


Air Braking Systems

for Agricultural and Forestry
Vehicles - Error Detection



2nd Edition

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Vehicle Control Systems

An American Standard Company

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Explanation of symbols

WARNING




Potential hazard situation which can cause serious personal injury or death if the safety instruction is not observed.

CAUTION



Potential hazard situations that can cause minor or moderate personal injury if the safety instruction is not observed.

 Additional instructions, information or tips that you should always observe.

- List
- Step

1 General safety instructions

Air Braking Systems for Agricultural and Forestry Vehicles

CAUTION

When disconnecting the trailer, always disconnect the red hose coupling (supply) first. This way you make sure that the trailer cannot move away.

When you have a trailer attached to the tractor, do not move off before the pressure gauge in the driver's cab shows a pressure of 5.0 bar.

When driving the tractor without a trailer, the covers of the tractor's hose couplings must be closed.

When the trailer is parked, the covers of its hose couplings also have to be closed or placed in the unused hose couplings.

Before connecting the trailer, please make sure that the sealing rings of the hose couplings are not damaged or dirty. The seals must be clean and undamaged.

Before moving off with one or more trailers, the lever of the trailer's empty/load valve must be moved to the right position for the load carried. (empty, ½ load, laden)

Regularly check the tension of the compressor's drive belt. Please follow the vehicle manufacturer's instructions !

Trailers designed for speeds of more than 25 k.p.h. are subject to the tests as defined in Section 29, Annex VIII of the Federal Motor Vehicle Construction and Use Regulation.

When acquiring a new tractor with a permissible top speed in excess of 40 k.p.h. (and up to 60 k.p.h.), the trailers which are to be used with this tractor and which have a permissible top speed of no more than 25 k.p.h. should be taken to an authorized workshop for proper setting of the brakes. A test run with laden and unladen trailers is recommended.

The maximum permissible weight of the trailer must **never** be exceeded.

The speed of the tractor-trailer combination must not exceed the permissible top speed of the slowest part of that combination.

Any adjustments on the braking system must be made by an authorized workshop.

2 Installation of Pipes

In Air Braking Systems for Tractors and Trailers

Before installing plastic pipes, make sure that the insert sleeves are in place.

Install pipes following the WABCO diagram.

Before installing the pipes, they should be blown out with clean air to help prevent dirt getting into the system.

Using colour coding for the pipes may make their identification easier.

Pipes and air lines must be fastened to suitable locations using cable fasteners, clips or chassis clamps.

When installing pipes, make sure that they are located in such a way that they do not chafe in their clamps or brackets, or are squeezed against other components. It is important that no water pockets can form.

The lowest point in any air braking system should be the drain valve.

On trailers, select the lengths of hoses from the towbar to the tractor (or to the first trailer) in such a way that the towbar can be turned through 75 degrees either way.

The hoses leading to the brake chambers must be connected in such a way that the control line is not lower than the cylinder body (to prevent contact with the ground).

For towbar trailers, a hose connection should be used from the centre of the live ring to the cylinder(s). The hoses must be long enough to permit the towbar to be turned through 75 degrees either way without the hoses being twisted.

Steel piping should be used on the towbar wherever possible to help prevent the hose being damaged in this area.

No drilling or welding is permitted on the towbar !!

Any welding work on the axles requires strict adherence to the axle manufacturer's welding instructions !!

When doing welding work, make sure that the plastic pipes or hoses are not damaged !!

After installation, all pipes and hoses must be checked to make sure they are firmly in place and do not chafe. Any leakage must be eliminated.

3 Maintenance Instructions

For Tractors and Trailers used in Agriculture and Forestry

3.1 Tractor

After a short running-in period (approx. 1 to 2 hours), check v-belt tension of the compressor drive and adjust as required.

Special attention must be paid to the mounting and maintenance instructions for compressors (see brochures 826 001 099 3).

Regularly check the screws on the compressor console for tightness.

The air reservoir must be drained **daily** using the drain valve.

Quarterly Maintenance

The outside of the air reservoir must be cleaned and any corrosion removed. If the air reservoir shows any damage it must be replaced.

Check the intake line of the compressor and clean the intake filter (engine filter) as required

All screwed connections of the tractor's hydraulic brakes or air braking system must be checked for tightness.

Check pipes and hoses for damage.

Any leakage, chafed sections and other damage must be eliminated.

Make sure the stoplight switch is working properly.

Check the pressure gauge on the dashboard.

Check the filling capacity in the compensating reservoir of the hydraulic wheel brakes and top up with fluid as required, following the tractor manufacturer's instructions.

3.2 Trailer vehicles

The reservoirs must be drained **daily** using the drain valves.

Quarterly Maintenance

Clean pipe filters or replace.

If the stroke of the brake cylinders on the trailer is 2/3 of the total stroke, the brake needs to be readjusted.

The brake lever and the linkage must move freely and easily, grease as required

The bellows must be in good condition and in place.

Check all pipes and hoses, eliminating any leakage or damage.

Check the pressures at the cylinders according to the test instructions.

4 Test Instructions

for Tractors Used in Agriculture and Forestry

CAUTION Turn off ignition before starting repairs.
Secure vehicle against rolling away.



- **Attach a visible note on steering wheel saying that repair work is being performed on vehicle.**
- **Take reading for unloader's cut-out pressure.**
- Connect pressure gauge to supply hose coupling (red). (If a high-pressure system is being used, connect > 8.5 bar to reservoir.)
- Fill compressed air system up to cut-out pressure. **Required value: depending on the kind of unloader (7.0 to 8.1 ^{+0.2} bar)**
recommended equipment:
calibrated pressure gauge
(e. g. 16 bar) 453 004 007 0
test hose (white) 452 600 004 0
test hose (blue) 452 600 003 0
2 x hose coupling (twin-line) 452 200 000 0
1 x hose coupling (single line) 452 201 010 0
- **Leakage test**
- Connect pressure gauge to supply hose coupling (red).
- Fill system up to cut-out pressure. Switch off the engine.
- There is no leakage in the system **if the drop in pressure is less than 0.2 bar over a period of 5 minutes.**
- While the brakes are actuated (hand brake = on), no notable drop in pressure may result.
- **Measurement the filling time**
- Pressureless system.
- Start engine, leaving it running at nominal speed until the unloader's cut-out pressure has been reached. Make a note of the time this takes.
Example for reference value:
With a compressor of 159 cm³, a reservoir of 20 litres and a nominal speed of 2800 min⁻¹, a filling time of 3 minutes should not be exceeded (or the manufacturer's data apply).
- **Checking reservoir pressure and pressure gauge.**

- Connect pressure gauge to reservoir.
- Compare the pressure in the reservoir with the pressure reading from the pressure gauge in the driver's cab.
- **Checking the twin-line braking system.**
- Fill system up to cut-out pressure.
- Release parking brake.
- Connect pressure gauge to control hose coupling (yellow). **Reference value: 0.0 bar**
- Gradually and smoothly actuate foot brake all the way. Pressure must rise gradually and react to the pressure applied to the foot brake.
Reference value: (depending on supply pressure) 7.0 to 8.1 ^{+0.2} bar
- While smoothly and gradually increasing the pressure on the foot brake, make sure that the pressure also rises smoothly.
- Release foot brake.
- Apply parking brake.
Reference value: 7.0 to 8.1 ^{+0.2} bar
- **Checking the single-line braking system.**
- Fill system up to cut-out pressure.
- Release parking brake.
- Connect pressure gauge to hose couplings single line (black) and twin line (yellow).
Reference value: 4.8 to 5.6 bar
- Apply foot brake steadily. The pressure must be reduced to 0.0 bar by continuous, sensitive braking.
Reference value:
After full application of the brakes 0.0 bar (hose coupling single line), a braking pressure of 1.0 bar (control hose coupling -yellow-) the pressure at the hose coupling (single line) must fall by between 0.5 and 2.5 bar, (depending on the type of trailer control valve used).
- Release foot brake.
- Apply parking brake.
Reference value: 0.0 bar (at single line hose coupling - black)
- **Checking the pressure limiting valve (high-pressure systems only)**
- Connect pressure gauge to supply hose coupling (red).

- Fill the system up to the cut-out pressure of the unloader.
- Switch off the engine.
- Check the pressure at the supply hose coupling.
Reference value: 7.0 to 8.1 ^{+0.2} bar
- **Checking the response behaviour of a twin-line braking system.**
- Connect pressure gauge to control hose coupling (yellow).
- Fill the air braking system up to the cut-out pressure of the unloader.
- With the brake pedals locked together, they are pushed down in the test run until the braking performance is perceived.
Reference value: depending on the variant of trailer control valve used, a rise in pressure must be noted on the pressure gauge.
- **Chronometry (to be done by authorized workshop personnel only !)**

After functional testing, any new system must be presented to the M.O.T. authorities for inspection and approval.

4.1 Leakage test

- Check all ports, pipes, hoses and screwed unions for leakage.
- Eliminate any leakage. If there is any sign of chafing, this must be remedied. Porous or defective hoses must be replaced.
- The system is considered to have no leakage if any fall in pressure over a period of 5 minutes is no more than 0.2 bar.

- **Checking the Pressure in the Reservoir** (for twin-line braking systems)
- **Reference value: 6.0 to 8.1 ^{+0.2} bar**
- **Checking the Brake Cylinder Pressure** (for twin-line braking systems)
- Connect a pressure gauge to the test connection of the brake cylinder.
Reference value:

brakes not actuated	0.0 bar
*) hand lever in 'full load' position between	6.0 to 8.1 bar
*) hand lever in 'half load' position between	3.6 to 4.2 bar
*) hand lever in 'empty' position between	2.0 to 2.3 bar

- *) These are approximate values. For pressure settings, please refer to the vehicle manufacturer's documents. If a load-sensing valve has been fitted, these values should be checked following the vehicle manufacturer's instructions. (load-sensing valve plate on the trailer).
- **Checking the Stroke of the Brake Cylinders.**
- In full brake application, the trailer's brake cylinders may not project by more than between 1/2 and 2/3 of the possible total stroke. If the stroke is greater, the brakes need to be adjusted.
- **Visually Checking the Brake Cylinders.**
- The dust sleeves or bellows must be checked for damage. Any damaged parts must be replaced.

Repair kits and reconditioned units are available for many types of equipment. Please contact your workshop or one of our WABCO Service Direct teams.

4.2 Testing Table

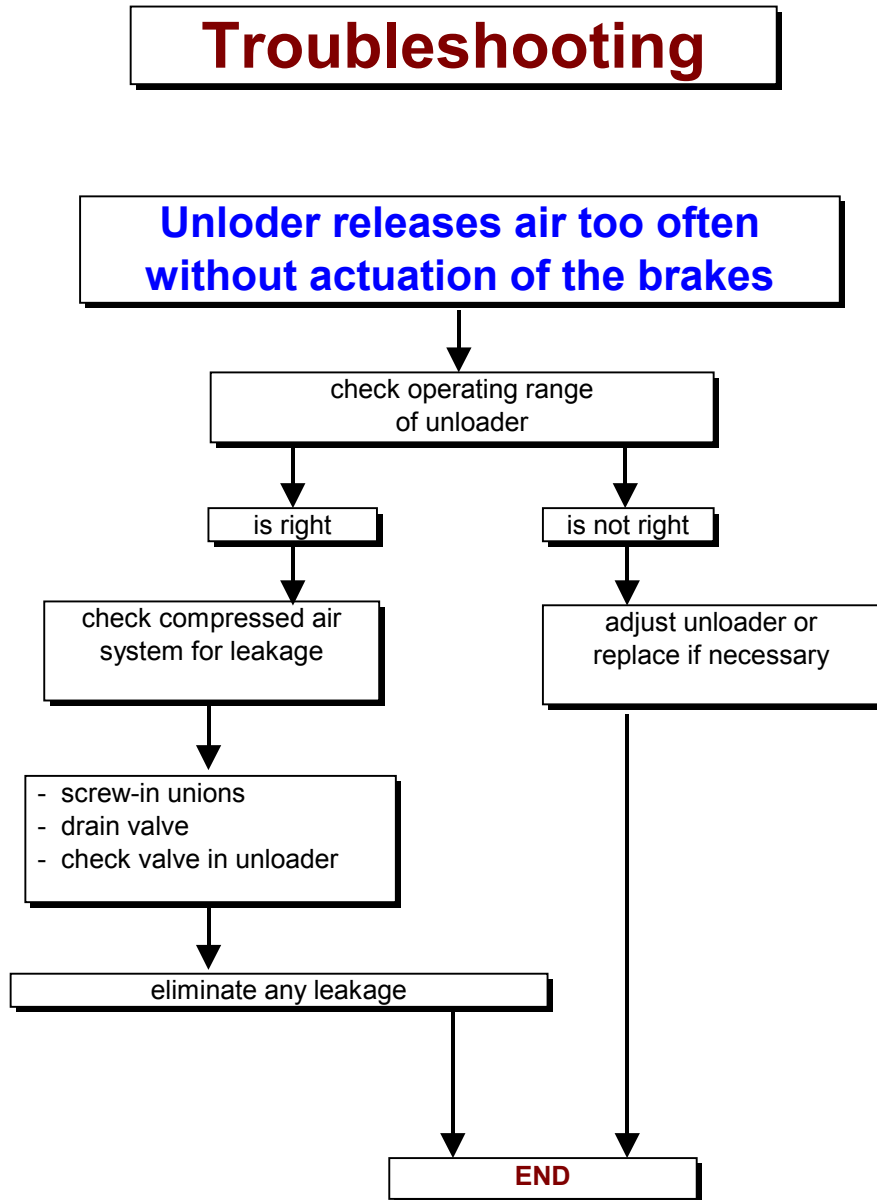
Tractor vehicle					Trailer	
Brake	Position	Measuring point *) HC	Pressure at hose coupling (bar)		Pressure at air reservoir (bar)	Pressure at brake cylinder (bar) #) see comment
			Reference values	Actual values		
Single line						
Foot brake	not actuated	1 - line	4.8 to 5.6		4.8 to 5.6	0.0
	fully actuated	1 - line	0.0		4.8 to 5.6	4.8 to 5.6
Hand brake	released		4.8 to 5.6		4.8 to 5.6	0.0
	engaged		0.0		4.8 to 5.6	4.8 to 5.6
Twin line						
Foot brake	not actuated	supply	7.0 to 8.1		7.0 to 8.1	0.0
		brake	0.0			
	fully actuated	supply	7.0 to 8.1		7.0 to 8.1	7.0 to 8.1
		brake	7.0 to 8.1			
Hand brake	released	supply	7.0 to 8.1		7.0 to 8.1	0.0
		brake	0.0			
	engaged	supply	7.0 to 8.1		7.0 to 8.1	7.0 to 8.1
		brake	7.0 to 8.1			

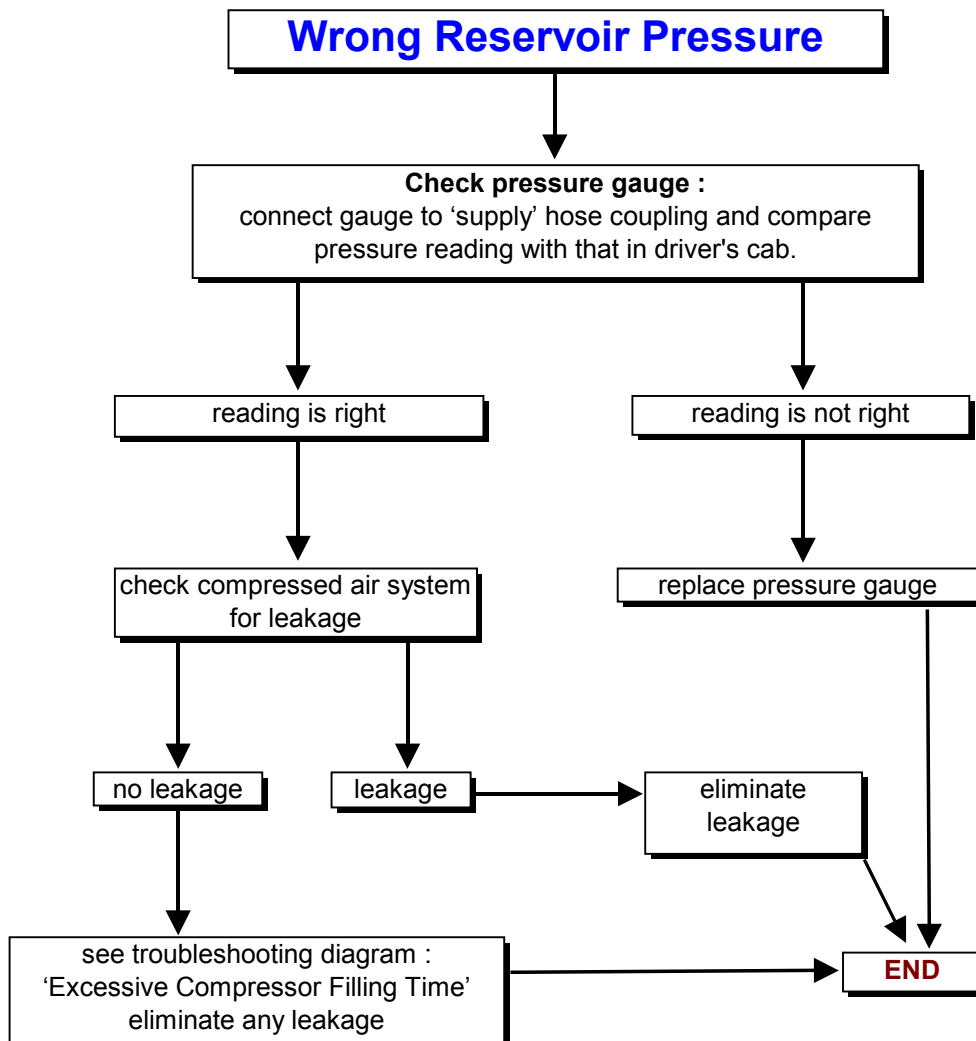
*) HC ⇒ Hose Coupling

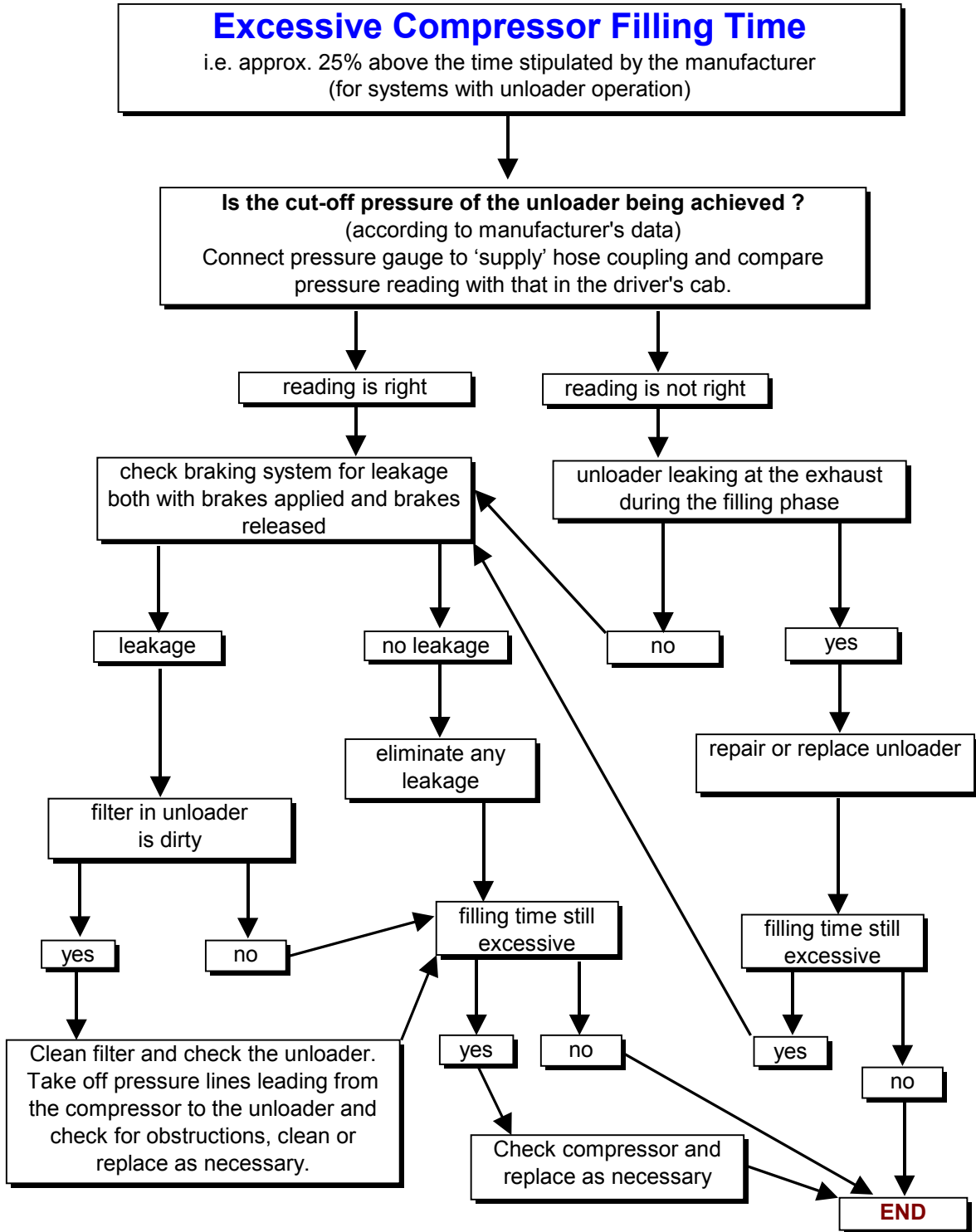
#) with hand lever setting at “fully load”

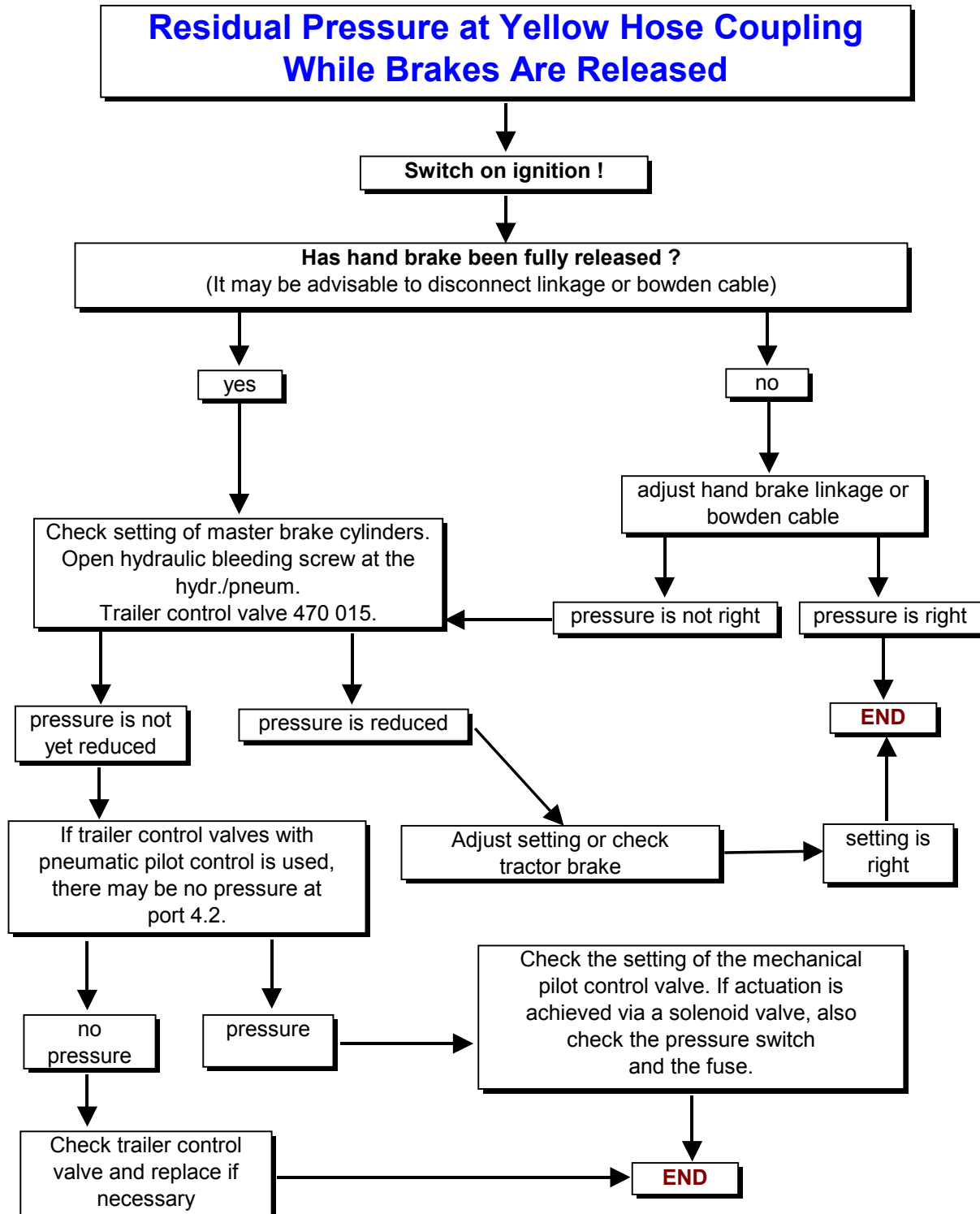
colours of hose couplings: **Supply = red**
 Brake = yellow
 Single line = black

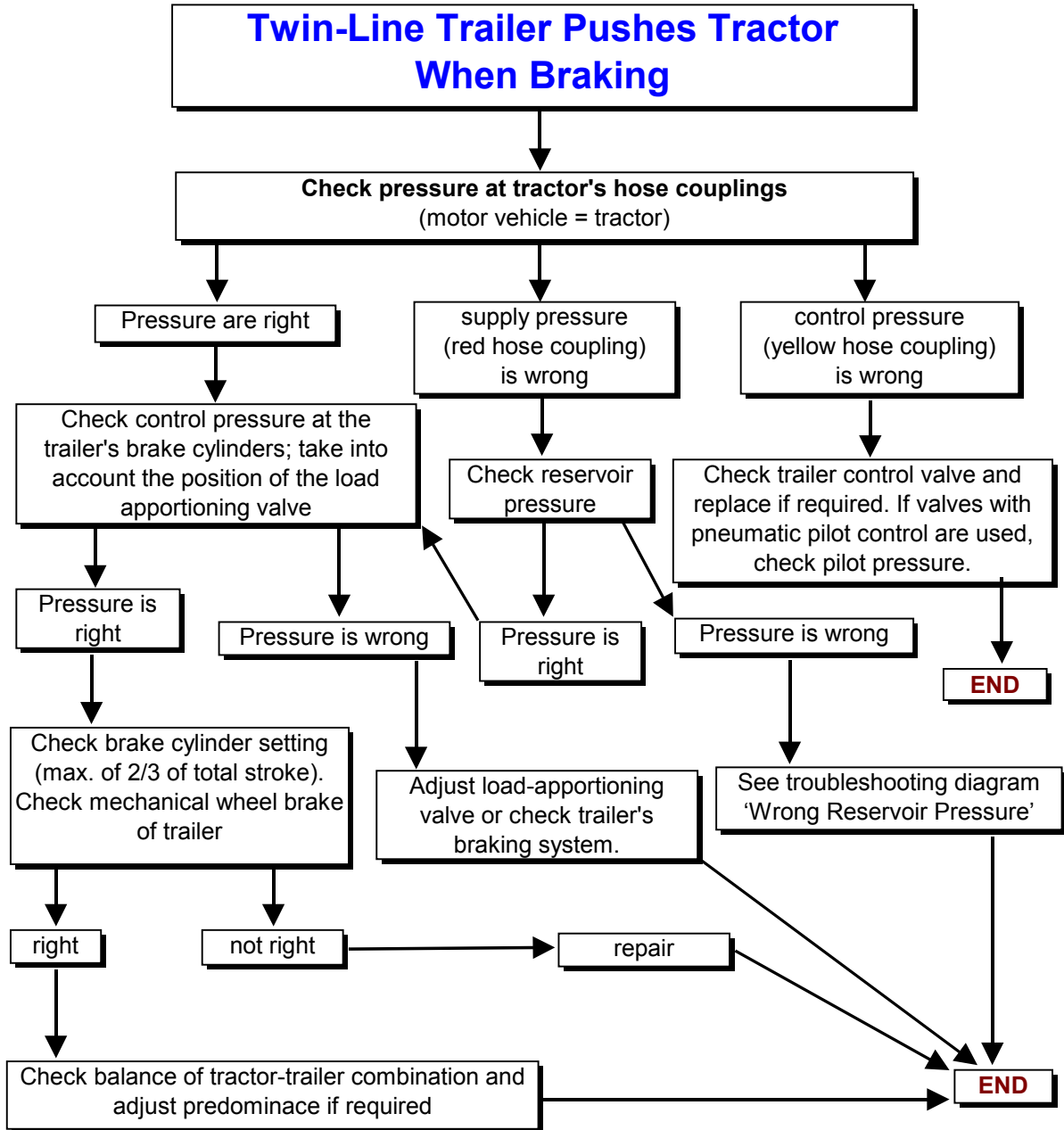
4.3 Troubleshooting

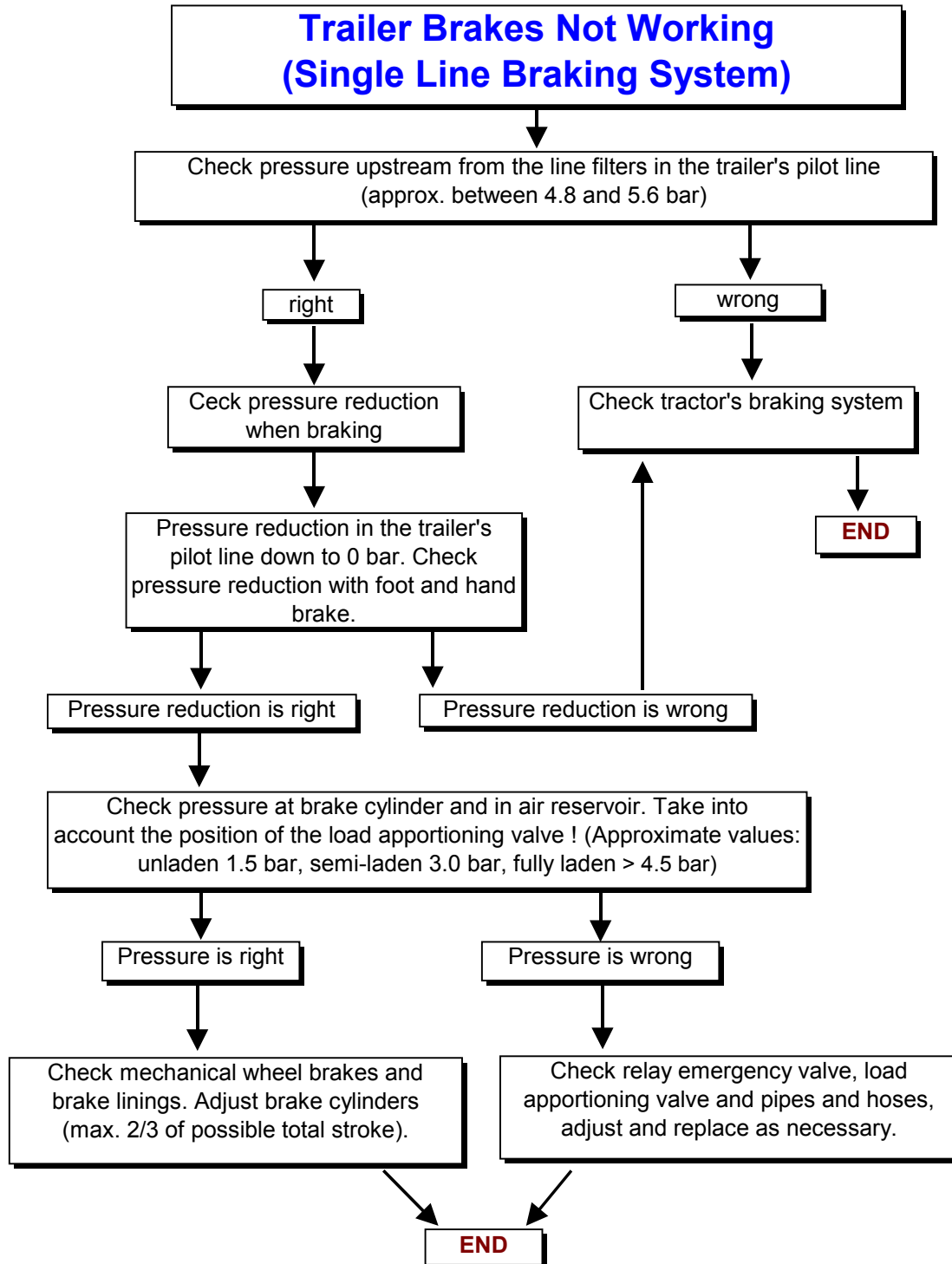


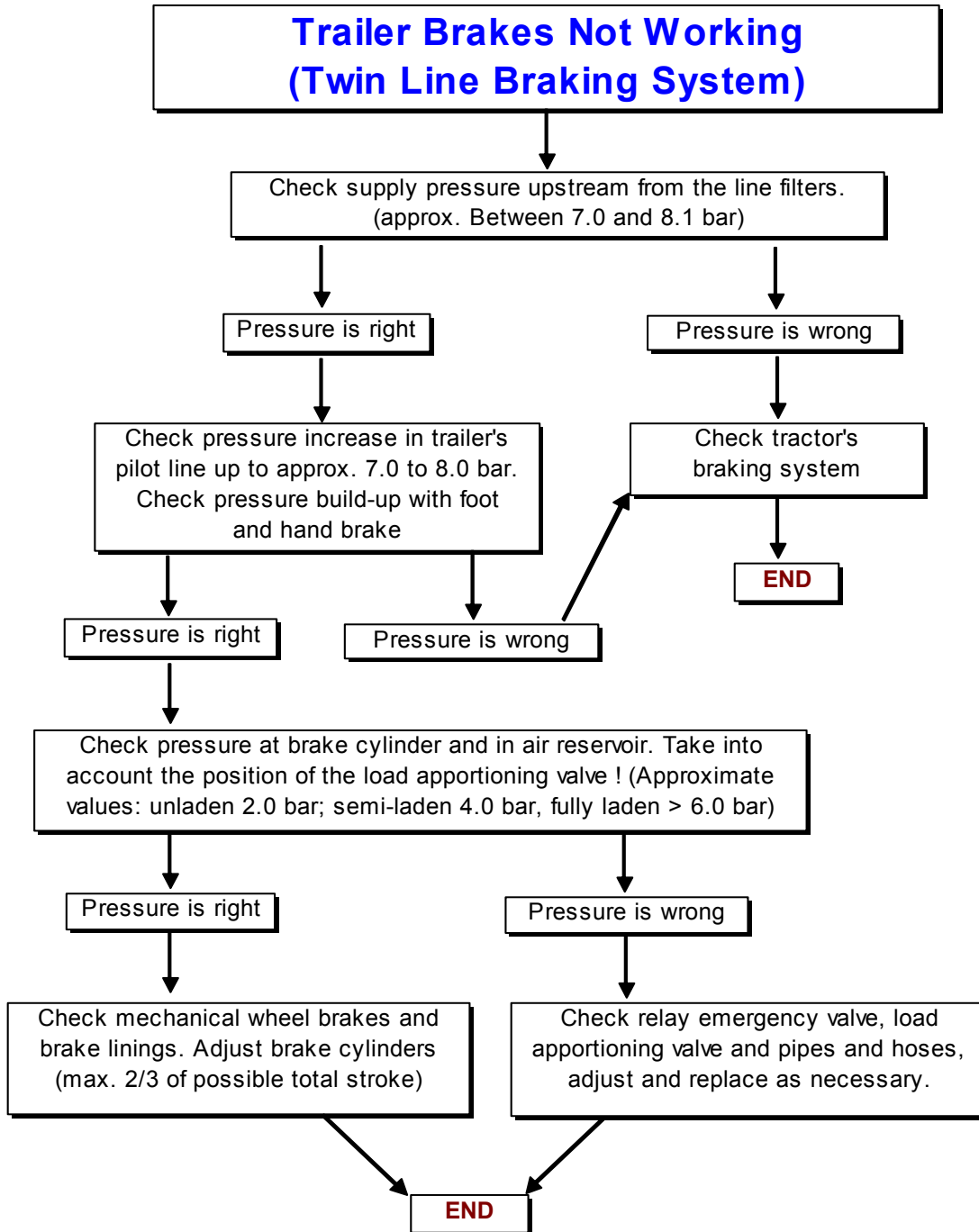




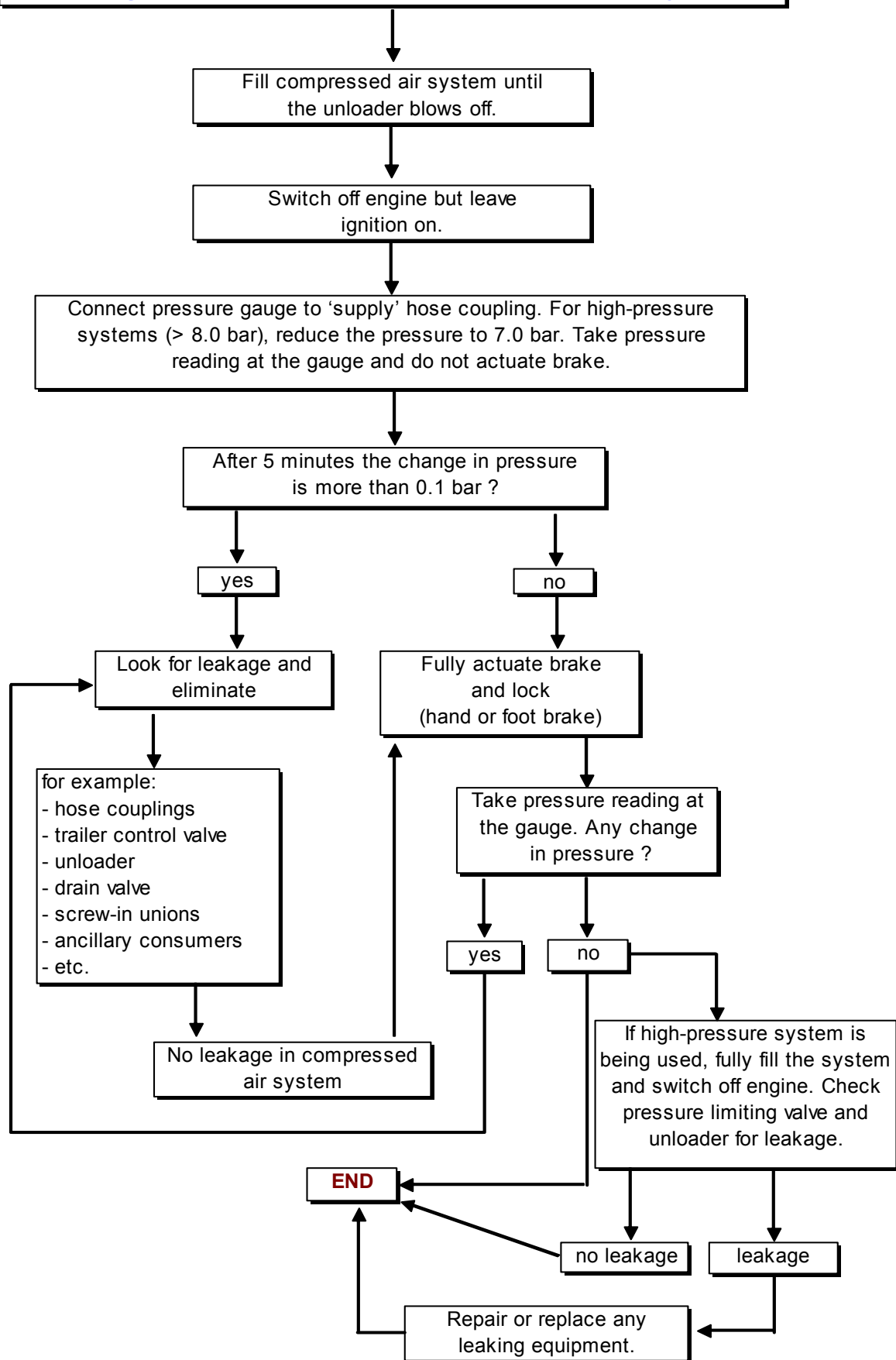








Leakage in Tractor's Compressed Air System

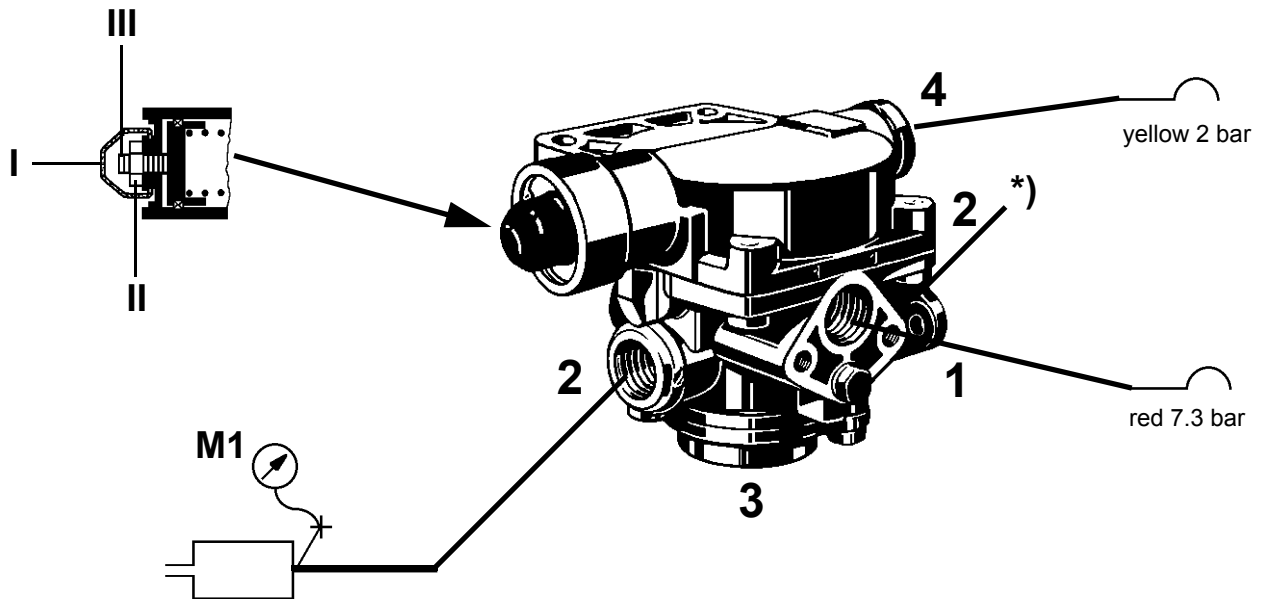


4.4 Hints for Troubleshooting

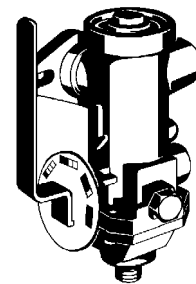
Questions + Answers	
I want to fit an air compression system on my tractor. What do I have to do ?	You tell us which type of tractor you have and we will give you the technical documents required, such as parts list and diagram.
I want to fit an air braking system on my trailer. What do I have to do ?	You let us have the technical data for the trailer and tell us which wheel brakes it uses. We produce a brake calculation for you.
Which legal requirements do I have to consider ?	Our brochure 'Retrofitting Air Braking Systems in Vehicles Used for Agriculture and Forestry As Per Section 41 Federal Motor Vehicle C.U.R.' tells you everything you need to know.
Do I have to have the tractor inspected by the M.O.T. after installing an air compression system ?	After fitting the air compression system, you have to have the vehicle inspected by the M.O.T. since otherwise the tractor's type approval will be void.
Which documents do I have to take with me when I first have my air braking system inspected by the M.O.T. ?	Please take the WABCO diagram, the parts list and the vehicle title (in which the system will be recorded).
Where can I go for support if I have any problems with my air braking system ?	The staff of our WABCO Service Direct teams will be glad to help you.
Can I buy repair kits or reconditioned equipment for repairs ?	For many types of equipment you can buy spares or repair kits with descriptions, or inexpensive repair-exchange units.
Can I repair any defective equipment myself, and am I allowed to do so ?	Any jobs beyond repairs with spares kits have to be done by authorized workshop staff.
What information materials are available on air braking systems ?	Our catalogue describes all components and their functions, other brochures give details on installation, testing and advice on maintenance and troubleshooting.
Can I take part in any training courses on air braking systems for vehicles used in forestry and agriculture ?	Ask your farmers' co-operative or WABCO's Service Direct teams. We offer such courses if there is a sufficient number of participants.

5 Adjustment of Trailer's Predominance on Relay Emergency Valve 971 002 150 0

5.1 (971 002 570 0: Combination relay emergency valve and load sensing valve)



- Remove rubber cap **I**.
- Unscrew counter nut **II**.
- Apply full supply pressure of 7.3 bar to port 1 (red hose coupling).
- Input a pressure of 2.0 bar at port 4 (yellow hose coupling).
- The pressure gauge (M1) connected to the test connection of the cylinder must show a pressure of $2^{+0.2}$ bar.
- By adjusting the Allen screw **III** the predominance can be adjusted to a max. of 1 bar. The load sensing valve at port 2 *) must be at full load.
- Tighten counter-nut **II** replace rubber cap **I**.



(When moving the vehicle, the load sensing valve must be set to the right position for the load carried on the trailer)

5.2 Change to the pressure settings for the load sensing valve 475 604 ... 0

! To you correct the load sensing valve default settings made in the plant, you should proceed as follows:

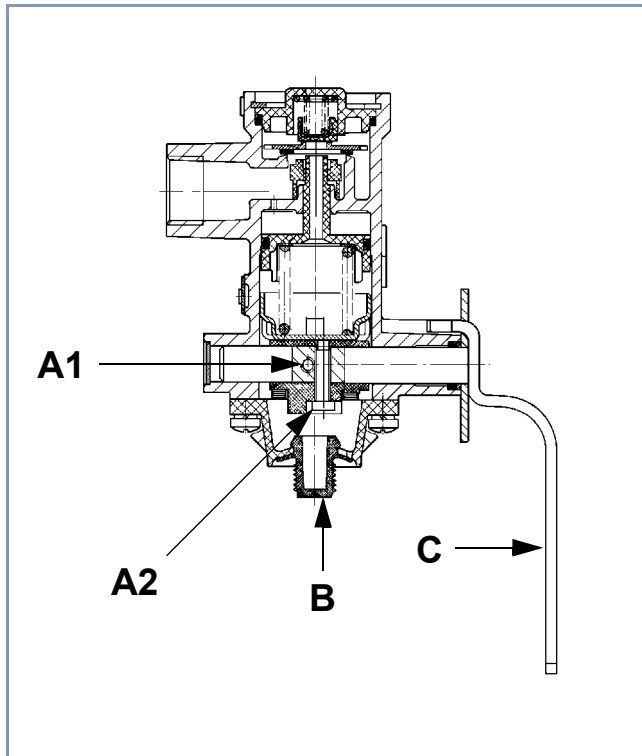


Fig. 1 Sectional view of the load sensing valve

- To set the **unladen pressure** determined in the WABCO brake calculation, adjusting screw "A 1" has to be adjusted.
- To do so, lever "C" must be set to "Full load". You must remove protective plug "B". You can now reach adjusting screw "A 1" with a hexagonal key.
- **Loosening** the adjusting screw results in an **increase**, **tightening** it results in a **reduction** of the pressure that can be measured in the cylinders.
- In the same way, you can also change the pressure for the "½ load" setting.
- To do so, you need to move the "C" lever to the "Release" position and make the correction to adjusting screw "A 2".

- In case of controllers without a "Release" setting, you reach adjusting screw "A 2" by setting the controller to the "Unladen" setting and removing the screw plug which only sits at the side of the body in these variants.

! When you adjust screws "A 1 or A 2" the controller must always been in an pressureless state.

5.3 Blocking the "UNLADEN" setting for manual control devices of series 475 604 ... 0

If the brake calculation resulted in an unladen brake pressure of more than 2.8 bar and the half-laden setting replaces the unladen setting, an example for blocking the unladen setting is illustrated below.

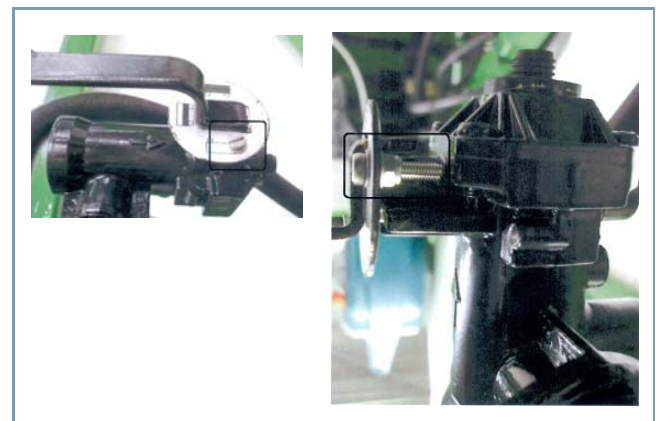


Fig. 2 Example for blocking the unladen position

WABCO -Bremsberechnung Nr:		vom	Seite 2
Bremschema-Nr.:			
maximaler Systemdruck: 8.5 bar			
Achse 1:			
Ventil 1:	971 002 300 0	WABCO	oder 971 002 150 0
	Anhängerbremsventil		pein 2.0 bar paus 2.0 bar
Ventil 2:	475 604 ... 0	WABCO	leer pab 3,5 bar
	Handregler		
Prüfung Typ I (zI = 0,07) für rdyn min : Achse1			
bei pm 1,0 bar => pzyl in bar : 1,0			

Fig. 3 Sample brake calculation

5.4 Alternatives for trailer control valve
470 003 000 0

5.4.1 Short description

! Trailer control valve 470 003 000 0 (or 470 003 000 7) is no longer available.

Alternatively you can use trailer control valve 470 015 010 0 (pos. 9) in connection with trailer control valve 471 200 008 0 (pos. 8).

Control valve 470 015 010 0 is controlled hydraulically, just the old control valve 470 003 000 0. However, it builds up pressure rather than reducing it.

Hence trailer control valve 471 200 008 0 must be used as well. This valve reduces the pressure and also reduces the supply pressure to 5.3 bar (you can see the pressure on the black coupling head).

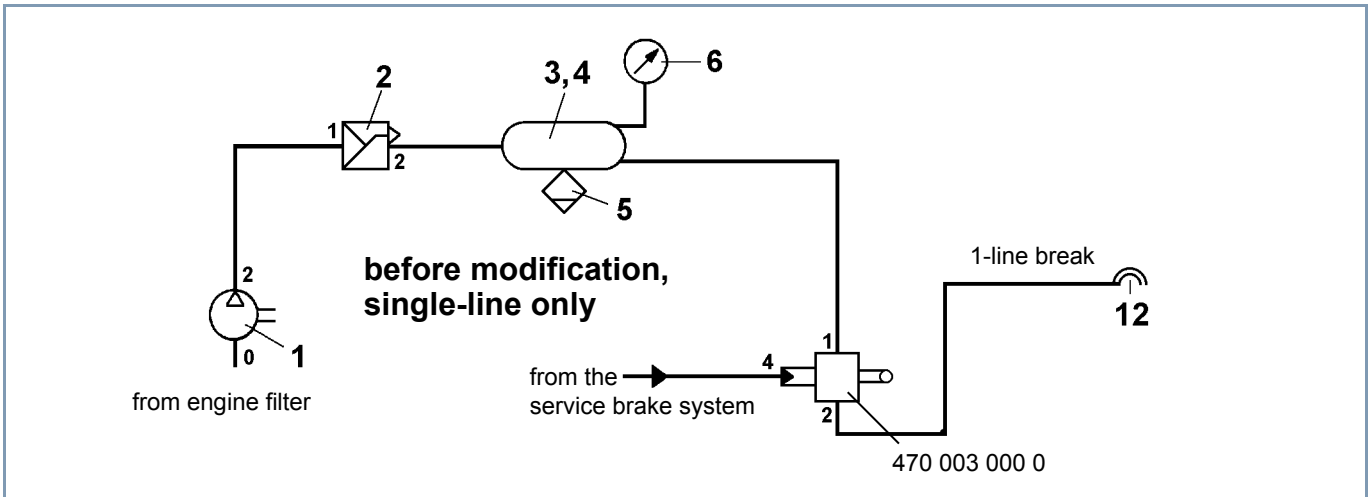


Fig. 4 Diagram 1 (shows what the system used to look like)

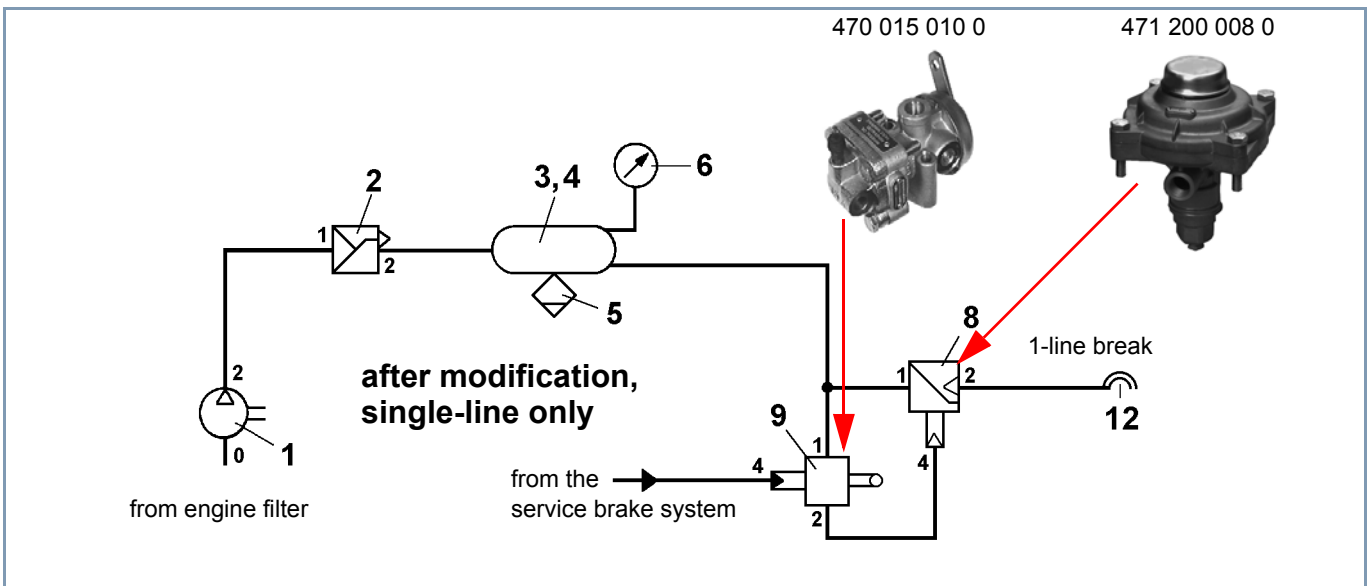


Fig. 5 Diagram 2 (shows the alternative system as a pure one-line system, as it used to be installed)

In braking, trailer control valve 470 015 010 0 is controlled hydraulically and outputs pneumatic pressure to port 4 of trailer control valve 471 200 008 0 in proportion to the hydraulic input pressure.

The supply pressure is passed to both trailer control valves via port 1.

In control valve 471 200 008 0 the supply pressure is reduced to 5.3 bar.

In braking, the pressure at the coupling head (black) is reduced according to the pneumatic input pressure at port 4 of trailer control valve 471 200 008 0.

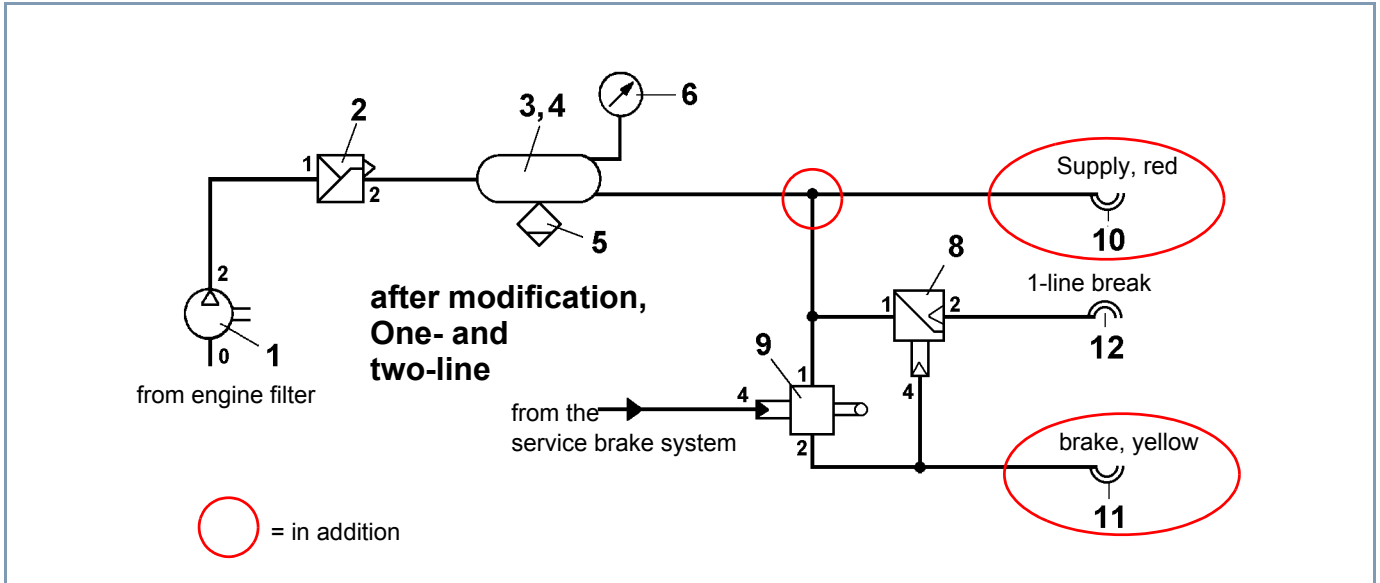


Fig. 6 Diagram 3 (shows the alternative system as a **combined one- and two-line system**)

This makes it possible to also tow trailer vehicles with two-line braking systems (which are common these days).

The only things required in addition are :

- 1x T fitting for the trailer control valve and the coupling head, supply
- 1x coupling head, supply 952 200 221 0 (red)
- 1x coupling head, brake 952 200 222 0 (yellow)

5.5 Conversion of one-line braking system to two-line braking system in trailer vehicle

! Replace position 4 with trailer brake valve 971 002 150 0 (reattach the manual control device)

– The following are required in addition:

- P. 6: Pressure limiting valve 475 010 003 0 (5.7 ^{+0.3} bar)
- P. 1: Coupling header with filter 952 201 004 0 (red)
- P. 2: Coupling header with filter 952 201 003 0 (yellow)

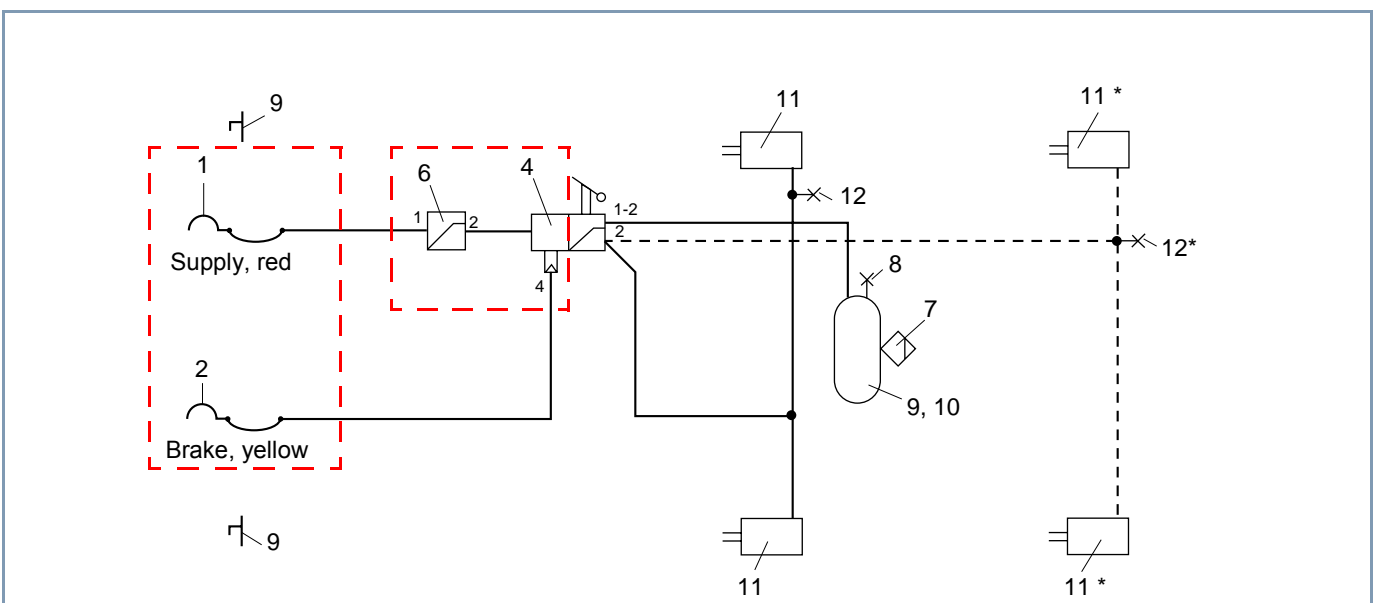



Fig. 7 2 axle trailer with manual control device

 Before you start the read all safety instructions thoroughly.



General safety instructions

- Only specialised personnel with specific system knowledge are authorised to carry out tests on the device.
- Always comply with the company and national accident prevention/health & safety regulations.
- Always wear the required protective clothing such as protective footwear, protective goggles, etc.
- Do not install a repaired device in the vehicle unless it has passed the following tests.
- Never install a leaking or damaged device on the vehicle. This could cause an accident.

Equipment/tools required

- Test bench 435 197 000 0 or adequate testing equipment
- Test hoses
- Matching test ports
- Test template 899 709 110 2
- Nozzle Ø 0.8
- Soapsuds and brush

Additional documents required

- Test Bench 435 197 000 0 - Operating Instructions
- General Repair and Test Information 820 001 074 3
- Outline Drawings




The documents are available on the WABCO website <http://www.wabco-auto.com> - simply enter the product or document number in INFORM.

Hints for testing

- While testing the device always observe the test instruction
- Only start testing after you have read and understood all information required for testing.
- Test the device only on a calibrated test bench.
- In case of doubt, use test values specified by the vehicle manufacturer.
- Perform the following test steps in the specified order.

Preparations

1 – Place device on workbench.

CAUTION **Danger of injury due to the device falling**
 Ensure that the device cannot roll or drop off the workbench. Otherwise your feet could be injured.

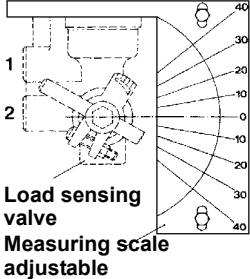
External evaluation

2 – Inspect device for external damage.


3 – Check all ports of the device for contamination by carrying out a visual inspection.

Preparations

4 – Clamp the test template into the bench vice.
 – Affix the device in the test template and align the zero point of the measurement scale to the centre point of the shaft of the load sensing valve.



5 – Connect device to test bench 435 197 000 0 or adequate test facility (see testing diagram).

CAUTION **Danger of injury due to hose coming loose, possibly with a loud bang**
 Make sure that plug-in connections on the test bench / testing equipment and on the device are safely plugged. A hose that comes loose may cause injury.

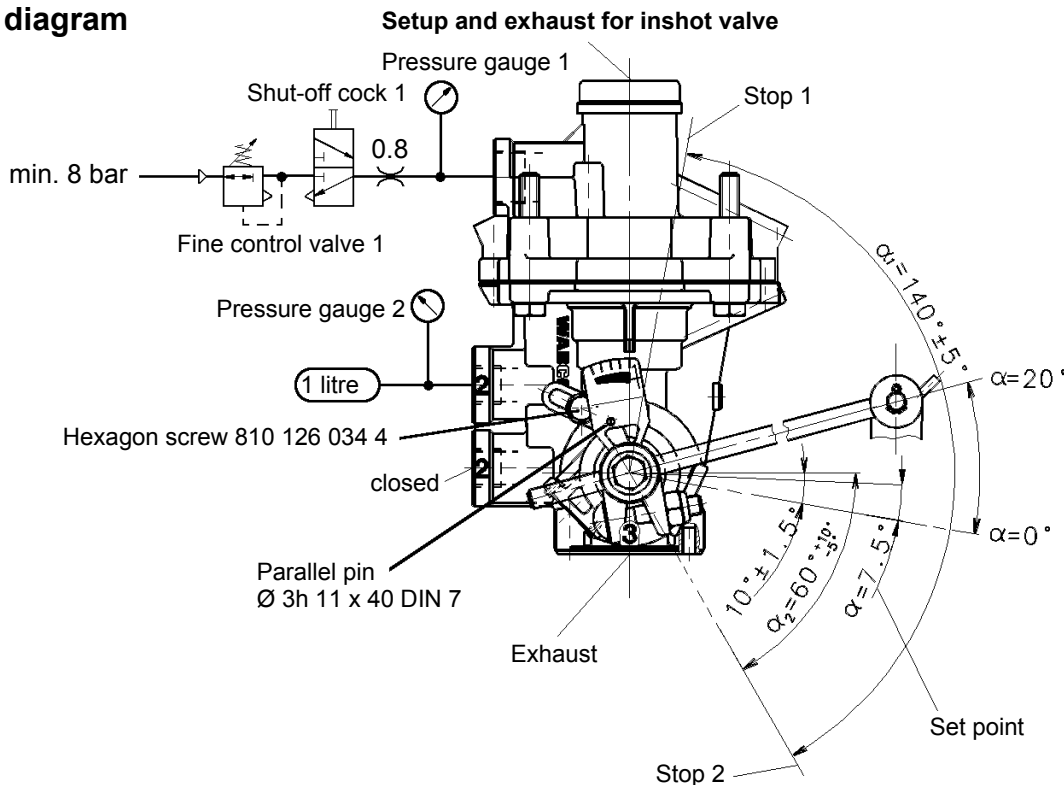
! For the relevant supply pressure, refer to proposal drawing.

! **Test Bench 435 197 000 0:** Ensure that the stopcocks are in a correct normal position.

Normal position of stopcocks on the test bench 435 197 000 0

Shut-off cocks	R	B	C	F	L	V	2	3	4	6	7	11	12	21	22
on	x											x			
off		x	x	x	x	x	x	x	x	x	x		x	x	x

Test diagram



Testing

No.	Test step	Default value		Test value	Comment
		Lever pos. [°]	M 1 (bar)	M 2 (bar)	
1	Connect device according to diagram.	–	0	0	Close port 2 once
2	Open shut-off cock 1. Charge device several times via <i>precision control valve 1</i> . Open and close <i>shut-off cock 1</i> several times. Move the lever from stop 1 to stop 2 several times. Reduce the pressure using <i>precision control valve 1</i>	–	7.5	–	Moving the lever must be easy. Angles $\alpha 1$ and $\alpha 2$ must be reachable.
		$\alpha 1 = 140^\circ \pm 5^\circ$ $\alpha 2 = 60^\circ \begin{smallmatrix} +10^\circ \\ -5^\circ \end{smallmatrix}$			
			0	0	
3	Increase pressure with <i>precision control valve 1</i>	–	0.5	–	Leakage quantity at device exhaust $V_n \leq 8 \text{ cm}^3/\text{min}$
4	Setting the pilot control				
4.1	Increase pressure via <i>precision control valve 1</i> .	–	7.5	–	Fix this lever position. You must block the lever for each subsequent lever position or angle change. If the test value at pressure gauge 2 is not correct: Change the pilot control setting. Repeat the check from point 4.3. * If piston 475 710 621 4 is used.
4.2	Move the lever until <i>pressure gauge 2</i> has reached the lowest value.	–	0... 7.5 ...0		
4.3	Lower pressure via <i>precision control valve 1</i> .	–	0	–	
4.4	Increase pressure via <i>precision control valve 1</i> .	–	1.4	$0.7 \begin{smallmatrix} 0 \\ -0,1 \end{smallmatrix}$	
4.5	Secure adjusting screw using 852 003 390 4*				
5	Setting the characteristic curve				
5.1	Increase pressure using <i>precision control valve 1</i> .	–	7.5	–	Lever length $\approx 7.5^\circ$ starting from 0° after test setup If the test value at pressure gauge 2 is not correct: Correct the lever position until the test value is correct. Repeat the check from point 5.2 ... 5.4.
5.2	Close <i>shut-off cock 1</i>	–	0	0	
5.3	Move lever	≈ 7.5	0	0	
5.4	Open <i>shut-off cock 1</i>	≈ 7.5	7.5	2.85 ± 0.1	

No.	Test step	Default value		Test value	Comment	
		Lever pos. [°]	M 1 (bar)	M 2 (bar)		
5.5	Close <i>shut-off cock 1</i>	–	0	0	If pressure gauge 2 displays a different value, repeat the check from point 5.2 ... 5.4.	
5.6	Open <i>shut-off cock 1</i>	–	7.5	2.85 ± 0.1		
5.7	Determine the angle difference between the desired angle and the actual angle.	–	7.5	–		
5.8	Close <i>shut-off cock 1</i>	–	0	0		
5.9	Loosen hexagon screw M8 on the clamping piece	–	0	0		
5.10	Move the lever to the stop to change the determined angle difference	–	0	0		Angle < 7.5° towards stop 1 Angle > 7.5° towards stop 2
5.11	Tighten hexagon screw M8 on the clamping piece	–	0	0		Tightening torque: M 10 ₂ Nm Ensure that the measurement of the distance is 62 ± 3 according to the proposal drawing.
6	Check the characteristic curve					
6.1	Move lever	17.5	0	0		
6.2	Open <i>shut-off cock 1</i>	17.5	7.5	6.6 ^{+0,5} _{-0,3}		
6.3	Lower pressure with <i>precision control valve 1</i> .	17.5	0	0		
7	Tappet clamping					
7.1	Increase pressure with <i>precision control valve 1</i> .	17.5	1.4	1.0 ± 0.1	max. permissible pressure drop Δp = 0.1 bar in 10 sec.	
7.2	Move lever	-5° < α < 0°	1.4	*	* value determined in point 7.1	
7.3	Lower pressure with <i>precision control valve 1</i> .	–	0	0		

No.	Test step	Default value		Test value	Comment
		Lever pos. [°]	M 1 (bar)	M 2 (bar)	
8	Fully laden position				
8.1	Set lever	21.5	0	0	Fix this position with a parallel pin $\varnothing 3 \times 40$ via the drilling $\varnothing 3$ of bracket 475 712 050 4 and clamp 810 126 034 4. Tighten screw 810 126 034 4 with M 4 $_{-1}$ Nm. Remove parallel pin.
8.2	Increase pressure with <i>precision control valve 1</i> .	21.5	0.2	> 0	
8.3	Increase pressure with <i>precision control valve 1</i> .	21.5	7.5	7.5	
8.4	Check device for leaks	21.5	7.5	7.5	
8.5	Lower pressure with <i>precision control valve 1</i> .	21.5	5.5	< 7.5	Permissible leakage: $V_n \leq 8 \text{ cm}^3/\text{min}$
8.6	Lower pressure with <i>precision control valve 1</i> .	21.5	0	0	
9	Unladen position				
9.1	Set lever	0	0	0	Pressure display at pressure gauge 2
9.2	Increase pressure with <i>precision control valve 1</i> .	0	0.4	> 0	
9.3	Increase pressure with <i>precision control valve 1</i> .	0	1.5	–	Pressure stages on pressure gauge 2 ≤ 0.1 bar
9.4	Test grading	0	> 1.5		
9.5	Increase pressure with <i>precision control valve 1</i> .	0	6.5	–	Pressure gauge 2 must follow immediately.
9.6	Test grading	0	> 6.5		Pressure stages on pressure gauge 2 ≤ 0.1 bar
9.7	Increase pressure with <i>precision control valve 1</i> .	0	7.5	1.2 ± 0.15	Permissible leakage: $V_n \leq 8 \text{ cm}^3/\text{min}$ M2 * = actual value same is in point 9.7 and 9.8
9.8	Check device for leaks	0	7.5	1.2 ± 0.15	
9.9	Lower pressure with <i>precision control valve 1</i> .	0	4	< M2 *	Pressure gauge 2 must follow immediately.
9.10	Lower pressure with <i>precision control valve 1</i> .	0	0	0	

No.	Test step	Default value		Test value	Comment
		Lever pos. [°]	M 1 (bar)	M 2 (bar)	
10	Full-load position after a break of linkage				
10.1	Release lever		–	–	Lever must move up to stop 1.
10.2	Increase pressure with <i>precision control valve 1</i> .		7.5	7.5	
11	<i>Set precision control valve 1 to 0 bar.</i>	0	0	0	2 open port 2 Do not disconnect the hose connections until you have vented the device to 0 bar. Clean device.
11.1	Unclamp device.				

