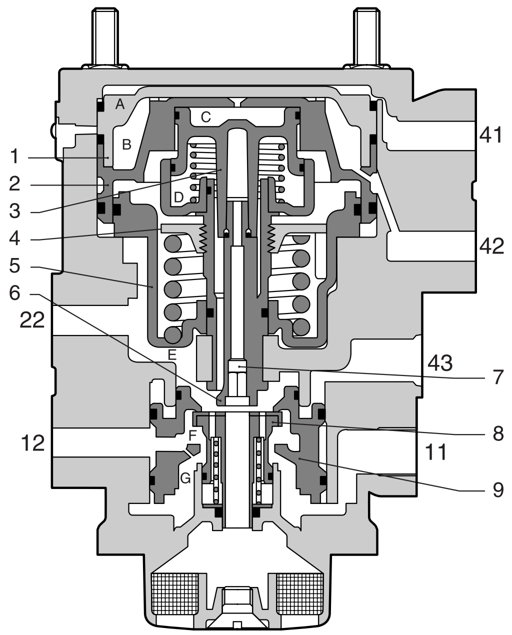


R600340

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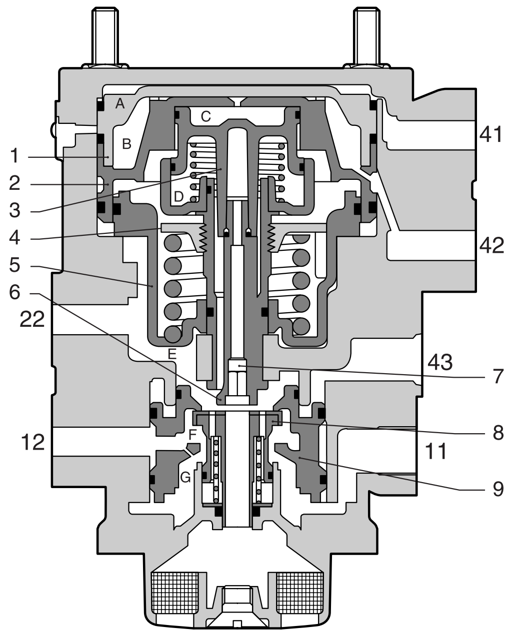
**Braking with the service brake**

**Pressure build-up**
With the service-brake valve, circuit 1, port 41, and circuit 2, port 42, are pressurised.
This will force pistons (1) and (2) downwards, closing the exhaust valve via valve (8) and opening the inlet valve. The reservoir pressure at port (11) can now flow via inlet valve (8) to port (22), (yellow) (semi-)trailer service-coupling head, and will cause the (semi-)trailer to brake.

**Regulating**
When a preset value has been reached in the output pressure at port (22), this pressure will once again force pistons (5) upwards, thus closing valve (8).
There is now a state of balance between the input pressure at port (41), and output pressure at port (22).

**Releasing**
When the service-brake valve is released, the input pressure at ports (41) and (42) falls away.
Pistons (1) and (2) are forced upwards by the spring under the spring retainer (4).
As a result, valve (8) is closed, and exhaust valve opened, thus linking port (22) with the exhaust.



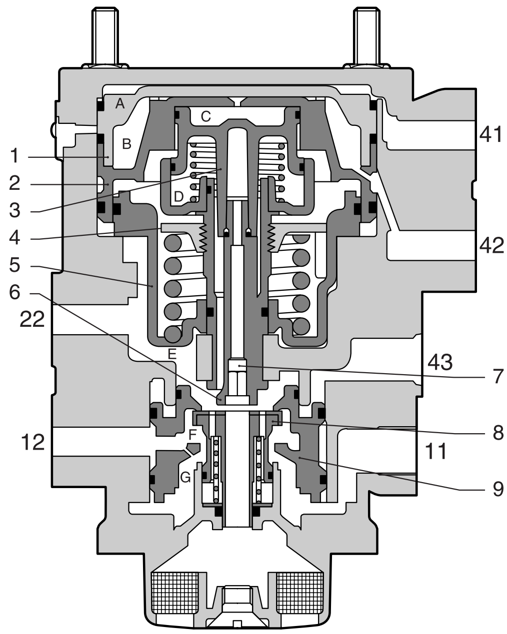
R600340

**Advance**

**Pressure build-up**
When the foot valve is operated, pressure will be built up at ports (41) and (42), the output pressure at port (22) will also force piston (5) upwards, and as a result valve (8) is closed. There is now a state of balance between the input pressure at port (41) and output pressure at port (22).

**Changing**
When adjusting bolt (6) is turned clockwise for example, spring retainer (4) will moved downwards, thus compressing the spring further. As a result, at a constant operating pressure at ports (41) and (42), a higher adjusting pressure under piston (5) will be required. This adjusting pressure is also located at the yellow coupling head

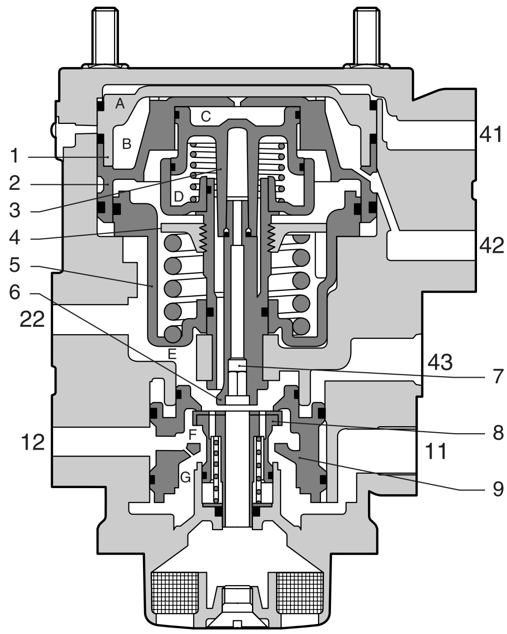
This service-pressure increase to the (semi-)trailer as compared to the braking pressure from the tractor is called braking-pressure advance.
For the setting procedure, refer to the chapter "Inspection and adjustment".




R600340

**Emergency brake**
When the parking-brake valve is moved into the locking position, port 43 will be gradually vented. Piston (9) moves upwards, and valve (8) is opened.
Depending on the drop in pressure at port (43), a pressure build-up will occur at port (22). When a preset value has been reached, valve (8) will close, and a state of balance will be achieved.

**Parking brake**
When the parking-brake valve is in its maximum position, i.e. the position at which the lever is blocked, port (43) is bled. As a consequence, there still is an output pressure at port 22.



R600340

**Safeguarding against fracture of the service line**
Braking will cause a pressure build-up at port 22. The air required will be provided via port 11.
In case of a fracture of the service line, no pressure is built up in chamber E, thus causing piston (9) to move upwards, and close off against the underside of valve (8). The supply from port (11) is interrupted, so that pressure is supplied from port (12).
The pressure in the reservoir line drops, and the (semi-)trailer brakes are applied.

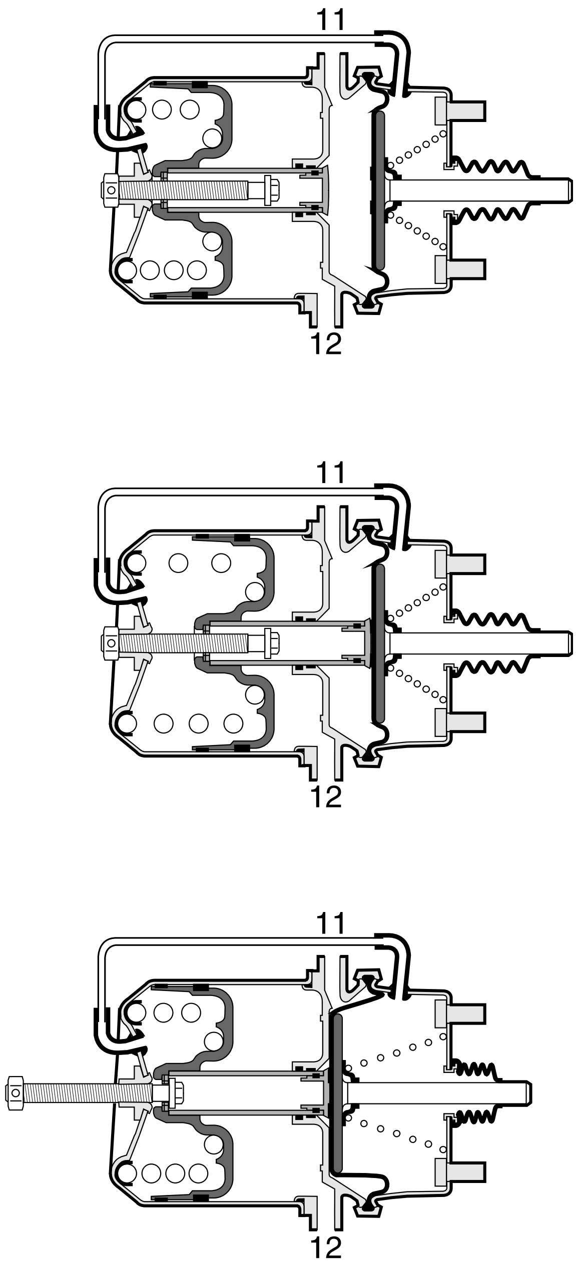
## 1.16 SPRING-BRAKE CYLINDER

**Purpose**
The purpose of the spring-brake cylinder is to force the brake shoes against the drum when the service or parking brake is operated.

**Operation**
The spring-brake cylinder consist of two parts: a service-brake chamber which is similar to a conventional brake chamber, and a spring-brake chamber, which is operated by the parking brake.

Normal position during driving.
Before the vehicle is driven off, the air reservoirs must be charged to a safe pressure. Insufficient air pressure is indicated by a warning signal (e.g. a buzzer).
If this compressed air is supplied to the spring-brake chamber, the piston will compress the powerful spring. The push rod is no longer under load and the vehicle brake will be released, due to the operation of the spring, etc.

**Service brake**
Because the service-brake chamber and the spring-brake chamber are separated, the spring brake cannot effect the operation of the service brake.
When the service brake is applied, the powerful spring continues to be compressed, whilst compressed air is applied against the diaphragm of the brake chamber. When the foot valve is operated, air passes through port (11) into the chamber behind the diaphragm.
The diaphragm and push rod are forced outwards against the pressure of the spring, and a lever linkage forces the brake shoes against the brake drum.
The air on the non-pressure side of the diaphragm can escape via vent holes. When the brakes are released, the push rod and the diaphragm return to their original position, by the action of the spring.




R600011

**Parking brake**
Port (12) is vented.
The powerful spring then forces the piston with the piston sleeve against the diaphragm, so that the push rod is forced outwards. As a result, the brake lever forces the shoes against the brake drum. This is brought about by means of the available energy in the compressed powerful spring.

**Releasing**
If, due to a failure, no compressed air is available in the spring brake cylinder, the vehicle brakes are automatically applied.
But it must still be possible to tow the vehicle. The spring brake cylinder is therefore fitted with a release bolt, at the rear. By turning this bolt counter-clockwise using a spanner, the powerful spring will be compressed.
As the bolt is provided with a thrust bearing, the torque required is not more than 20 - 40 Nm.
A pneumatic spanner may not be used for this purpose.

**Because the spring brakes have been released mechanically, the parking brake can no longer be applied.**

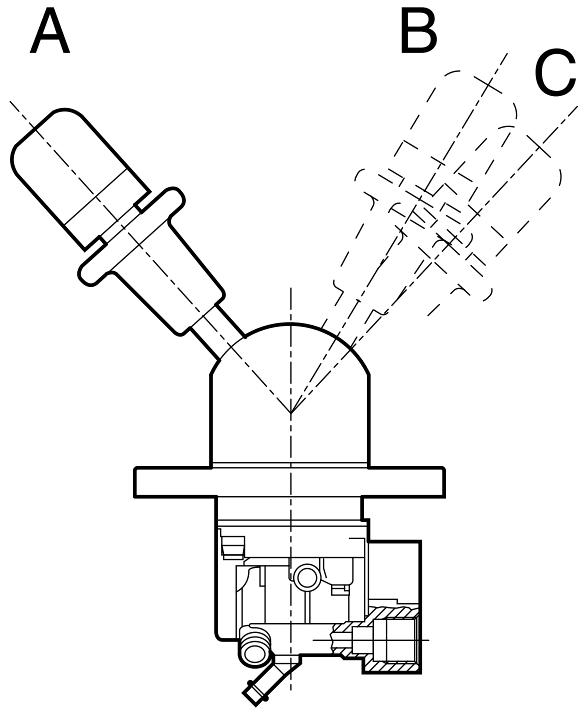
Once the failure has been remedied, and the system pressure is restored, compressed air can once again be supplied to the spring-brake cylinder by operating the parking-brake valve. The release bolt should then be screwed back in with the spanner, and tightened to a torque of 30 Nm. The pressure in the spring-brake cylinder circuit should be at least 5.1 bar.

## 1.17 PARKING-BRAKE VALVE

**PARKING-BRAKE VALVE WITH (SEMI-)TRAILER CONNECTION**

**Purpose**
The parking-brake valve enables simultaneous, controlled operation of both the parking-brake system of the tractor and the (semi-)trailer brakes.

**Operation**
The parking-brake valve has 3 positions:
A: driving position
B: parking position
C: test position

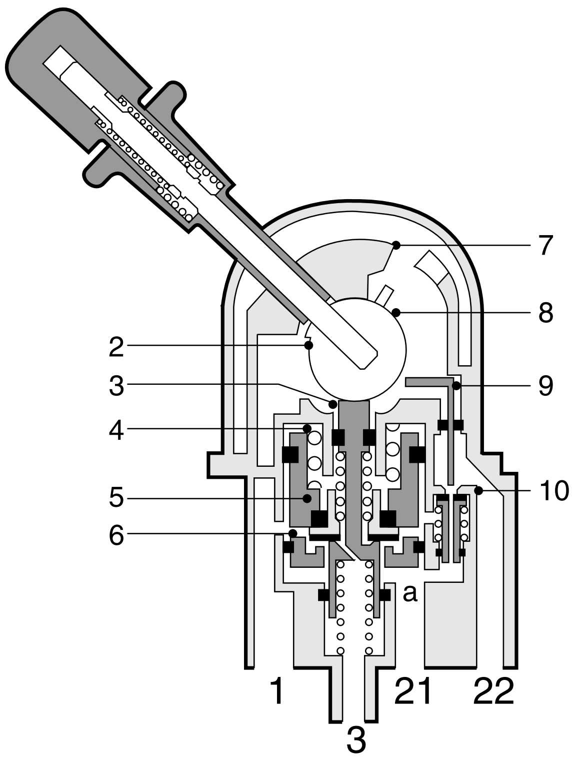



R600089

**Driving**
With the handle in the driving position, there is a through connection for the reservoir pressure (port 1) to the connections for the spring-brake cylinders (21) and the (semi-)trailer (22). The exhaust is closed now.
The output pressure at ports (21) and (22) is now approx. 8 bar (see graph).

**Emergency brake**
When the handle is moved backwards against the spring pressure, stem (3) will be forced downwards by eccentric (2). Chamber (a) can now be vented and as a result the pressure at port (22) will drop. Via the bore in valve (10) the pressure at port (22) will also drop. Spring (4) forces piston (5) down until valve (6) comes into contact with the seal collar of stem (3). A state of balance is now achieved.

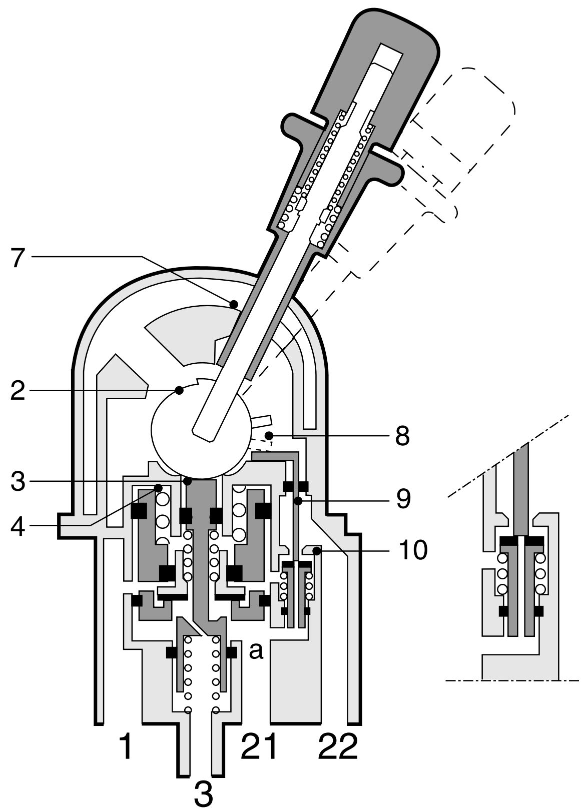
When the handle is moved against stop (7), the exhaust will remain open, so that the spring brakes and the (semi-)trailer brakes will be applied to their maximum (max. emergency-brake position).



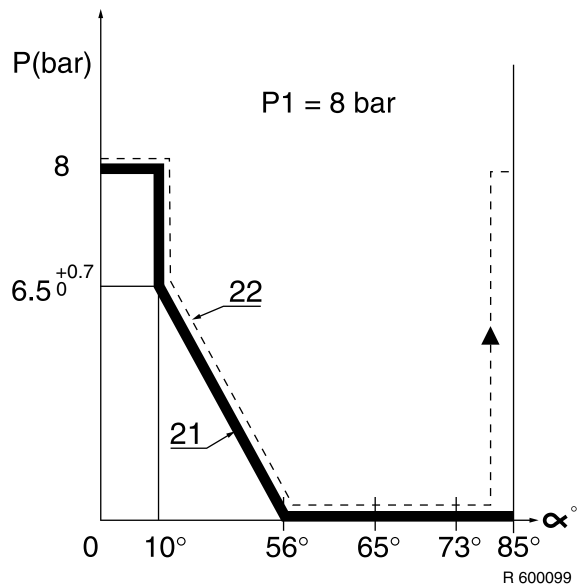

R600092

**Parking brake**
When the handle is pulled past stop (7), it is locked in position.
Ports (21) and (22) will remain pressureless, so that the spring brakes and the (semi-)trailer brakes are still applied to their maximum.

**Test position**
When the handle is moved beyond the parking position, cam (8) will move stem (9) downwards, causing the bore in valve (10) to be closed and the valve to be raised from its seat.
The reservoir pressure can now be passed to port (22) via a bore in piston (5). As a result, the (semi-)trailer brakes will be released. Port (21) remains vented, so that the spring brakes keep the brake shoes applied.
The combination is now braked only by the force exerted by the spring-brake cylinders on the towing vehicle. This will enable the driver to test whether the combination can be held when the trailer brakes are not applied. When the handle is released, it will automatically return to the parking position.




**Releasing the brakes**
When the handle is once again moved fully forwards, stem (3) will move upwards, against valve (6), and will push the valve from its seat in piston (5). As a result, the reservoir pressure can reach ports (21) and (22). The pressure in chamber (a) returns to approx. 8 bar.





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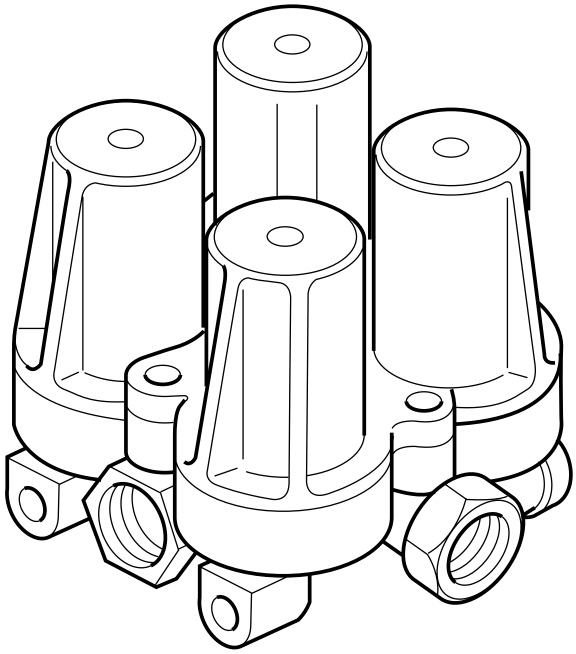
## 1.18 FOUR-CIRCUIT SAFETY VALVE

**KNORR design without circuit 3 reverse flow function**

**Purpose**
The purpose of the four-circuit safety valve is to split up the brake system into four parallel circuits, and at a failure of one circuit, to protect the remaining circuits against full venting.

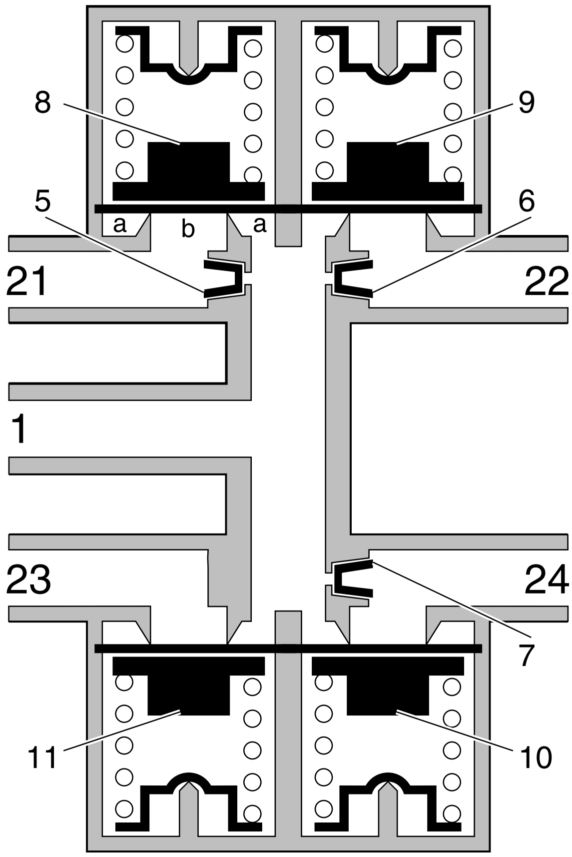


R600043

**Operation**
The opening pressure is the pressure applied at port (1) for opening valves (8), (9), (10) and (11) when the brake system is not pressurised.
The opening pressure is determined by diaphragm surface (a) and by the force of the spring acting on the diaphragm.

The static closing pressure is the pressure in the intact circuits whereby the valves in these circuits are forced onto their seats, if an air leakage occurs in a faulty circuit, and the compressor fails to refill the system.
The static closing pressure is determined by diaphragm surface (a) and (b) and by the force of the spring operating on the diaphragm.

Four circuits are connected to the valve, i.e. circuits 1, 2, 3 and 4.
Circuits 1 and 2 (ports 21 and 22) supply the service brake at the rear and front axle. Circuit 3 (port 23) supplies the parking brake and (semi-)trailer brake. Circuit 4 (port 24) supplies the other compressed-air consumers.
Compressed air enters the valve via port (1) and travels via the three small by-pass valves (5), (6) and (7) into the system. At the same time pressure builds up under valves (8), (9), (10) and (11). When a predetermined pressure (the opening pressure) has been reached, these valves will open so that the diaphragms are lifted, against the pressure of the adjustable springs. The compressed air can now flow into the four circuits unobstructed.
It should be remembered that circuits 1, 2 and 4 have a lower opening pressure than circuit 3. See main group “Technical data”.
If, for example due to a leakage or line fracture, a circuit fails, the pressure in the other circuits will first drop until the dynamic closing pressure of the faulty circuit is reached. The closing pressure cannot be precisely indicated, because it depends on the speed at which the pressure drops. That it why it is called “dynamic” closing pressure.
Subsequently, the intact circuits are refilled to the opening pressure of the faulty circuit.
The purpose of the three by-pass valves in circuits 1, 2 and 4 is to refill a pressureless brake system up to the opening pressure of the faulty circuit after the circuit with the lowest opening pressure (in view of tolerances) has failed. This is achieved as follows.
Via port (1), compressed air from the compressor is applied to the underside of valves (8), (9), (10) and (11), which remain closed for the time being by the springs. These circuits receive a (limited) supply of compressed air through by-pass valves (5), (6) and (7). As a result a slight pressure builds up in the intact circuits, and therefore under the diaphragms. This will cause the opening pressures of the intact circuits with a by-pass valve to drop to a value below the pressure of the faulty circuit. As a result, the intact circuits will first be refilled up to the opening pressure of the faulty circuit.

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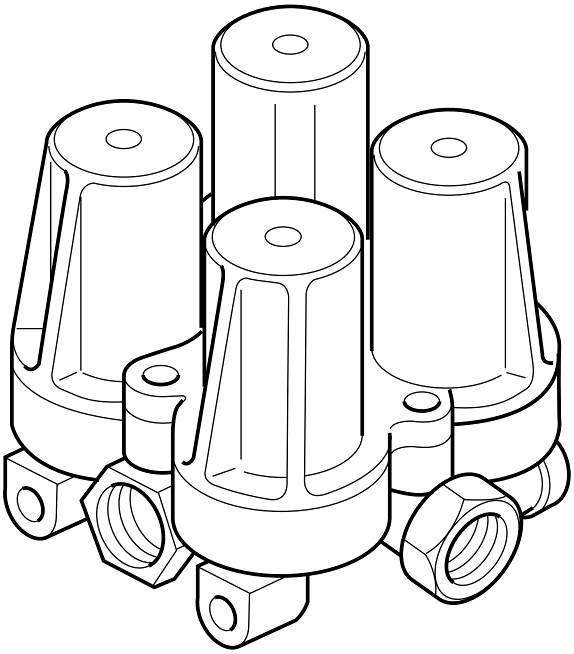
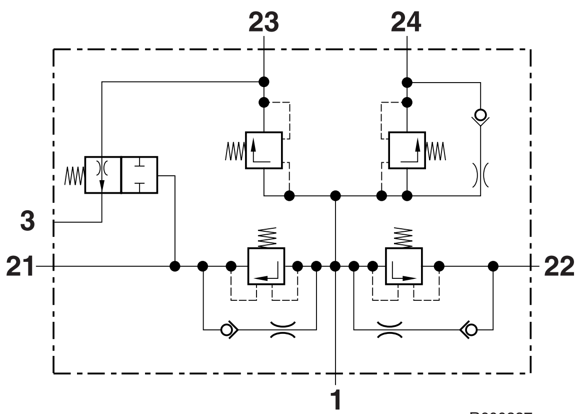
**KNORR design with circuit 3 reverse flow function**




**Purpose**
The purpose of the four-circuit safety valve is to split up the brake system into four parallel circuits, and at a failure of one circuit, to protect the remaining circuits against full venting.
The purpose of this version is to prevent the spring-brake cylinders (circuit 3) from being vented, or vented again, if the pressure in the service brake circuit 1 is too low.




**Operation**
The opening pressure is the pressure applied at port 1 for opening valves (8), (9), (10) and (11) when the brake system is not pressurised.
The opening pressure is determined by diaphragm surface (a) and by the force of the spring acting on the diaphragm.

The static closing pressure is the pressure in the intact circuits whereby the valves in these circuits are forced onto their seats, if an air leakage occurs in a faulty circuit, and the compressor fails to refill the system.
The static closing pressure is determined by diaphragm surface (a) and (b) and by the force of the spring operating on the diaphragm.

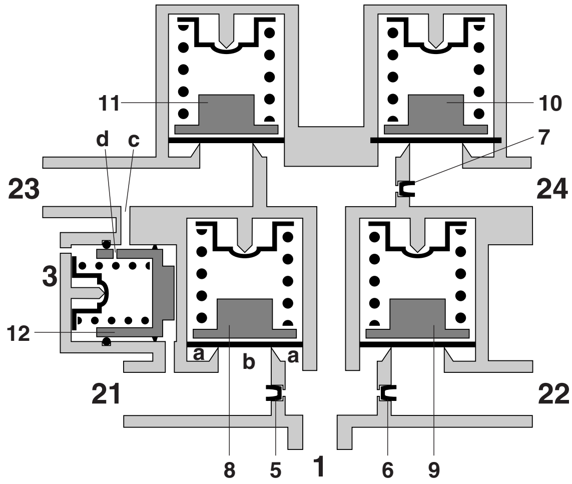
3

Four circuits are connected to the valve, i.e. circuits 1, 2, 3 and 4.
Circuits 1 and 2 (ports 21 and 22) supply the service brake at the rear and front axle. Circuit 3 (port 23) supplies the parking brake and (semi-)trailer brake. Circuit 4 (port 24) supplies the other compressed-air consumers.

Compressed air enters the valve via port 1 and travels via the three small by-pass valves (5), (6) and (7) into the system. At the same time pressure builds up under valves (8), (9), (10) and (11). When a predetermined pressure (the opening pressure) has been reached, these valves will open so that the diaphragms are lifted, against the pressure of the adjustable springs. The compressed air can now flow into the four circuits unobstructed.
It should be remembered that circuits 1, 2 and 4 have a lower opening pressure than circuit 3. See main group “Technical data”.

If, for example due to a leakage or line fracture, a circuit fails, the pressure in the other circuits will first drop until the dynamic closing pressure of the faulty circuit is reached. The closing pressure cannot be precisely indicated, because it depends on the speed at which the pressure drops. That it why it is called “dynamic” closing pressure.
Subsequently, the intact circuits are refilled to the opening pressure of the faulty circuit.

The purpose of the three by-pass valves in circuits 1, 2 and 4 is to refill a pressureless brake system up to the opening pressure of the faulty circuit after the circuit with the lowest opening pressure (in view of tolerances) has failed. This is achieved as follows.

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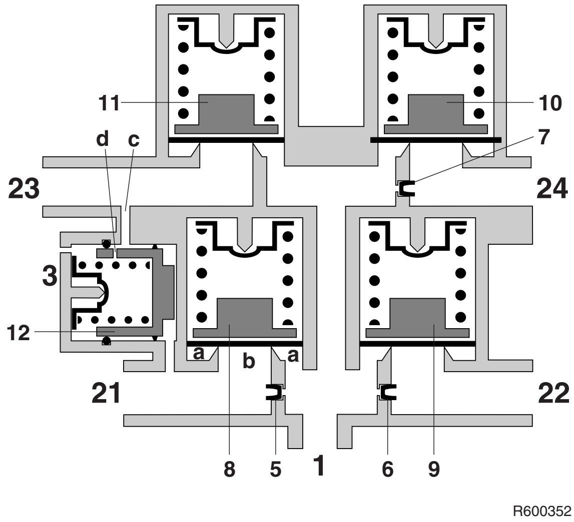
Via port (1), compressed air from the compressor is applied to the underside of valves (8), (9), (10) and (11), (see a) which remain closed for the time being by the springs. These circuits receive a (limited) supply of compressed air through by-pass valves (5), (6) and (7). As a result a slight pressure builds up in the intact circuits, and therefore under the diaphragms (see b). This will cause the opening pressures of the intact circuits with a by-pass valve to drop to a value below the pressure of the faulty circuit. As a result, the intact circuits will first be refilled up to the opening pressure of the faulty circuit.




**Operation of the circuit 3 reverse flow function**

If the pressure in circuit 1 falls below a certain value (see main group “Technical data”), piston (12) will be pushed to the right by a spring. This will cause circuit (3) to be slowly fully vented over the channels (c) and (d) and the exhaust (3). The spring-brake cylinders can now no longer be vented (released).

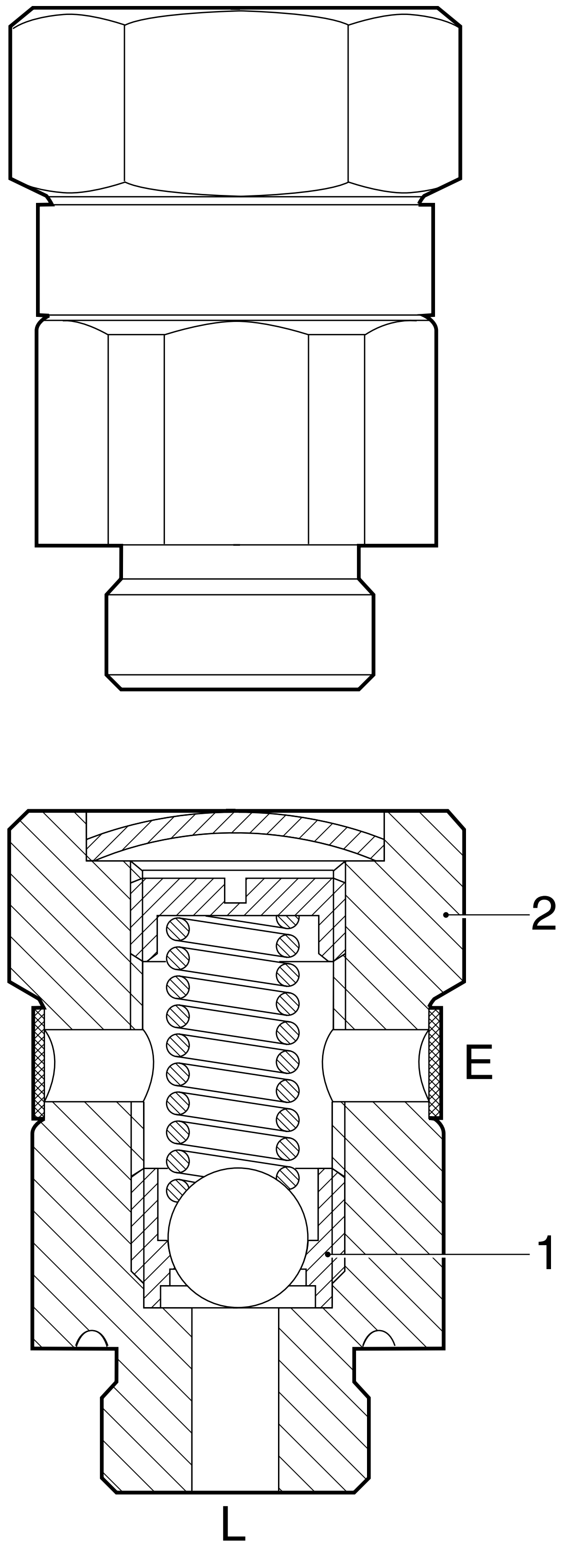
3

## 1.19 SAFETY VALVE

**Characteristics**
The opening-pressure level is 13 + 2 bar or 16 + 2 bar, depending on the relevant version. This value is indicated on the safety valve.

**Purpose**
The purpose of the safety valve is to limit the pressure build-up to a given value.

**Operation**
The compressor air enters at L and arrives at spring-loaded ball (1). When the pressure exceeds the preset value, the ball will be lifted from its seat, The excess air is vented to the atmosphere via the bores (E).
When the pressure drops below the preset value, the ball will close again.




R600050

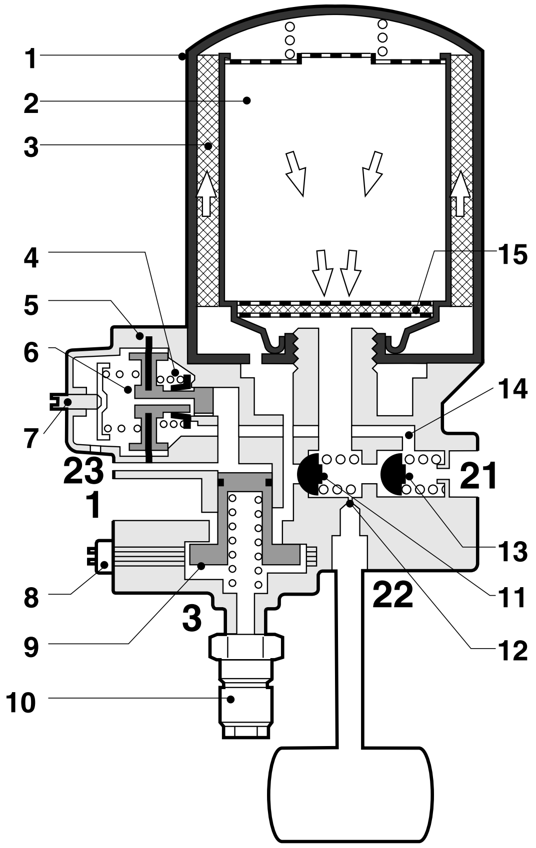
## 1.20 AIR DRYER

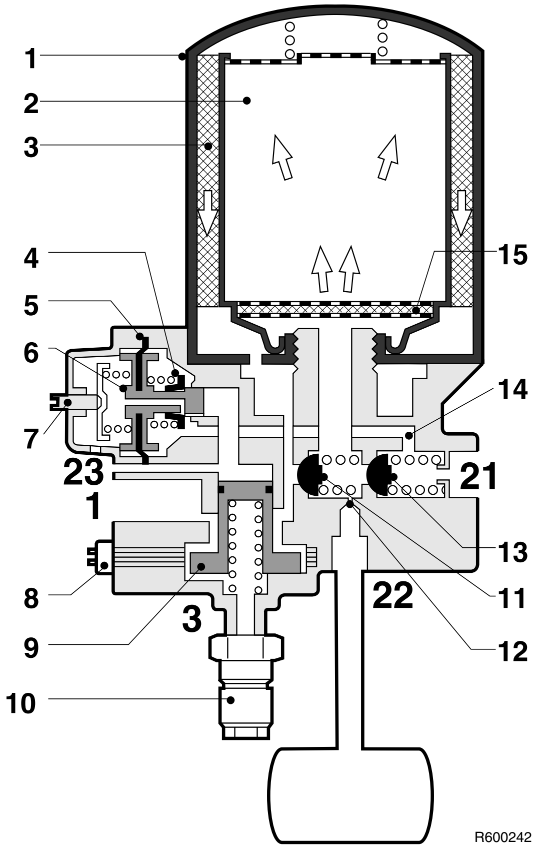
**Purpose**
The purpose of the air dryer is to remove water, oil and other foreign matter from the air before it enters the brake system, and to adjust the system pressure by means of a built-in pressure regulator.

**BOSCH design**

**Operation**

**Filling the system**
The air supplied by the compressor reaches the air dryer via port (1) and passes the venting/safety valve (9).
The air flows to filter element (1) via a bore.
In the filter element, the air passes through coarse filter (3), which sieves out the oil and dirt particles.
In addition, the air condenses against the cool wall of the element. Next, the air passes through the dessiccant.
The special filter dessiccant grains have a very high absorbing capacity, which means that the grains extract water vapour from the air. Dust filter (15) prevents grains or dust from becoming airbound.
The air thus dried flows via non-return valve (13) to exhaust port (21).
At the same time a small part of the dried air flows through constriction (12) to exhaust (22).
A small reservoir, the regeneration reservoir, is connected to exhaust (22).
If the filter element should become clogged and thus cause a pressure increase, over-flow valve (11) will open and connect input (1) and exhaust (21).

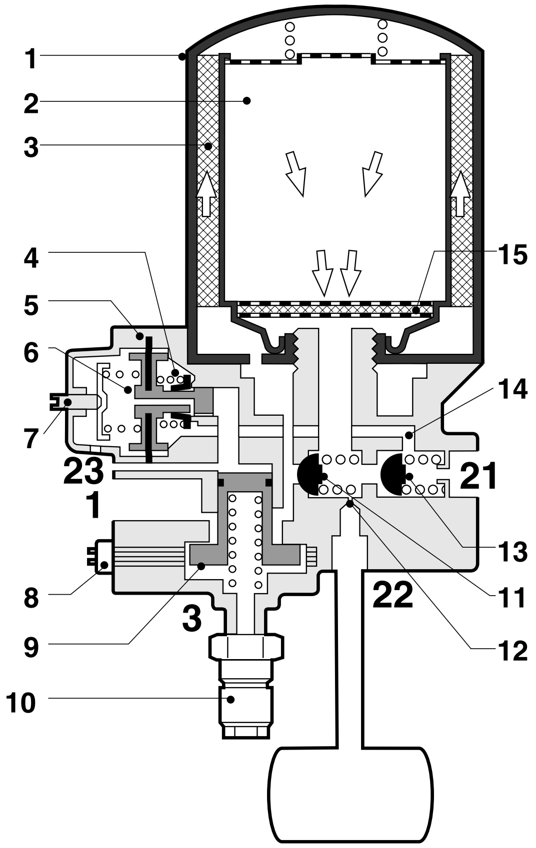


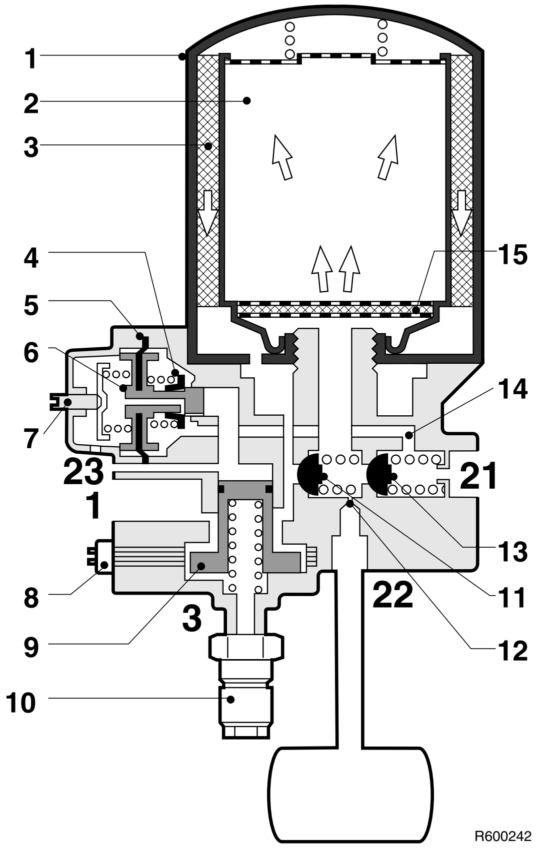



**Operation pressure regulator**
The pressure increase occurring during filling is returned to the built-in pressure regulator via bore (14).
This pressure reaches diaphragm (5).
At the preset system pressure, diaphragm (5) will have been moved far enough to the left that control valve (4) will be lifted from its seat.
The air now enters the chamber above venting valve (9) and will force this valve downwards. This way a direct connection to the outside atmosphere is created.
The pressure above venting valve (9) is also returned to the compressor via exhaust (23).

If the pressure in the brake system decreases due to air consumption, control valve (4) reaches its seat and as a result the chamber above venting valve (9) is vented through venting bolt (6) of the pressure regulator.
Venting valve (9) now closes. As a result the brake system is filled again.
To prevent blow-off opening (10) from freezing in winter, heating element (8) is provided.

**Regenerating**
If the system pressure is reached, the filter element is depressurised.
Via constriction (12) the pressurised air in the regeneration reservoir will expand and flow through the filter element in the reverse direction. As a result, the water and dirt are extracted from the dessiccant grains, thus restoring their absorbing capacity. The extracted water and dirt are drained via blow-off opening (10).

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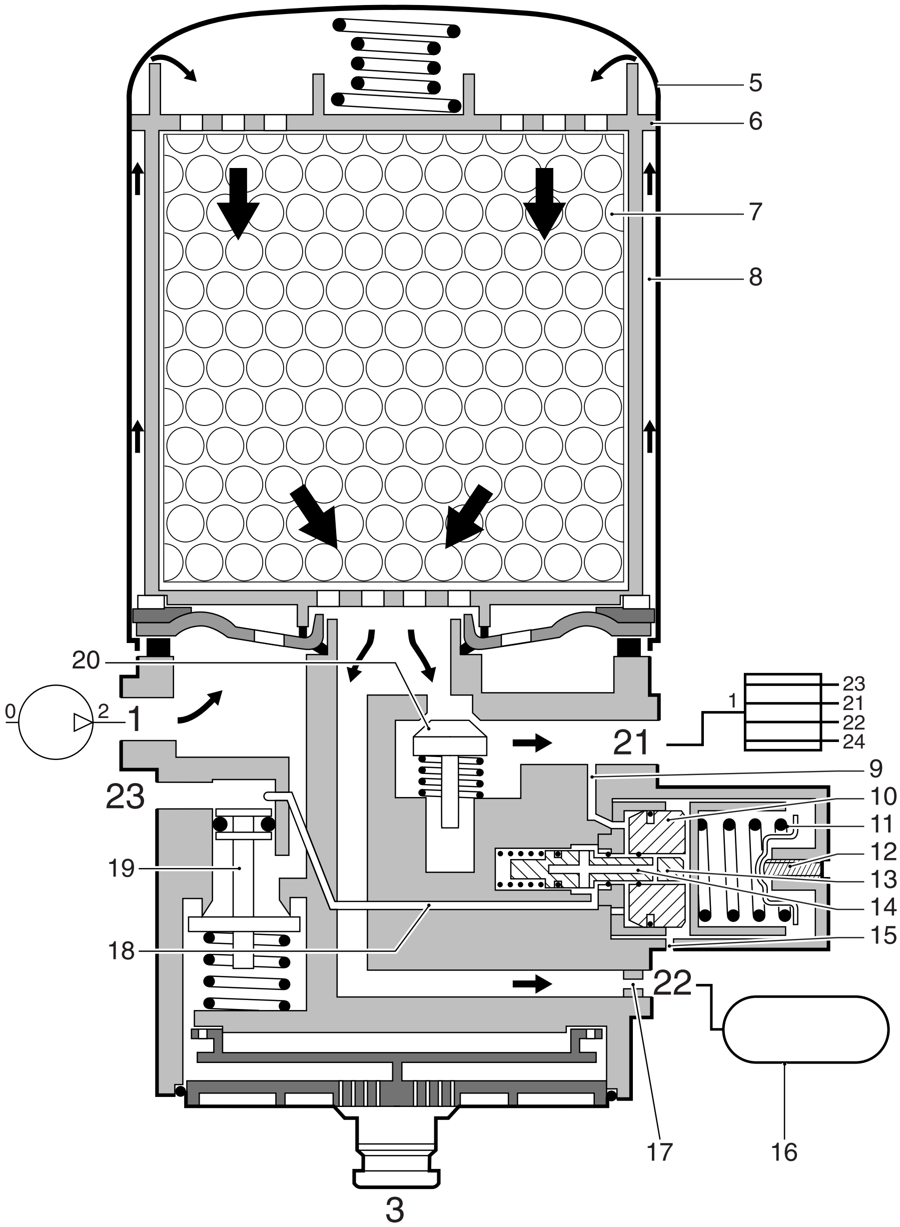
**KNORR design**

**Operation**

**Filling the system**
The air supplied by the compressor reaches the air dryer via port (1). The air flows to filter element (5) via a bore.




R600259

In the filter element, the air passes through coarse filter (6), which sieves out the oil and dirt particles.
In addition, the air condenses against the cool wall of the element. Next, the air passes through the dessiccant (7).
The special filter dessiccant grains (7) have a very high absorbing capacity, which means that the grains extract water vapour from the air.
The air thus dried flows via non-return valve (20) to exhaust port (21).
At the same time a small part of the dried air flows to port (22).
A small reservoir, the regeneration reservoir (16), is connected to exhaust (22).

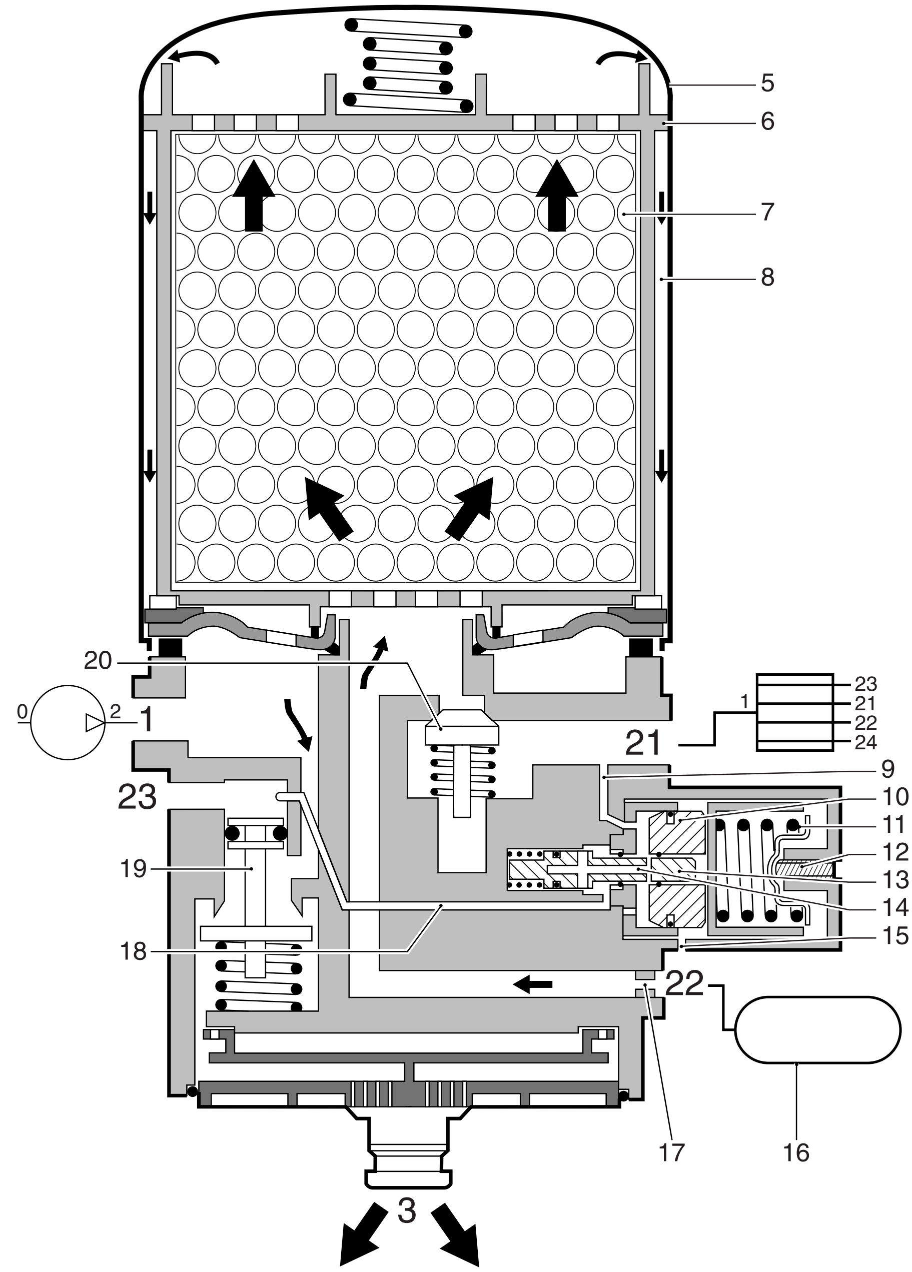


**Operation pressure regulator**

The pressure increase occurring during filling is returned to the built-in pressure regulator via bore (9).
At the preset system pressure, piston (10) is moved to the right against the spring pressure.
This clears bore (14) in pin (13), so that the system pressure opens the venting safety valve (19) via bore (18).
The pressure above venting safety valve (19) is also returned to the compressor via port (23), thus activating the compressor's energy-saving function.

If the pressure in the brake system decreases due to air consumption, piston (10) closes bore (14), and the chamber above the venting safety valve is vented via bore (14) and pin (13).
Venting safety valve (19) closes, the compressor's energy-saving function is deactivated and the braking system is filled again.

**Regenerating**
If the system pressure is reached, the filter element (5) is depressurised.
Via constriction (17) the pressurised air in the regeneration reservoir 16 will expand and flow through the filter element (5) in the reverse direction. As a result, water is extracted from the dessiccant grains, thus restoring their absorbing capacity. The extracted water is drained via venting safety valve (19) at port (3).

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## 1.21 AUTOMATIC SLACK ADJUSTER

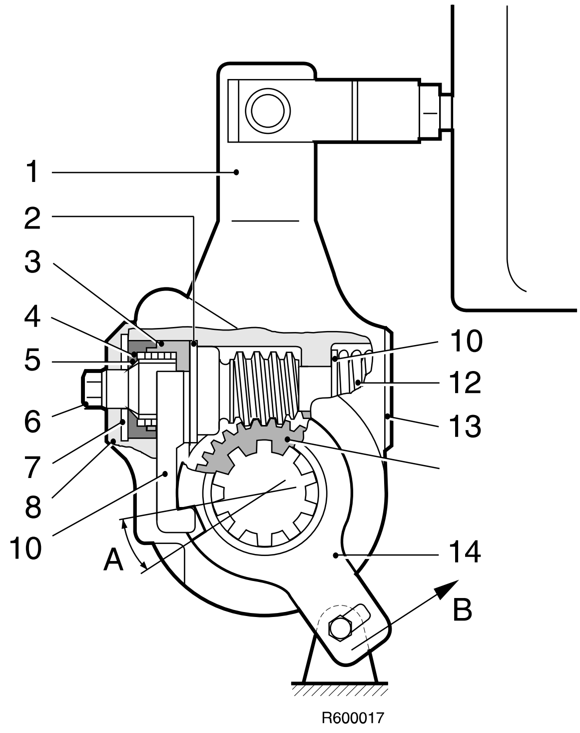
**Purpose**
The purpose of the automatic slack adjuster is to automatically compensate for any excessive play between the brake lining and the brake drum. As a result the chamber travel during braking remains more or less constant.

**Operation**
Cylinder wearing causes extra clearance between lining and drum. This is adjusted during the return stroke of the slack adjuster.
The brake-cylinder travel is composed of the following three components:

- the basic brake travel which corresponds to the normal clearance between lining and drum;
- the additional travel which corresponds to the additional clearance between lining and drum due to lining wear;
- the elastic travel due to the elasticity of drum, lining, shoes and brake camshaft.

1. Housing
2. Bearing
3. Pinion of overrunning clutch
4. Spring of overrunning clutch
5. Conical ring of overrunning clutch
6. Worm shaft
7. Pivot bearing
8. Screw cap
9. Gearwheel
10. Rack
11. Spring retainer
12. Spring
13. Screw cap
14. Control plate

Angle A: the angle corresponding to the basic brake travel.





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**Basic brake travel**
The basic brake travel is determined by the notch in control plate (14), which is attached to the axle housing. In the rest position, the rack should rest against the upper edge of the notch. When the travel exceeds angle A, the adjusting system is activated. Angle A corresponds to the normal travel.

**Additional travel**
When the normal travel is exceeded, the lower edge of the notch of the control plate forces rack (10) upwards. As a result pinion (3) is turned. An overrunning clutch, consisting of spring (4) and conical clutch (5), has been fitted between the pinion and worm shaft (6), which permits free turning in this direction.
During the return travel, the rack is pulled downwards by the upper edge of the notch. The pinion now turns in the opposite direction, so that the overrunning clutch drives worm shaft (6) and the brake is adjusted.

**Elastic travel**
During the elastic section of the travel, the considerable force transmitted pushes worm shaft (6) axially against spring (12). This will cause the worm shaft to become disengaged from the conical clutch.
As a result, the conical clutch will be able to turn freely over a certain distance during the return travel, until clutch and worm shaft are reengaged, without driving the worm shaft.
From that moment, any rotation of the pinion will once again adjust the length of travel. As a result of this construction, the elasticity of the component involved will not be instrumental in adjusting the travel.

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# CONTENTS



4

# 1. INSPECTION AND ADJUSTMENT

## 1.1 INSPECTION OF COMPRESSOR CAPACITY

1. Run the engine to operating temperature.
2. For an air-suspended vehicle, the chassis should be at the normal vehicle-driving height.
3. Put blocks in front and behind the rear-axle wheels, so that the vehicle cannot roll away.
4. Position the parking brake in the driving position.

**Note:**
If, when draining the air reservoirs, they appear to hold an excessive quantity of oil, check the condition of the compressor and check the compressor for the presence of carbon deposits (see chapter “Inspection of compressor line”).

5. Drain the brake system.
6. The capacity test requires that a completely empty system should be at operating pressure within 5 minutes, at an engine speed of 0.6 x maximum engine speed.

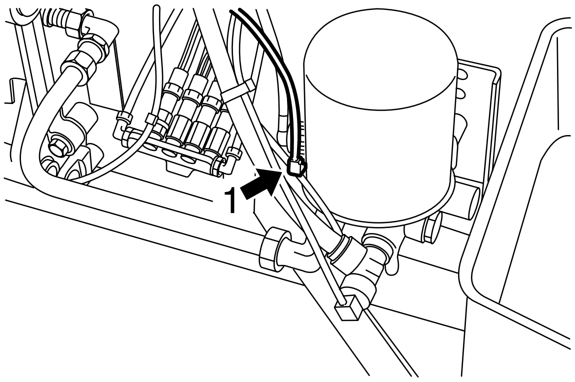
## 1.2 INSPECTION, COMPRESSOR PIPE

**Maintain a safe distance from rotating and/or moving components.**

**Note:**
When measuring excessive values, the inside of the air-dryer housing and the silencer on the exhaust should first be cleaned.

Then repeat the following checks.
1. Run the engine to operating temperature.
2. Drain the brake system to a pressure below the cut-in pressure of the pressure switch.
3. Remove compressor control line (1) which is connected at port (23) of the air dryer. Then seal the opening at port (23).
4. Build up pressure in the brake system (governor should cut out).
5. When the engine is not running, remove the safety valve from the compressor line and replace it with a test nipple.
6. Connect a pressure gauge (measuring range 0 - 16 bar) to the test nipple.
7. Start the engine and run it at maximum speed.
8. The pressure gauge should indicate a pressure below 2 bar **with the pressure regulator switched off**. If the pressure indicated exceeds this value, the line between compressor and air dryer should be purged or renewed.

**Note:**
If the pressure reading is too high, there is excessive carbon deposit in the compressor line. This may be caused by a poor condition of the compressor (oil consumption).



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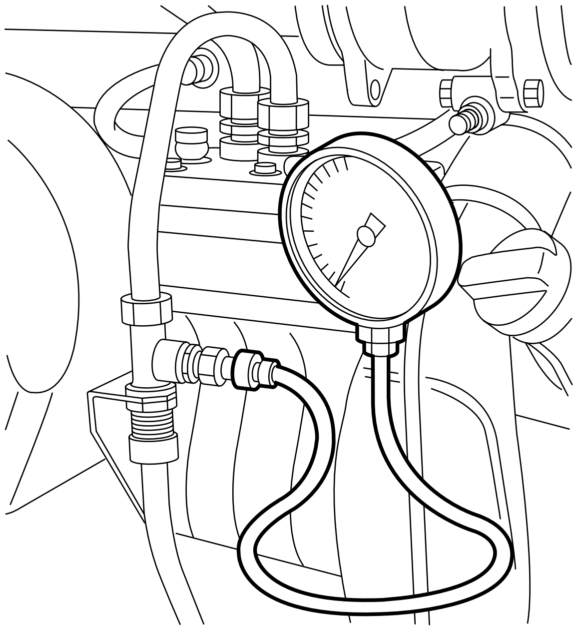

R600249

9. Run the engine at idling speed.

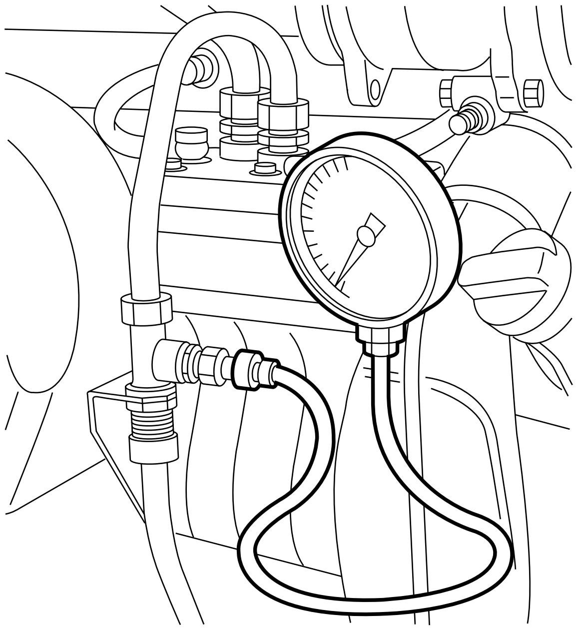
10. Bleed the brake system until the governor cut-in pressure is reached. The indicator on the pressure gauge should not drop rapidly. If necessary, check the system for leaks; special attention should be paid to the compressor line and the compressor.

11. Replace the safety valve.

12. Remove compressor control line which is connected at port (23) of the air dryer.

## 1.3 INSPECTION OF COMPRESSOR CONTROL

**Maintain a safe distance from rotating and/or moving components.**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1. Run the engine to operating temperature.
2. When the engine is not running, remove the safety valve from the compressor line and replace it with a test nipple.
3. Connect a pressure gauge (measuring range 0 - 16 bar) to the test nipple.
4. Start the engine and run it at maximum speed.
5. The pressure gauge should indicate a pressure of approx. 0 bar **with the pressure regulator switched off**.
6. Reassemble the safety valve from the compressor line, when the engine is not running.

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## 1.4 INSPECTION AND ADJUSTMENT, SERVICE-BRAKE VALVE

**Inspection foot-brake valve**

1. Connect a pressure gauge to one brake chamber of the front axle (if present, in front of the empty/load valve).
2. Connect a pressure gauge in front of the load-sensing valve.
3. Pressurise the system.
4. Depress the brake pedal a few times, alternately quickly and slowly, until the end stop.
   Check if there is a discrepancy between both gauge readings (discrepancy maximum 0.3 bar).
5. When the brake pedal is gradually depressed, both circuits should not show larger pressure increases than 0.3 bar.
6. When the service-brake valve is completely depressed, the reading of both gauges should indicate the reservoir pressure.
7. When the brake pedal is not depressed, the pressure gauges should not indicate any pressure.

**Adjusting the service-brake valve**

1. Check whether the brake pedal can be fully depressed. When fully depressed, the pedal should not touch the floor mat. This is especially important if circuit 1 were to be break down. The pedal will need to be depressed more than once to achieve full pressure at circuit 2.
2. The stop bolt should be adjusted so, that there is a noticeable play between bolt and pedal.

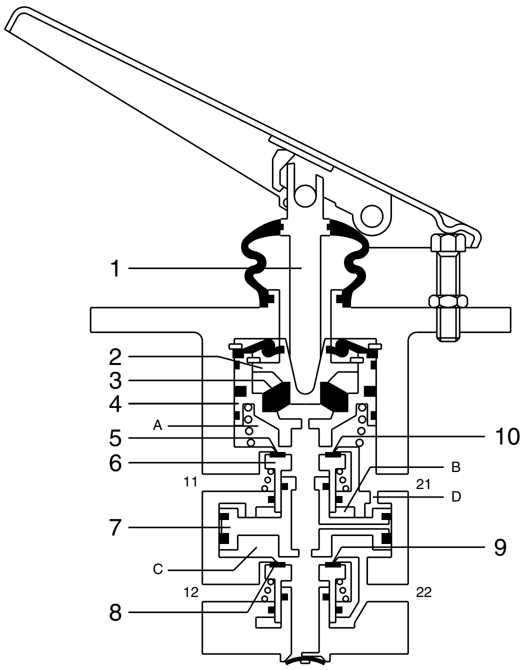


Fig. 2

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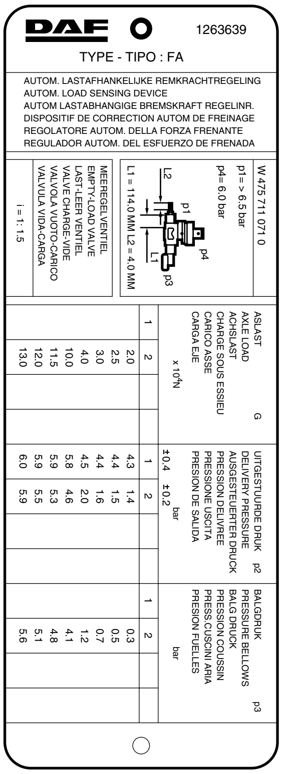
## 1.5 INSPECTION AND ADJUSTMENT, LOAD-SENSING VALVE, AIR SUSPENSION

**Explanation of instruction plate**
The information contained on the instruction plate relates to the axle loads, the output pressures and bellows pressures, in accordance with the order of axles beneath the vehicle.
So “1” is the front axle, etc.
The data for the “driven axle” given on the instruction plate are important when the load-sensing valve is checked.

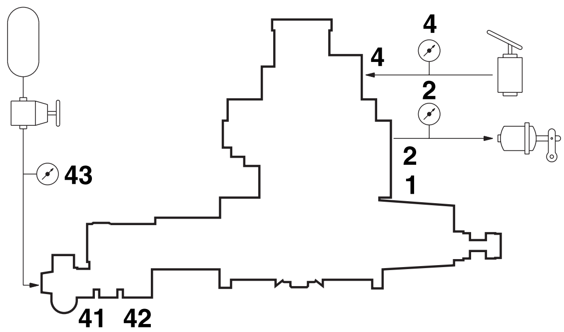
L1 = Effective length of unloaded spring between retainer sleeve and adjustable plug. Spring length in mm.
L2 = Screw length up to lock nut in mm.





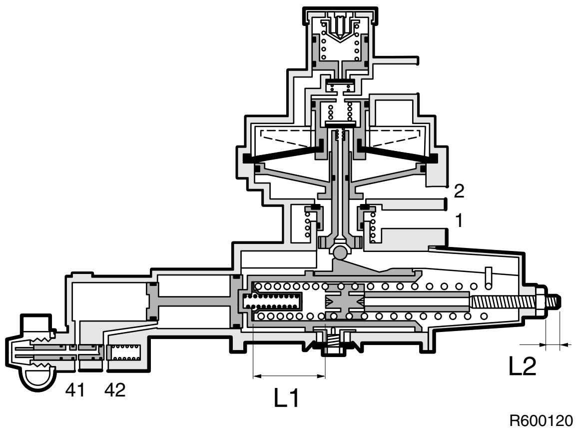

M6046

1. Check whether the correct valve is fitted (see instruction plate).
2. Connect pressure gauge (4) to the test connection of the load-sensing valve (input pressure).
3. Connect pressure gauge (2) to the test connection at the rear-axle brake cylinder (output pressure).
4. Connect pressure gauge (43) with a pressure-reducing valve to the simulation connection of the load-sensing valve (simulated adjustable bellows pressure).
5. Make sure that the reservoir pressure is higher than 6.5 bar throughout the testing process.




M6102

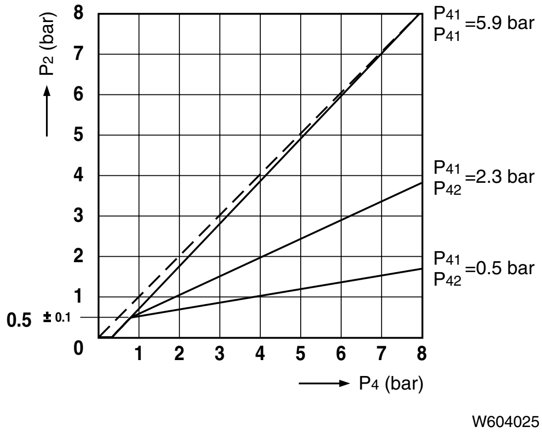
6. Set the simulated bellows pressure at its highest value, as indicated on the instruction plate. Depress the brake pedal until gauge (4) indicates a pressure of 6 bar.
   Read off pressure gauge (2) and check whether this braking pressure matches the pressure marked in the table on the instruction plate.
   If the braking pressure is incorrect, L2 should be adjusted.
   Before attempting to change L2, first make all connections pressureless.
   - Braking pressure too high: shorten L2
   - Braking pressure too low: extend L2




7. Repeat the procedure described in point 6 until the measured braking pressure reading is within the tolerance limits.



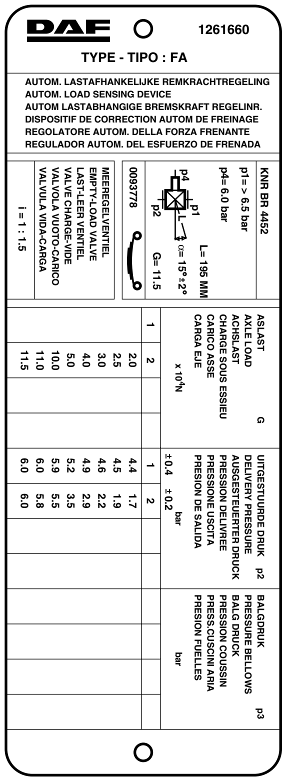
8. Set the simulated bellows pressure at its second lowest value, as indicated on the instruction plate. Depress the brake pedal until gauge (4) indicates a pressure of 6 bar.
   Read off pressure gauge (2) and check whether this braking pressure matches the pressure marked in the table on the instruction plate.
   If the braking pressure is incorrect, L1 should be adjusted. This is possible without removing the spring.
   Insert a crosshead screw driver of sufficient length into the hollow adjusting screw.
   Before attempting to change L1, first make all connections pressureless.
   - Braking pressure too high: extend L1
   - Braking pressure too low: shorten L1




9. If L1 has been changed, repeat the procedure from point 6.

## 1.6 INSPECTION AND ADJUSTMENT, LOAD-SENSING VALVE, LEAF SPRINGS

**Explanation of instruction plate**
The data of the axle loads and the output pressures are listed on the instruction plate per axle from front to rear.
So "1" is the front axle, etc.
The data for the "driven axle" given on the instruction plate are important when the load-sensing valve is checked.




M6045

1. Measure the rear axle load.
   **Note:**
   A load-sensing valve on a vehicle with a leaf-sprung trailing axle should be adjusted with the trailing axle lowered. When adjusting the load-sensing valve, take the weight of both axles.

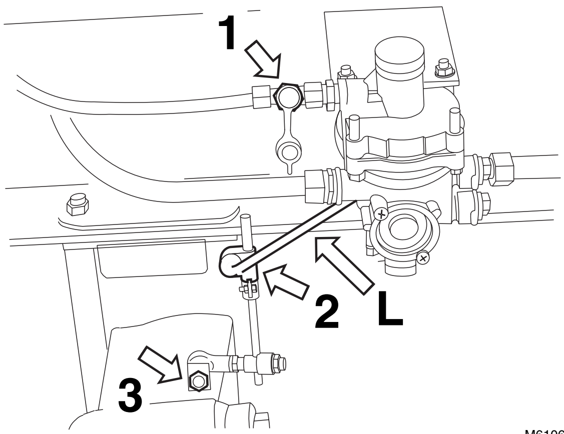
2. Check the attachment of the control lever and its ease of operation.

3. Also check whether the correct valve and the correct spring assembly have been fitted (for information, see the instruction plate).

4. Check length L of the control lever (see instruction plate).

5. Connect pressure gauge (1) to the test connection (1) of the load-sensing valve and pressure gauge (2) to the test connection on one of the spring-brake cylinders (service-brake connection) of the rear axle.

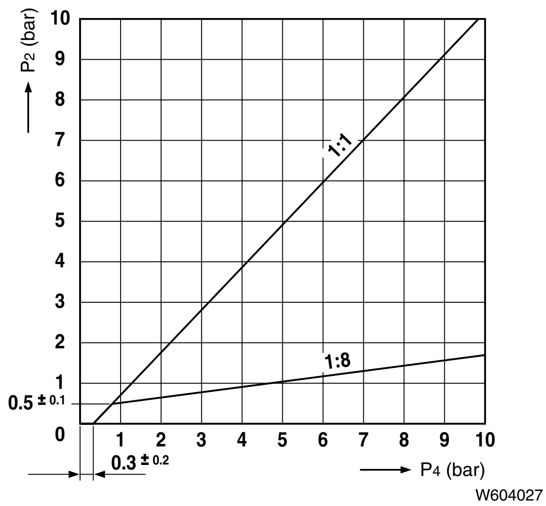
6. Make sure that the reservoir pressure exceeds 6.5 bar.



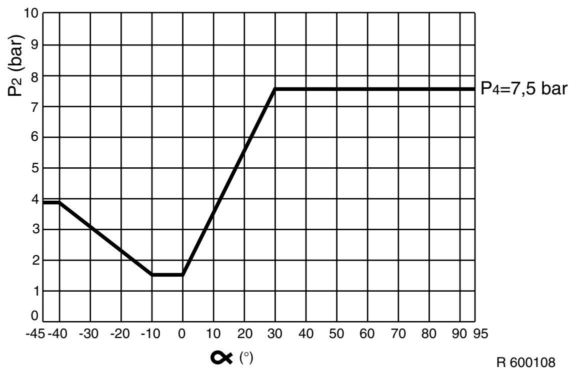

M6106

4

7. Depress the brake pedal until pressure gauge (1) reads 6 bar, and on pressure gauge (2), read off the braking pressure of the rear axle.
8. Compare this value with the data on the table, mounted on the door post.
9. The braking pressure can be corrected by moving the rubber socket (2) in relation to the vertical connecting rod; **do not** adjust length L of the control lever.

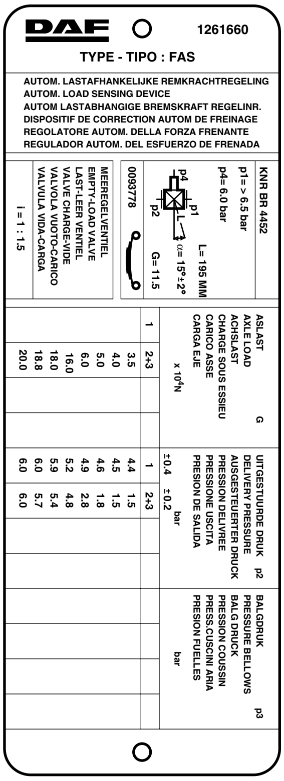



10. Also check whether the delivery pressure is passed on practically unreduced under maximum load. For this check remove ball joint (3) and move the lever towards the maximum load position.



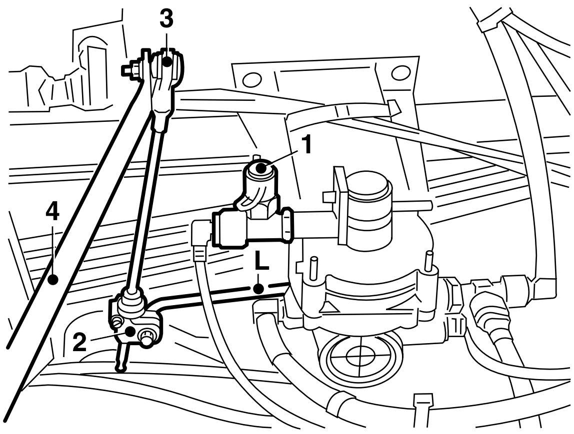
## 1.7 ADJUSTMENT OF THE LINKAGE MECHANISM OF THE LOAD-SENSING VALVE WITH LEAF-SPRING TRAILING AXLE

**Explanation of instruction plate**
The data of the axle loads and the output pressures are listed on the instruction plate per axle from front to rear.
So “1” is the front axle, etc.
The data for the “driven axle” given on the instruction plate are important when the load-sensing valve is checked.



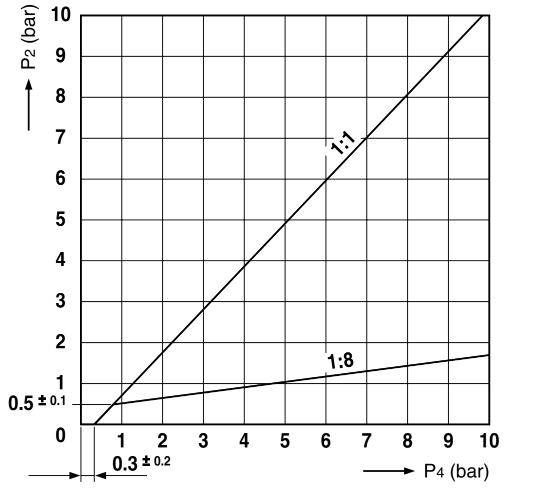

R600326

1. Measure the axle loads of the driven axle and the trailing axle, with the trailing axle lowered.
2. Check the attachment of the control lever and its ease of operation.
3. Also check whether the correct valve and the correct spring assembly have been fitted (for information, see the instruction plate).
4. Check length L of the control lever (see instruction plate).
5. Connect pressure gauge to the test connection (1) of the load-sensing valve and pressure gauge to the test connection on one of the spring-brake cylinders (service-brake connection) of the rear axle.
6. Make sure that the reservoir pressure exceeds 6.5 bar.




R600327

7. Depress the brake pedal until pressure gauge (1) reads 6 bar, and on pressure gauge (2), read off the braking pressure of the rear axle.
8. Compare this value with the data on the table, mounted on the door post.
9. If the value on the gauge does not equal the data on the table, check the adjustment of the linkage mechanism (4); see main group “Technical data”.
10. If the linkage mechanism is properly adjusted, the braking pressure can be corrected by moving the rubber socket (2) in relation to the vertical connecting rod; **do not** adjust length L of the control lever.
11. Also check whether the delivery pressure is passed on practically unreduced under maximum load. For this check remove ball joint (3) and move the lever towards the maximum load position.

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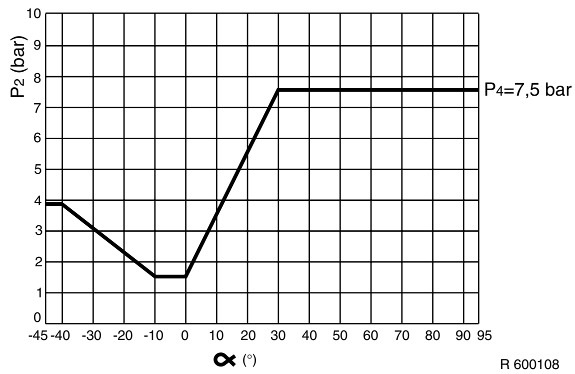
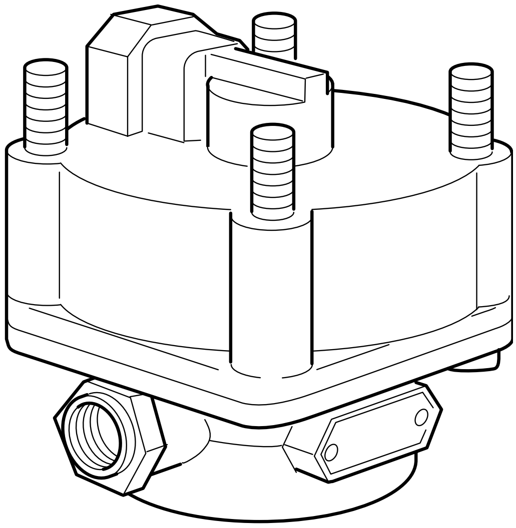


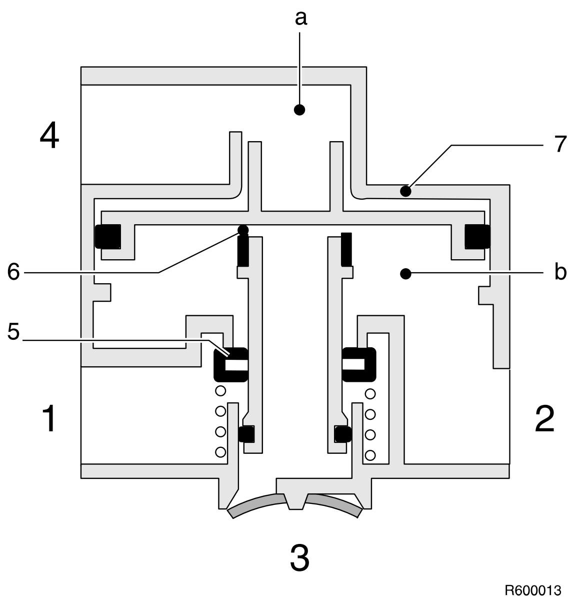

R 600108

## 1.8 INSPECTION RELAY VALVE

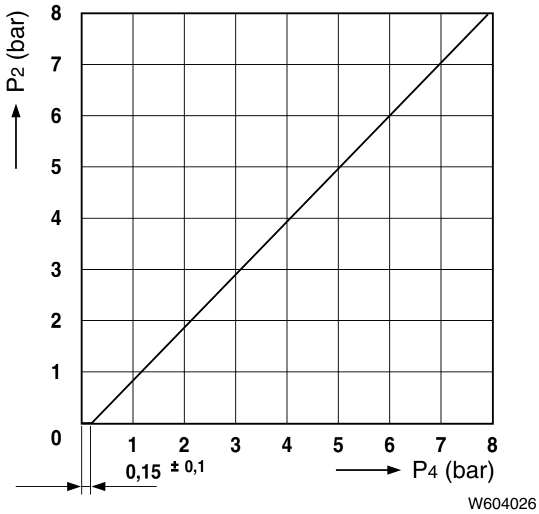
**Models without increase of control pressure**

1. Connect a pressure gauge to port (2) of the relay valve.
2. Connect a pressure gauge to port (4) of the relay valve.
3. Pressurise the system.
4. Depending on the position of the relay valve in the brake system, slowly activate the service brake or parking brake.



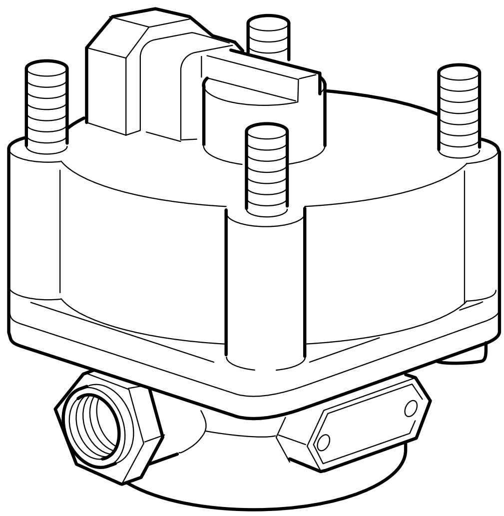


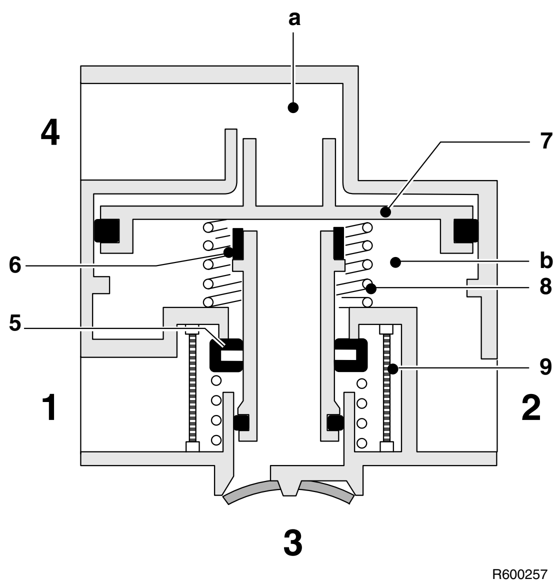
5. The pressure registered in both pressure gauges should increase evenly. The pressure gauge connected to port (2) should not rise in jumps. Both gauges should indicate approximately the same value.




**Models with increase of control pressure**

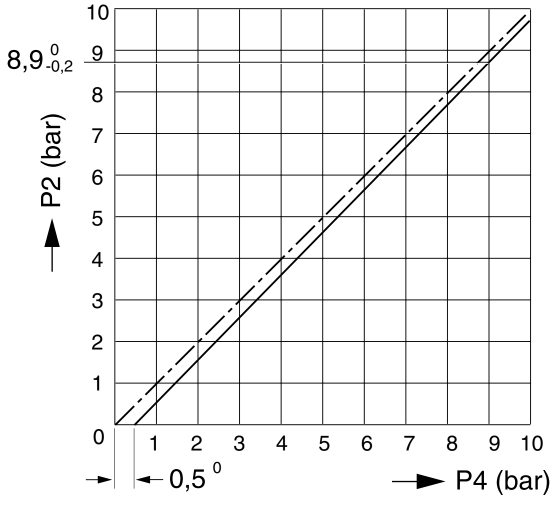
1. Connect a pressure gauge to port (2) of the relay valve.
2. Connect a pressure gauge to port (4) of the relay valve.
3. Pressurise the system.
4. Depending on the position of the relay valve in the brake system, slowly activate the service brake or parking brake.






4

5. The pressure in the gauge connected to port (4) should rise to 0.5 bar (increase of control pressure), without any perceptible pressure at port (2). From this point on, the pressures registered in both pressure gauges should increase evenly. The pressure gauge connected to port (2) should not rise in jumps. Both gauges should indicate a value in accordance with the graph.







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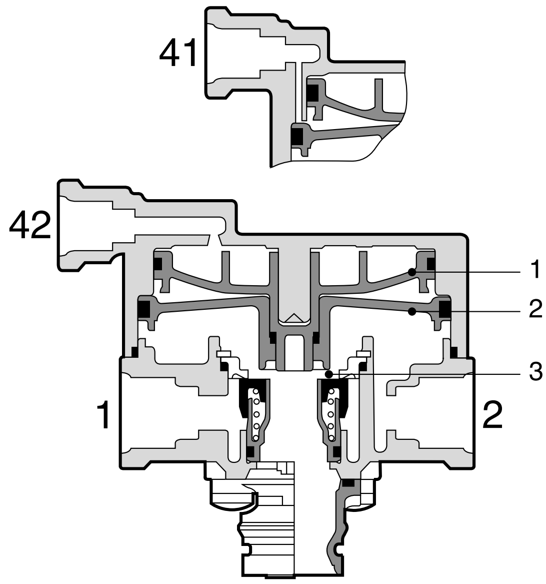
## 1.9 INSPECTION CHECK/RELAY VALVE

**Checking the relay operation**

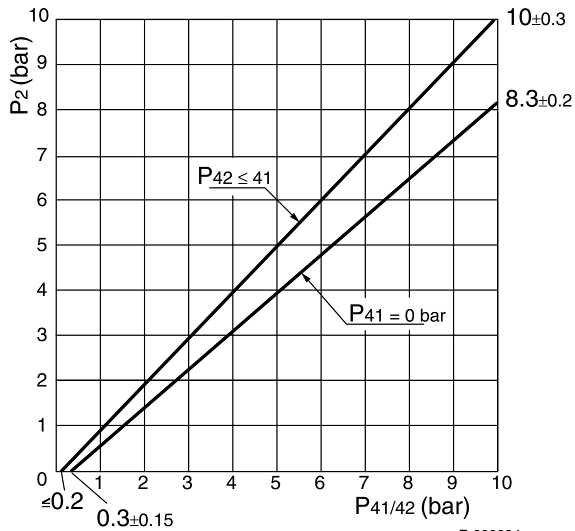
1. Ensure there is sufficient system pressure.
2. Via a T-piece, connect a pressure gauge to port (42) of the double check/relay valve, and a pressure gauge to port (12) of the spring-brake cylinder.
3. Place the emergency parking brake valve in the driving position, and check the reduced output pressure from the double check/relay valve to port (12) of the spring-brake cylinder (see graph, line P41 = 0 bar).




R600082

**Checking non-increment function**

1. Ensure there is sufficient system pressure.
2. Via a T-piece, connect a pressure gauge to port (4) (test connection) of the load-sensing valve, and a pressure gauge to port (12) of the spring-brake cylinder.
3. Set the parking brake valve in the parking position.
4. Slowly depress the brake pedal; both gauges should indicate a similar pressure increase (see graph, P42 ≤ 41).




R 600084

## 1.10 INSPECTION EMPTY/LOAD RELAY VALVE

1. Using a T-piece, connect a pressure gauge to port (41).
2. Connect a pressure gauge to the test connection on one of the brake chambers of the front axle.
3. Connect a pressure gauge to the test connection on one of the brake chambers of the rear axle.
4. Pressurise the system.

**Testing when empty**

5. Set the load-sensing valve to the empty position.
6. Slowly depress the brake pedal.
   The pressure increase on the front axle should rise gradually, not in jumps.
   The pressure at the front axle will increase more gradually than at port (41). (An empty vehicle will show a larger difference than a partially loaded vehicle.)

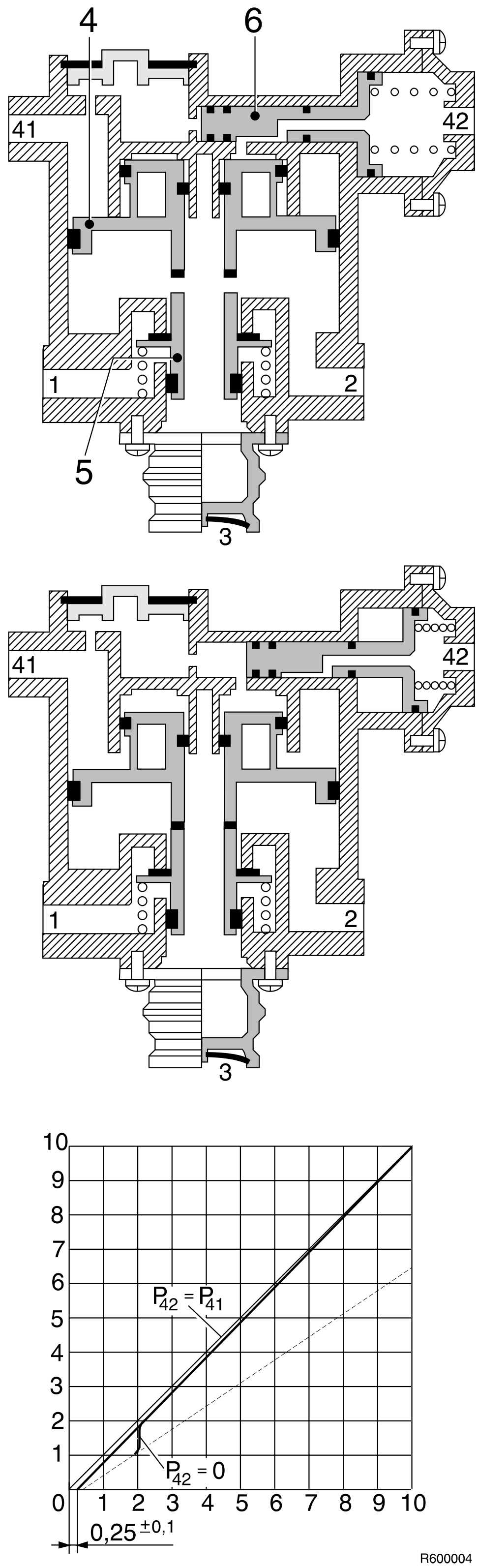
**Testing when fully loaded**

7. Set the load-sensing valve to the full-load position.
8. Slowly depress the brake pedal.
   The pressure increase on the front axle should rise gradually, not in jumps.
   The pressure at the front axle will increase as quickly (approx. 0.2 bar) as at port (41).
   It should be possible to achieve system pressure.

**Testing when faulty**

9. Disconnect the line at port (42), and plug off this line.
10. Repeat point 8.
11. Set the load-sensing valve as specified.
12. Reconnect the lines to ports (41) and (42), as originally fitted.
13. Remove the pressure gauges.

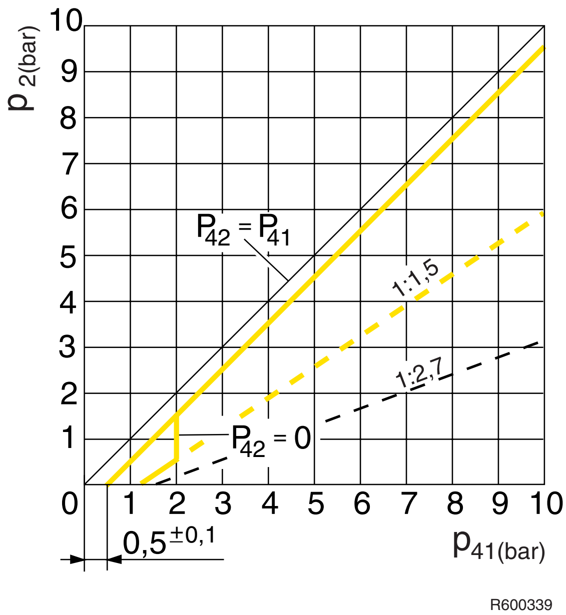





R600004

**Checking the output pressure to the front axle**

1. Measure the rear axle load.
2. Check the setting of the load-sensing valve.
3. Connect a pressure gauge to the test connection for the load-sensing valve (input pressure) and a pressure gauge to the test connection on the spring-brake cylinder of the front axle.
4. Make sure that the reservoir pressure exceeds 6.5 bar.
5. Depress the brake pedal until the pressure gauge on the test connection of the load-sensing valve reads 6 bar, and read off the braking pressure on the pressure gauge on the front axle.
6. Compare this value with the data on the table, mounted on the door post.




Pressure reduction models with increase of control pressure

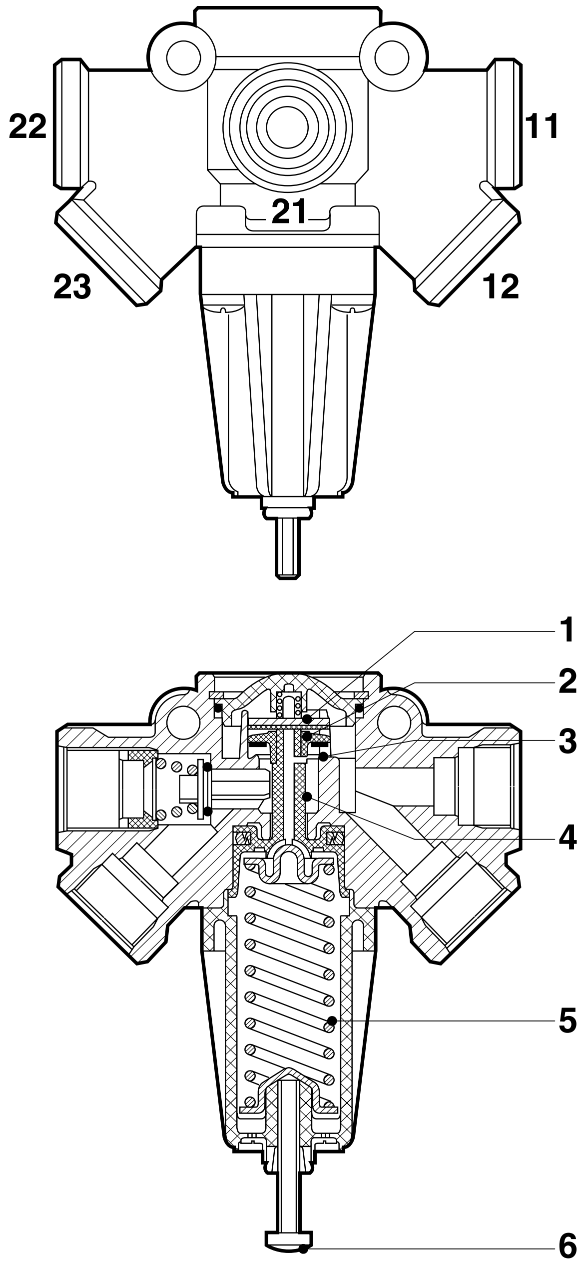
## 1.11 INSPECTION AND ADJUSTMENT, PRESSURE-LIMITING VALVE WITH INTEGRATED NON-RETURN VALVE



**Inspection pressure-limiting valve**
1. Place pressure gauges on ports (22) and (23).
2. Increase and decrease the pressure at port (11) or (12) without exceeding the limiting pressure; the gauge reading should rise and fall simultaneously.
3. Increase the pressure at port (11) or (12) until it exceeds the limiting pressure; the pressure gauge should indicate the limiting pressure.
   Adjust the pressure limiting valve, if required.

**Checking the non-return valve**
1. Place pressure gauges on ports (22) and (23).
2. Make sure that the reservoir pressure exceeds 6.5 bar.
3. Simulate a defect at port (21).
4. The pressure gauge readings on both pressure gauges (ports 22 and 23) should not fall.

**Adjustment pressure-limiting valve**
1. The pressure-limiting valve can be adjusted with the adjustment screw.



R600226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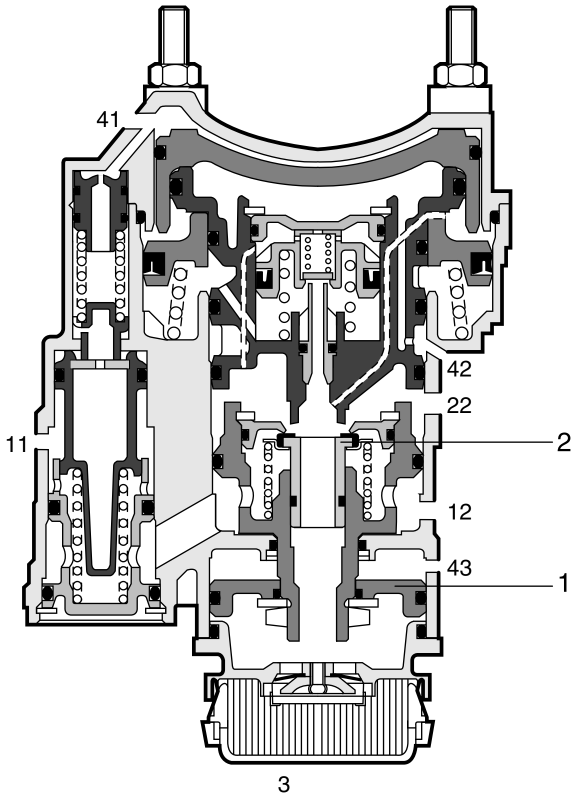
## 1.12 INSPECTION (SEMI-)TRAILER REACTION VALVE

**WABCO design**

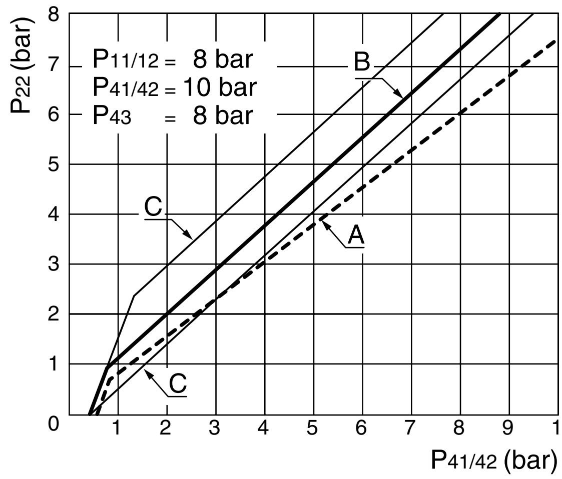
Explanation of graph
A Curve of failure in circuit 1
B Curve of intact circuit 1 and circuit 2, or failure in circuit 2
C Area for braking-pressure advance adjustment.

1. Ensure there is sufficient system pressure.
2. Check whether air is escaping via the exhaust.
3. Depress the brake pedal, and again check for leaks.
4. Disconnect the line at port (42), and plug off this line.




R600122

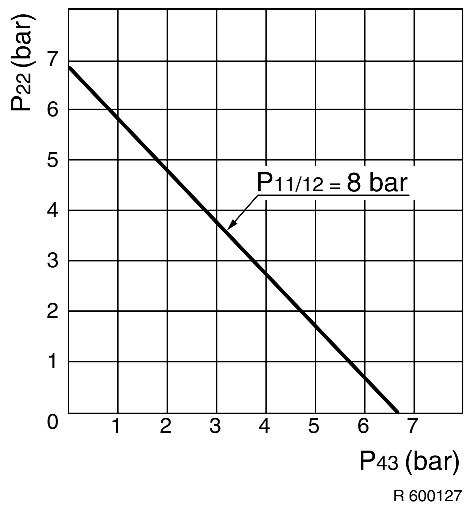
5. Depress the brake pedal, and check for pressure build-up in the service line.
6. Reconnect the line.
7. Repeat the last three points, now for port (41).
8. Operate the parking brake; pressure should build up in the service line.




R 600126

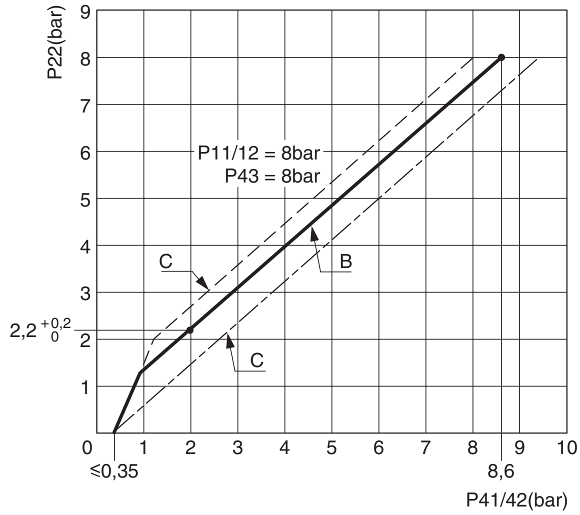
9. Operate the parking brake to the stop, and lock the lever; the service line should once again become pressureless.

10. Simulate a leak in the service line, and depress the brake pedal: within two seconds, the outflow of air from the leak should slow down considerably.



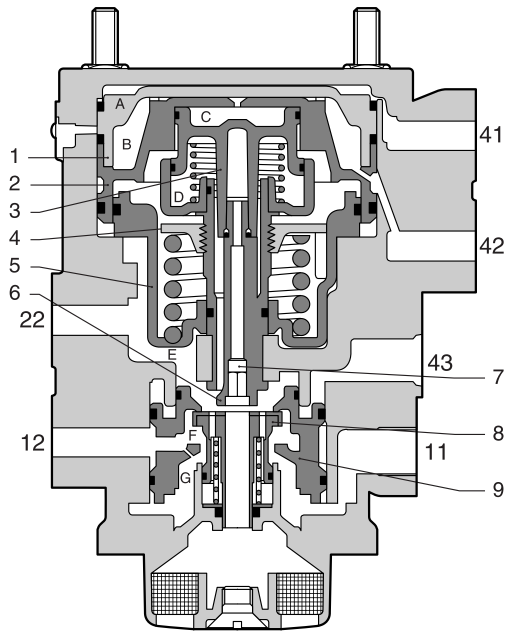
**KNORR design**

Explanation of graph
B. Curve of intact circuit 1 and circuit 2, or failure in circuit 2
C. Area for braking-pressure advance adjustment.



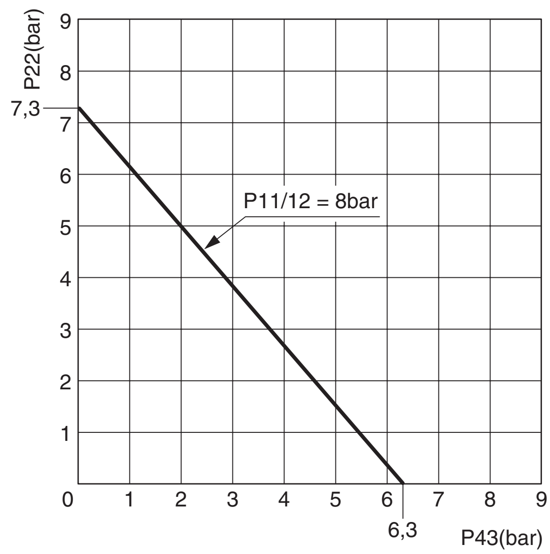
R600333

1. Ensure there is sufficient system pressure.
2. Check whether air is escaping via the exhaust.
3. Depress the brake pedal, and again check for leaks.
4. Disconnect the line at port (42), and plug off this line.
5. Depress the brake pedal, and check for pressure build-up in the service line.
6. Reconnect the line.
7. Repeat the last three points, now for port (41).
8. Operate the parking brake; pressure should build up in the service line.



R600340

9. Operate the parking brake to the stop, and lock the lever; the service line should once again become pressureless.
10. Simulate a leak in the service line, and depress the brake pedal: within two seconds, the outflow of air from the leak should slow down considerably.




R600332

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## 1.13 INSPECTION AND ADJUSTMENT, BRAKING-PRESSURE ADVANCE IN (SEMI-)TRAILER REACTION VALVE

**WABCO design**

**Inspection braking-pressure advance in (semi-)trailer reaction valve**

**Note:**
The pressure ratio between prime mover and (semi-)trailer is 10 : 8 (10 bar system pressure for prime mover and 8 bar system pressure for (semi-)trailer).

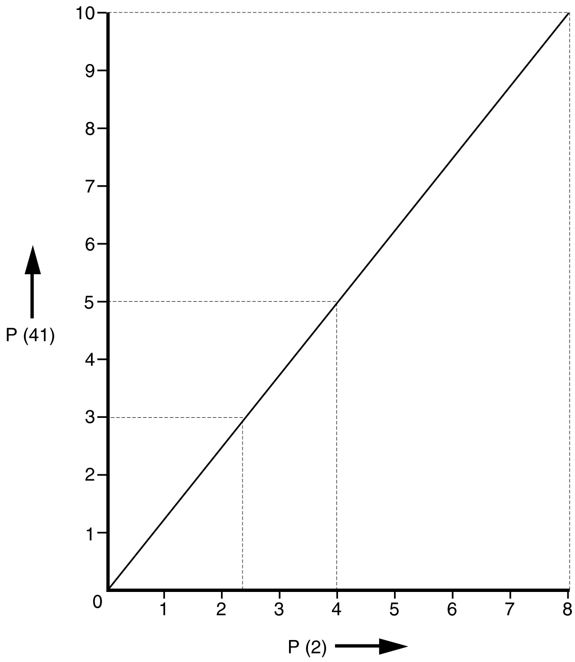
This means that if no braking-pressure advance is applied, at an input pressure of 3 bar at port (41), the output pressure at port (2) is equal to (3 x 8) : 10 = 2.4 bar If a braking-pressure advance of 0.6 bar is now applied, the output pressure at port (2) should be: 2.4 + 0.6 = 3.0 bar.

1. Connect a pressure gauge (1) to the test connection for the load-sensing valve and a pressure gauge (2) to the service coupling head.
2. Depress the brake pedal until the input pressure (measured at pressure gauge 1) is 3 bar.
   The reading at pressure gauge (2) should now be 3.0 bar. This equals 0.6 bar braking-pressure advance.
3. If the braking performance of the (semi-)trailer (provided it is in good condition) is poorer than that of the tractor, the braking-pressure advance may be increased by several tenths of a bar.

**Braking-pressure advance adjustment in (semi-)trailer reaction valve**

**Note:**
The pressure at which the readings are taken must always be built up. If the specified pressure is exceeded, bleed off some air, and once again let the air pressure build up.

1. Slacken the 4 screws of the exhaust (3) and remove the silencer.
2. Using a philips-head screw driver, turn adjusting screw (9) counter-clockwise.

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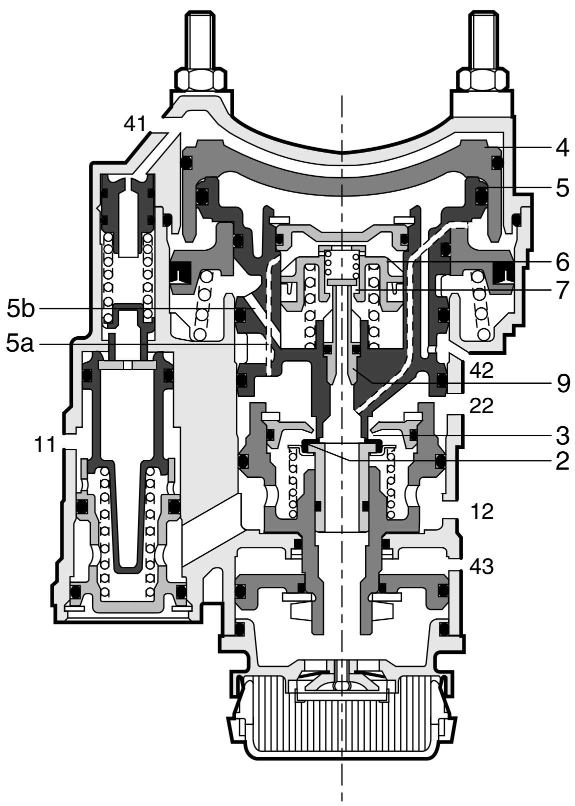


R600123

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3. Measure the braking-pressure advance again.
   Repeat these actions until the required advance is reached.

4. Reconnect the exhaust.

**KNORR design**

**Inspection braking-pressure advance in (semi-)trailer reaction valve**

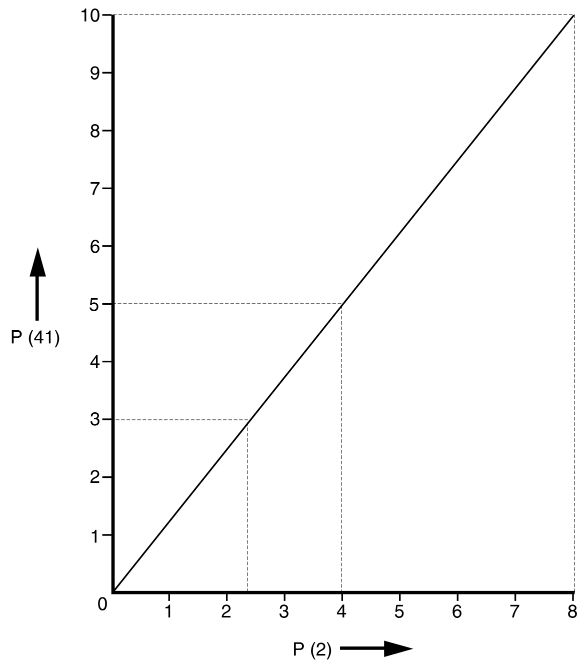
**Note:**
The pressure ratio between prime mover and (semi-)trailer is 10 : 8 (10 bar system pressure for prime mover and 8 bar system pressure for (semi-)trailer).

This means that if no braking-pressure advance is applied, at an input pressure of 3 bar at port (41), the output pressure at port (2) is equal to (3 x 8) : 10 = 2.4 bar If a braking-pressure advance of 0.6 bar is now applied, the output pressure at port (2) should be:
2.4 + 0.6 = 3.0 bar.

1. Connect a pressure gauge (1) to the test connection for the load-sensing valve and a pressure gauge (2) to the service coupling head.

2. Depress the brake pedal until the input pressure (measured at pressure gauge 1) is 3 bar. The reading at pressure gauge (2) should now be 3.0 bar. This equals 0.6 bar braking-pressure advance.

3. If the braking performance of the (semi-)trailer (provided it is in good condition) is poorer than that of the tractor, the braking-pressure advance may be increased by several tenths of a bar.

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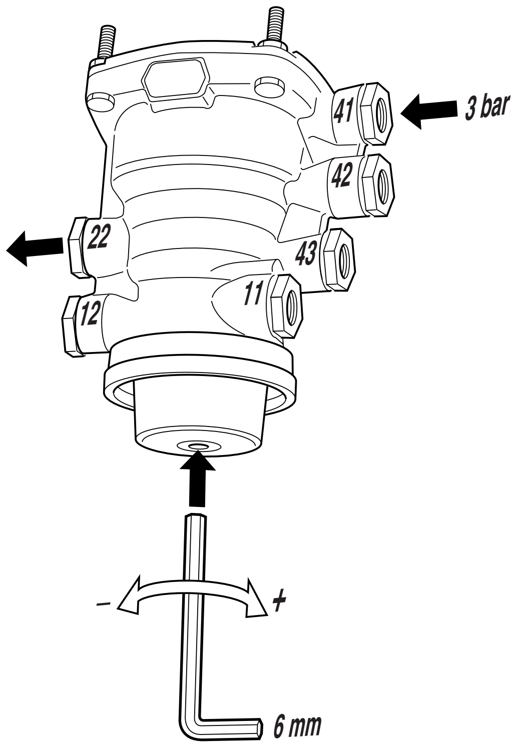
**Braking-pressure advance adjustment in (semi-)trailer reaction valve**

**Note:**
The pressure at which the readings are taken must always be built up. If the specified pressure is exceeded, bleed off some air, and once again let the air pressure build up.

1. Remove the sealing plug.
2. **Note:**
   When adjusting the braking-pressure advance, make sure the valve is not operated.

   Rotate the central section (7) counter-clockwise or clockwise to decrease or increase the braking-pressure advance, by using a hexagonal socket-screw spanner (6 mm).
3. Measure the braking-pressure advance again.
4. Repeat these actions until the required advance is reached.
5. Re-fit the sealing plug.




R600341

## 1.14 INSPECTION PARKING-BRAKE VALVE

1. Ensure there is sufficient system pressure.
2. Using T-pieces, connect two pressure gauges to port (43) of the relay emergency valve, and port (42) of the double check/relay valve.

**Checking the driving position**

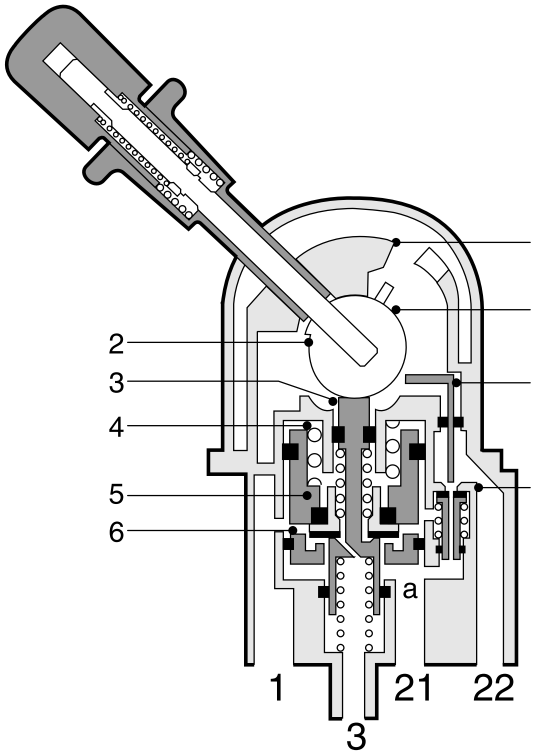
3. Set the parking brake valve in the driving position. Both pressure gauges should read approx. 8 bar. This is the limiting pressure of the pressure limiting valve.

**Checking the emergency brake**

4. Move the parking-brake valve slowly towards the parking position. Both pressure gauges should now gradually fall to 0 bar (with the exception of the first 10° angular rotation, see graph).

**Checking the parking position**

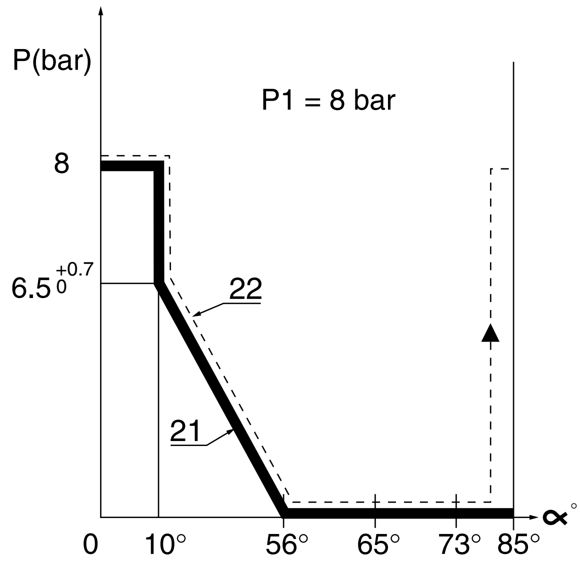
5. In the parking position, both pressure gauges should read 0 bar.




R600092

**Checking the test position**

6. Place the parking-brake valve in the parking position, depress the handle, and move it to the test position. The pressure gauge on port (43 )of the (semi-)trailer reaction valve should read approx. 8 bar. The pressure gauge on port (42) of the double check/relay valve should read 0 bar.

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## 1.15 INSPECTION FOUR-CIRCUIT SAFETY VALVE

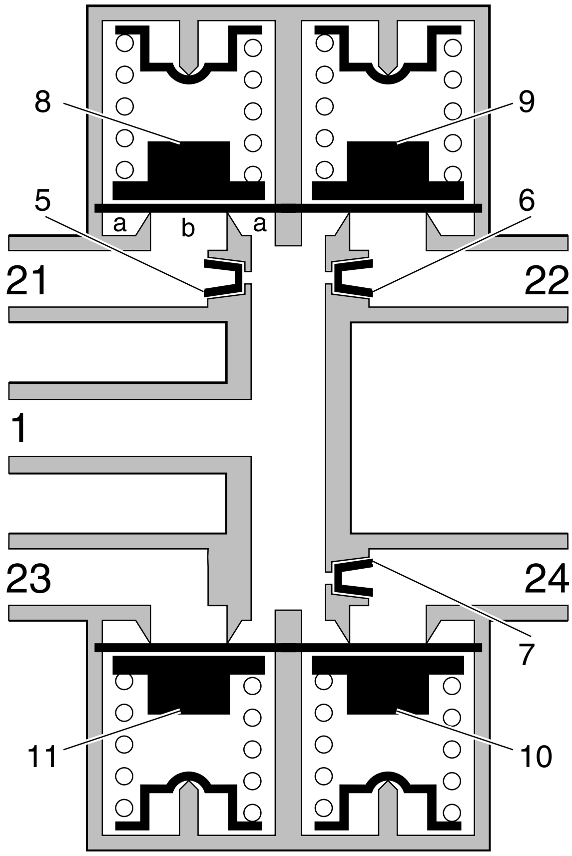
**Version without circuit 3 reverse flow function**

**Inspecting circuits 1, 2 and 4**

1. Lower the pressure in the system to 0 bar.
2. Connect pressure gauges to circuits 2 and 4.
3. Simulate a fault in circuit 1 of the service brake circuit (by disconnecting the line from the four-circuit safety valve).
4. Pressurise the other circuits using the compressor (engine speed approx. 1000 rpm).
5. The pressure in the intact circuits should now increase to at least 6.5 bar (to be read off the gauges).
6. Switch off the engine. The pressure in the intact circuits should not fall below the specified closing pressure, see main group “Technical data”.
7. Check the other circuits in the same way.

**Checking circuit 3**

1. Lower the pressure in the system to 0 bar.
2. Connect pressure gauges to circuits 1 and 3.
3. Pressurise the circuits using the compressor (engine speed approx. 1000 rpm).
4. At a pressure of 7.5 bar in circuit 1, the pressure gauge on circuit 3 should start to rise.
5. Switch off the engine and vent a circuit. The pressure in circuit 3 may not fall below the specified closing pressure, see main group “Technical data”.

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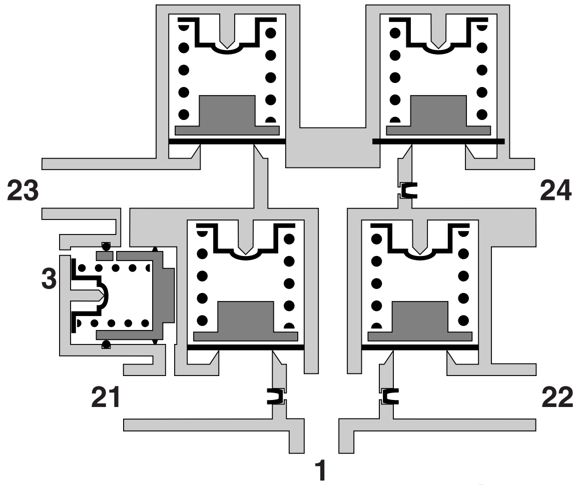
**Version with circuit 3 reverse flow function**




**Inspecting circuits 1, 2 and 4**
1. Lower the pressure in the system to 0 bar.
2. Connect pressure gauges to circuits 1 and 4.
3. Simulate a fault in circuit 2 of the service brake circuit (by disconnecting the line from the four-circuit safety valve).
4. Pressurise the other circuits using the compressor (engine speed approx. 1000 rpm).
5. The pressure in the intact circuits should now increase to at least 6.5 bar (to be read off the gauges).
6. Switch off the engine. The pressure in the intact circuits should not fall below the specified closing pressure, see main group “Technical data”.
7. Carry out similar checks with a fault in circuit 3, and then in circuit 4.

**Checking circuit 3**
1. Lower the pressure in the system to 0 bar.
2. Connect pressure gauges to circuits 1 and 3.
3. Pressurise the circuits using the compressor (engine speed approx. 1000 rpm).
4. At a pressure of 7.5 bar in circuit 1, the pressure gauge on circuit 3 should start to rise.
5. Switch off the engine and vent a circuit. The pressure in circuit 3 may not fall below the specified closing pressure, see main group “Technical data”.

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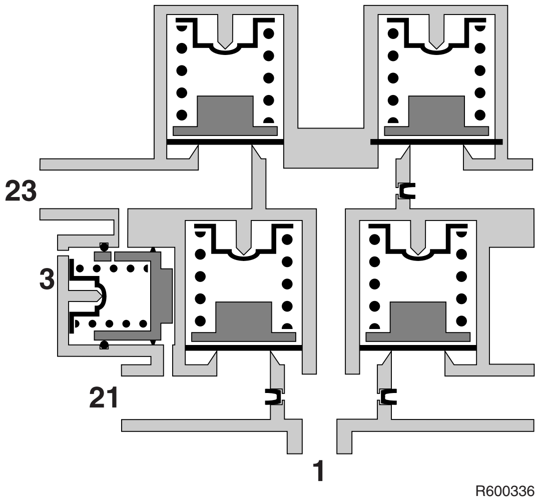
**Checking circuit 3 reverse flow function**

1. Connect pressure gauges to circuits 1 and 3.
2. Pressurise the circuits using the compressor (engine speed approx. 1000 rpm).
3. Switch off the engine and lower the pressure in circuit 1. When the pressure drops below 4 bar, circuit 3 will slowly be vented via the exhaust. The pressure gauge reading on circuit 3 will drop to 0 bar.



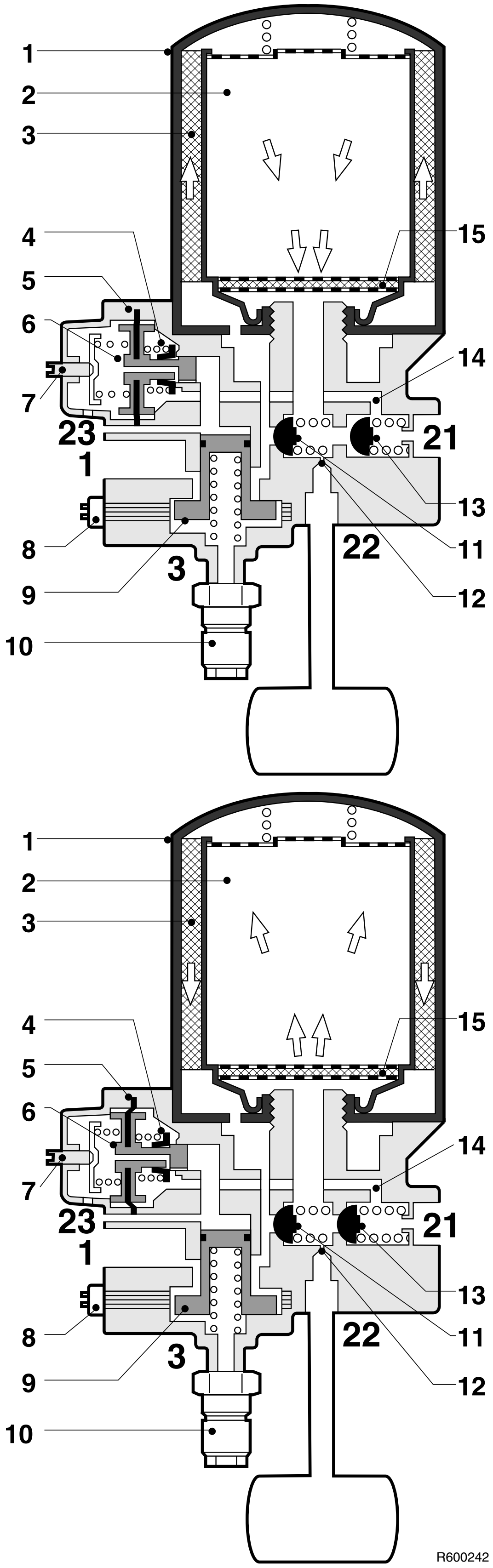
## 1.16 INSPECTION AND ADJUSTMENT, AIR DRYER

**BOSCH design**

**Adjusting the cut-out pressure (9.8 ± 0.2 bar)**
1. Adjust the cut-out pressure with adjusting screw (7).

**Checking the regenerative action of the air dryer**
1. Pressurise the compressed air braking system (pressure regulator should cut out).
2. Switch off the engine.
3. The regeneration air should escape via the exhaust port of the air dryer, for some time.



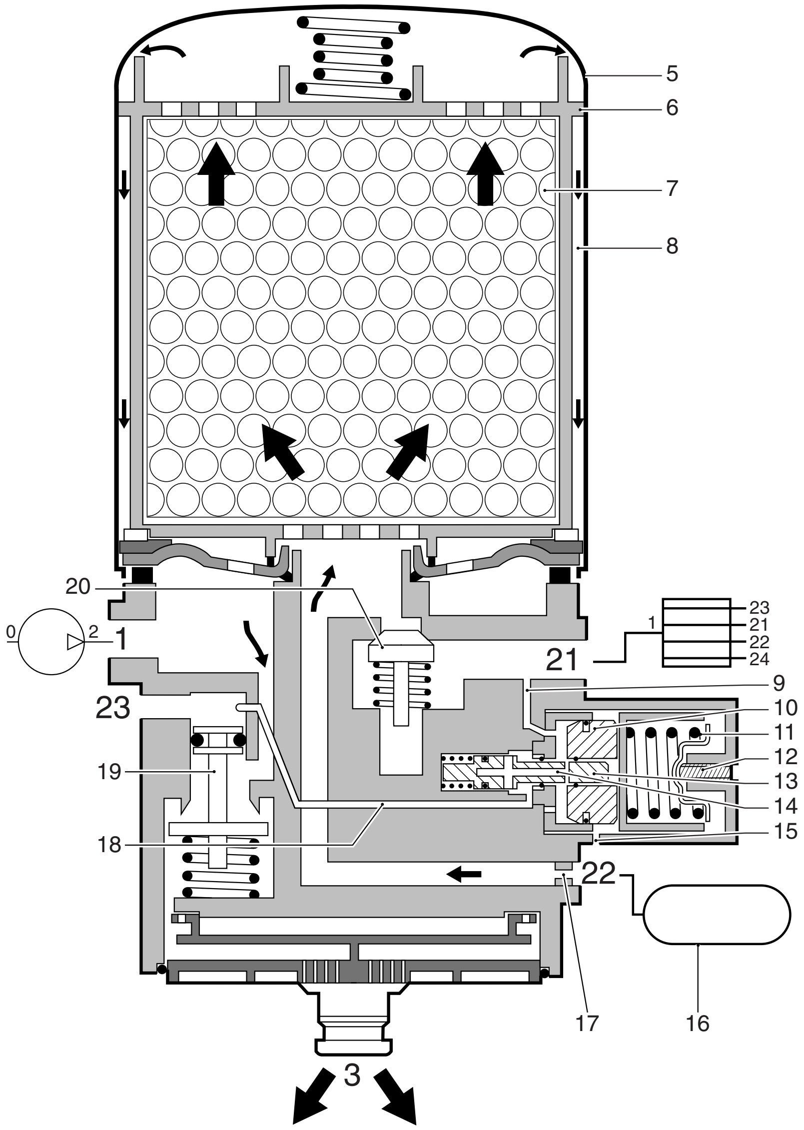


**KNORR design**

**Adjusting the cut-out pressure**
1. Adjust the cut-out pressure with adjusting screw (12). For the specified cut-out pressure, see the main group “Technical data”.

**Checking the regenerative action of the air dryer**
1. Pressurise the compressed air braking system (pressure regulator should cut out).

2. Switch off the engine. The regeneration air should escape via the exhaust port of the air dryer, for some time.

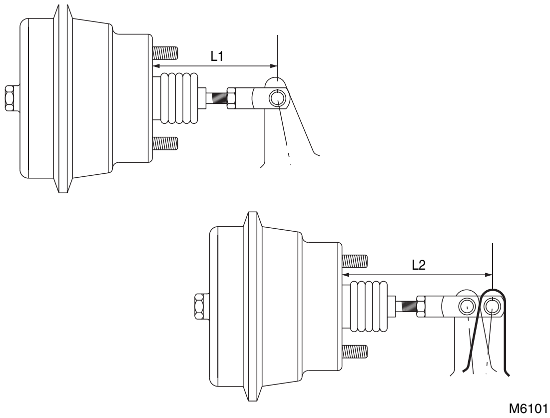



R600260

## 1.17 INSPECTION, AUTOMATIC SLACK ADJUSTER

**Inspection of slack adjuster stroke**

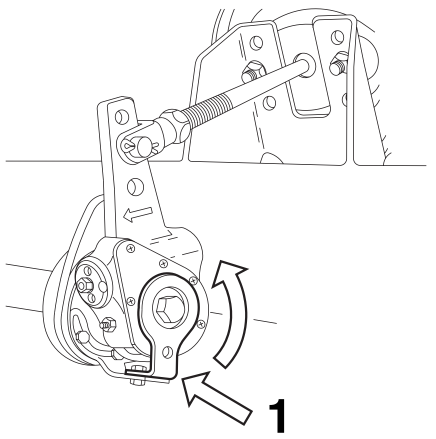
1. Measure the basic setting L1.
2. Measure the position when the brakes are applied, L2 (minimum brake system pressure 6 bar).
3. Calculate the slack adjuster stroke L3.
   L3 = L2 - L1  (L3 = 35 - 40 mm).
4. If the slack adjuster stroke differs considerably from the specified value, take the following action:
   - Check whether the control plate (1) is locked in relation to the fixed bracket.
   - If not, turn the control plate as far as possible (until the internal stop is felt) in the direction in which the slack adjuster is moved during braking.
   - Fix the control plate in **this** position, using the attachment nut on the fixed bracket.
   - Check the internal slip using a torque wrench.



M6101

**Checking the internal slip**

1. Make certain that there is sufficient pressure in the reservoirs (min. 6.5 bar).
2. Release the parking brake.
3. Turn the hexagonal adjustment screw counter-clockwise using a torque wrench.
4. If a tightening torque of 18 Nm is **not** reached, but the worm shaft turns at a **lower** torque, the slack adjuster should be replaced.



M6005

## 1.18 INSPECTION DRUM BRAKES

Due to the preservation applied, brake drums of new vehicles must be cleaned with a cleaning agent.

The brake drums must be lifted using a hoist. Because there is a danger of limbs getting trapped.

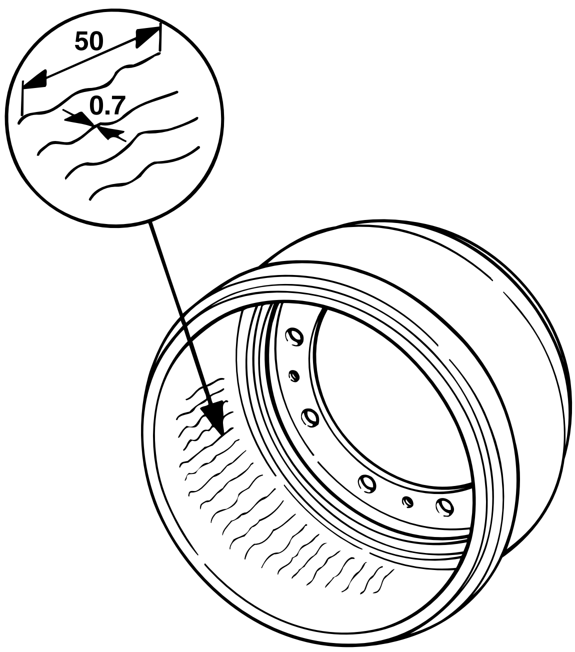
Always be careful when braking with new brake drums and brake linings.

A brake drum which is thermally overloaded will show heat cracks. These heat cracks will become larger and deeper the longer the drum is used. Thermal stress will increase the formation of cracks.

Thermal stress may be caused by:
- poor braking force distribution
- seized brakes
- jammed brake shafts or spring-brake cylinders
- insufficient clearance between brake lining and brake drum in the event of new brake linings
- continuous application of the service brake, whilst driving.

Cracks are permissible to a maximum width of approx. 0.7 mm and a length of 50 mm. It should be possible to remove these cracks when the brake drum is reconditioned.
If the cracks cannot be completely removed following the reconditioning of the brake drums, accelerated brake liner wear must be expected.
If the brakes are once again thermally overloaded, the edges of the cracks will rise again, which will result in premature wear of the lining, due to abrasion.

**Note:**
Brake drums with cracks exceeding a width of 0.7 mm and a length of 50 mm may not be reused.




R 6 00 128

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A brake drum may also show burns and hardened spots also caused by high temperatures.
Where the structure of the brake drum material has changed, these burns must be removed by reconditioning and grinding.
If the spots cannot be removed, braking will always be accompanied by vibrations.
The brake linings will always first show rough wear grooves at these spots.

A brake drum may be used until the internal diameter has reached the maximum value.

As soon as this diameter is exceeded, the brake drum must be replaced.
For the dimensions and tolerance limits for reconditioned brake drums, see the main group "Technical data".



**Reconditioning of brake drums**
If the turning tool comes into contact with large or deep hardened spots, listen for creaking noises.
If such creaking noises are heard, the brake drum must be ground in order to obtain a perfectly round wearing surface.
If the brake drum has been reconditioned, fit an oversize brake lining, and turn it on the lathe.


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## 1.19 INSPECTION BRAKE LININGS

In the case of separated brake linings, the words “remnokzijde” (brake cam side) and “draaipuntzijde” (pivot side) are marked on the side of the lining.
The brake lining with the words “remnokzijde” should be attached to the brake camshaft. The brake lining with the words “draaipuntzijde” should be attached to the pivoting end.

**Note:**
If these markings are not applied, fit the thin side of the lining to the pivoting end, and the thick side of the lining to the camshaft end.

**Note:**
Always fit the same type of brake linings to a vehicle.

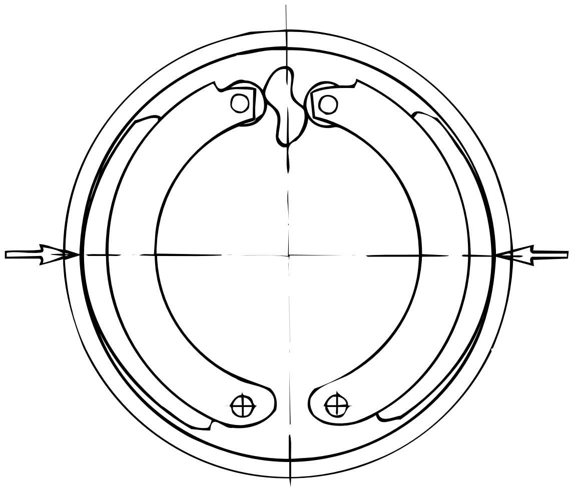
- When the brakes are applied, kinetic energy is converted into heat.
- The temperatures of the brake lining may become very high.
- A brake lining must be effective in a wide temperature range. This means that the friction coefficient should be independent of temperature as much as possible.
- The brake lining must also have a long service life.
- The brake lining must be unaffected by weather conditions, and should produce as little noise as possible.
- Excessive heat may cause changes to the wearing surface of the brake drum.

**Aspects of the brake lining (including the brake shoe) to be checked:**
- braking performance after running in
- glazing
- moisture absorption (oil absorption)
- lining wear
- heat cracks
- corrosion
- zwel

**Corrosion**
Brake shoes may exhibit considerable corrosion, as a result of excessive ageing and the action of moisture on the assembly face.

**Incorrect bearing surface**
The surface is no longer smooth. The lining no longer has a sufficient mounting surface at the rivet recess and ruptures during riveting. The lining could be released from the shoe and lifted. As a result, the clearance between lining and drum decreases or disappears completely.
Even when the brakes are not applied, the temperature of the brake increases, and as a result, heat cracks may occur in the bearing surface of the brake drum.

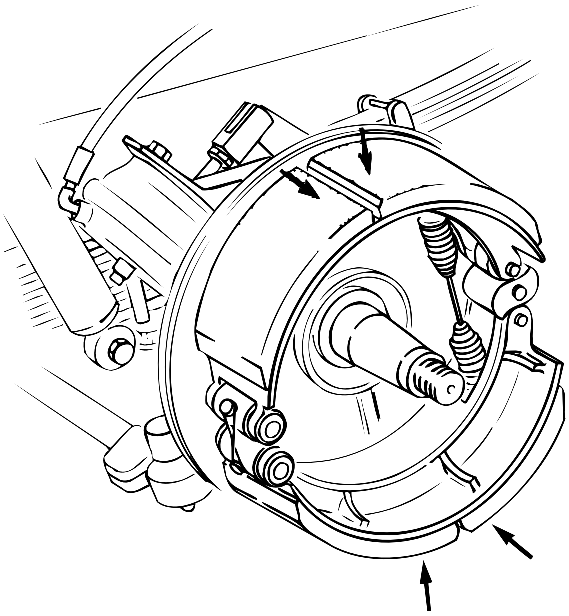
**Bearing pattern**
When turning the brake lining, the lining will bear on the radius of the drum with the entire brake surface. Such a bearing pattern guarantees the best possible breaking performance from the beginning. The turning of the brake lining may be carried out on a brake lining lathe, or with a special dummy back plate on a special lathe.
The bearing pattern of the brake lining can be improved by turning of the brake lining to a diameter which is max. 1.0 mm smaller than the drum diameter. So, in the case of a brake drum diameter of 420 mm, the brake lining should be turned to a max. diameter of 419 mm.



R 6 00 129

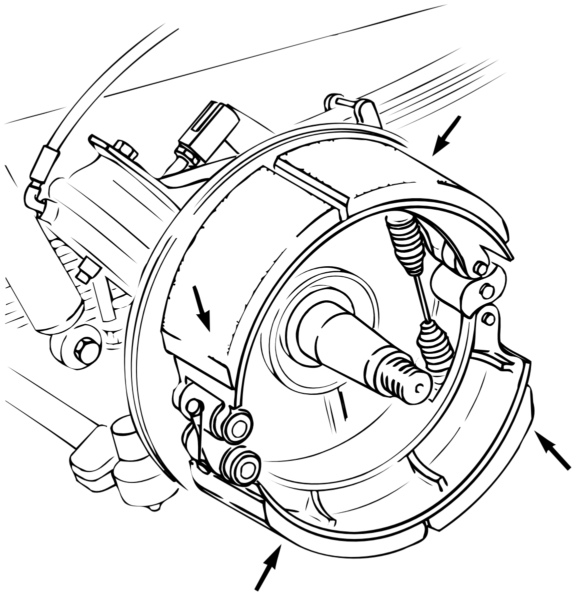
**Wheel brake with modified lining diameter (see drawing)**
The lining will bear on the centre of the lining length first, after which the bearing pattern is extended from the centre towards the ends. This will prevent an (unduly) heavy self-servo action during the running-in period.

The brake lining must be turned gradually, i.e. not too much lining material should be removed in one operation.



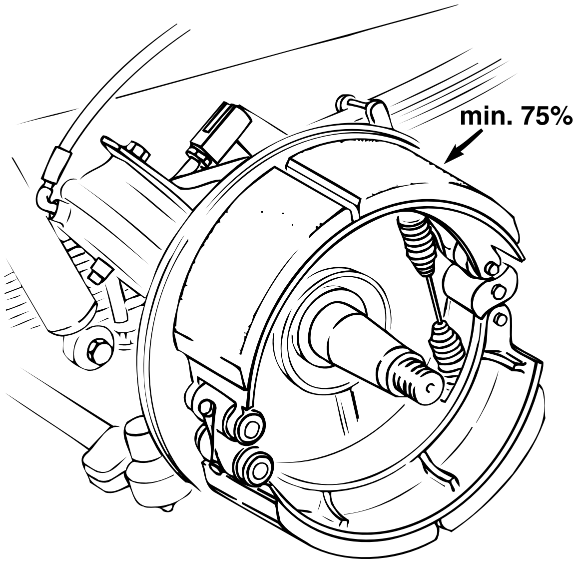
R 6 00 130

If this instruction is not followed, the turning tool will bend and be inclined to lift the leading brake shoe of the brake cam. The initial bearing pattern will then not be at its best.



R 6 00 131

It is not necessary to turn “clean” the entire surface. It is sufficient to touch 75% of the surface with the turning tool.




R 6 00 132

**A wheel brake lining with insufficient bearing surface**
The ends of the brake lining are still free. As a result, the load on the smaller brake lining surface will be considerably heavier at the same press-on force. As a result, the lining will be squeezed, the temperature will increase and there will be accelerated lining wear, until the braking surface is eventually correct.
In the case of reconditioned brake drums, it is recommended that a new lining should be turned to the radius of the brake drum after it has been fitted.

**Glazing of brake linings**
"Glazing" is the slow deterioration of the brake lining friction. This is the result of very slight braking. Assessment of the braking surface is very difficult.
Glazing only rarely occurs with modern linings. The wearing surface of the lining collects small particles of materials having lubricant properties. Generally, these particles are removed by braking hard a view times, or by turning the lining.
Thus a new wearing surface is created.

The stability of the coefficient of friction may vary considerably, depending on the quality of the lining.
It is therefore vital that genuine brake linings be used.

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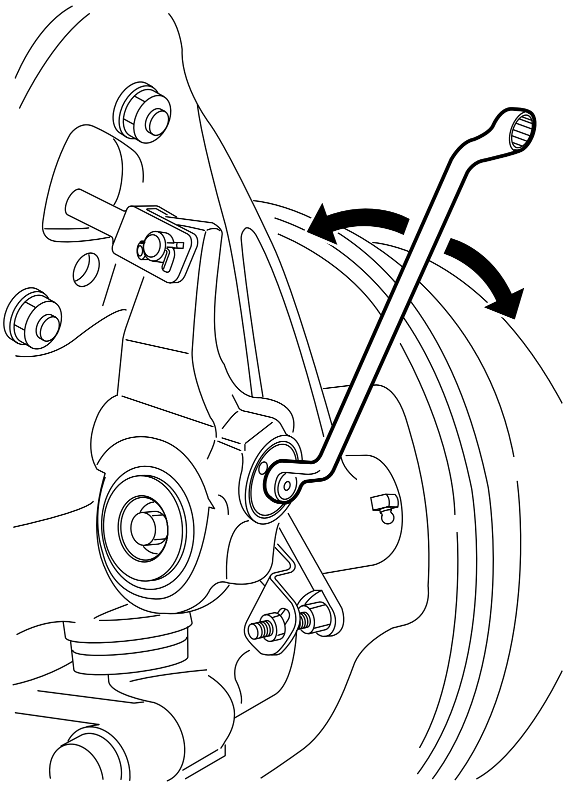
## 1.20 BRAKE ADJUSTMENT

1. Set the brakes by turning the adjusting hexagon-head bolt clockwise.
2. Turn the adjusting bolt until the brake lining is square against the brake drum.
3. Then turn the adjusting bolt back (90° - 120°) until the bake lining is free from the brake drum.



R600253

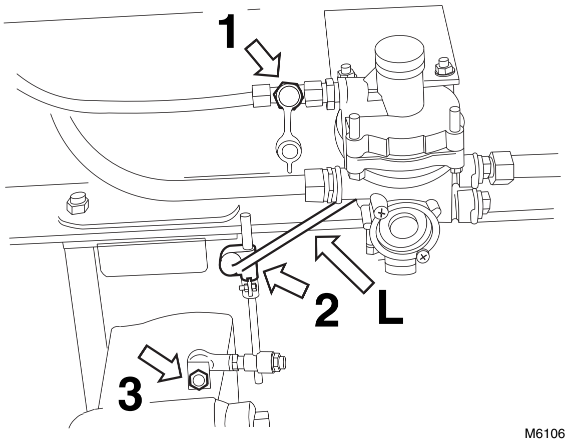
## 1.21 INSPECTION FOR AIR-TIGHTNESS

**Air-tightness**
If the brake system of a vehicle has been charged to the maximum pressure, it should generally be possible to drive the vehicle away after a period of 16 hours of uninterrupted standstill, without having to first charge the brake system to sufficient operating pressure. This comes down to a maximum pressure drop of approx. 0.4 bar per hour at a normal system pressure.
**Note:**
Auxiliary consumers and accessories must only be connected to circuit 4.

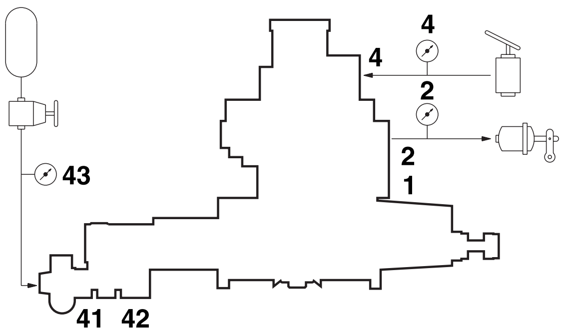
## 1.22 INSPECTION OF BALANCING FRONT AND REAR AXLES OF THE TRACTOR

Depending on the superstructure of the vehicle, the lining wear between the various axles will vary. In case of an inadvertent superstructure, a difference of **100%** is admissible.
If the difference exceeds this percentage, act as follows:

First check the correct setting of the load-sensing valve. If required, follow the adjusting procedure. Always use reliable gauges. Check this reliability by repeating the first measurement, switching both gauges.



M6106



M6102

**Note:**
Automatic load-sensing valves as applied at leaf-spring suspension cannot be adjusted correctly for an unloaded vehicle leaving the factory. Because of the “swelling” of the springs, this should always be checked and/or corrected during the first service inspection.

Next, carry out a measurement as described below.

- Connect pressure gauges to the rear and front axle brake chambers.
- Set the automatic load-sensing valve at **maximum** (lever at maximum upward position or, in case of air suspension, min. 6 bar at simulation connection No. 43).

Now measure the front-axle braking pressures at the reference values in the following table (remember the reliability of the gauges).

| | | | | | | |
|---|---|---|---|---|---|---|
| **Rear axle braking pressure** | **0.5** | **0.8** | **1.0** | **1.5** | **2.0** | **3.0** |
| **Front-axle braking pressure** | | | | | | |
| First measurement | ... | ... | ... | ... | ... | ... |
| Second measurement | ... | ... | ... | ... | ... | ... |


DAF
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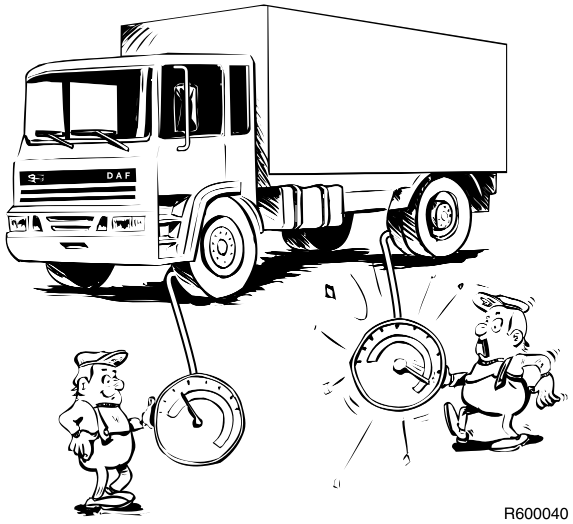
The braking pressures measured should be equal at 1 bar. This in view of hysteresis, i.e. tolerances of the various valves. At a pressure of 1 bar these tolerances are almost equal. In case of deviations, three different situations can arise:

- The rear-axle pressure exceeds the front-axle pressure.
- The front-axle pressure exceeds the rear-axle pressure.
- Complaints about braking performance in spite of equal braking pressures.

**The rear-axle pressure exceeds the front-axle pressure**
If the differential pressure is considerable (0.35 bar or more), this will cause increased lining wear on the rear axle.
Furthermore, if the vehicle is not fitted with ABS, there is a danger of the rear wheels blocking too soon causing the rear axle to skid outwards. On vehicle combinations, this may result in jack-knifing.




R600040

Possible solutions are:
- Using the setting tolerances of the automatic load-sensing valve (± 0.2 bar at the braking pressure and, in case of air suspension, + 0.2 bar at the bellows pressure) to reduce the rear-axle pressure, thus improving the front/rear axle balancing
- If this does not give sufficient improvement, the rear-axle braking pressure may be reduced by fitting check valve DAF no. 0291686 in port (4) of the automatic load-sensing valve (see drawing).
- If necessary, the check action of this valve may be reduced by removing one or more rings from the valve, or by shortening the spring inside the valve.

**Note:**
After a braking-pressure adjustment has been made, the braking pressure of the axles must be checked again (see the previous page). Check setting(s) and wear pattern during the next service inspection.

4

**The front-axle pressure exceeds the rear-axle pressure**
If the differential pressure is considerable (0.2 bar or more), this will cause increased lining wear on the front axle.
Possible solutions are:

- On 10-bar systems, the factory-fitted relay valve (DAF no. 1333733) (W 973 011 008 0) in the front axle circuit can be replaced by a version with a spring under the regulating piston (DAF no. 1340470) (W 973 011 009 0), reducing front-axle braking pressure by 0.5 bar (see figure).

R600041

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| Type | Empty/load relay valve (with increase of control pressure) | Maximum reduction ratio |
|---|---|---|
| FA 95*XF* | (W 973 011 109 0)<br>DAF no. 1340471 | 1:1.5 |
| FAC 95*XF* | (W 973 011 110 0)<br>DAF no. 1350673 | 1:2.7 |
| FAR/FAS 95*XF* | (W 973 011 109 0)<br>DAF no. 1340471 | 1:1.5 |
| FAT 95*XF*<br>with 1355T | (W 973 011 109 0)<br>DAF no. 1340471 | 1:1.5 |
| FAD 95*XF*<br>with 1355T | (W 973 011 110 0)<br>DAF no. 1350673 | 1:2.7 |

If desired, the idle relay valve of vehicles not yet equipped with the idle relay valve with increase of control pressure can be adapted. The control pressure can be increased by installing a spring (DAF no. 1342405) directly below the regulating piston of the idle relay valve.

- Less rear-axle braking can also be achieved by means of fitting an extra return spring between the brake shoes.


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**Complaints about braking performance in spite of equal braking pressure at front and rear**

The measurements recommended above are static measurements, i.e. measurements made while the vehicle is stationary. Application of the brakes while the vehicle is being driven (dynamic conditions), increases the load on the front axle and decreases the load on the rear axle. Depending on the type of vehicle (for example, a truck with semi-trailer or a tractor with trailer) and as a consequence of special operating conditions or a special superstructure, this nodding effect may be reinforced. This means that complaints may persist even though the results of the static measurements are satisfactory.

In such cases, the balance between front axle and rear axle should be adjusted in accordance with the instructions given above, taking the brake lining wear into account.

R600038

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# 2. REMOVAL AND INSTALLATION

## 2.1 REMOVAL AND INSTALLATION, LINES

When lines are fitted close together or close to other parts of the vehicle, they should be protected against chafing. This can be done by releasing one or more line couplings and then retorquing them in a slightly different position. If this is not possible, the lines can be secured with special plastic pipe clips or cable ties.

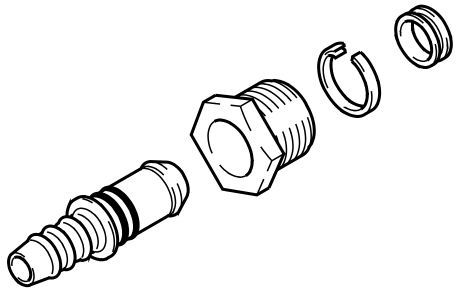
## 2.2 REMOVAL AND INSTALLATION, BRAKE-LINE CONNECTIONS

### QUICK-RELEASE COUPLINGS

**VOSS 230 version**

The VOSS 230 quick-release coupling consists of four parts, i.e.:
- plug (male) with hose adapter
- socket (female)
- circlip
- ring

The plug (male) has a black and a red O-ring. The black O-ring prevents air from escaping and the red O-ring prevents dirt from entering. The red O-ring also serves to indicate whether the plug has been fitted correctly.



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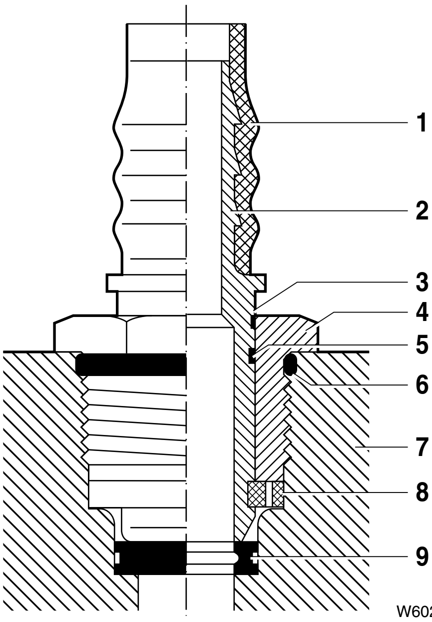



W602005

1. Plastic line
2. Plug (male)
3. Red O-ring
4. Socket (female)
5. O ring
6. O ring
7. Valve
8. Circlip
9. Ring

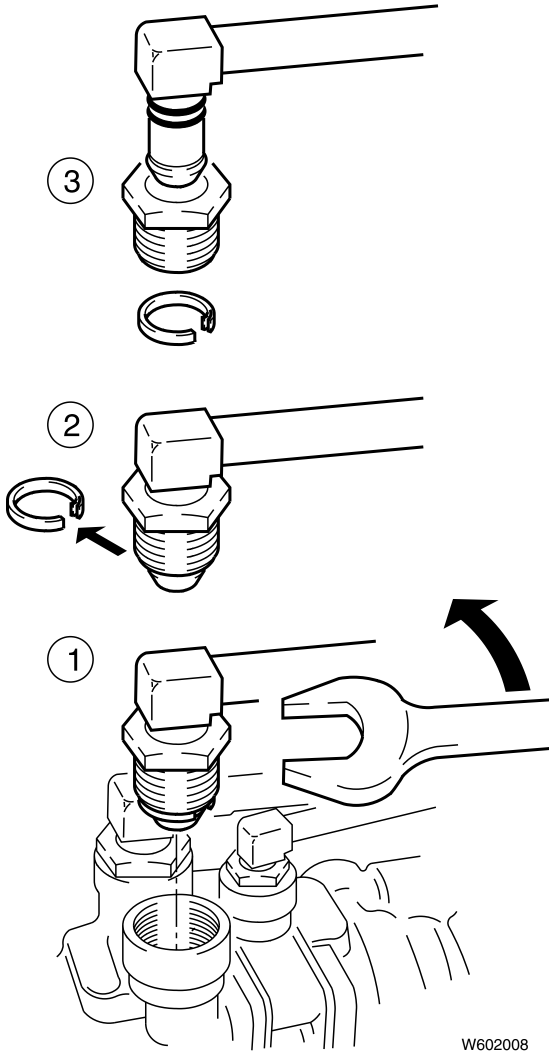
**Removing the line from a coupling**
1. Cut the line just in front of the hose adapter.

2. Remove the remainder of the line using heat or the “cutting point” of an soldering iron.

**Removing a complete quick-release coupling from a valve**
1. First of all ensure that the port concerned is pressureless.

2. Loosen the socket using an open-end spanner.

**Always replace the plastic circlip after removing a VOSS 230 coupling from the braking system.**

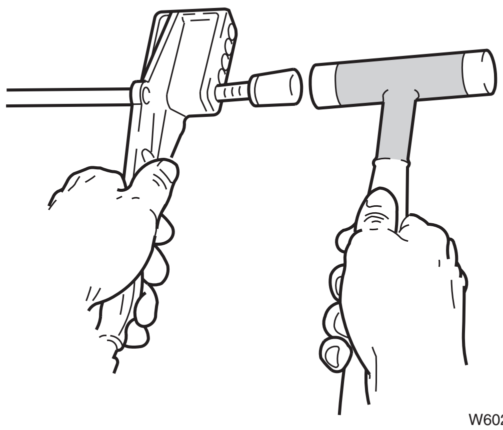


W602008

**Installing the plastic line to the hose adapter**
- The plastic line must not be heated.
- The hose adapter must be absolutely free of damage. Damaged pipe connectors are likely to leak.
- The hose adapter must be clean and free from grease.

When installing a quick-release coupling, use a gripping device and a plastic mallet.
Hold the line with the gripping device. The coupling can now easily be fitted in the line by tapping it with a plastic mallet.

**Note:**
All plugs (males) are supplied with a protective plastic cover. This cover prevents them from getting damaged when the pipe is being connected.


W602009

**Installing a VOSS 230 coupling**

**Note:**
Before the O-rings are fitted they must be greased with brake grease (DAF no. 1250185).

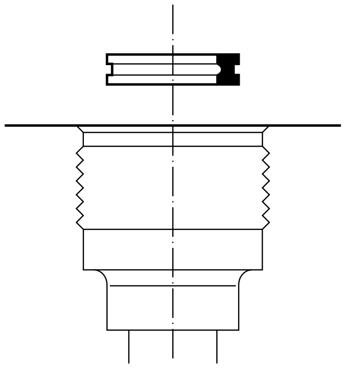
1. Now attach the sleeve nut, the locking clip and the circlip at the end of the correct tool (DAF no. 1310404).
2. Now tighten the assembly by hand and remove the tool.
3. Tighten the socket to the specified tightening torque, see main group "Technical data".
4. Remove the protective cover from the plug (male).
5. Push the plug into the socket until the circlip engages in the groove of the plug.
   When pushing in the plug it should be kept parallel to the socket to prevent the circlip from being damaged.

**Note:**
Never tapping the plug home using a tool, e.g. when the line is (too) short.
Having inserted the plug, the red dust ring on the plug should no longer be visible.

Protect the assembled plug against powerful bumps.

6. Put the special tool (DAF no. 1240101) between the plug and the sleeve nut. Apply a little force (approx. 30 N), to check the locking of the connection.

**Note:**
If the connection has not been properly locked by the locking clip, it could come loose if pressure is applied. This could cause unsafe situations in traffic.



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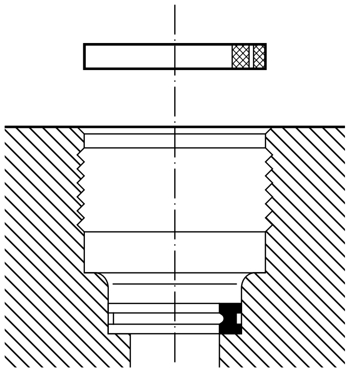

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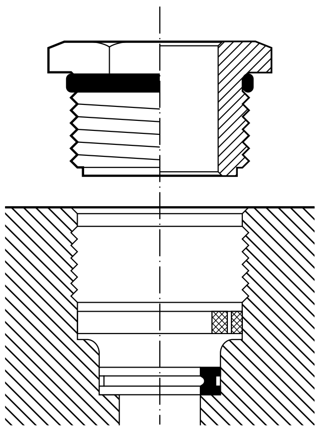

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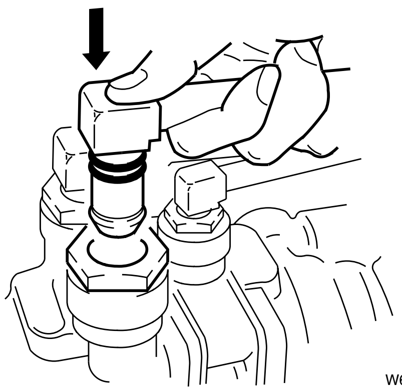


W602006

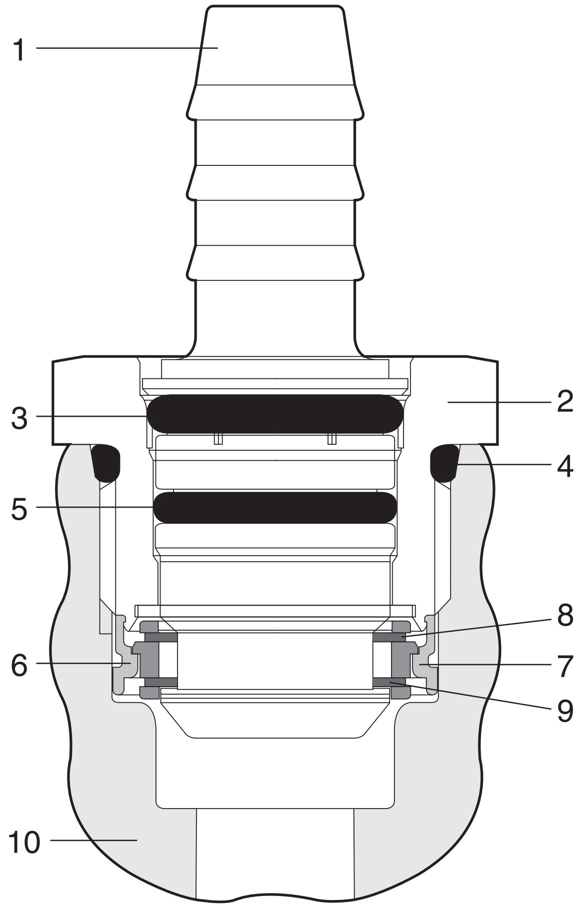
**VOSS 232 version**

The VOSS 232 quick-release coupling consists of two parts, i.e.:
- plug with hose adapter
- socket

The plug is fitted with two O-rings The upper O-ring ensures pre-loading and prevents dirt from entering. Like the O-ring, the lower O-ring provides sealing between the socket and the valve.

The socket is fitted with a retaining ring with two circlips This retaining ring with circlips is held in place by a sleeve.

1. Plug
2. Socket
3. O-ring (Pre-load and dirt protection)
4. O-ring (seal valve-socket)
5. O-ring (seal plug-socket)
6. Sleeve
7. Retaining ring
8. Circlip
9. Circlip
10. Valve




R600365

**Removing the line from a coupling**

**Be sure to depressurise the relevant port before removing any lines and/or quick-release couplings.**

1. Cut the line just in front of the hose adapter.
2. **Note:**
   Do not use any sharp objects to remove the remainder of the line This in order to avoid damaging the hose adapter. Damaged hose adapters are likely to leak.

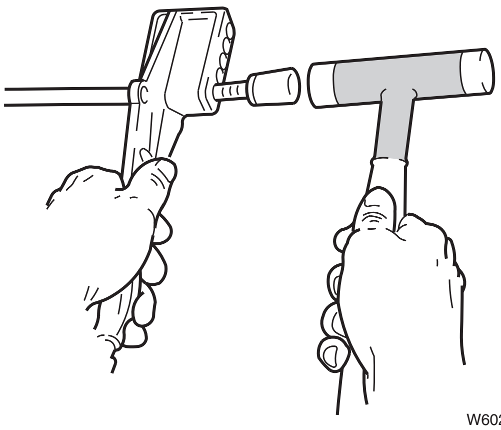
   Remove the remainder of the line using heat or the “cutting point” of a soldering iron.

4

**Connecting a line to a coupling**
- The line must not be heated.
- The line must be cut at a right angle and must not show any burrs.
- The hose adapter must be absolutely free of damage. If the hose adapter is damaged, the hose adapter and socket must be replaced.
- The hose adapter must be clean and free from grease.

**Note:**
All plugs (males) are supplied with a protective plastic cover. This cover prevents them from getting damaged when the pipe is being connected.

Use the special tool (DAF no. 0694829) and a plastic mallet to fit the line to the hose adapter.



W602009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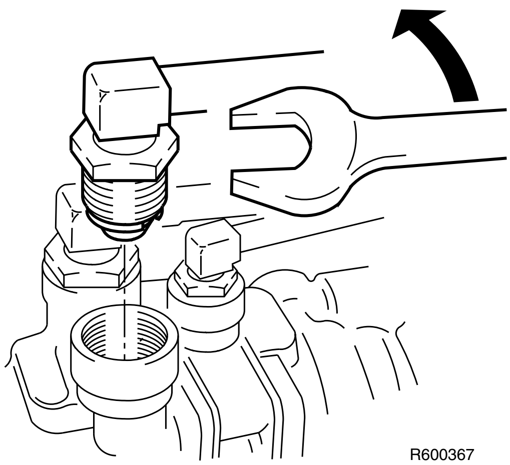
**Removing a complete quick-release coupling from a valve**

**Be sure to depressurise the relevant port before removing any lines and/or quick-release couplings.**

1. Loosen the socket using an open-end spanner.
2. Remove the socket and the hose adapter as a whole from the valve.

**Installing a complete quick-release coupling in a valve**
1. Check the bore hole for dirt and clean the bore hole if necessary.
2. **Note:**
   If the plug is not removed from the socket, the entire quick-release coupling (plug and socket) can be reinstalled as a whole. The socket does **not** have to be replaced.

   Grease the O-ring with brake grease (DAF no. 1250185).
3. Tighten the socket to the specified tightening torque, see main group "Technical data".


R600367

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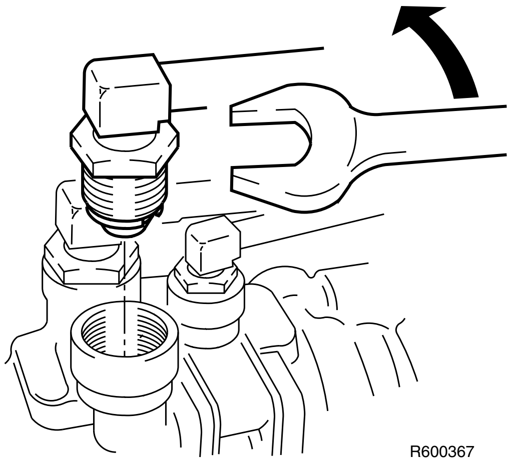
**Removing the plug from the socket**

1. Remove the entire quick-release coupling from the valve.



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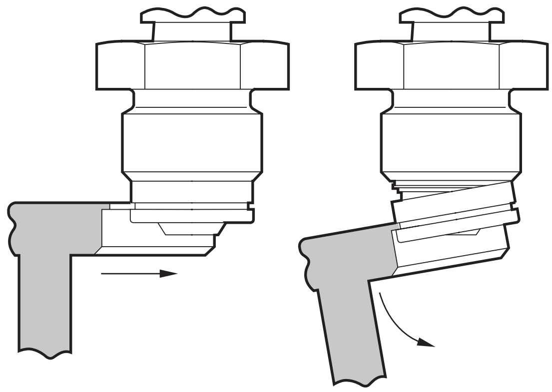
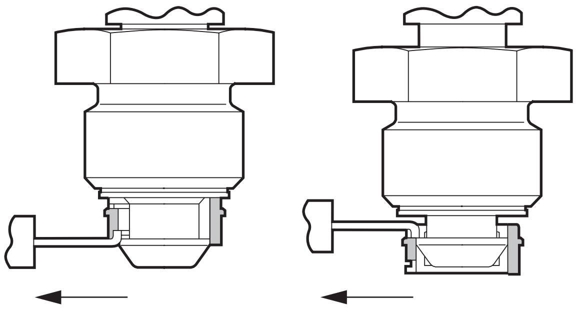
**Note:**
Make sure not to damage the plug while removing sleeve, circlips and retaining ring.

2. Remove the sleeve using the special tool (DAF no. 1329459).



R600368

3. Remove the retaining ring and the two circlips using the special tool (DAF no. 1329549).



R600369

4. Remove the plug from the socket

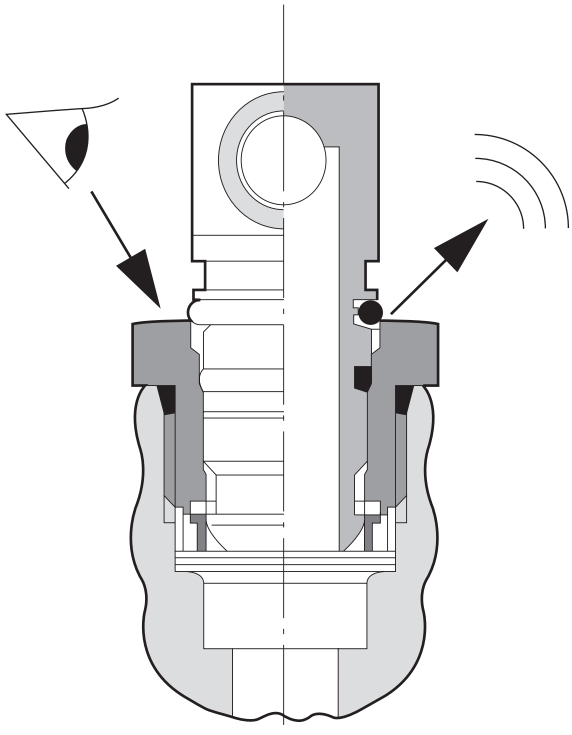
**Installing the plug in the socket**

1. Check the bore hole for dirt and clean the bore hole if necessary.

**If the plug is removed from the socket, the socket must always be replaced. This is supplied complete with retaining rings, circlips and sleeve.**

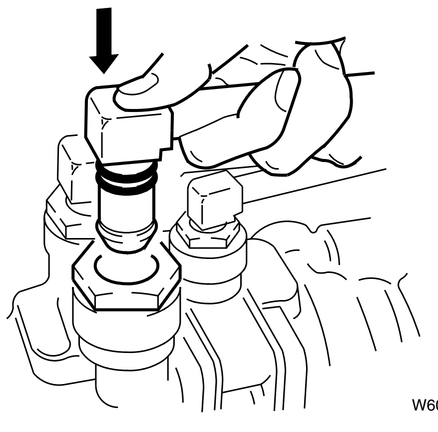
2. Install the new socket in the valve and tighten to the specified tightening torque, see main group “Technical data”.
3. Check the O-rings of the plug for damage and replace if necessary.

   **Note:**
   If the upper O-ring is still visible, the connection is not fully locked. Furthermore, air will audibly escape if pressure is present.



R600366

4. Install the plug in the socket and check if the connection is fully locked by pulling it directly upwards.



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## STANDARD COUPLINGS

**Removal of connection pieces with hose adapter**
Cut off the line close to the connection piece. Remove the section of line attached to the connection piece by heating, and not by cutting along its length. The latter could cause damage to the hose adapter and lead to leakage.

**Connecting the connection pieces with the hose adapter**

1. If a hose adapter has already been fitted on the end of the line, first cut off this section of line.
2. Ensure that the line is long enough. Replace as necessary.
3. On no account heat the pipe.
4. Use a special gripping device to clamp the pipe (DAF no. 0694829, for line diameters 6, 8, 10 and 12 mm).
5. Enter the line from the side with the smallest bore into the gripping device. On the other side of the grip, there is then sufficient room to permit expansion of the line.
6. The banjo union or nipple can now be tapped into the pipe with little difficulty using a plastic mallet.

**Leaky line connections**

- If a compression coupling is leaky, the union nut may only be turned a half turn tighter, and only once.
- If the leak has not been corrected, the connection must be removed and checked for damage or fouling.
- If necessary, replace the complete connection.
- Leaky banjo unions may not be made extra tight. Check for damage or fouling. If necessary, replace the connection.

## 2.3 REMOVAL AND INSTALLATION, BRAKE CHAMBER

**Removal of the brake chamber**

1. Release the brakes until there is no more tension on the yoke pin.
2. Remove the split pin and the yoke pin.
3. Remove the compressed air connection to the brake chamber.
4. Remove the attachment nuts from the brake chamber and remove the brake chamber.

**Installation of the brake chamber**

1. Install the brake chamber on the support and tighten the attachment nuts using the specified tightening torque, see main group "Technical data".
2. Insert the yoke pin and split pin.
3. Connect the air pipe.
4. Adjust the brakes, see chapter "Inspection and adjustment".

## 2.4 REMOVAL AND INSTALLATION, SPRING-BRAKE CYLINDER

**Removal of the spring-brake cylinder**
1. Chock the front and rear wheels.
2. Place the parking-brake valve in the "Driving" position. Using a 24 mm spanner, screw out the release bolt in the spring-brake cylinder, as far as possible (turn counter-clockwise).
3. Place the parking-brake valve in the parking position and disconnect the two air pipes from the spring-brake cylinder.
4. Remove the pin from the yoke and the brake lever.
5. Remove the attachment nuts and spring washers, and remove the spring-brake cylinders from the bracket.

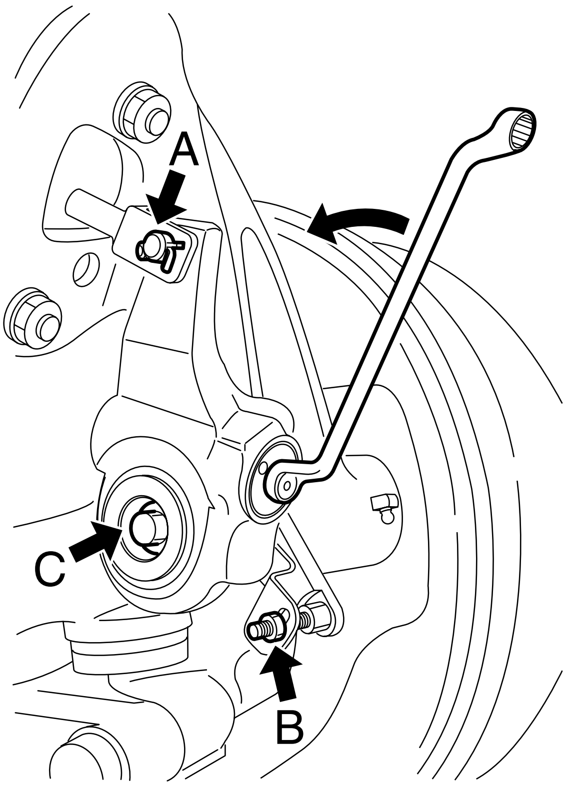


**Installation of the spring-cylinder assembly**
1. Mount the spring-brake cylinder on the bracket, and attach it with the spring washers and the nuts.
2. Pass the yoke pin through the yoke and the brake lever. The bracket should be flat (tolerance $< 0.4$ mm).
3. Connect the air pipes:
   - port 11 service brake,
   - port 12 parking brake.
4. Pressurise the air reservoirs, and place the parking-brake valve in the "Driving" position. Screw the release bolt completely in, and tighten it to a torque of 30 Nm.
5. Check for leaks. Check the adjustment of the brake shoe.
6. Check the brake adjustment, see chapter "Inspection and adjustment".

## 2.5 REMOVAL AND INSTALLATION, AUTOMATIC SLACK ADJUSTER

**Removal of the automatic slack adjuster**

1. Pressurise the system to at least 6.5 bar.
2. Support the axle, and place chocks in front of and behind the wheels of the other axle.
3. Set the parking brake to the “Driving” position.
4. Completely unscrew the spindle of the spring-brake cylinder.
5. Release the brakes completely, by turning the hexagonal adjusting bolt counter-clockwise. During this operation, clicks will be heard.
6. Remove the split pin and yoke pin (A).
7. Remove attachment nut (B) from the control plate.
8. Turn the hexagonal adjusting bolt counter-clockwise, so that the slack adjuster is released from the yoke.
9. Remove attachment bolt (C) with the washer and adjusting rings.
10. Remove the slack adjuster.

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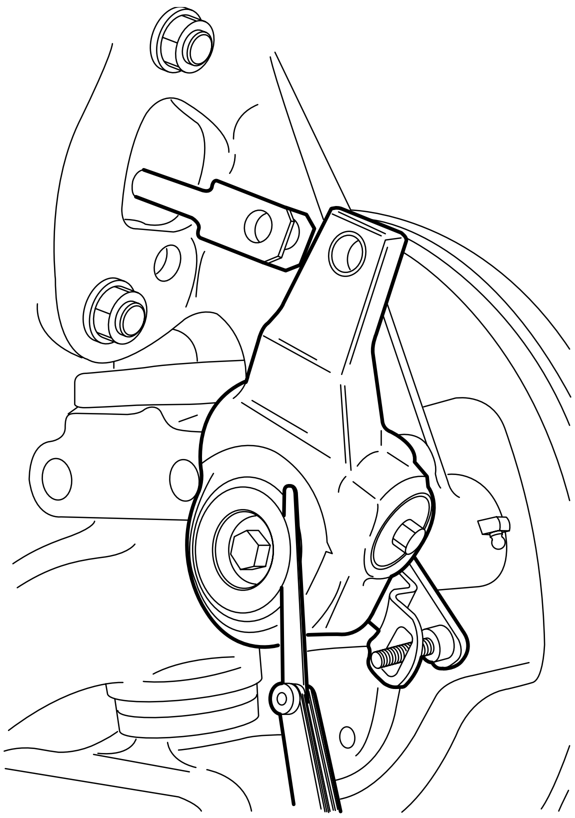
**Installation of the automatic slack adjuster**

**Note:**
It is possible that during the installation of the slack adjuster, the brake camshaft will be pushed inwards. This can be prevented by fitting a bolt in the brake camshaft, so that during installation of the slack adjuster the brake camshaft is held in position.

1. Check the splines of the brake camshaft for damage and wear, and regrease them.
2. Fit the spacer so that the slack adjuster is in line with the yoke.
3. Slide the slack adjuster onto the brake camshaft. Note the arrow indicating the direction of rotation during braking.
4. Turn the hexagonal adjusting bolt clockwise, until the hole of the slack adjuster and the yoke engage.
5. Insert the yoke pin with split pin.
6. Lubricate the attachment bolt with Loctite and fit the bolt with the sealing plate.
7. Now check the axial play of the slack adjuster. The axial play should be between 0.5 mm and 1 mm. Check that the control plate can still be moved.
8. Turn the control plate as far as possible (until the internal stop is felt) in the direction in which the slack adjuster is moved during braking. Fix the control plate in this position, via the attachment nut on the fixed bracket.
9. Adjust the brakes, see chapter "Inspection and adjustment".



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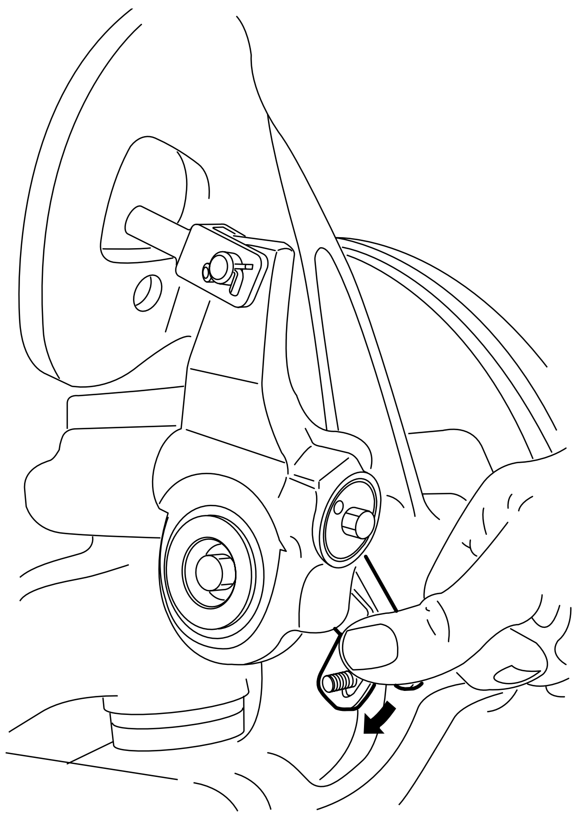

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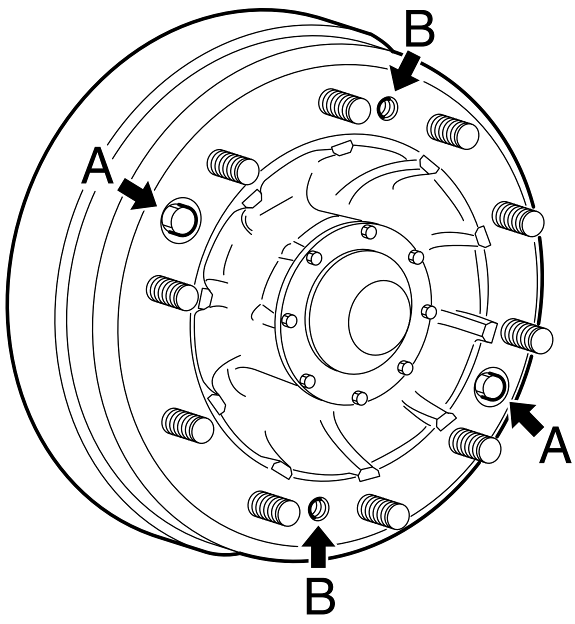
## 2.6 REMOVAL AND INSTALLATION, BRAKE SHOES

**Removal of the brake drum**

1. Pressurise the air system.
2. Place chocks in front of and behind the wheels of another axle on which you are not working.
3. Release the parking brake by the parking-brake valve or by removing the release bolts from the spring-brake cylinders.
4. Fully reset the automatic slack adjuster.
5. Unscrew the wheel nuts.
6. Jack up the axle in question.
7. Support the axle with stands.
8. Remove the wheels.
9. Remove the two attachment bolts (A) from the brake drum.
10. Insert two jack screws in the threaded holes (B).
11. **Note:**
    Never use airtools to tighten the jack screws.

    Evenly tighten the jack screws manually. This will put pressure on the brake drum. Use a copper punch to remove the brake drum from the hub. Use lifting gear to remove the brake drum.




R600144

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**Installation of the brake drum**

1. Clean the fitting edges of the brake drum and the wheel rim with a steel wire brush.
2. Grease the fitting edge lightly with grease. This grease layer should prevent the brake drum from “rusting tight”.
3. Remove the jack screws from the brake drum.
4. Fit the brake drum using the lifting gear.
5. Fit two wheel nuts opposite one another.
6. Tighten these wheel nuts evenly, until the brake drum is correctly on the hub.
7. Remove the wheel nuts.
8. Fit the attachment bolts for the brake drum.
9. Fit the wheels and wheel nuts and tighten the nuts evenly, in the correct order (see group 7).
10. Adjust the brakes, see chapter “Inspection and adjustment”.
11. Remove the jack and chocks from the rear wheels. If the spring-brake cylinder was mechanically released, the release bolt should be screwed back in and tightened to a torque of 30 - 35 Nm. The pressure in the spring-brake cylinder circuit should be at least 5 bar.




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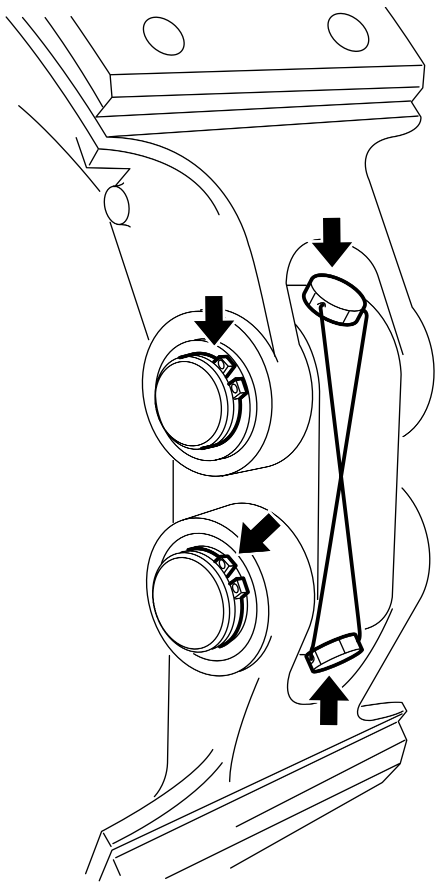
## 2.7 REMOVAL AND INSTALLATION, BRAKE SHOES

**Removal of the brake shoes**

1. Remove the brake drum.
2. Remove the lock rings, felt rings and retainer rings from the side of the brake shoe.
3. Remove the lock bolts or lock studs from the anchor pins.



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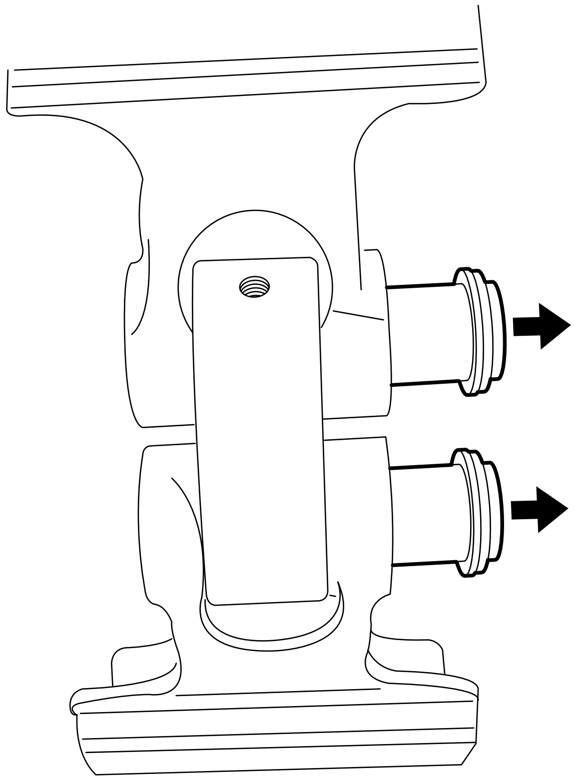
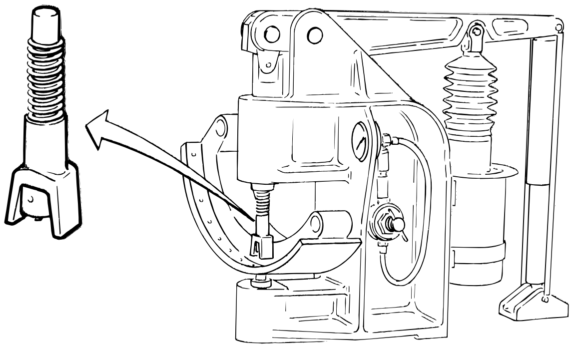
4. Remove the anchor pins.
5. First remove the bottom brake shoe by moving it outwards from the anchor pin holes.
6. Unhook the return spring, and remove the upper brake shoe.


R600146

**Installation of the brake shoes**
1. Clean all parts.
2. Lubricate the anchor pins, roller cams and contact surfaces of the brake shoes with Copaslip.
3. Fit the return spring in the brake shoes.
4. First fit the upper brake shoe in position, then the lower shoe.
5. Fit the anchor pins. Ensure that the flattened section is placed beneath the bore in the back plate.
6. Fit the felt ring, retainer ring and lock ring to the anchor pin.
7. Lock the anchor pins with the lock bolt and fit the locking wire, or lock the anchor pins using a stud.
8. Fit the dust plates.
9. Fit the brake drum.

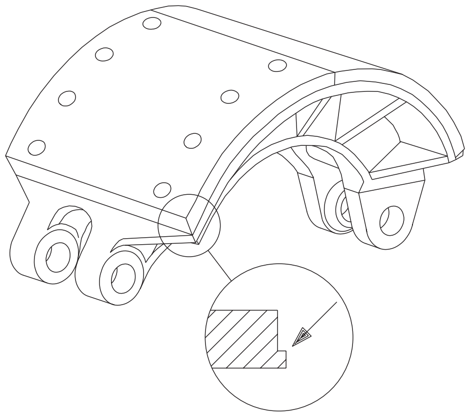
## 2.8 ASSEMBLE BRAKE LINING TO BRAKE SHOE

A brake lining should be riveted correctly with a riveting machine, to prevent damage such as cracks in the rivet surface. For that reason, always use the specified rivets.
The brake lining may be riveted with a riveting punch (DAF no. 1240000).



R 6 00 133

1. Brake linings should be renewed when they have been contaminated by oil or grease, or when the lining is worn down to approx. 1 mm above the rivet head, or to the wear indicator. The thickness can be measured via the inspection holes in the back plates.



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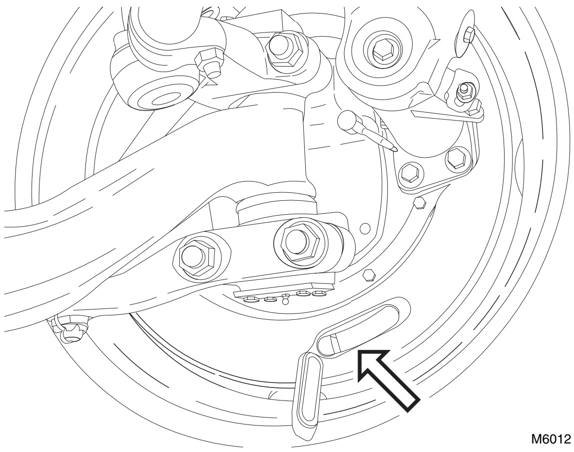

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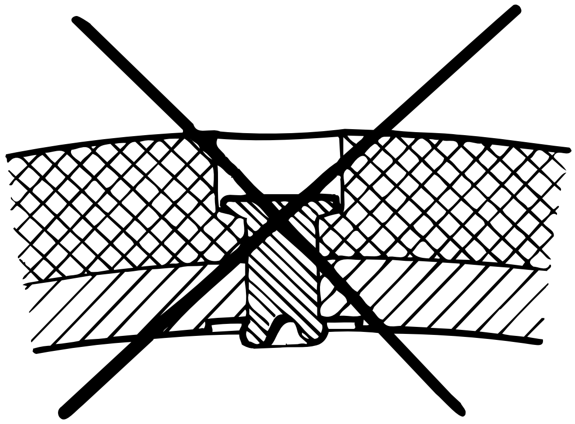
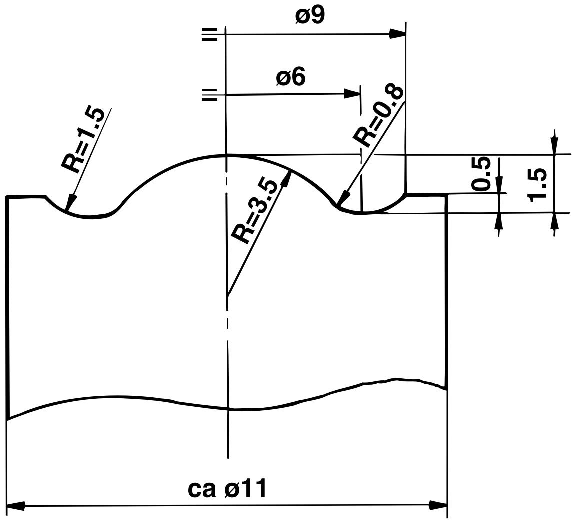
2. Ensure that the correct linings and rivets are available (see Accessory Booklet). Check whether the inside diameter of the lining is the same as the outside diameter of the brake shoe, by fitting them together. The hole pattern of both parts must also be exactly identical.
3. Both lining and brake shoe should be thoroughly clean. If required, use a steel wire brush to clean these. Check whether the brake-shoe surface is even and undeformed. Grind down any raised edges around the holes. The holes in the brake shoe must not become damaged or too big as a result of uncareful removing of old rivets.
4. The riveting punch must have a diameter of approx. 11 mm (= the outside diameter of the closed collar) and it must have the correct shape.



R 6 00 137



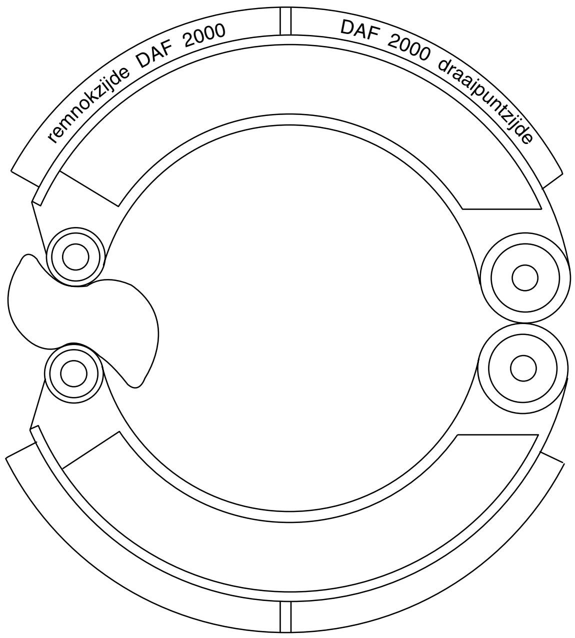

R 6 00 135

**Riveting**

5. Place the lining on the brake shoe. If the linings are so marked, fit the “draaipuntzijde” (pivoting end) to the pivoting end of the brake shoe and the “remnokzijde” (camshaft end) to the camshaft end of the shoe.

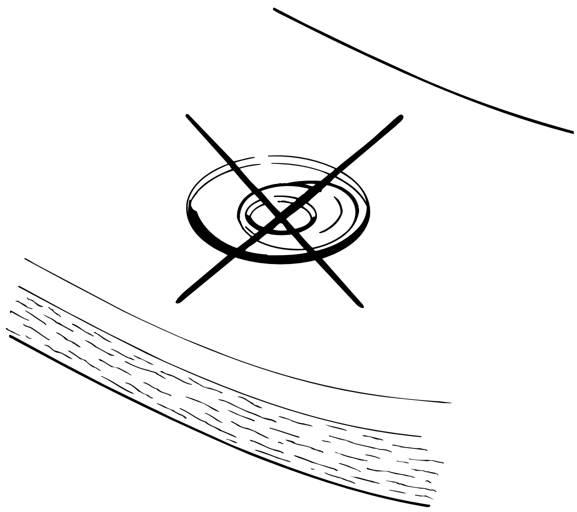
**Note:**
If these markings are not applied, fit the thin side of the lining to the pivoting end and the thick side of the lining to the camshaft end.

6. Start by riveting at the two holes in the centre of the lining. Make sure that the holes in the lining and the brake shoe are exactly in line with each other and that the lining is well bedded down onto the shoe. (Use one or more clamps.)




R600147

7. Set the riveting machine at a moderate riveting force. This should be approx. 20,000 N.
8. Place the upper punch carefully in position and gradually increase the force (this will result in the upsetting of the rivet shank i.e. filling the hole, and the formation of a collar on the shank).
9. Check the joints made for the following points:
   - the collar formed on the shank must be uniform all round and not flattened on one side. If not OK, then:
   - the holes in the lining and brake shoe are not in line.
   - the brake shoe was not held level during the riveting process.
   - the rivets are wrong.
   - there must be no cracks in the collar formed on the shank of the rivet. If cracks are present, the riveting force was too high.
   - the newly formed collar must abut the brake shoe closely. If not, the riveting force was too low.
   - the head of the rivet must not be forced to one side in the lining. This can be checked, for example, with the depth measurement part of a caliper gauge, or visually by the asymmetrically formed collar on the shank. If the latter is the case, the holes in the lining of the brake shoe are out of alignment, or the brake shoe was not held level during the riveting process.



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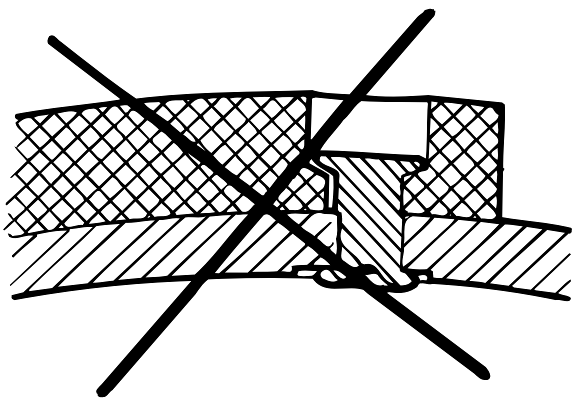

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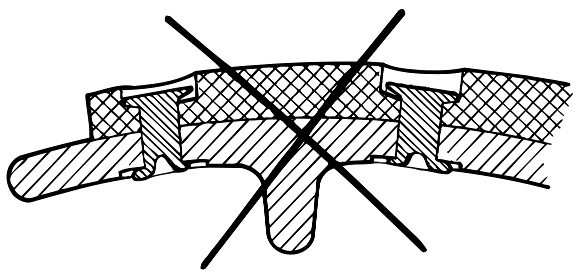
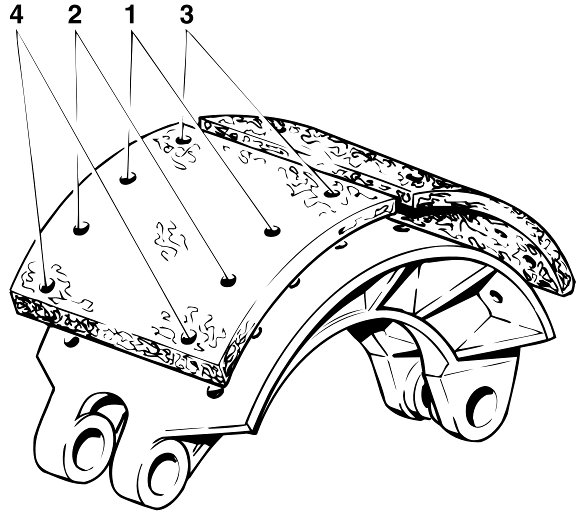


R 6 00 138

10. Check the brake lining for cracks around the rivet head. If this is the case, the riveting force was too high or the hole drilled in the brake lining was too small. To prevent the appearance of cracks, the diameter of the hole in the lining must be approx. 0.5 mm larger than the hole in the brake shoe.
11. If the joint is found to be in order, continue with the further riveting of the lining. Make sure that the lining is pressed firmly against the shoe at each riveting point.
    Work from the centre towards the ends, alternately to one end and the other. Follow this procedure for each set of two rivets. This will ensure that the lining is evenly bedded down over the entire length.



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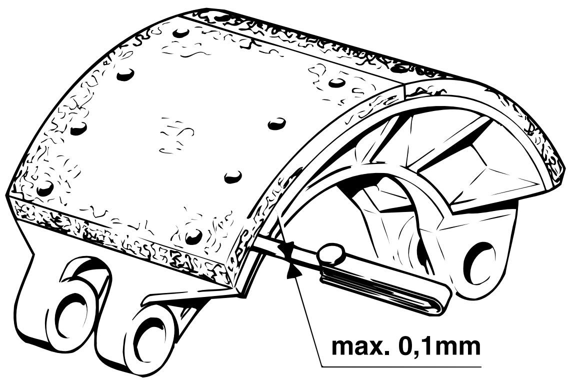
**Checking the riveted joints**

12. Now check all the riveted joints in the manner described, and use a feeler gauge to measure any play between lining and brake shoe. This side play not exceed 0.1 mm with mechanic air brakes. It must not be possible to slip in the feeler gauge further than the first row of rivets.
    At the end of the lining, the play up to the first row of rivets must not exceed 0.1 mm in case of mechanical air brakes.
    No play at all is allowed for a distance of 5 mm around the rivets.

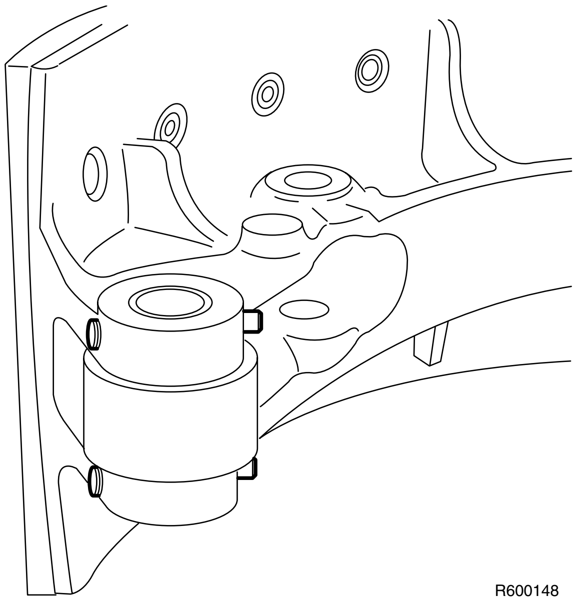


R 6 00 140

## 2.9 REMOVAL AND INSTALLATION, BRAKE-SHOE BEARING

### ANCHOR-PIN BEARING

1. Remove the brake shoes.
2. Force the new bearing bushes into the brake shoe. Check whether the anchor pins can rotate in the new bearing bushes.
3. Fit the brake shoes.



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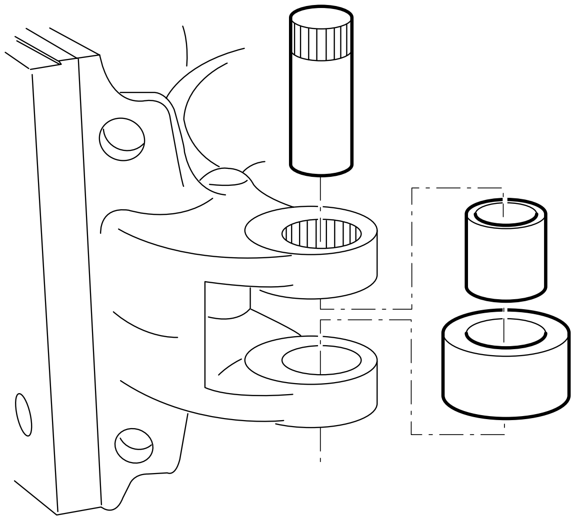
### ROLLER-CAM BEARING

The axles for the roller-cam bearings can be locked in two ways.

- Locking by means of a spindle and two spring pins.
- Locking by means of a spindle with a knurled edge.



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For the model of the spindle with knurled edge, the following should be remembered:

- The first time the spindle with the knurled edge is fitted is during production.
  The spindle may be fitted a maximum of **THREE TIMES** on ones side of the brake shoe**.** Every time it is **REINSTALLED**, a mark must be made on the brake shoe with a centre point.
  Two centre points indicate that the spindle must be fitted in the **REVERSE** direction**.**
  In this position too, the spindle may not be fitted more than three times.
  After the spindle is fitted three times on the other side of the brake shoe, the brake shoe **MUST** be renewed**.**

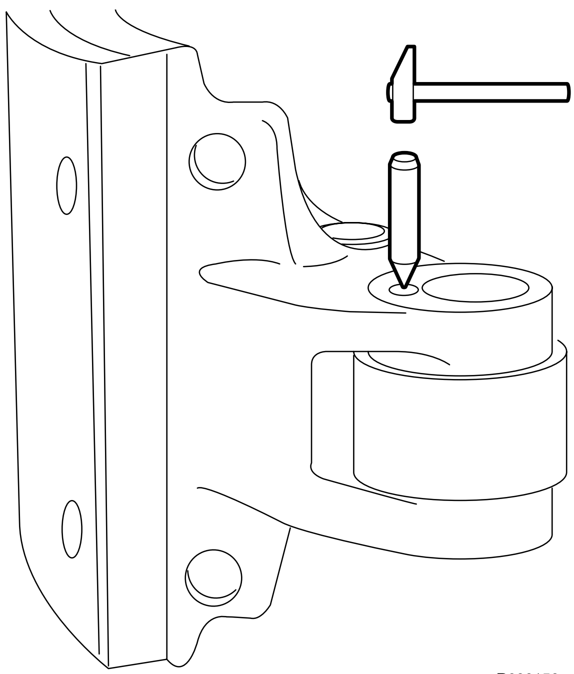


**Removal of the roller-cam bearing**

1. Remove the brake shoes.
2. If fitted, remove the spring pins.
3. Force the spindle from the brake shoe. For the version with the knurled edge, force the spindle from the shoe in such a way that the knurled edge is not forced through the complete brake shoe.

**Installation of the roller-cam bearing**

1. Check the brake shoe, spindle and roller cam for damage. Replace if necessary.
2. Force the new bearing bush into the roller cam.
3. Force the spindle into the brake shoe with the roller cam. For the version of the spindle with the knurled edge, mark the spindle as indicated in this chapter.
4. Fit the brake shoes.



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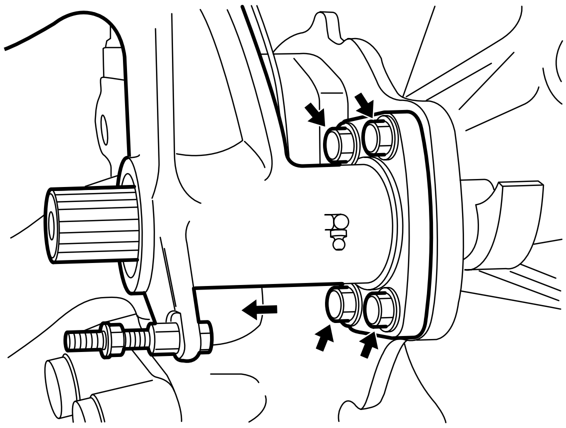
## 2.10 REMOVAL AND INSTALLATION, BRAKE CAMSHAFT

**Removal of the brake camshaft**

1. Remove the brake shoes.
2. Remove the automatic slack adjuster.
3. Disconnect the air pipe to the spring-brake cylinder.
4. Remove the attachment bolts from the spring-brake cylinder bracket.
5. Slide the spring-brake cylinder bracket complete with the spring-brake cylinder from the brake camshaft. Support the brake camshaft during this process.



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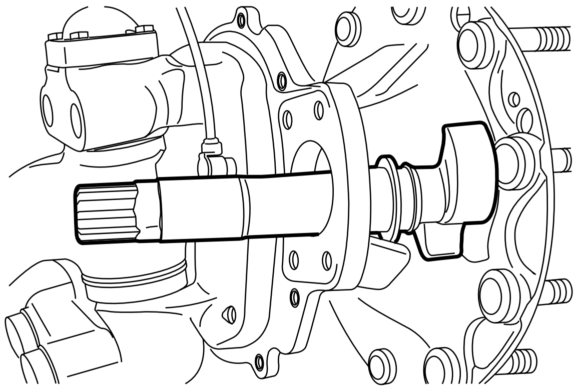
6. Remove the brake camshaft from the back plate.
7. Check the brake camshaft. The curve against which the rollers run should not be worn or damaged.



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**Installation of the brake camshaft**

1. Before installation, first clean all parts and lubricate them with Copaslip.
2. Check the seals in the bracket. If necessary, replace these.
3. Insert the brake camshaft with the spacer ring through the back plate, and slide the spring-brake cylinder bracket complete with spring-brake cylinder over the brake camshaft.
4. Tighten the spring-brake cylinder bracket with the specified torque to the back plate, see main group “Technical data”.
5. Check the radial play. This must be minimal. If necessary, replace the bearing bush.
6. Fit the brake shoes.
7. Fit the automatic slack adjuster.




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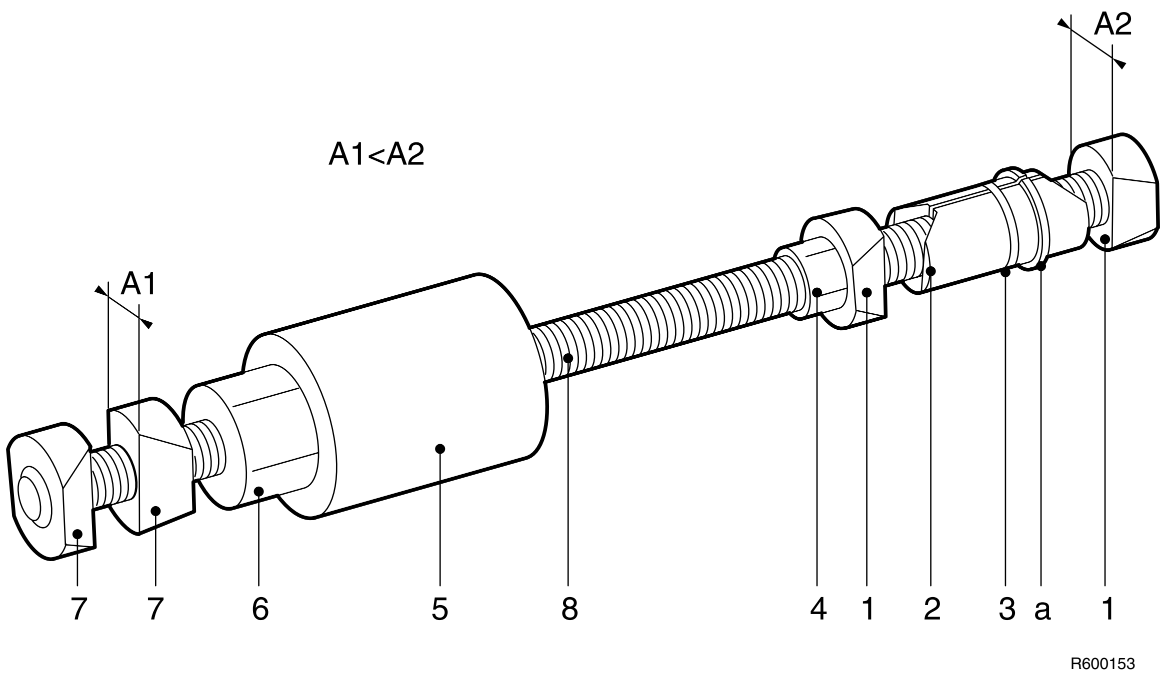
## 2.11 REMOVAL AND INSTALLATION, BRAKE-CAMSHAFT BEARING

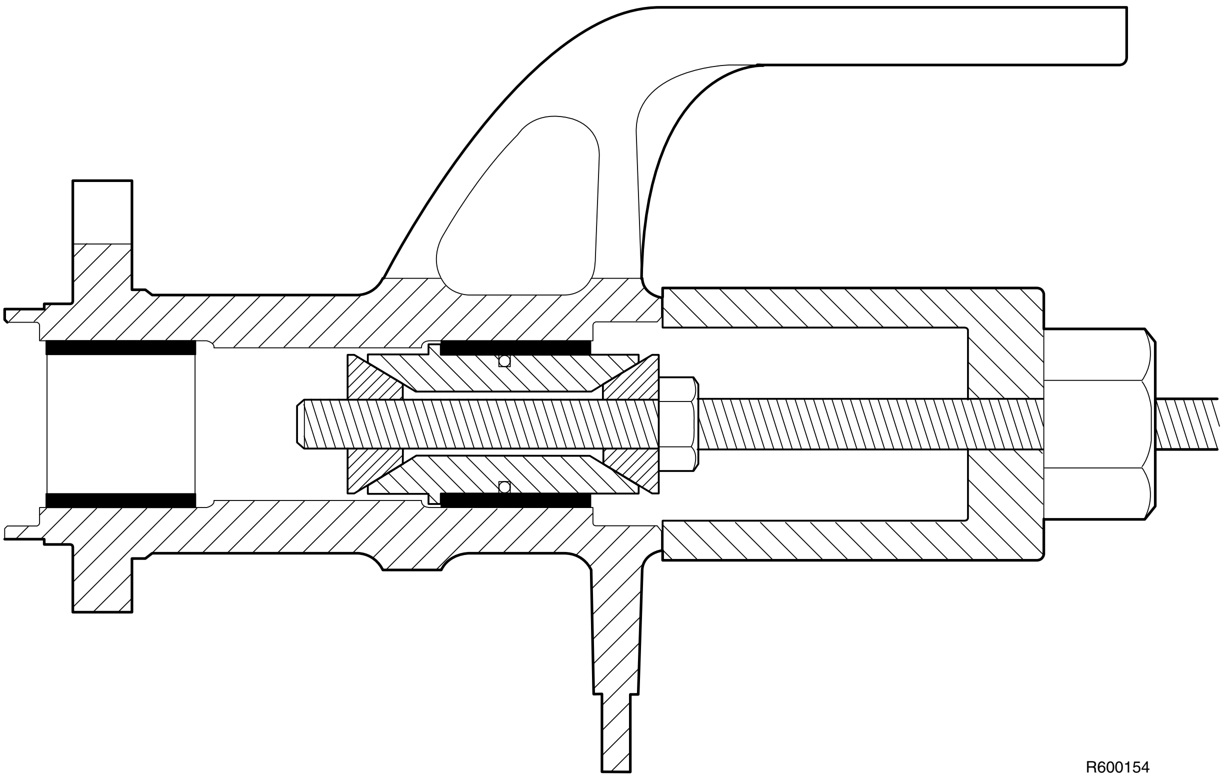
**Removal of the brake-camshaft bearing**

1. Remove the brake camshaft.
2. Remove the oil seals from the spring-brake cylinder bracket. These must always be replaced.
3. To remove the brake camshaft use the special tool (DAF no. 0694794). Determine the correct set of wedges for each bearing bush, and fit them on the puller.




4. Move loose wedge (1) back so that the halves of pulling piece (2), which are kept together by the O-ring, are joined.

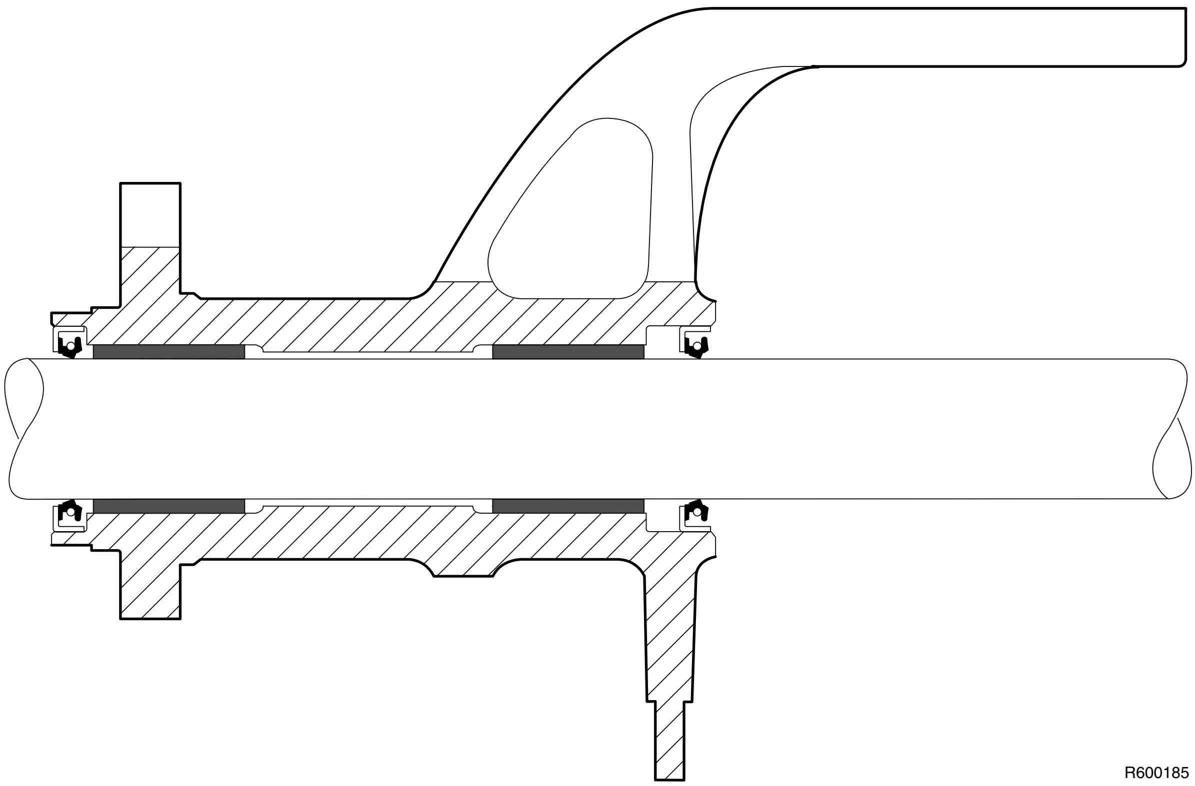
5. Place the puller in the spring-brake cylinder bracket, so that shoulder (a) is behind the bearing bush. When working on the front axle, ensure that the shoulder engages with the recess between the bearing bush and the spring-brake cylinder bracket.


R600154

6. Using nut (4), screw the wedges as far as possible inwards. Tighten the nut fingertight.
7. Place spacer sleeve (5) against the spring-brake cylinder bracket and screw nut (6) until the bearing bush is pulled out of the bracket. Ensure that the contact faces of nut (6) and spacer sleeve (5) and threaded spindle (8) are sufficiently lubricated.

**Installation of the brake-camshaft bearing**
1. Check the spring-brake cylinder bracket for damage. If necessary, replace.
2. Check whether the lubricating nipple is open, so that the bearings can be lubricated with grease from the automatic greasing system.

3. Use the special tool (DAF no. 1310421) to fit the bearing bushes.
4. Check the brake camshaft for smooth operation. If necessary, ream the bushes. Play between spindle and bush 0.1 to 0.2 mm.
5. Fit the oil seals.
   **Note:**
   The oil seal on the wheel brake end should form a seal, whilst the oil seal on the slack adjuster end should be able to discharge grease from the bracket.
6. Fit the brake camshaft.



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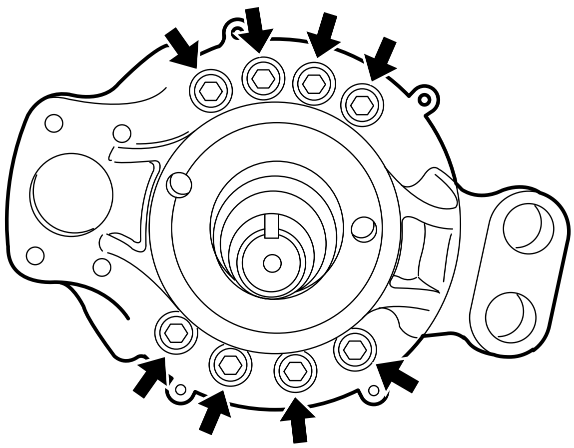
## 2.12 REMOVAL AND INSTALLATION, BRAKE BACK PLATE

**Removal of the brake back plate**
1. Remove the brake drum.
2. Remove the brake shoes.
3. Remove the automatic slack adjuster.
4. Remove the brake camshaft.
5. Remove the hub (see group 7 and/or group 8 of the workshop manual).
6. Remove the brake back plate.

**Installation of the brake back plate**
1. Clean the contact surfaces of the brake back plate and the spindle. Be sure to let these surfaces dry for approx. 20 minutes before installing the back plate. Thoroughly clean all other parts.
2. Install the back plate and tighten the attachment bolts to the specified torque, see main group “Technical data”.
3. Fit the hub (see group 7 and/or group 8 of the workshop manual).
4. Fit the brake camshaft.
5. Fit the brake shoes.
6. Fit the brake drum.
7. Fit the automatic slack adjuster.

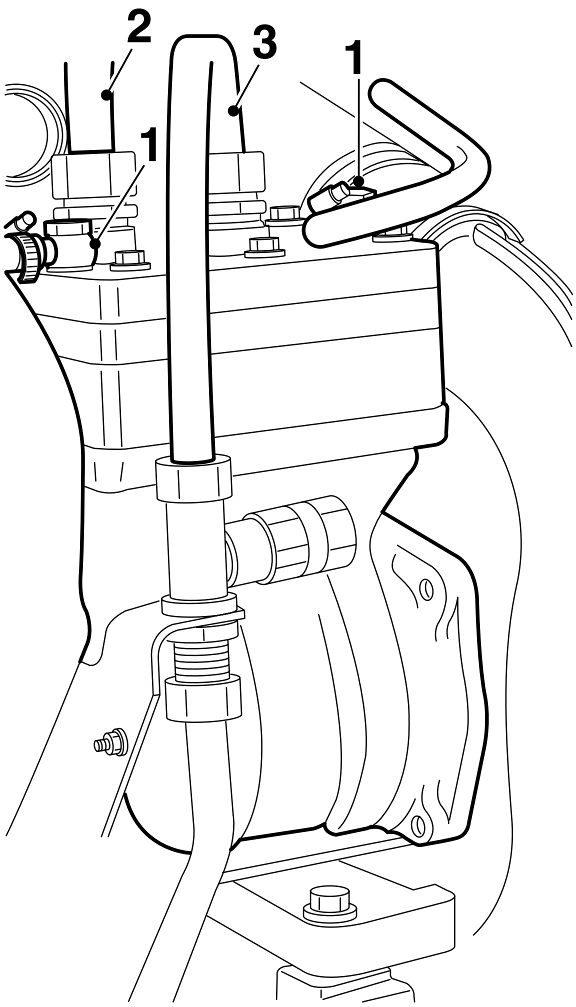


R600156

## 2.13 REMOVAL AND INSTALLATION, COMPRESSOR CYLINDER-HEAD GASKET

**Removal of the compressor cylinder-head gasket**

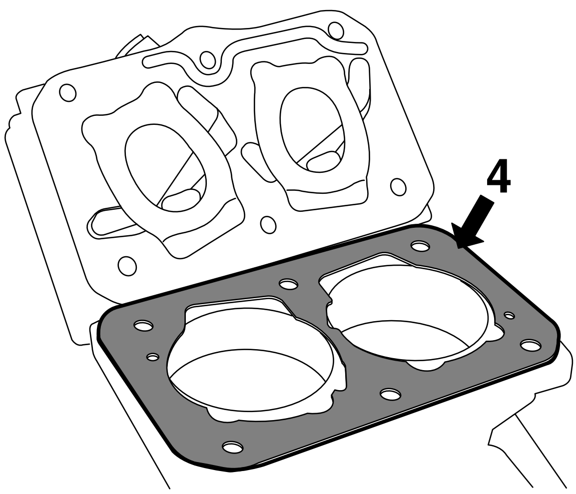
1. Drain part of the engine coolant, see group 2 of the workshop manual.
2. Remove the coolant connections (1) of the compressor.
3. Remove air-suction line (2) and compressed-air line (3) of the compressor.
4. Remove the 6 cylinder-head bolts (M8) and loosen the two middle attachment bolts (M6), but do not remove these yet.




R600246

**Note:**
When removing the cylinder head from the compressor, various parts can remain behind in the compressor.

5. Remove the complete cylinder head from the compressor.
6. Remove cylinder-head gasket (4).
7. Remove the two attachment bolts (M6) from the cylinder head.
8. Remove the gaskets between the cylinder-head halves.

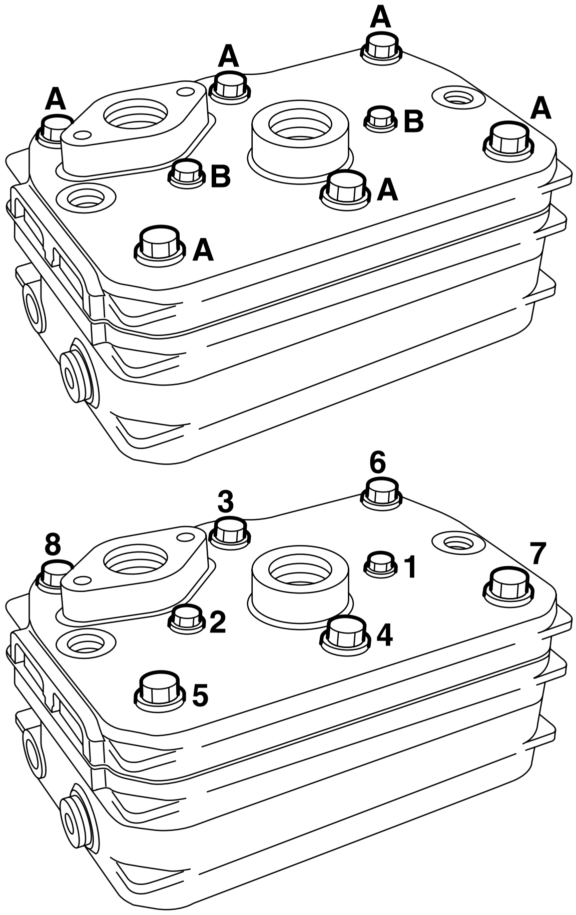



R600248

4

**Installation of the compressor cylinder-head gasket**

1. Clean the cylinder-head halves.
2. Fit a new cylinder-head gasket on the compressor.
3. Install the lower cylinder-head half, i.e. the half with the valves.
4. Fit the remaining cylinder-head halves which have been fitted with new gaskets.
5. Fit the two attachment bolts (B) and fingertighten these.
6. Fit the cylinder-head bolts (A).
7. Tighten cylinder-head bolts (A) and (B) according to the sequence indicated and to the specified torque, see main group “Technical data”.
8. Install air-suction line (2) and compressed-air line (3) of the compressor.
9. Install the coolant connections (1) of the compressor.
10. Fill the engine with coolant, see group 2 of the workshop manual.







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## 2.14 REMOVAL AND INSTALLATION, BRAKE-CHAMBER DIAPHRAGM

**Removal of the brake-chamber diaphragm**

1. Release the brakes until the spring in the brake chamber is under tension.
2. Mark the position of the brake-chamber halves in relation to one another.
3. Remove the clamping ring from the brake chamber.
4. Remove the rear half of the brake chamber, and the diaphragm.

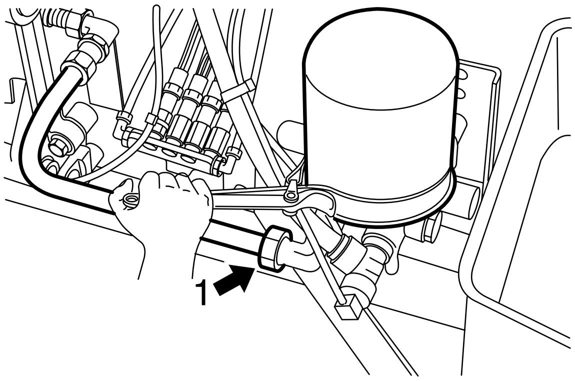
**Installation of the brake-chamber diaphragm**

1. Fit the new diaphragm and brake-chamber half. (Watch out for the markings or the small drainage hole.)
2. Fit the clamping ring.
3. Adjust the brakes, see chapter "Inspection and adjustment".
4. Check the complete brake chamber for air leaks.

## 2.15 REMOVAL AND INSTALLATION, AIR DRIER FILTER ELEMENT

**Removal of the air drier filter element**

1. Remove compressor line (1); as a result, the inside of the air dryer will become pressureless.
2. Remove the filter element by turning it counter-clockwise using a strap wrench.
3. Clean the inside of the air drier.
4. Check the air dryer's screw thread (2) for damage and lubricate it lightly with grease.

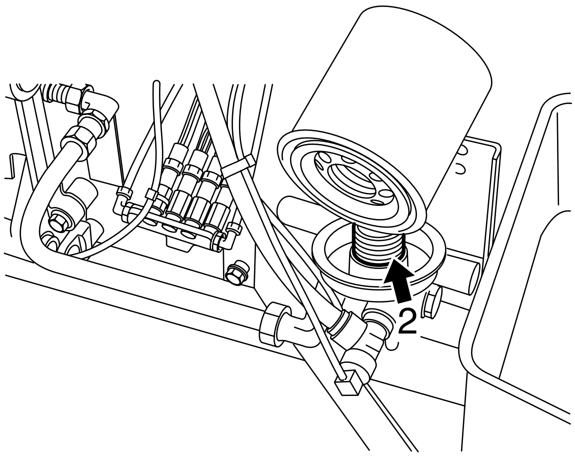



R600251



**Installation of the air drier filter element**

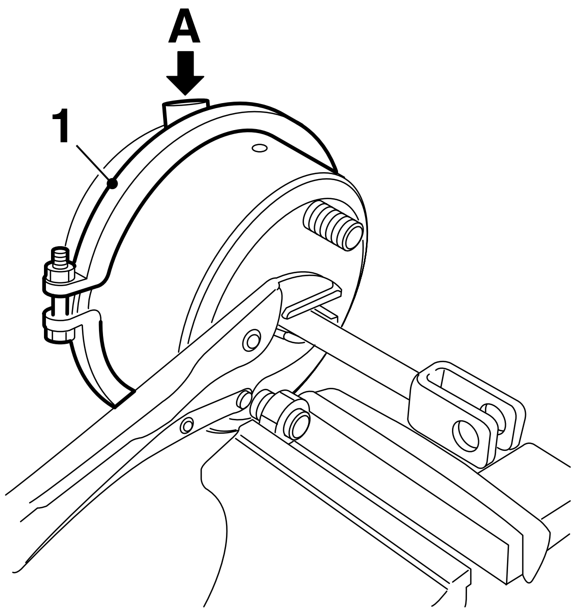
1. Oil the sealing ring of the new filter element lightly with grease.
2. Install the filter element by hand tightening it until the sealing ring abuts. Then turn the air drier filter element another full turn by hand.
3. Fit compressor line (1).
4. Build up pressure in the system and then check the air drier for possible air leaks.




R600252

# 3. DISASSEMBLY AND ASSEMBLY

## 3.1 DISASSEMBLY AND ASSEMBLY, BRAKE CHAMBER



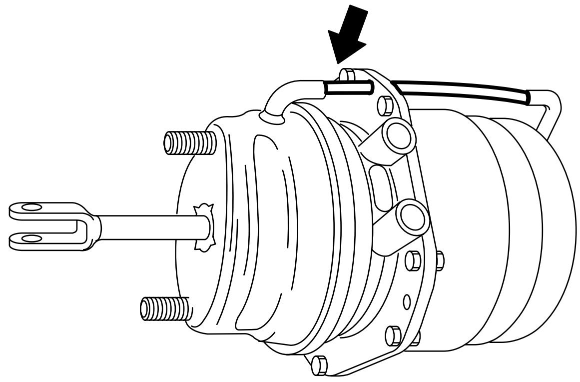

**Disassembly of the brake chamber**
1. Clean the brake chamber.
2. Put pressure at brake chamber port (A) for a short time.
3. Place a wrench on the yoke rod at the assembly surface of the brake chamber.
4. Remove clamping strip (1).
5. Remove the rear cover from the brake chamber.
6. Remove the diaphragm.
7. Remove the wrench from the yoke rod.
8. Remove the entire yoke from the front cover.
9. Remove the split ring between yoke and spring retainer. The spring retainer and spring can now be removed.

**Installation of the brake chamber**
1. Place the spring and spring retainer on the yoke, and fit the split ring.
2. Place the front cover of the brake chamber on the yoke and depress the cover downwards against the spring tension. Place a wrench on the yoke rod at the assembly surface of the brake chamber.
3. Install the diaphragm.
4. Fit the rear cover of the brake chamber.
5. Fit the clamping ring.
6. Remove the wrench from the yoke rod.

## 3.2 DISASSEMBLY AND ASSEMBLY, WABCO SPRING-BRAKE CYLINDER

**Disassembly of the brake chamber**

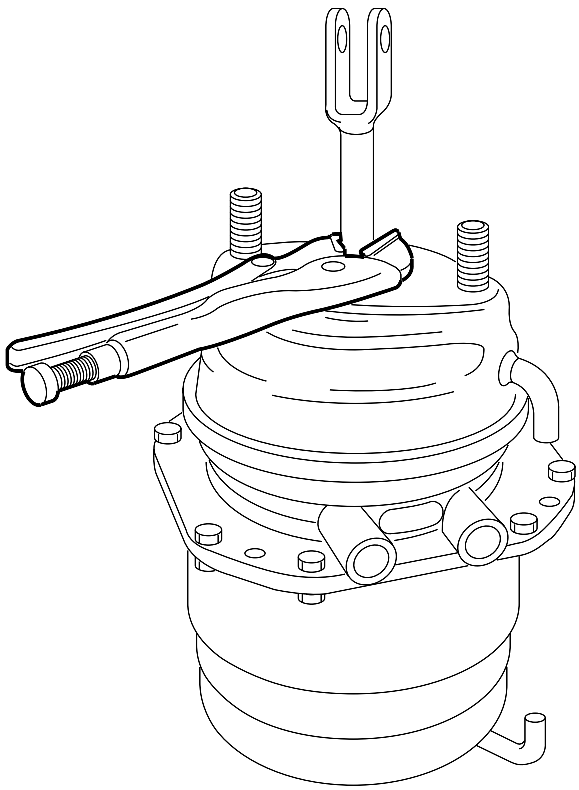
1. Clean the spring-brake cylinder.
2. Remove the flexible bleed line with the internal sinter filter.



R600197



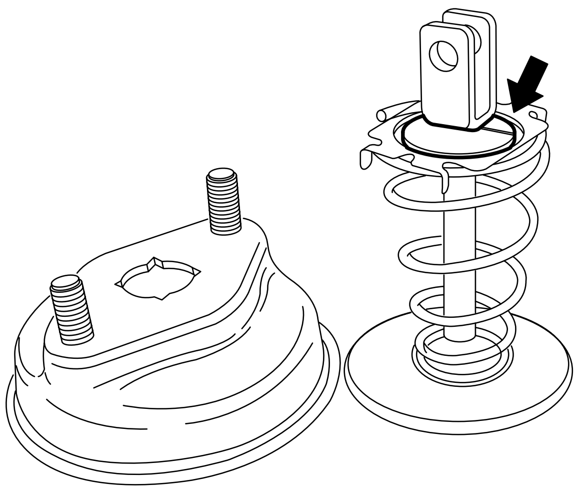
3. Place a wrench on the yoke rod at the assembly surface of the brake chamber.
4. Apply pressure to port (12) (min. 6.0 bar).
5. Remove the clamping strip.
6. Remove the front cover from the brake chamber.
7. Remove the diaphragm.
8. Remove the front cover from the yoke.



R600194

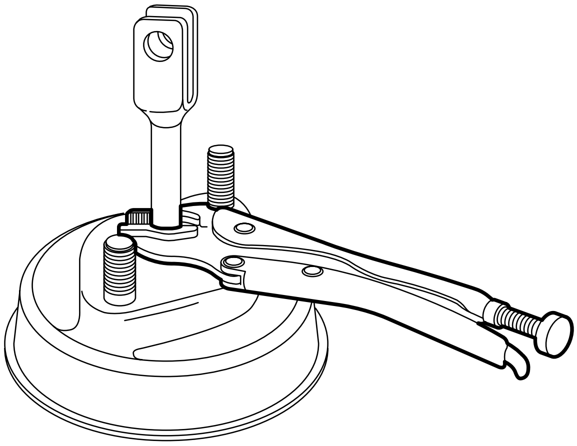
9. Remove the split ring between yoke and spring retainer. The spring retainer and spring can now be removed.

**Installation of the brake chamber**
1. Apply pressure to port (12) (min. 6.0 bar).
2. Install the diaphragm.
3. Place the spring and spring retainer on the yoke, and fit the split ring.



R600195

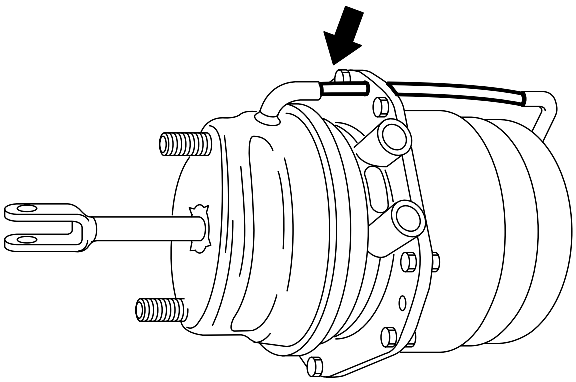
4. Place the front cover of the brake chamber on the yoke and depress the cover downwards against the spring tension. Place a wrench on the yoke rod at the assembly surface of the brake chamber.
5. Place the complete front cover on the brake chamber and install the clamping strip to the specified torque, see main group "Technical data". Remove the wrench.



R600196

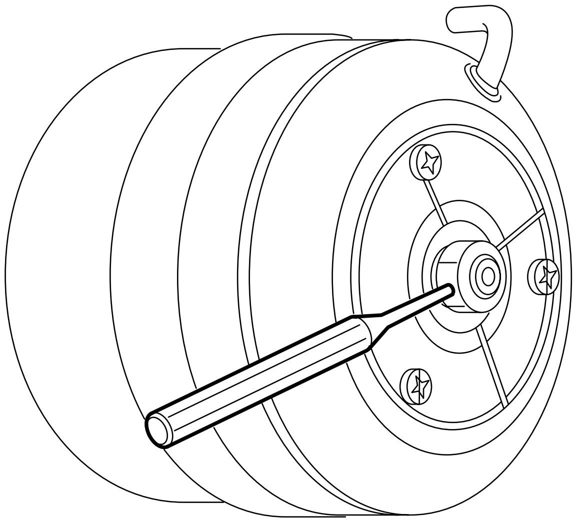
6. Fit the flexible bleed line with the sinter filter fitted at the brake-chamber side. Ensure that the filter is correctly mounted in the flexible bleed line, to prevent any dirt from entering the spring-brake section.

**Disassembly of the spring-brake section**
1. Remove the flexible bleed line with the internal sinter filter.
2. Apply marks to the two halves of the spring-brake cylinder housing.



R600197

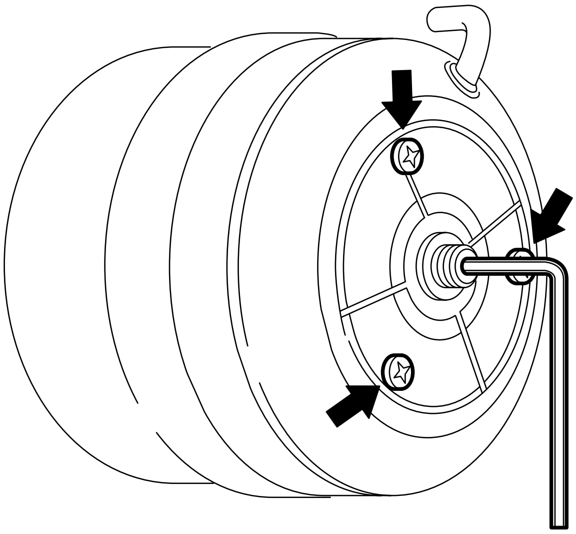
3. Remove the spring pin from the release bolt and remove the nut, washer and O-ring from the release bolt.



R600198

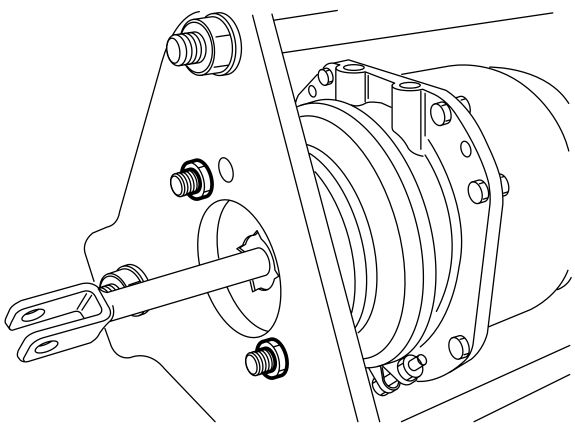


4. Using a hexagonal socket-screw spanner, screw the release bolt into the spring-brake chamber until it falls freely into this chamber.
5. Remove the three screws with the instruction plate on the rear of the spring-brake cylinder.



R600199

6. Place the complete spring brake actuator in the special tool (DAF no. 0484840) and tighten the spring-brake cylinder on the special tool, using two nuts.



R600200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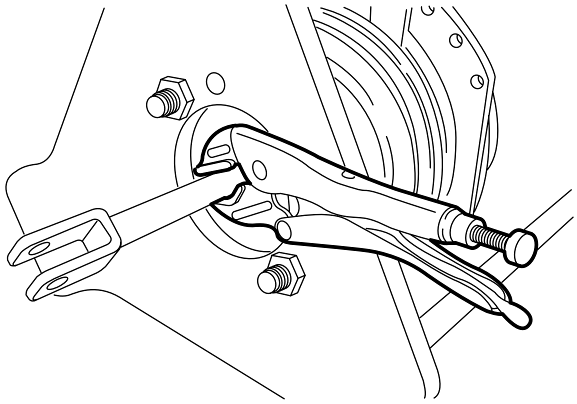
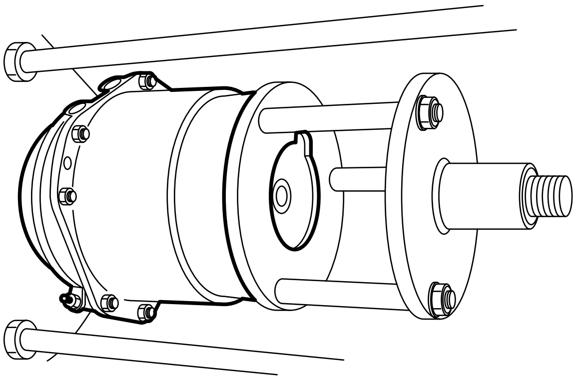
7. Apply pressure to port (11). As a result, the yoke will come out of the brake chamber. Place a wrench on the yoke rod at the assembly surface of the brake chamber. Now vent the brake chamber.



R600201

8. Place the auxiliary tool (DAF no. 0484845) on the spring-brake cylinder; subsequently turn the tool until it is under pressure.
9. Remove four of the eight attachment bolts at the circumference of the spring-brake cylinder and fit four studs, each with two nuts, in their place. The studs should be made in the workshop, length approx. 210 mm.
10. Remove the four remaining attachment bolts.
11. Release the tool and thus the spring. Remove the various spring-brake components from the special tool.



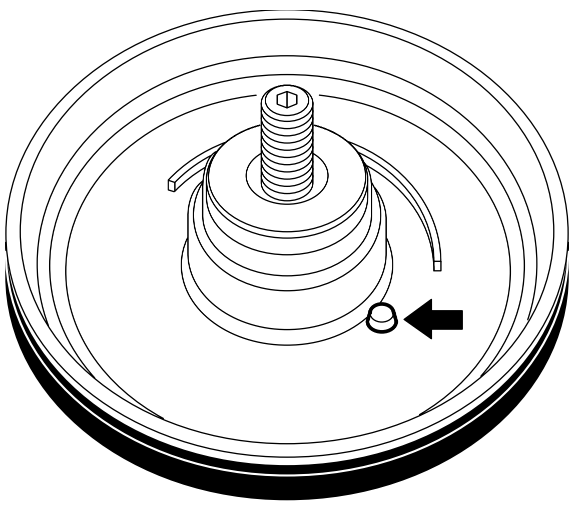
R600202



**Assembly of the spring-brake part**

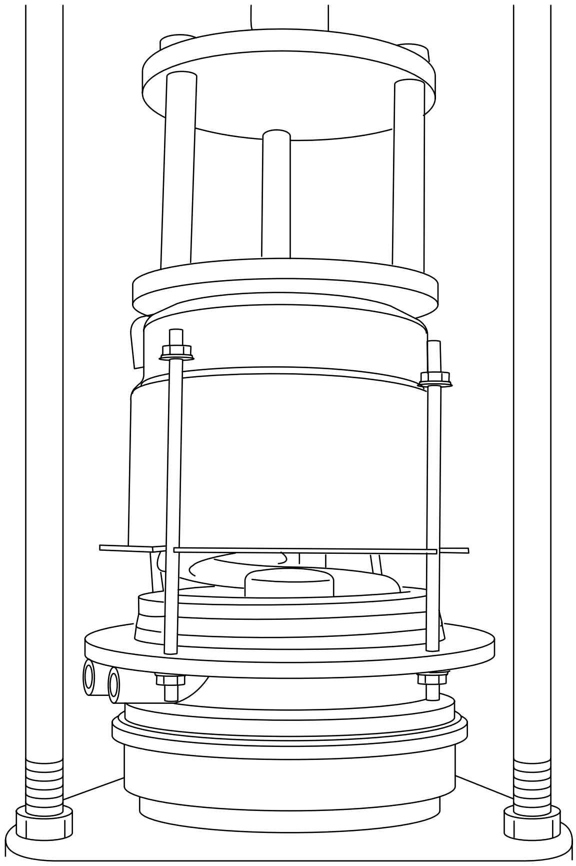
1. Insert the top spring retainer in the spring-brake cylinder.
2. Fit a new, greased sleeve on the lower spring retainer.
3. Fit a new O-ring and sealing ring in the intermediate housing of the spring-brake cylinder.
4. Fit the bottom spring retainer, greased, in the intermediate housing.
5. **Note:**
   When fitting the spring on the bottom cam retainer, the end of the spring must touch the cam in the spring retainer

   Place the spring on the bottom spring retainer.
6. Place the spring-brake cylinder and the auxiliary tool over the spring.



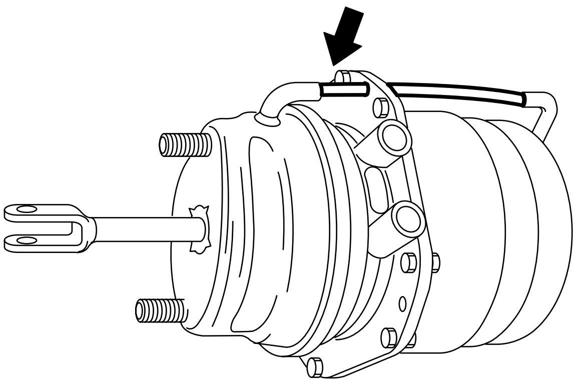
R600203

7. Fit four studs in the attachment holes. Remember the marks.
8. Using the special tool, apply pressure to the spring, so that the two halves of the housing come into contact with one another. The studs also serve as guides.
9. Install the attachment bolts and tighten them to the specified tightening torque, see main group “Technical data”.
10. Remove the studs and tighten the remaining four attachment bolts to the specified torque, see main group “Technical data”.
11. Remove the wrench.
12. Remove the complete spring-brake cylinder from the special tool.
13. Assemble the spring-brake cylinder in such a way that the release bolt in the spring-brake cylinder touches the top spring retainer. Screw the release bolt into the spring retainer.
14. Fit the O-ring and sealing ring on the release bolt. Fit the nut and spring pin, and tighten the release bolt using the specified tightening torque, see main group “Technical data”.



R600204

15. Fit the flexible bleed line with the sinter filter fitted at the brake-chamber side. Ensure that the filter is correctly mounted in the flexible bleed line, to prevent any dirt from entering the spring-brake section.



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# CONTENTS



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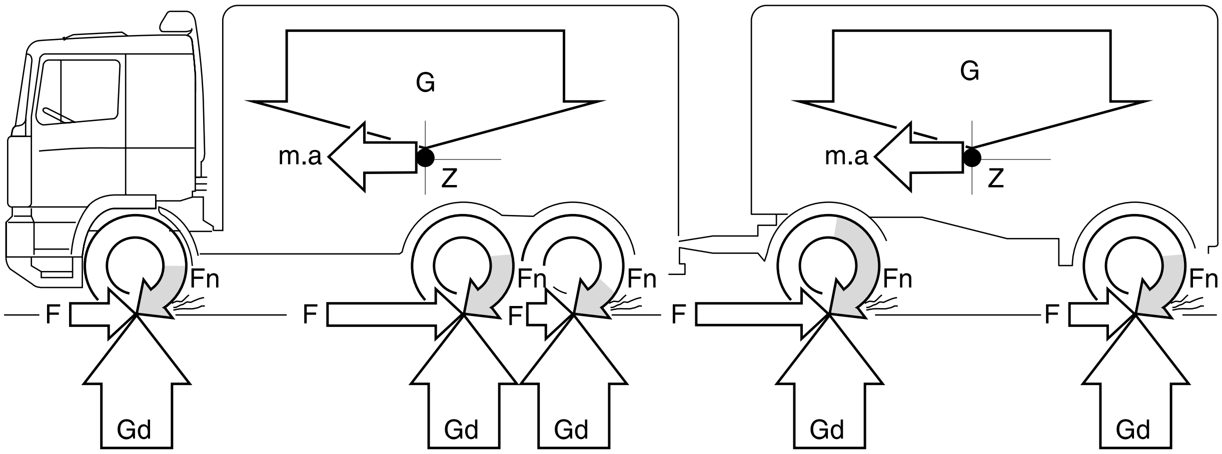
# 1. GENERAL

## 1.1 INTRODUCTION




| | | |
|---|---|---|
| G | = | weight |
| m | = | earth |
| a | = | deceleration (m x a is the force changing the axle load) |

Dynamic axle load: When the brakes are applied, the load on the axle increases.

| | | |
|---|---|---|
| F | = | braking force (Fmax = Gd x $\mu$) |
| Gd | = | dynamic axle load |
| m | = | the friction coefficient between tyre and road |
| Fn | = | braking force of the wheel brake. |

How is a good braking performance of a vehicle combination (truck/trailer, tractor/semi-trailer) achieved, both for new vehicle combinations and reconditioning of the brakes, while still guaranteeing interchangeability?
The vehicles should meet the legal requirements and all settings should be in accordance with the directives. However, adhering to the directives does not necessarily mean that there will be no brake problems.

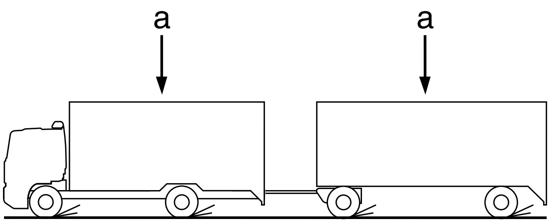
## 1.2 WHAT IS A VEHICLE COMBINATION WITH A GOOD BRAKING PERFORMANCE?

A vehicle combination of which, in laden condition and with a 1 to 3 bar pressure at the service coupling head, the braking deceleration of the towing vehicle is the same or virtually the same as that of the towed vehicle.

When problems occur which are related to the brake system, such as excessive brake-lining wear, brake vibrations or the vehicle pulling to one side during braking, the cause should primarily be sought in an unbalanced distribution of braking forces.

**- for vehicle combinations:**
between tractor and (semi-)trailer.

**- for rigid vehicles:**
between the different axles.



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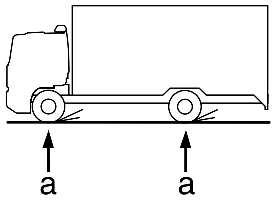

R600025

**Conditions for a practice-oriented distribution of braking forces**

- Both vehicles should have a complete and sufficiently effective brake system without mechanical defects or failures in the air system.

With vehicle combinations, the braking performance level of the (semi-)trailer often proves to be noticeably lower than that of the tractor. This means that the tractor has to provide a disproportionally large part of the deceleration required for the total vehicle combination. As the brakes of the (semi-)trailer will consequently be subjected to low loads only, their condition will deteriorate (risk of glazing) which will lead to even higher overloading of the tractor brakes.


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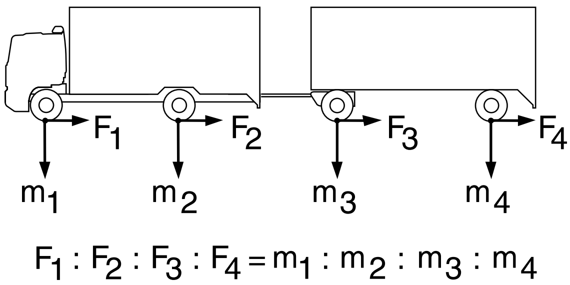
**Possible causes of poor braking performance of a (semi-)trailer:**

- Unduly large brake-chamber stroke.
- Incorrect position of the brake levers.
- Damaged diaphragms in the brake chambers.
- Greasy, glazed or fully worn linings.
- The mechanical part of the wheel brake does not operate smoothly.
- A leak in the brake system.
- A blockage in the brake-line system.
- Not all the valves are in good working order.
- Incorrect setting of the load-sensing valve.

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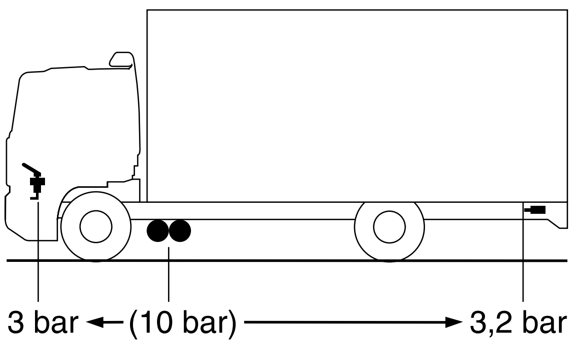
The starting point is that the braking forces between the axles of the vehicle combination should be distributed in proportion to the axle loads. This will also distribute the temperature correctly over the axles.
Whether this will give the correct distribution between tractor and (semi-)trailer depends not only on the quality of the two brake systems, but also on a correct balancing of the braking pressures. The latter can be achieved by adjusting the braking-pressure advance in such a way that at the most frequently used braking pressures, i.e. 2 - 3 bar on the service line, the braking performance of the tractive unit is the same as that of the drawn vehicle.
This means that the manufacturer's pre-set braking-pressure advance will in many cases have to be adjusted.

Manufacturer's pre-set braking-pressure advance in the (semi-)trailer reaction valve:
- 10-bar system: 3 bar in circuit 1 results in 3 bar at the yellow coupling head, an advance of 0.6 bar.




R600027

Note: for a 10-bar brake system, the braking-pressure advance is more than the arithmetic difference between the input and output pressures. This is due to the fact that the system pressure for a drawn vehicle never exceeds 8 bar.
A braking pressure of 3 bar in an 8-bar system (on the (semi-)trailer) gives a higher braking performance than the same pressure in a 10-bar system (on the tractor).
As a result, the braking deceleration of the tractor is the same as that of the (semi-)trailer.

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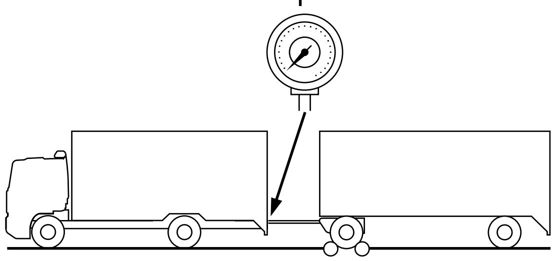
# 2. INSPECTION AND ADJUSTMENT

## 2.1 MEASURING WITH A DYNAMOMETER

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Make sure the vehicle combination is in **laden condition.**
A vehicle in laden condition will result in accurate measurements. The tolerances of the various brake-system valves are small when the vehicle is laden.
Furthermore, the maximum braking performance will be achieved when the vehicle is in laden condition.

Write down the braking forces of the various axles at the following braking pressures, measured at the service-line coupling head:

p = 0.5 1.0 1.5 2.0 3.0 4.0 5.0 bar

The combination is correctly balanced if the braking performance at 2 - 3 bar for the tractor and the (semi-)trailer are at the same position in the appropriate so-called EC band, i.e. both in the upper part, both in the lower part or both in the middle part. The bands (curves) and how to fill these out are mentioned below.

A correct balance can be obtained by adjusting the braking-pressure advance in the (semi-)trailer reaction valve. Often, it is also possible to adjust the braking-pressure advance in the (semi-)trailer brake valve (on the (semi-)trailer).
For optimum interchangeability of vehicles, the correct choice between these two alternatives must be made.

**Truck or tractor**
Increasing the braking-pressure advance at the (semi-)trailer reaction valve will decrease the deceleration of the motor vehicle, because: increasing the braking-pressure advance will, at an equal pressure at the reaction coupling head, result in a lower braking-cylinder pressure (and therefore less braking force) in relation to the towed vehicle.

**Semi-trailer or trailer**
Increasing the braking-pressure advance at the (semi-)trailer brake valve will increase the deceleration of the motor vehicle, because: increasing the braking-pressure advance will, at an equal pressure at the service-line coupling head, result in a higher braking-cylinder pressure (and therefore more braking force) of the towed vehicle in relation to the towing vehicle.

Ideally, the deceleration curves for towing vehicle and towed vehicle should coincide up to a pressure of 2.5 bar at the service-line coupling head. At higher pressures, the curves will diverge.

Adjustments made to the braking-pressure advance of the towing vehicle and/or the towed vehicle, will affect the deceleration curves.



In general, the braking performance of DAF tractive units is better than that of drawn vehicles. If necessary, the braking-pressure advance of the tractort, i.e. in the (semi-)trailer reaction valve, should therefore be increased by a few tenths of a bar.
Of course, a new brake test must be carried out whenever adjustments have been made.

Bear in mind that an increase in the braking-pressure advance does not necessarily improve the braking performance of the (semi-)trailer. It only means that the braking-pressure balance between tractor and (semi-)trailer is changed. Moreover, in the event of an emergency stop, the poorer braking performance of the (semi-)trailer will again be noticeable, as the braking pressure advance is eliminated when the **maximum braking pressure** is used.

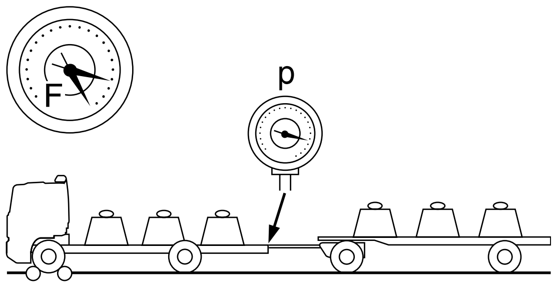
## 2.2 COMPLETING THE BRAKING DECELERATION TEST SHEET

**Note:**
1 kg = 10 Newton (N)

1. Determine the weight of the **laden** tractor and (semi-)trailer (coupled), and enter these values in the table.
2. Make a short test run to warm up the brakes.
3. Position the vehicle's front axle on a dynamometer.
4. Connect a pressure gauge to the yellow coupling head.
5. Depress the brake pedal until the pressure gauge reading is 0.5 bar. Always build **up** pressure, i.e. from low to high pressure, and never from high pressure to low pressure, and always begin every measurement with 0 bar.
6. Read the braking forces and enter these readings (in kg or Newton) in the column for the braking forces of the first axle.
7. Now repeat this procedure at pressures of 1.0, 1.5, 2.0, 3.0, 4.0 and 5.0 bar.
8. Carry out this test on all axles.
9. Work out the total braking force, both for the tractor and the (semi-)trailer, at each of the above-mentioned pressures and enter these totals in the columns for the total braking force.
10. Divide the braking forces just entered (in kg or Newton) at point 9 by the weight of the vehicle (in kg or Newton), multiply the result by 100 (%) and enter the values thus obtained in the next column.

$$\frac{F_{tot.}\ (kg/N)}{m_{tot.}(kg/N)} \times 100\ \% = \text{braking deceleration in \% of the weight}$$

11. Plot the values from point 10 in the graph, using "xxx" for the tractor and "ooo" for the (semi-)trailer.



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The values for the semi-trailer of a truck/semi-trailer combination may be slightly lower than those for the tractor. The deceleration for a truck/trailer combination must be the same. The reason for this lies in the dynamic axle load displacement, which on semi-trailers causes a transfer of weight to the tractor, whereas on trailers it does not cause a transfer of weight to the truck.
The “EC bands” for the deceleration values, are shown on the following pages.

**Note:**
When the braking-pressure advance in the (semi-)trailer-reaction valve is **increased or decreased**, the position of the (semi-)trailer curve in the graph will not be affected**.** This is because the reference pressures are measured at the yellow coupling head (= service line). For the same reason, however, the curve for the tractor will move to the right or the left (will appear to be lower or higher, respectively).
So the horizontal axis indicates how much the braking-pressure advance has to be changed.




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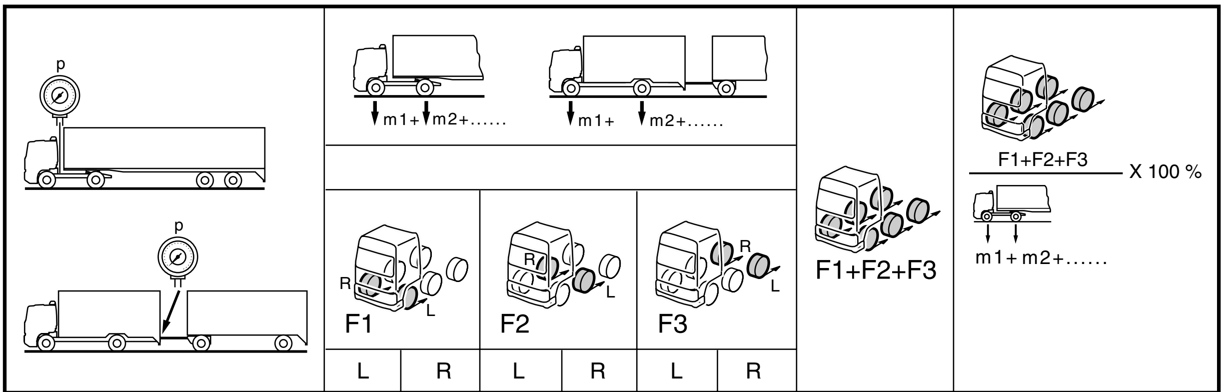
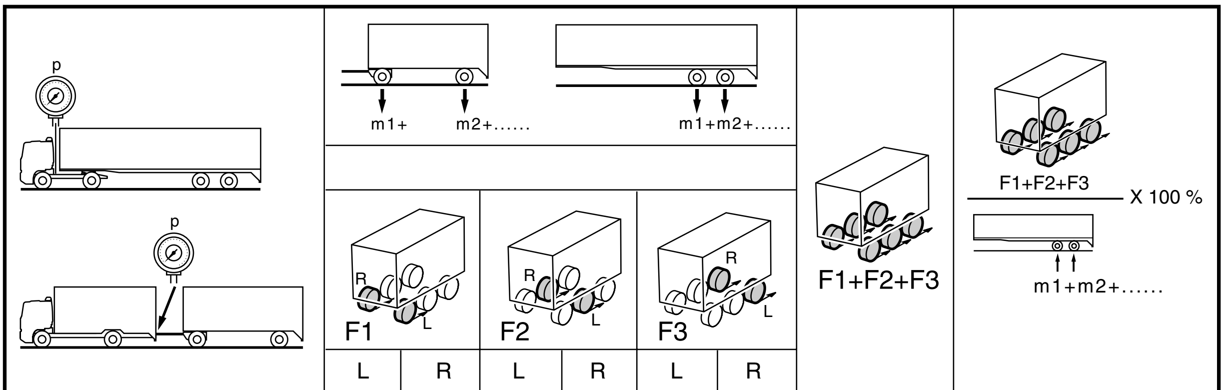
## 2.3 DYNAMOMETER TEST SHEET




| p | F1 L | F1 R | F2 L | F2 R | F3 L | F3 R | F1+F2+F3 | |
|---|---|---|---|---|---|---|---|---|
| 0.5 | | | | | | | | % |
| 1.0 | | | | | | | | % |
| 1.5 | | | | | | | | % |
| 2.0 | | | | | | | | % |
| 3.0 | | | | | | | | % |
| 4.0 | | | | | | | | % |
| 5.0 | | | | | | | | % |




| p | F1 L | F1 R | F2 L | F2 R | F3 L | F3 R | F1+F2+F3 | |
|---|---|---|---|---|---|---|---|---|
| 0.5 | | | | | | | | % |
| 1.0 | | | | | | | | % |
| 1.5 | | | | | | | | % |
| 2.0 | | | | | | | | % |
| 3.0 | | | | | | | | % |
| 4.0 | | | | | | | | % |
| 5.0 | | | | | | | | % |

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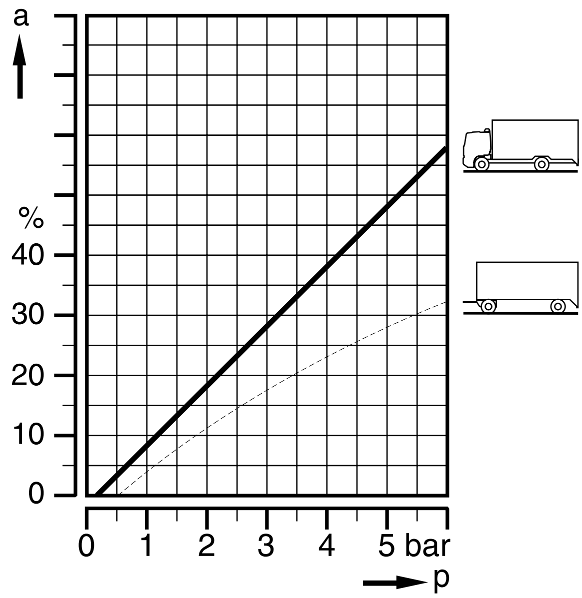
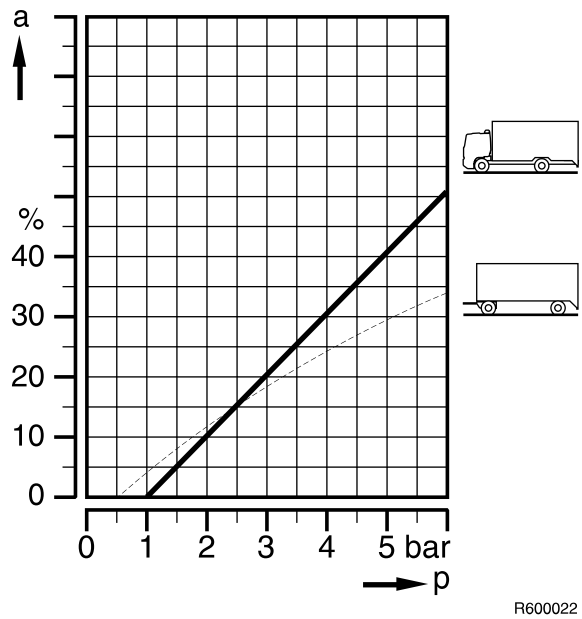
Example of a diagram for a tractor/(semi-)trailer combination with poor brake balance.

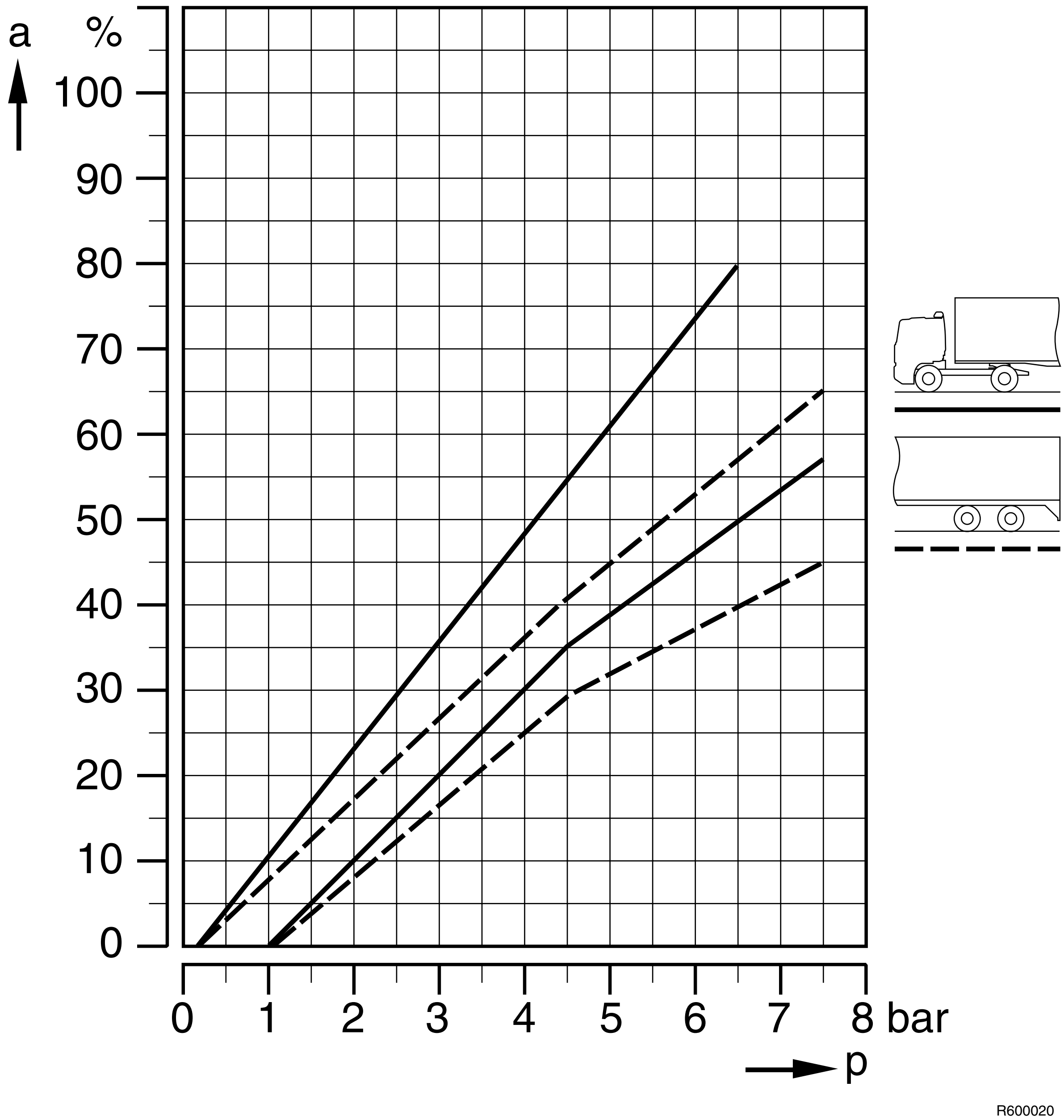




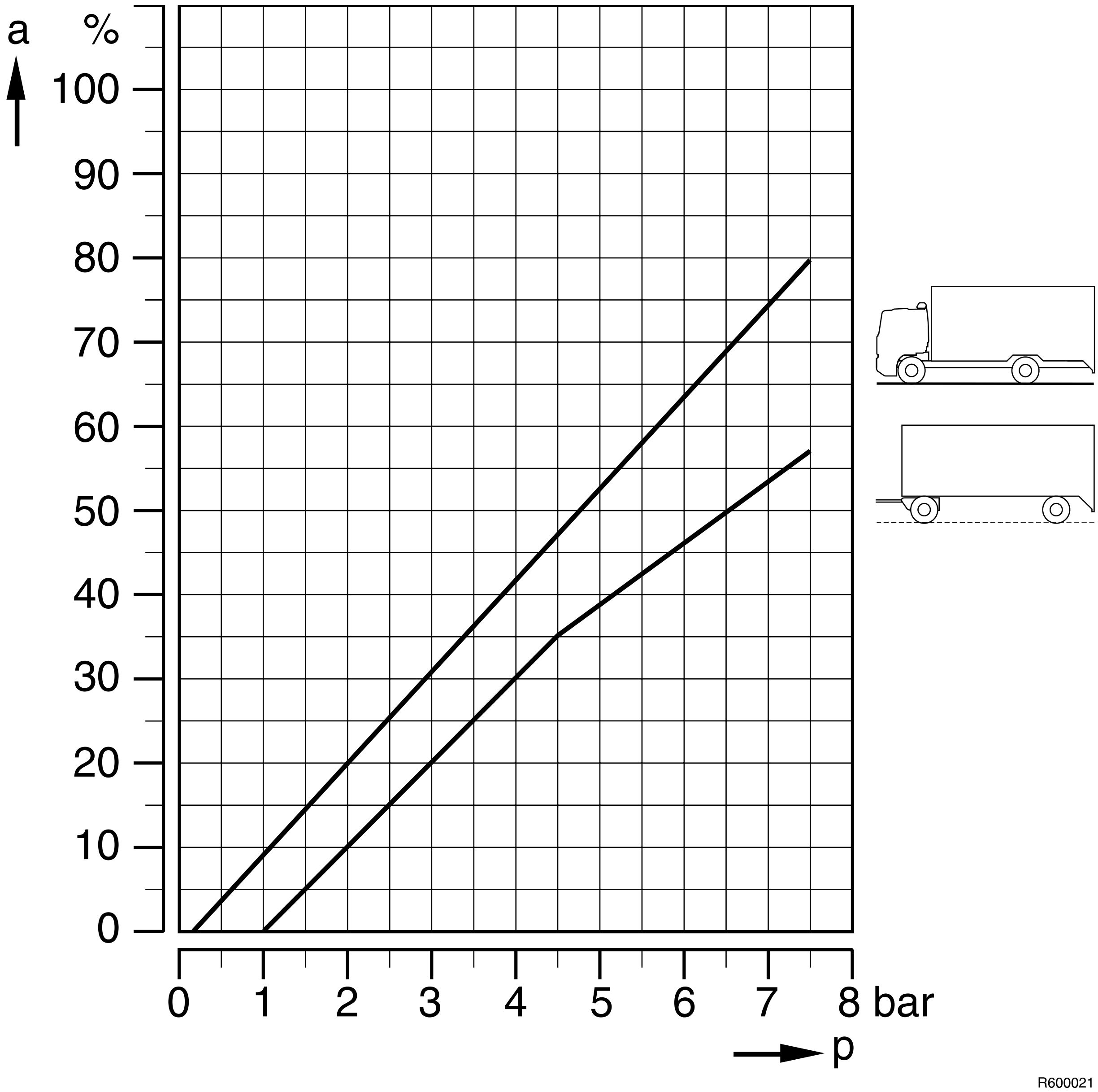

Example of a diagram for a tractor/(semi-)trailer combination with correct brake balance.



### 2.4 EC BAND FOR A LADEN TRACTOR/SEMI-TRAILER COMBINATION



## 2.5 EC BAND FOR A LADEN TRUCK/TRAILER COMBINATION




**For mid-axle trailers equipped with air brakes:**
The permissible ratio between the deceleration and the pressure at the yellow coupling head of a laden mid-axle trailer with air brakes should be within the two areas derived from the EC band for a laden truck/trailer combination, for which the vertical scale has been multiplied by 0.95.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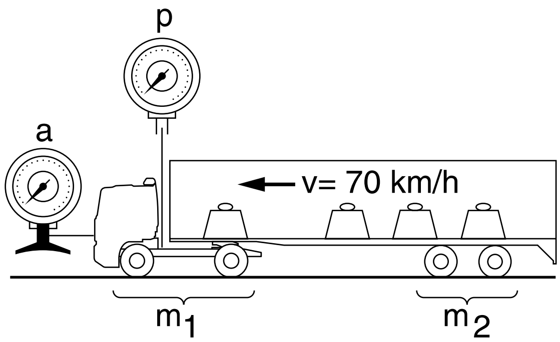
## 2.6 MEASURING WITH A DECELEROMETER

If a dynamometer is not available and the tractor is equipped with an independent (semi-)trailer brake, a decelerometer can be used to check the combination's brake balance.
If an independent (semi-)trailer brake valve is not present either, one can be temporarily installed.

Note the following points when carrying out a brake test:
- Testing the brakes, may not cause unexpected movements of the vehicle on the road.
- When driving straight ahead, check the vehicle for directional stability.
- Check the operation of warning lamps and instruments on the instrument panel.
- To obtain a proper braking deceleration, a dry road surface is recommended.
- The wheels should not lock during the brake test.

1. Determine the weight of the coupled laden tractor ($m_1$) and the weight on the (semi-) trailer's axles ($m_2$).
2. Install the decelerometer in the cab according to the supplier's instructions.
3. Using a hose, connect a pressure gauge to the service line (tractor/trailer or truck/semi-trailer). For this purpose, install a test connection directly before, in, or directly behind the line with the yellow coupling head. Put the pressure gauge in the cab and secure the hose at several points to avoid any problems.

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**Observe road-safety rules during the following actions!**

4. Warm up the brakes by braking with moderate pressure while driving.
5. Increase the vehicle speed to approximately 70 km/h.
6. Depress the brake pedal until the pressure gauge reading is 3 bar.
7. Meanwhile, read the braking deceleration (if not using a ‘writing’ decelerometer).
8. Repeat the procedure as from point 5 with identical pressure and speed, but now only using the independent (semi-)trailer brakes.

- The first reading gives an indication of the total braking deceleration of the combination, whereby the braking deceleration of the total weight is achieved by all wheel brakes together.
- The second reading displays a braking deceleration whereby the (semi-)trailer brakes must decelerate the weight of the (semi-) trailer that of the tractor. This value will therefore be very low.
  To calculate the actual braking performance of the (semi-)trailer only, this reading must be multiplied by the gross combination weight divided by the (semi-)trailer weight:

$$\text{(SEMI-)TRAILER DECELERATION} = \text{DECELERATION USING (SEMI-)TRAILER BRAKES} \times \frac{\text{gross weight}}{\text{drawn-vehicle weight}}$$

On a combination with a good braking performance, the total deceleration and the calculated (semi-)trailer deceleration will be about the same.
If this is not the case, increase (or decrease) the braking-pressure advance and repeat both deceleration tests.

To obtain a more precise braking performance comparison, the above tests can also be conducted at various braking pressures.

**Note:**
The graphs used for dynamometer tests are not valid for decelerometer tests.


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