SCANIA

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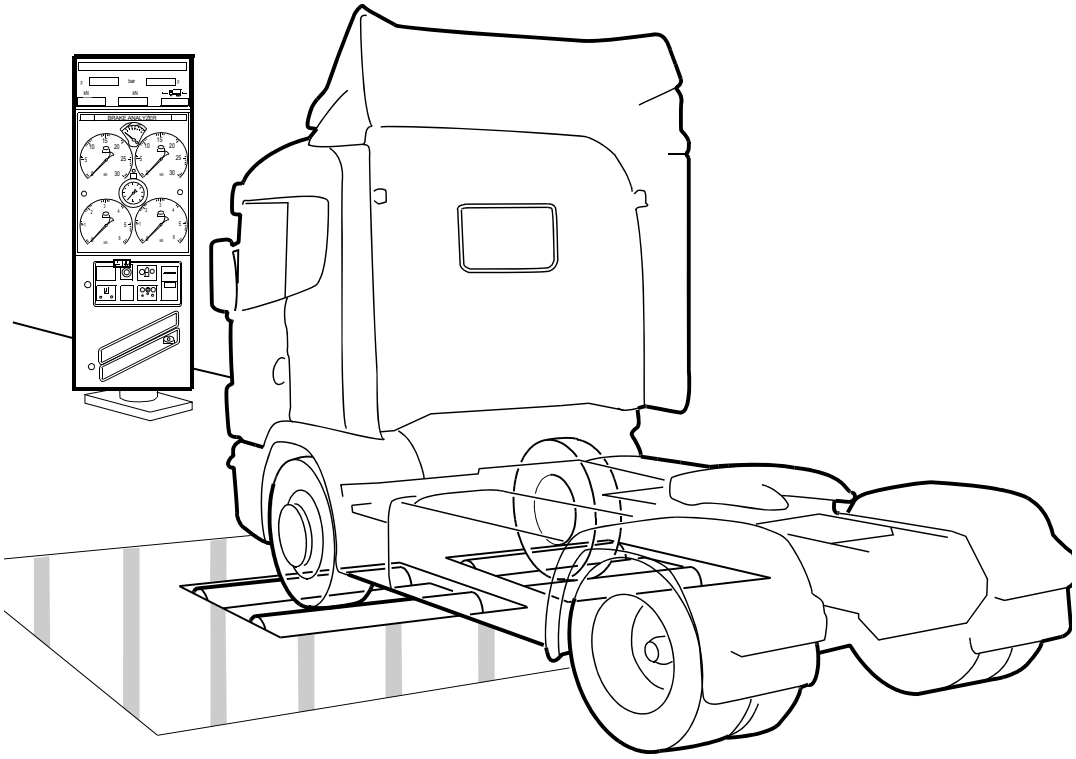
Issue 2.1 **en**

Brake adaptation using roller brake tester

for drum brake



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Contents

Brake adaptation

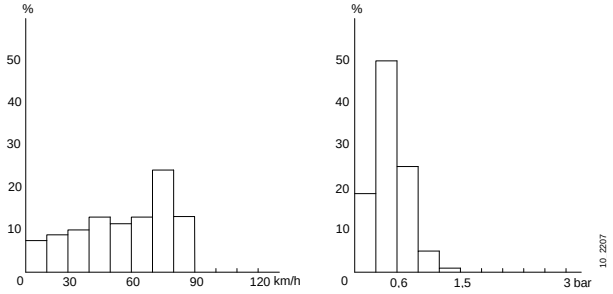
General

Brake adaptation means that the brakes on the truck and the trailer are adapted to each other. The adaptation is primarily a concern for road safety. The vehicle combination must be stable during hard braking.

This function is partly carried out by the ABS system.

Incorrect brake adaptation can also cause overheating of single brakes which in turn can cause fading on these.

Another reason for brake adaptation is to evenly distribute the wear between all the brakes in the vehicle combination.



Distribution of braking during normal driving

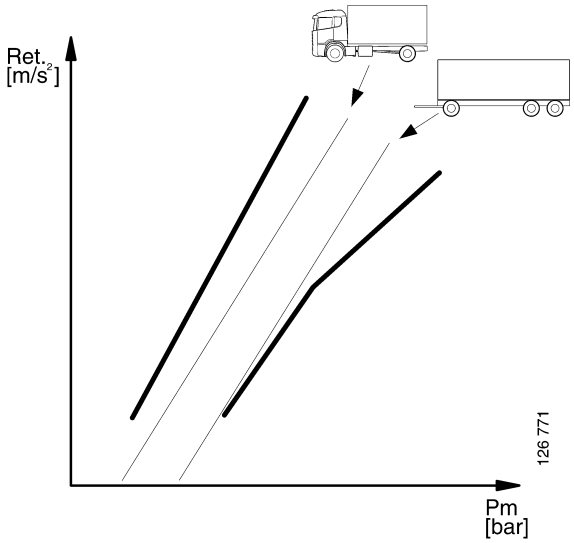
It is not enough that the vehicle complies with the law and that both truck and trailer are within the so called brake corridor.

Legislation is mainly concerned with what happens when braking hard. As 90% of all brake incidences take place at brake pressures under 2 bar the balance between the brakes at these low pressures is very important. This mainly concerns wear but also safety.

One condition for achieving a good result when carrying out brake adaptation on a vehicle is that there are no faults in the brake system. Start pressure adaptation must be checked before brake adaptation or by using a roller brake tester during brake adaptation.

If the corridor is used to its maximum the distribution of brake energy is very uneven during low pressures. This leads to much higher temperature and wear on the brakes which start braking at low pressures.

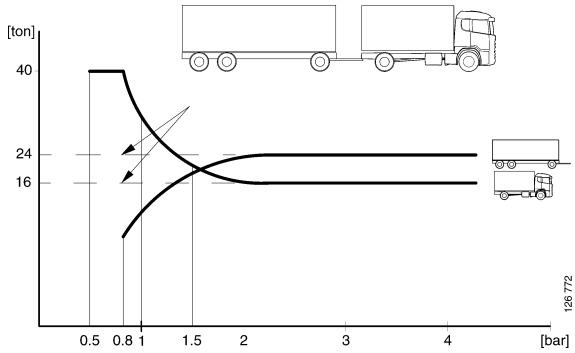
The diagram shows a truck with a brake performance high up in the brake corridor while the trailer brake performance is low.



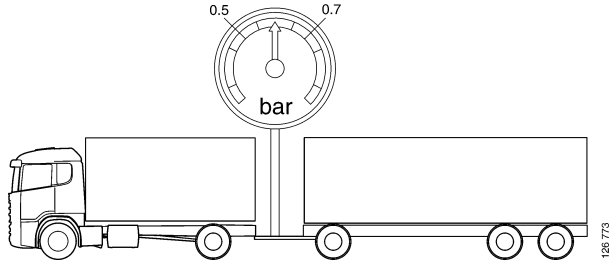
The next diagram shows how the brake work is distributed on such a vehicle. Unevenly distributed brake work also leads to unevenly distributed temperature and thus high brake wear on the overloaded brakes.

The most important condition for good brake adaptation at low pressures is probably that all wheel brakes on the whole vehicle combination start braking at the same Pm pressure (i.e. have the same Pm start pressure). This is checked at the so called start pressure adaptation.

As different markets have different requirements and legislation we have to offer a flexible procedure. Therefore, select the adaptation methods that are most suitable.



Distribution of brake work between truck and trailer at a Pm start pressure of 0.5 bar for the truck and 0.8 bar for the trailer. The arrows are pointing at the dotted lines which represent the ideal condition where the Pm start pressure is the same on all brakes.



Note: *Pm start pressure is always measured in the control pipe to the trailer.*

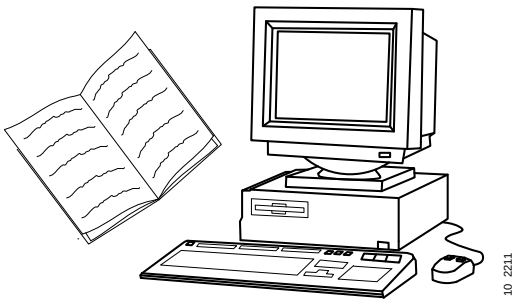
Different adaptation methods

Theoretical brake adaptation

As the name implies, this is a theoretical adaptation which gives a rough indication of the vehicle brake adaptation.

It is possible to calculate the expected retardation at different brake pressures using values from the truck and trailer brake systems.

This can also give some idea of how various factors affect brake adaptation. It is never adequate to only carry out the theoretical adaptation but it is an important check.

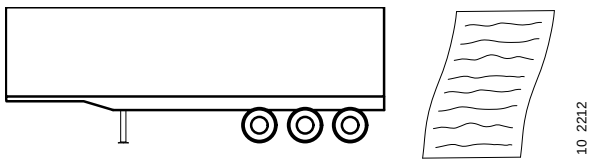


Mapping out the trailer brake system

It is important to know how the trailer brake system is designed and which valves are fitted and how they are connected.

Use this knowledge to gain a better understanding of causes to faults and unusual trailer brake behaviour.

Note this down in the report.



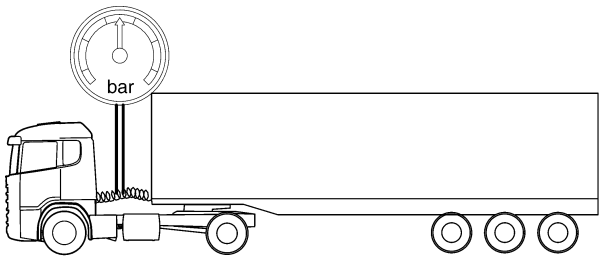
Start pressure adaptation

This is the most important part of the whole brake adaptation procedure. Without the start pressure adaptation it is difficult to achieve good results.

Since such a large part of brake incidences take place at low pressures it is very important that all wheel brakes on the whole vehicle combination start braking at the same Pm pressure (the operating pressure to the trailer).

The method involves measuring the result of the whole circuit of valves instead of measuring each valve separately. The advantage is that it eliminates the risk of adding several incorrect measurements.

The measuring can be done on a roller brake tester or manually by raising the axle and rotating the wheels.



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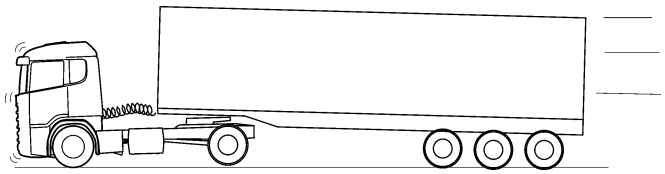
Practical brake adaptation

The method involves real brake incidences at 50 km/h using a retardation gauge in the cab.

The method has been tested in Scandinavia and it gives good results if carried out properly, as this method imitates real situations.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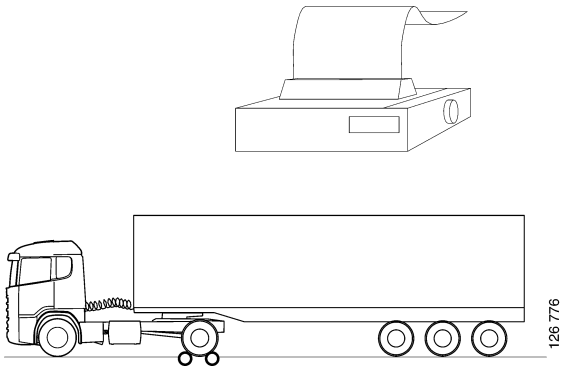
Adaptation using roller brake tester

This is the most commonly used method in Europe and offers a good adaptation over a large part of the pressure area (if the axle load is high enough), but there is one great disadvantage with this method.

The test speed is too low. There are brake lining qualities with completely different behaviour at 2-3 km/h and 80 km/h. Therefore it is important that adaptation using roller brake tester is carried out together with temperature measuring. The reason for this is that brake linings on truck and trailer with good brake adaptation during the roller brake test may be very unbalanced during a real brake situation on the road.

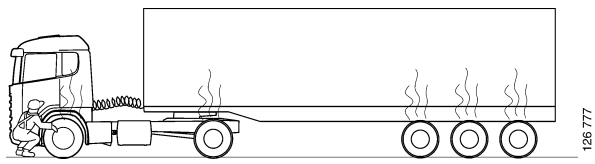
The start pressure adaptation can also be carried out satisfactorily on the roller brake tester.



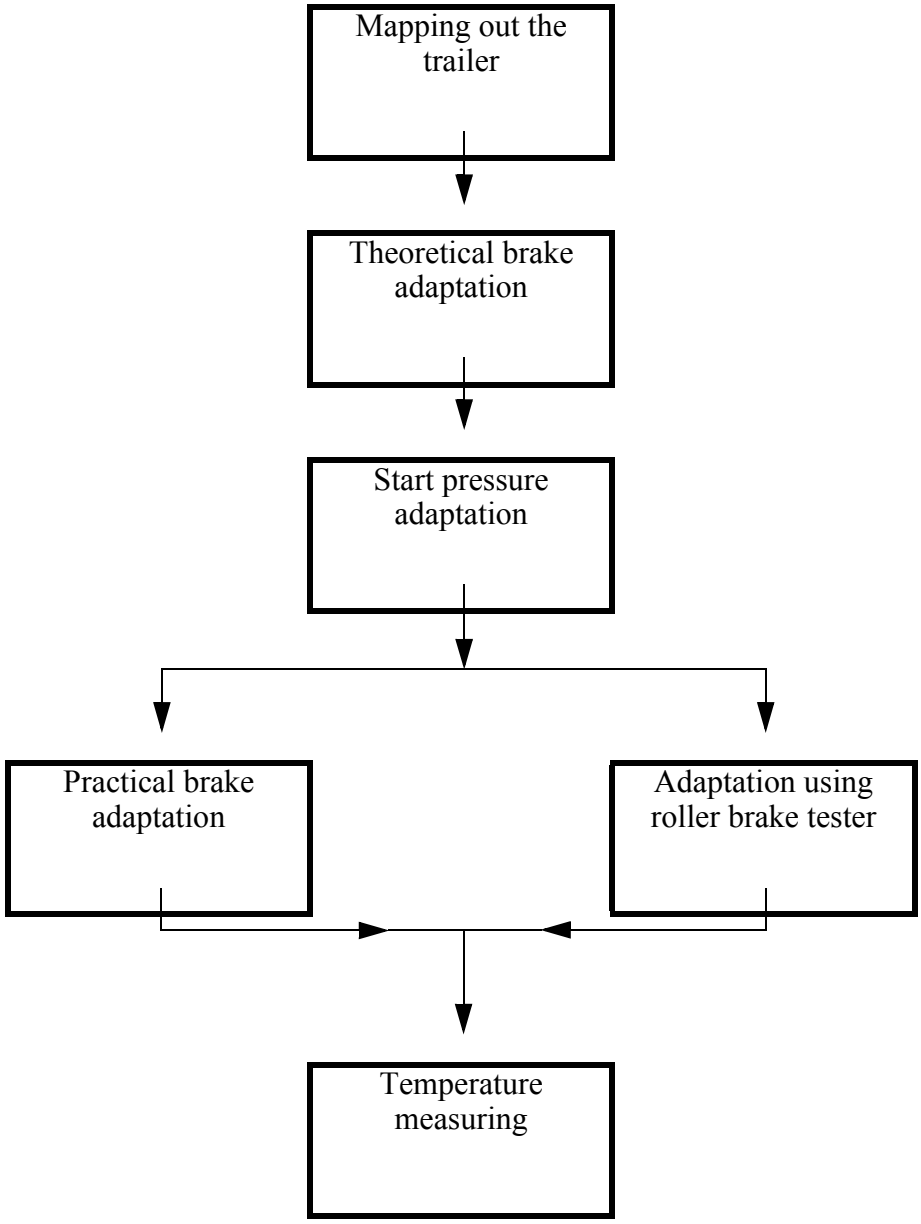
Temperature measuring during operation

In order to check the result of the brake adaptation it is necessary to measure the temperature on the vehicle during normal operation, since the brakes are going to work during normal operation.

All brakes should have the same temperature for best economy and safety.



Flow chart for brake adaptation



Definitions

Equipment

The equipment of the vehicle which determines the braking capacity, e.g. brake type, chamber size, brake slack adjuster length and tyre dimension.

Example:

Brake type: BPW SN42

Brake chamber size: 24"

Brake slack adjuster length:165 mm

Tyre dimension: 295/80 R22.5

Pc pressure

The pressure measured in a brake chamber on a tested axle.

Pm pressure

The pressure measured in the control pipe to the trailer. This is called Duomatic pressure in some markets.

Pc initial pressure

The pressure measured in the chamber when the brake starts applying brake force.

Pm start pressure

The pressure measured in the control pipe to the trailer when the brake starts applying brake force.

Maximum gross weight

The weight including the maximum load permitted for the vehicle by law.

Total weight

The technically highest permissible weight including load on the vehicle.

Guaranteed pressure

Guaranteed pressure is the lowest permissible level of pressure in the brake chambers during maximum braking. This value is used when extrapolating brake forces during roller brake tests.

Guaranteed pressure

Series	Guaranteed pressure [bar]
3 and 4 series from model year 1980	7
4 series bus	8
P, G and R series	8
K, N and F	8
Control pressure, semi-trailer/trailer	6.5

Guaranteed supply pressure, semi-trailer/ trailer

Series	Guaranteed pressure [bar]
3 series	7
4 series	7.5
P, G and R series	8
K, N and F	8

Ovality

In print-outs from the roller brake tester this is the generic term for how the brake force varies under one revolution. This often depends on an ovality or out-of-round of the brake drum, thus the designation ovality. However, this can also be due to for example hard spots or cracks in the drum. It is really variations in brake force that is measured. The unit is therefore Newton (N).

It is generally difficult to pin point what ovality is acceptable, but on front wheels the ovality should not exceed 150 daN per wheel or 200 daN per axle.

Brake force

The force between the tyre wear pattern and the surface when braking.

Retardation

Retardation can be described as negative acceleration and is a measurement of how powerfully the vehicle brakes.

The unit of measure for retardation is normally m/s^2. Another unit often used is % of g (gravitation).

100% g = 9.81 m/s^2 (50% ~ 5 m/s^2).

Calculate the retardation by dividing the total brake force of the vehicle with the vehicle weight.

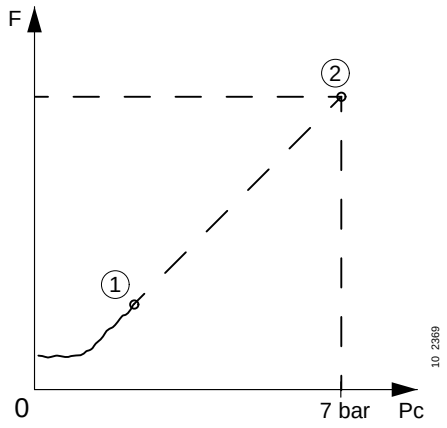
Rounded up retardation / rounded up brake force

When the authorities inspect the brake capacity it is not always possible to measure the maximum brake capacity because the wheels can lock during braking when the vehicle is not loaded.

It is then possible to round up the brake force from the measured value to a higher brake pressure and then divide the rounded up brake force with the total weight to reach the rounded up retardation.

This is useful when estimating how the truck will brake at total weight in an emergency.

The formulas for these calculations vary from country to country.



1 Measured value

2 Rounded up value

Brake performance

The brake capacity of the vehicle.

This is often expressed as a retardation at a specific brake pressure, e.g. 5 m/s^2 at 6 bar Pc pressure.

Brake corridor

In order for truck and trailer brakes to work well together it is required through legislation that the vehicle brakes must fulfil certain requirements.

One of these is that the vehicle retardation must be within certain limits.

The area between these limits is often called the brake corridor.

Opening pressure

The pressure needed to overcome the stiffness that exists in all valves.

Pressure increase

The difference between the outgoing control pressure from the trailer relay valve (i.e. in the control pipe to the trailer) and the incoming control pressure to the trailer relay valve (i.e. from the foot brake valve).

The pressure increase is measured at 2 bar input control pressure in the valve.

Roller brake tester category A

Roller brake tester with processing and print out of results according to Scania's guidelines.

Roller brake tester category B

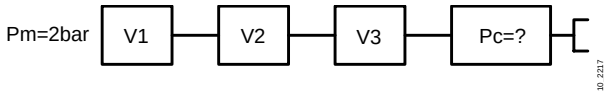
Roller brake tester similar to category A, but it does not present results according to Scania's guidelines.

Roller brake tester category C

Roller brake tester without advanced print out.

Mapping out the trailer

It is important to know the design of the trailer brake system in order to correctly evaluate the brake adaptation.



V = valve

How much brake pressure is lost on the way through the valves due to their opening pressure?

See group 10 for the report to be used to map out the trailer brake system.

Start by obtaining all information about the trailer brake system and note this in the report.

The service brake is the most important component in the compressed air system.

The pressure drop in the system to the brake chambers depend on which and how many valves the air must pass through.

The order of the location of the valves may also be of significance.

There are some diagrams over compressed air systems on trailers in the report. The diagrams do not contain information about the parking brake or the air suspension as these do not affect brake adaptation.

Select the diagram which closest resembles the brake system on the actual trailer and modify the diagram if necessary.

If it is difficult to modify the diagram you can draw your own diagram in the third box.

Write down a simple description of the system, e.g. "Load-sensing valve before trailer brake valve. ABS valves integrated with relay valves" or "Single system with one relay valve and without ABS".

If possible, also write down information about valve type and valve number.

Start pressure adaptation

This is the most important of all steps regarding good brake adaptation within the vehicle and between truck and trailer.

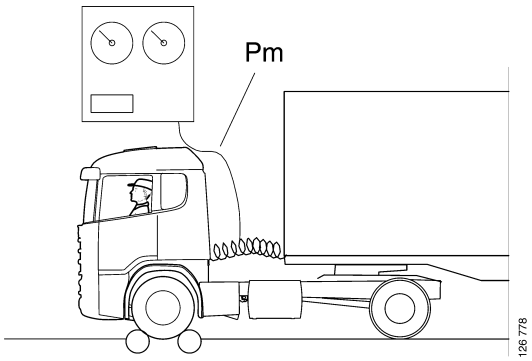
There are two methods of measuring the start pressure. One method uses a roller brake tester and the other method can be carried out in a normal flat workshop area. Even if a roller brake tester is not available, it is important to carry out this adaptation.

If the vehicle is not fully laden, make sure that the load-sensing valve is completely open.

Method 1

Roller brake tester (one person)

Connect a manometer or a pressure sensor to the control pipe (Pm) to the trailer. See figure.



Drive the vehicle onto the roller brake tester and brake very carefully until the brake force values start to increase.

Repeat the test a few times and note down the average value for Pm pressure when the brake force gauge starts to show a value.

For a roller brake tester with a printer the value can be read later in the report.

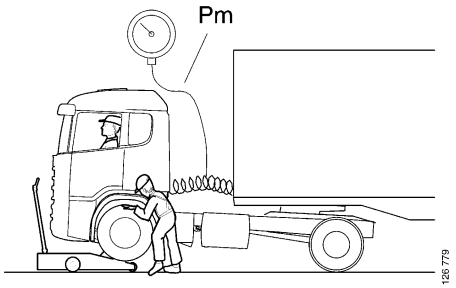
Carry out this test on all axles on the truck and also on the trailer. The pressure sensor or manometer must not be moved.

Method 2

Rotate the wheels (two people)

With this method it is necessary to raise the wheels.

Connect a manometer or a pressure sensor to the control pipe (Pm) to the trailer. See figure.



Rotate the wheel at the same time as someone slowly increases the brake pressure by pressing the brake pedal down.

Note the brake pressure value when the wheel stops.

Repeat the test a few times and calculate the average value.

Test all wheels on both truck and trailer in the same way.

When testing the trailer wheels and the pressure increase is great on the truck it can sometimes be difficult to have time to read the manometer value because the pressure passes over the interesting value so quickly. If this is the case, connect workshop air with a pressure relief valve to the trailer control pipe (Pm) instead.

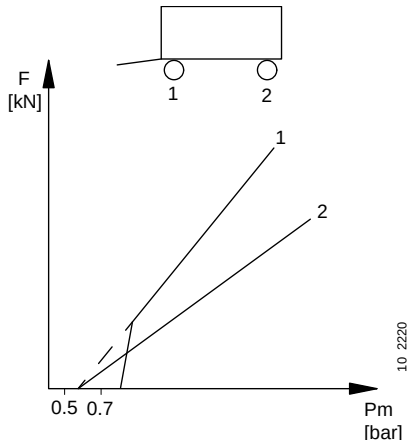
It is then possible to increase the pressure slowly and clearly see what the Pm start pressure is.

The results for the different wheels must not deviate from each other more than 0.2 bar.

A smaller adjustment of the pressure increase can be necessary to adapt the vehicle to local conditions, but not outside permissible limits. See the vehicle manufacturer's recommendations.

IMPORTANT! It is important not to adjust the pressure increase to compensate for faults caused by stiffness or other faults in the brake system.

Some trailer manufacturers will fit an adaptor valve on the first axle in order to raise the start pressure as the axle has relatively powerful brake equipment. It is permissible for these axles to have a slightly higher Pm start pressure.



Trailer with powerfully equipped front axle and adaptor valve

If the Pm start pressure is still outside the tolerance range after establishing that there are no faults on the vehicle and the pressure increase is adjusted within permissible tolerances, please contact the vehicle manufacturer.

Adaptation using roller brake tester

A roller brake tester is advantageous to use during brake adaptation as long as the limitations of this method are remembered.

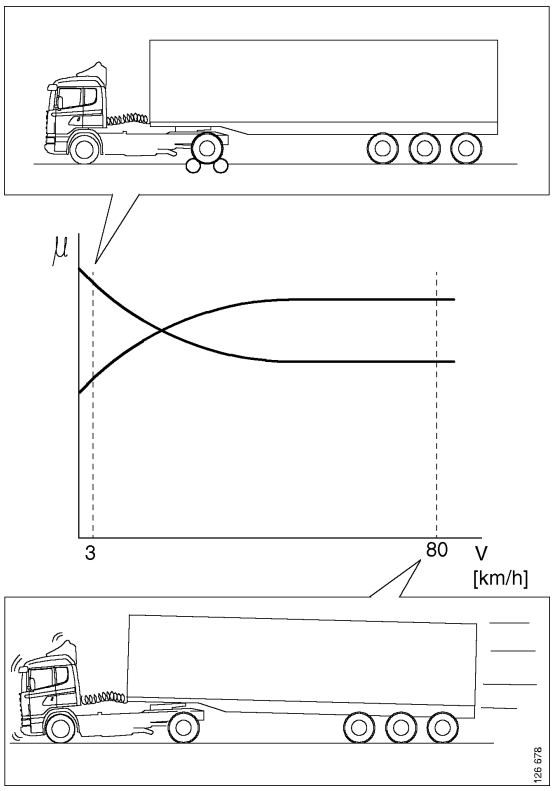
These limitations mainly concern the uncertainty about the brake values at the low test speed.

The diagram to the right illustrates how two different types of brake linings behave when testing with a roller brake tester (2-3 km/h) and when braking on a road (80 km/h). The friction (μ) varies completely on the two brake linings in this example.

Therefore it is important to complete this adaptation using theoretical brake adaptation, start pressure adaptation and temperature measuring. The start pressure adaptation can easily be carried out on the roller brake tester at the same time as the brake adaptation.

Carry out a test according to the roller brake tester instructions and measure the Pm pressure at the same time. It is recommended to measure the cylinder pressure (Pc) at the same time to make it easier to find any faults, but it is not necessary for the brake adaptation itself.

If the vehicle is not loaded to its maximum permissible weight the load-sensing valve should be in the open position.



Friction is dependent on speed

Tester with print out

Slowly depress the pedal during the test. It is very important to depress the pedal slowly for an accurate reading of the Pm start pressure.

Follow the manufacturer's instructions.

Tester without print out

See Method 1 under Start pressure adaptation.

It may also be useful to note the Pc start pressure for possible fault diagnosis at a later stage.

After measuring the Pm start pressure and Pc start pressure (if applicable) it is time to measure the brake force.

Slowly depress the brake pedal and note the brake force values and the Pc pressures for each step for the Pm pressure in the report on the following page.

Test using roller brake tester

Tractor													
Axle 1			Axle 2			Axle 3			Axle 4			Ret.	Pm
Pc bar	F left daN	F right daN	Pc bar	F left daN	F right daN	Pc bar	F left daN	F right daN	Pc bar	F left daN	F right daN	m/s^2	truck bar
0	50	50	0	75	75								0.0
0.2	50	50	0.2	75	75								0.5
0.7	150	150	0.7	200	100								1.0
1.2	350	350	1.2	450	350								1.5
1.7	550	550	1.7	700	600								2.0
2.2	750	750	2.2	950	800								2.5
2.7	950	950	2.7	1,200	950								3.0
3.7	1,350	1,350	3.7	1,700	1,200								4.0
													4.5
													5.0
4.1	1,500	1,500	3.8	1,750	1,250								Max.
													rounded up

Initial pressure

Axle	Pc		Pm	
	V	H	V	H
1	0.4	0.4	0.7	0.7
2	0.3	0.5	0.6	0.8
3				
4				

Temp. measuring

Axle	V	H
1		
2		
3		
4		

Total weight of truck = ... kg

The retardation is the total of all braking forces divided by the total weight.

Load-sensing valve, suspension without air springs

Brake slack adjuster position	Unladen position	Semi-laden position	Laden position
Setting pressure	6 bar	6 bar	6 bar
Pressure reading	1.6	2.8	6.0

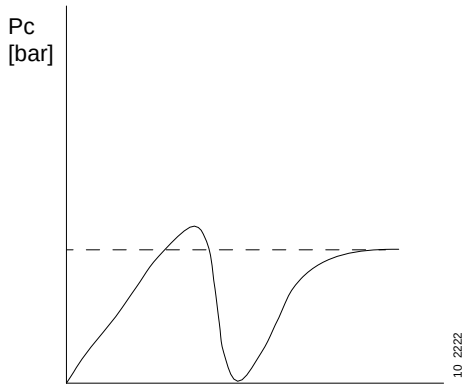
Load-sensing valve, air suspension	
Setting pressure	Initial pressure
4x2	1.0 bar
6x2	0.5 bar
Pressure reading	(1.7-1.8 bar)

It is important to depress the pedal all the time so that the pressure increases or does not change but never decreases.

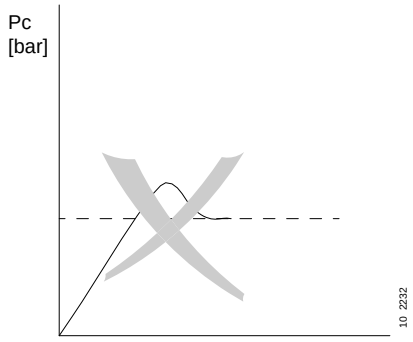
If the required value is passed, it is necessary to release the brake pedal completely and start from the beginning again.

It is useful to test all the vehicle axles in as large a part of the pressure range as possible, even though the adaptation is most important at low pressures.

For further information see Using roller brake tester for drum brake in group 10.



Correct. Release the pedal completely and try again to reach the value at the dotted line.



Incorrect.

The result of the adaptation

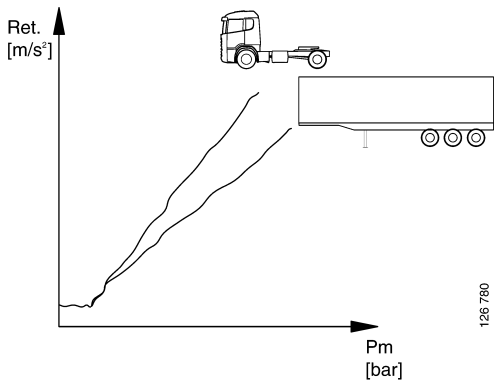
The most important area for adaptation is brake pressures below 2 bar.

The retardation difference between truck and trailer should be a maximum of 0.1-1.2 m/s^2. At higher pressures it is permissible for the difference between truck and trailer to be slightly higher. Tractor for semi-trailer should have the same or higher retardation than the semi-trailer at higher pressure. This is because the tractor must brake a larger proportion of the semi-trailer weight compared to the axle load when the vehicle does not brake.

Example:

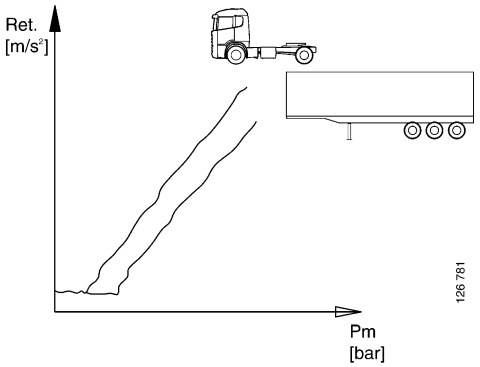
- Good brake adaptation

The Pm start pressure is similar and the retardation difference is acceptable.



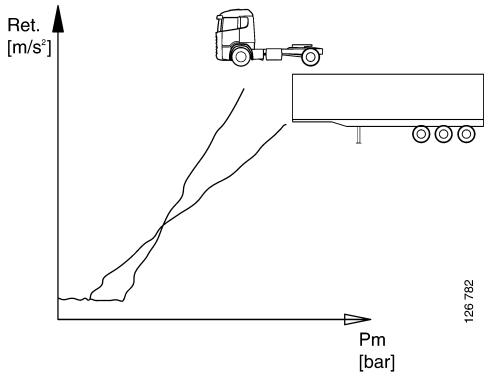
- Bad brake adaptation

The brake equipment is probably acceptable, but the Pm start pressure is incorrect. In this case the truck brakes will always brake more than the trailer brakes.



- Bad brake adaptation

There is a high brake force on the truck which is illustrated by the steep angle of the curve. This cannot be compensated for by increasing the Pm start pressure on the truck to achieve good brake adaptation. The brake adaptation on this vehicle will only be there at a single brake pressure when the curves cross each other.



Temperature measuring during operation

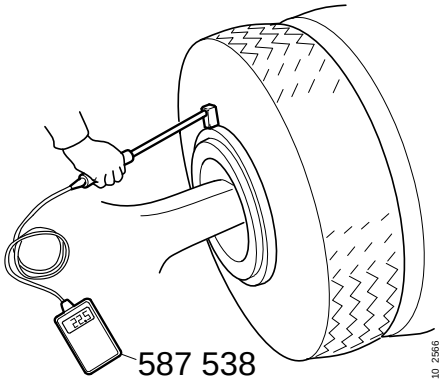
This is an excellent method to check that the brake adaptation has been carried out correctly.

It is important to measure the temperature at normal operation. Let the regular driver drive the vehicle with normal load and under normal driving conditions. It is important to drive the truck long enough so that the material around the brakes have time to warm up to a stable level. The time it takes to reach a stable level depends on the driving conditions. At least 30 minutes is recommended.

Make sure that dirt and rust is removed from the brake drums to achieve good contact.

Measure the temperature on all drums with temperature gauge 587 538 or a non-contact temperature gauge and write the values in the report.

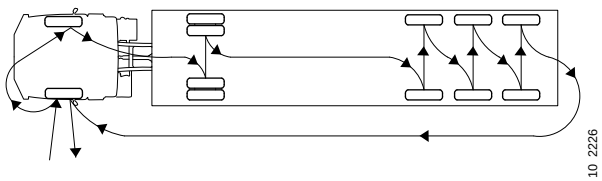
The brake drums on a stationary vehicle cools down quite slowly so there is plenty of time to carry out the measurements.



Temperature measuring

When you have measured all the wheels it is a good idea to measure the first wheel again to check that the temperature has not changed too much.

If the temperature has decreased more than 10-15°C the measurement should be repeated after a longer test drive.



Recommended order of measuring

On a vehicle combination with equally sized brakes on both truck and trailer (approximately 410-420 mm inner diameter on the brake drum) the temperature should not differ more than 20°C between the brake drums at temperatures below 100°C.

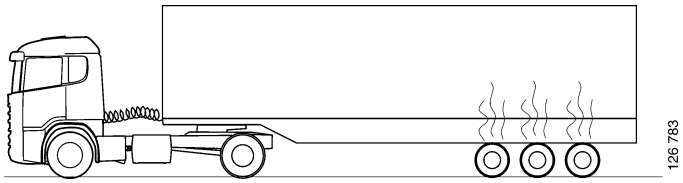
Trucks with hub reduction gear may have a slightly higher temperature in the drums due to inferior cooling conditions and heat release from the hub reduction gear.

If the brakes on the trailer are smaller than 410-420 mm, e.g. brake drums with an inner diameter of 360 mm or even 300 mm, these will have a higher temperature as there is less mass to store the brake energy.

If the same combination of truck and trailer is always used the difference in drum size can be compensated for by lowering the pressure increase slightly and let the truck brakes do some of the trailer brake work.

If different trailers are used on the same truck, one has to accept that small brakes will get hotter and wear quicker than large ones.

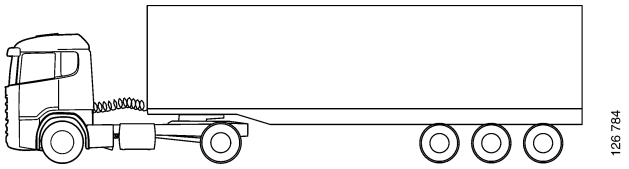
If any axle in the vehicle combination is fitted with disc brakes they will also get hotter than the drum brakes fitted on other axles.



Small brakes get hotter and wear more quickly than large brakes.

Examples of brake adaptation

Example 1



Conditions

Roller brake tester category A with print out.

Tractor with three axle semi-trailer.

The theoretical brake adaptation is carried out on both truck and trailer at delivery (even if these are not delivered at the same time).

The results of the theoretical brake adaptation show that the semi-trailer has slightly lower retardation than the truck, but still within permissible limits.

The mapping out of the trailer brake system shows a normal system without any unusual valves.

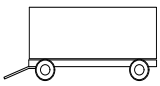
Note: Text written in this style is handwriting, written by the operator.

Date: *26/9*
Customer data: .....
.....
.....

Truck
Vehicle type/manufacturer: *R113MA4x2*
Total weight: .....*17,500* kg
Registration number: .....
Chassis serial number: .....

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*20* ”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 2	.....*24* ”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: (YES)/ NO
Setting at test: (Open /) Reduced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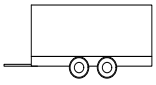
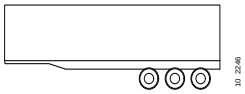

☐

Trailer
Vehicle type/manufacturer: ..... *Pacton*
Total weight: .....*24,000* kg
Registration number: .....
Chassis serial number: .....


☒

Brake type (trailer): .....*BPW SN42* Brake system Alt. ..... *1* (see page 2)

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*24* ”	.....*135* mm	.....*Beral 1517*	... *385/65R 22.5*
Axle 2	.....*24* ”	..... *135 mm*	.....*Beral 1517*	... *385/65R 22.5*
Axle 3	.....*24* ”	..... *135 mm*	.....*Beral 1517*	... *385/65R 22.5*
Axle 4	.....”	.....mm	.....	... *385/65R 22.5*

Load-sensing valve: (YES)/ NO
Setting at test: (Open /) Reduced

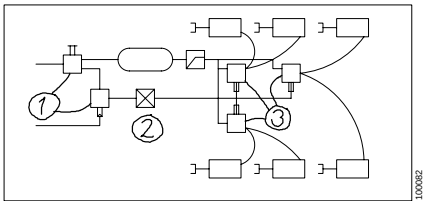
Notes: .....
.....
.....
Tested by: .....*Thomas*

Map out the trailer brake system

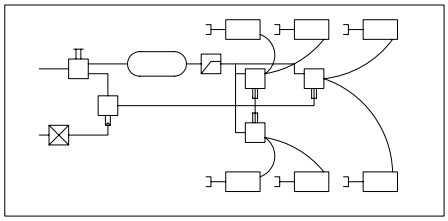
Semi-trailer/trailer

Select the alternative that is the closest representation of the trailer brake system and modify as necessary. You can also draw your own system as alternative 3.

Option 1



Option 2



Option 3

Brief description, e.g. load-sensing valve in series after trailer brake valve or similar system description: .....

..... ABS system with three ABS relay valves. Brake valve with integrated manoeuvring valve.

.....

.....

Valves:

Type and no. *Wab 9710020* 1

Type and no. *Wab 4757145000* 2

Type and no. *Wab 4721950200* 3

Type and no. 4

Type and no. 5

Trailer brake valve with manoeuvring valve

Manoeuvring valve

Load-sensing valve

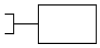
Adaptor valve

Pressure limiting valve

Relay valve

Relay valve integrated with ABS valve

ABS valve



Brake chamber

Compressed air tank

Test on roller brake tester

(Brake and start pressure adaptation)

When you compare the curves you see that the start pressure adaptation is good. Both vehicles have a similar Pm start pressure (truck 0.6 bar and trailer 0.7 bar). The retardation curves are close to each other. This is especially important at low pressures.

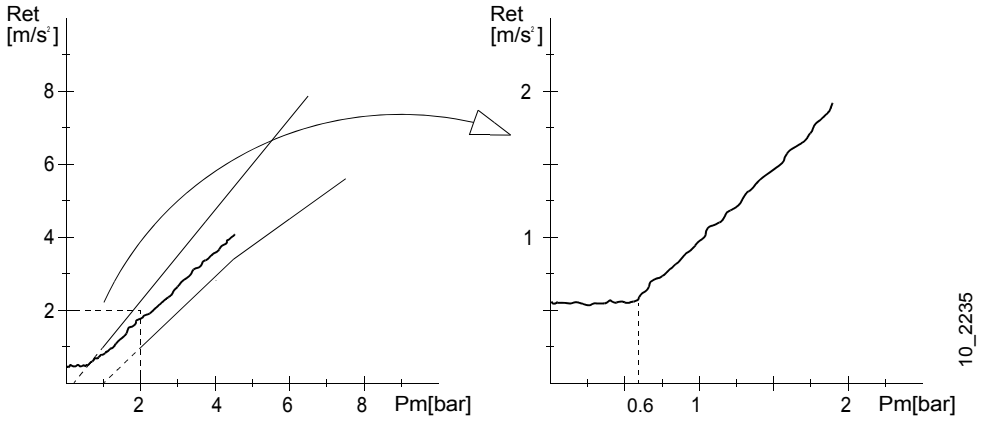
The temperature measuring indicated that the results from the roller brake tester were correct. The temperature was a little higher on the truck brakes.

Retardation results for the whole vehicle

Date: 1994-09-26 14:30 Serial No. 0087 Page 5

Vehicle: Truck

Retardation chart for total weight 17,500 kg

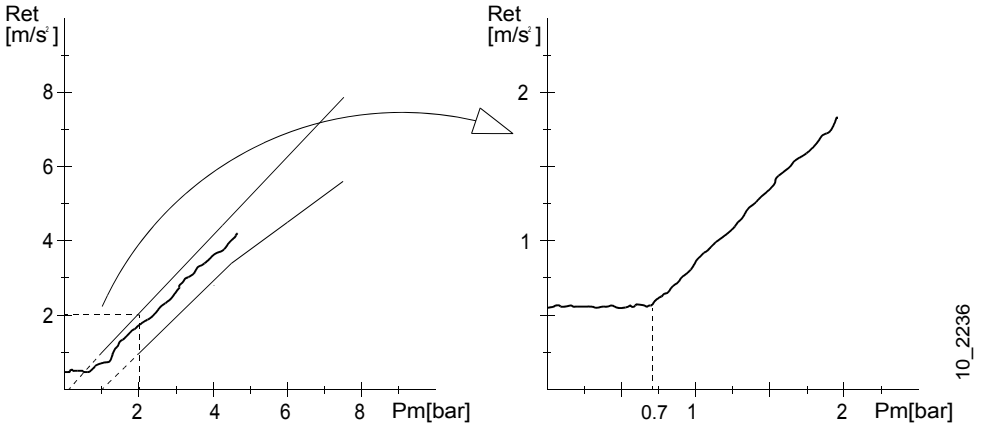


Retardation results for the whole vehicle

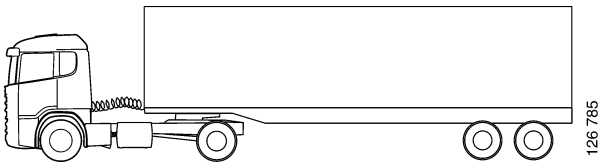
Date: 1994-09-26 14:40 Serial No. 0088 Page 5

Vehicle: Trailer

Retardation chart for total weight 24000 kg



Example 2



Conditions

Roller brake tester category A with print out.

Truck with semi-trailer

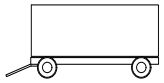
Concerns about high brake lining wear on the vehicle drive axle.

The theoretical brake adaptation is good. The mapping out of the trailer brake system shows that the trailer brake system is probably not the cause to the problem.

Date: *24/9*
Customer data: .....
.....
.....

Truck
Vehicle type/manufacturer: *R143MA4x2*
Total weight: .....*17,500* kg
Registration number: .....
Chassis serial number: .....

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*20*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 2	.....*24*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....
Load-sensing valve:		YES / NO		
Setting at test:		Open / Reduced		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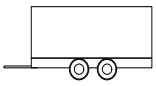
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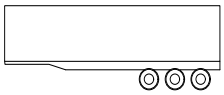
Trailer
Vehicle type/manufacturer: .....*van Hool*
Total weight: .....*16,000* kg
Registration number: .....
Chassis serial number: .....



☒

Brake type (trailer): .....*BPW SN42* Brake system Alt. ..... *1* (see page 2)

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*24*”	.....*150* mm	.....*Beral 1517*	... *385/65R 22.5*
Axle 2	.....*24*”	.....*150* mm	.....*Beral 1517*	... *385/65R 22.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....
Load-sensing valve:		(YES) / NO		
Setting at test:		(Open) / Reduced		

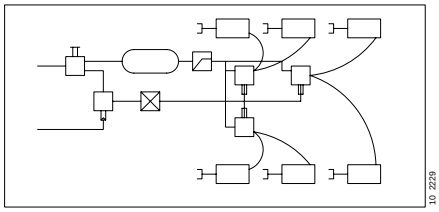
Notes: .....
.....
.....
Tested by: .....*Thomas*

Map out the trailer brake system

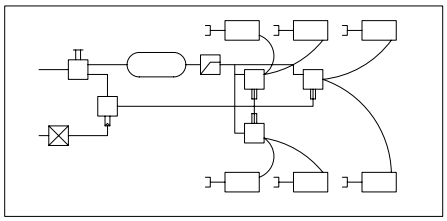
Semi-trailer/trailer

Select the alternative that is the closest representation of the trailer brake system and modify as necessary. You can also draw your own system as alternative 3.

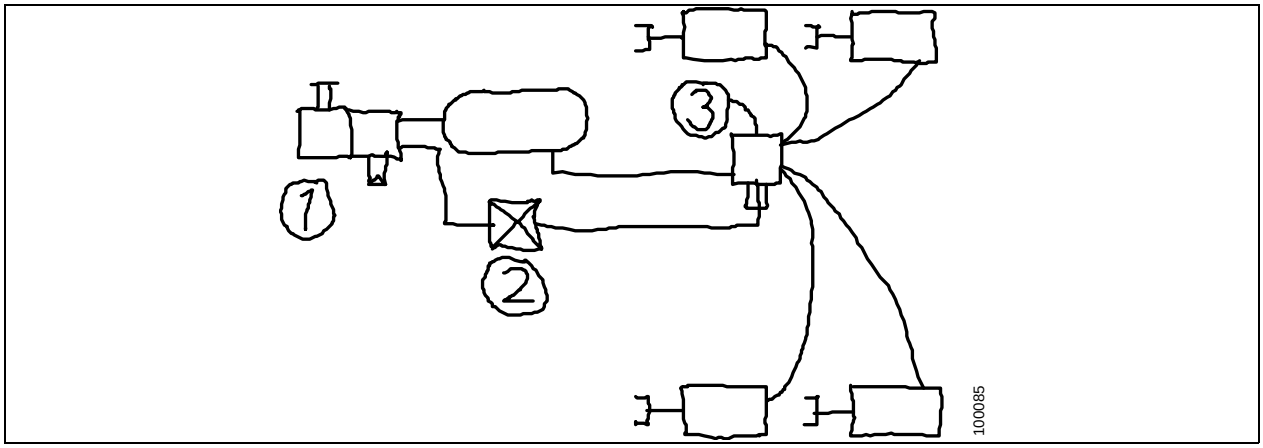
Option 1



Option 2



Option 3



Brief description, e.g. load-sensing valve in series after trailer brake valve or similar system description: .....

.....

System without ABS and with one relay valve for the four brakes .....

.....

Valves:

Type and no. *Wab 9710020* 1

Type and no. *Wab 4757145000* 2

Type and no. *Wab 9730110000* 3

Type and no. 4

Type and no. 5

Trailer brake valve with manoeuvring valve

Manoeuvring valve

Load-sensing valve

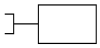
Adaptor valve

Pressure limiting valve

Relay valve

Relay valve integrated with ABS valve

ABS valve



Brake chamber

Compressed air tank

Test on roller brake tester

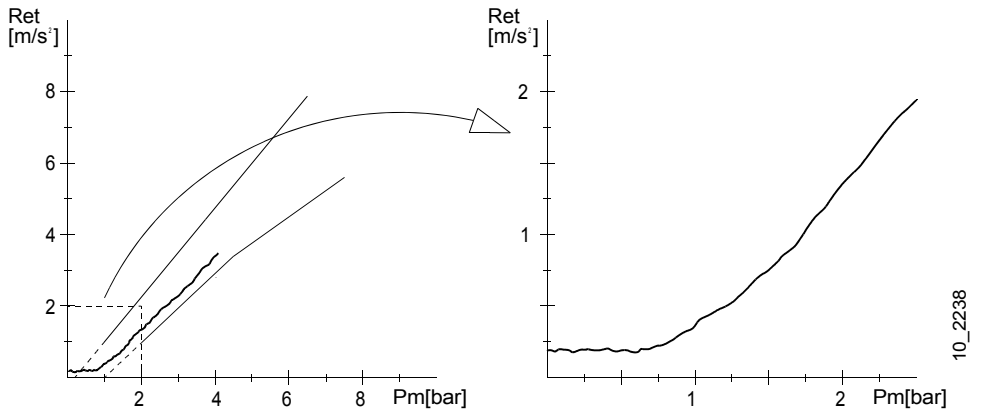
The retardation curve for the vehicle shows some interesting things. The truck has an unclear start pressure point, i.e. it is difficult to judge what the Pm start pressure is. The semi-trailer has a high Pm start pressure and also a low retardation.

Retardation results for the whole vehicle

Date: 1994-09-24 15:00 Serial No. 0089 Page 5

Vehicle: Truck

Retardation chart for total weight 17,500 kg

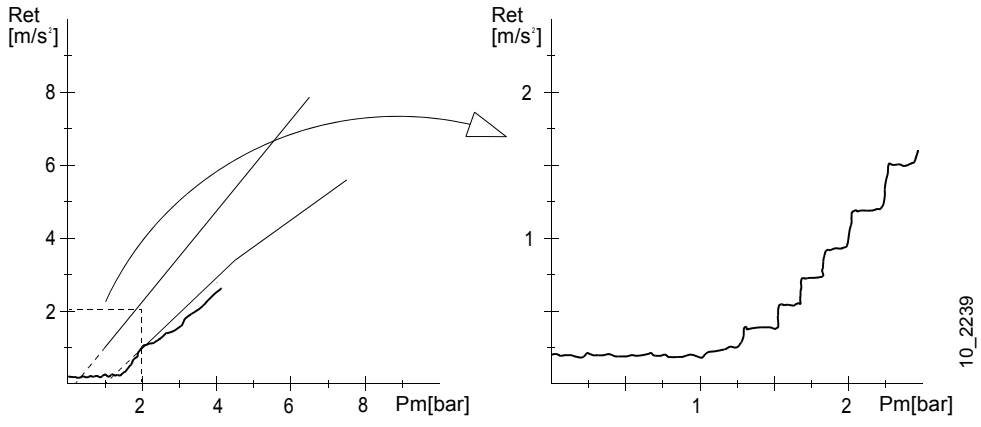


Retardation results for the whole vehicle

Date: 1992-09-24 15:10 Serial No. 0090 Page 5

Vehicle: Trailer

Retardation chart for total weight 16,000 kg

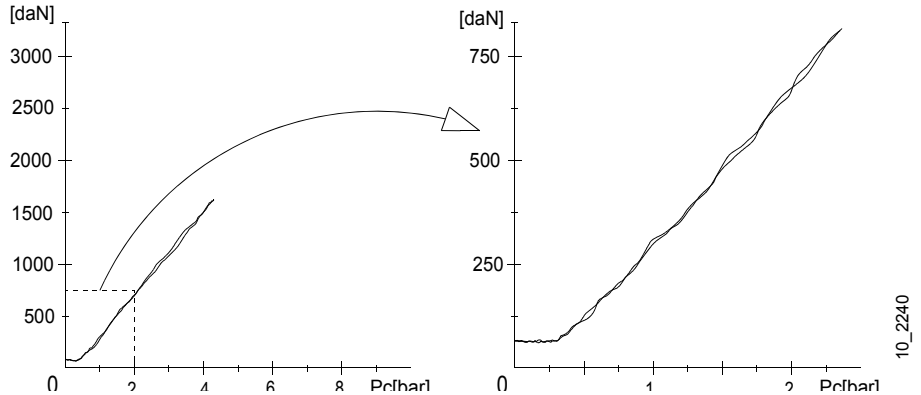


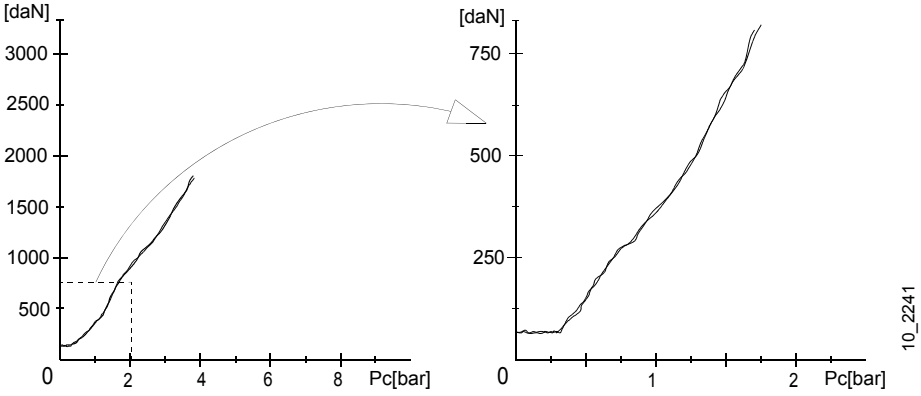
After examining the results for the truck a bit closer it is clear that the mechanical condition of the rear axle brakes are good, e.g. the Pc start pressures are similar and low.

The brake force curves below for both front axle brakes (upper diagram) and the rear axle brakes (bottom diagram).

Date: 1994-09-24 15:00 Serial No. 0089 Page 2

Axle No.	: 1		
Current axle weight	: 3,860 kg		
Ovality RH	: 80 daN		
Ovality LH	: 92 daN		
Braking force difference LH/RH	: 4%		
Brake type/drum diam.	: *Scania*.....	Brake chamber	: *20"*.....
Brake slack adjuster length	: *165 mm*...	Type of brake lining	: *MM*.....
Tyre dimension	: *12R 22.5* .	LSV (YES) / NO	(Open) / Reduced





Study the summary of the pressure and brake force values. Here you can see a difference in air pressure between front and rear circuit of about 0.4 bar. The maximum difference allowed is 0.2 bar.

Additional measuring is needed in order to decide if there is a fault on the foot brake valve or the relay valve. For further work description, see Testing the brake system in the Workshop Manual, group 10. In this case it turned out to be the foot brake valve that was faulty.

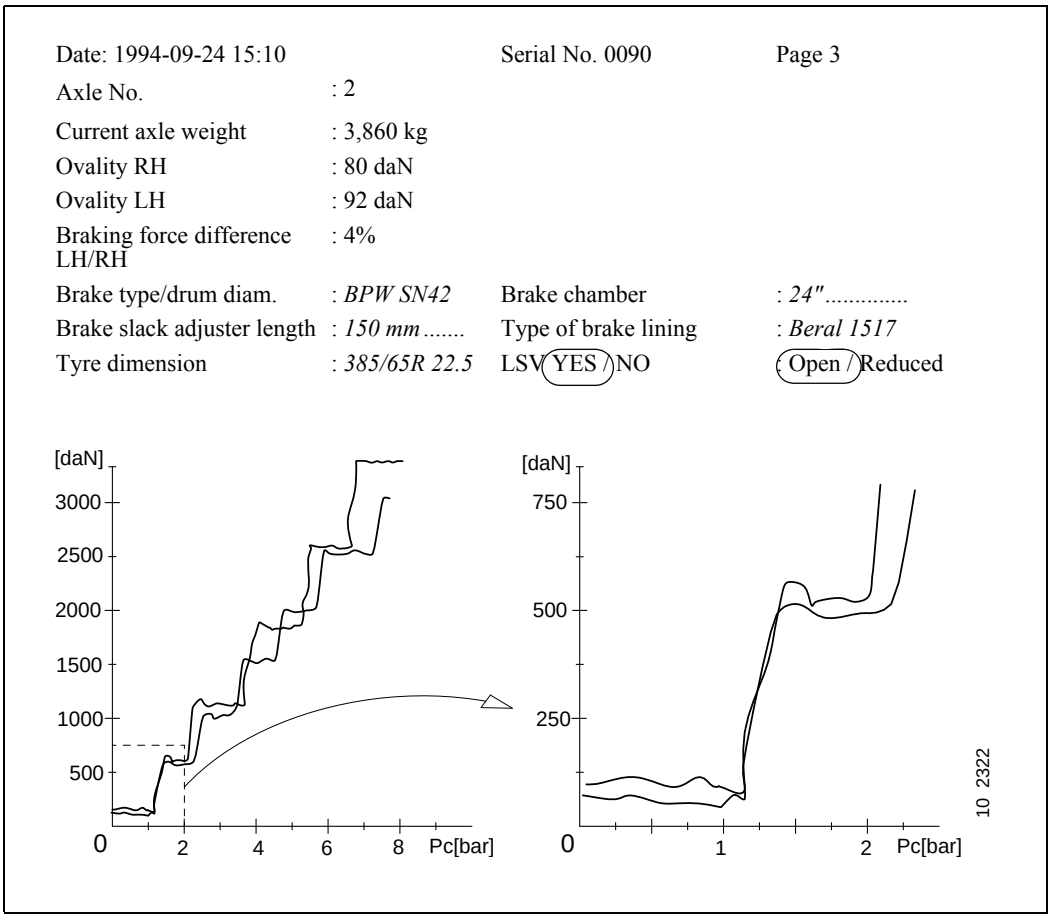
Date: 1994-09-24 15:00 Serial No. 0084 Page 4

Pm	Axle 1				Axle 2			
	bar Pc	daN F left	daN F right	daN F total	bar Pc	daN F left	daN F right	daN F total
0.0	0.0	76	82	158	0.0	70	60	130
0.1	0.1	60	72	132	0.0	60	70	130
0.2	0.2	80	60	140	0.0	80	70	150
0.3	0.3	66	78	144	0.0	70	80	150
0.4	0.4	140	106	246	0.0	62	72	134
0.5	0.5	160	120	280	0.1	76	70	146
0.6	0.6	180	130	310	0.2	70	80	150
0.7	0.7	200	140	340	0.3	70	72	142
0.8	0.8	220	150	370	0.4	180	150	330
0.9	0.9	250	165	415	0.5	220	150	370
1.0	1.0	270	180	450	0.6	240	190	430
1.5	1.5	460	300	760	1.1	360	320	680
2.0	2.0	650	420	1,070	1.6	480	430	910
3.0	3.0	1,100	700	1,800	2.6	850	800	1,650
4.0	4.0	1,500	950	2,450	3.6	1,220	1,170	2,390
4.5	4.5	1,720	1,120	2,840				
4.9	4.9	1,850	1,200	3,050				

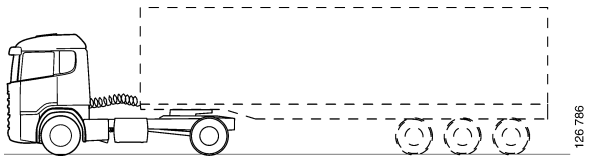
The diagram "Mapping out the trailer brake system" shows that the trailer brakes have a high Pm start pressure and the retardation is low.

The right axle diagram shows that the brakes seem to be in a bad condition. The brakes have high mechanical start pressures (Pc start pressure), an uneven curve (stiffness) and a bent curve (stiffness or require excessive cylinder stroke). The compressed air system does not have abnormally large pressure losses and therefore does not need rectifying. Do not adjust the pressure increase at this stage.

Renovate all the wheel brakes on the trailer. Discuss with the customer preventative maintenance of the trailer together with the truck. In cases like this, where a fault is found which need rectifying, there is no need to measure the temperature until after the repair.



Example 3



Conditions

Roller brake tester category A with print out.

Tractor without trailer.

The theoretical adaptation and mapping out of the trailer cannot be carried out in the usual way. Instead, try to find out what type of brake systems are fitted on the trailer(s) that this truck normally pulls.

The values look good on the roller brake tester with the exception of the values for the load-sensing valve. The truck is probably run with a reduced pressure to the rear axle even when fully laden. When the truck is tested without a trailer it is difficult to judge if the Pm start pressure is good or bad. Scania recommend that the Pm start pressure should be within 0.5 and 0.7 bar, but there are local variations. Therefore it is very important for the workshop to know what the Pm start pressure normally is on their particular market. The most important requirement for good brake adaptation is that the Pm start pressures on the truck and the trailer are similar.

Do not adjust the pressure increase to compensate for stiffness or other faults in the brake system.

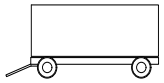
Measure the temperature with a normal trailer fitted with a representative brake system to check that the temperature of the brakes are similar. When comparing the trailer brake temperature it is important not to draw too far reaching conclusions since the trailer is only an example of a normal trailer.

Date: *11/5*
Customer data: .....
.....
.....

Truck
Vehicle type/manufacturer: *R143MA4x2*
Total weight: .....*17,500* kg
Registration number: .....
Chassis serial number: .....

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*20*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 2	.....*24*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: (YES) / NO
Setting at test: Open / Reduced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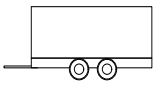
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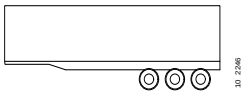


☒

Trailer
Vehicle type/manufacturer: .....
Total weight: .....*often 24,000*kg
Registration number: .....
Chassis serial number: .....

Brake type (trailer): ..... Brake system Alt. ..... *1* (see page 2)

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*24*”	.....*135* mm	.....	... *385/65R 22.5*
Axle 2	.....*24*”	.....*135* mm	.....	.....
Axle 3	.....*24*”	.....*135* mm	.....	.....
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: YES / NO
Setting at test: Open / Reduced

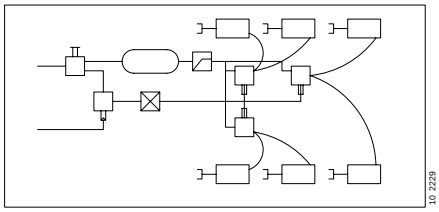
Notes: *Pulls rental trailers from ERT*.....
.....
.....
Tested by: .....*Thomas*

Map out the trailer brake system

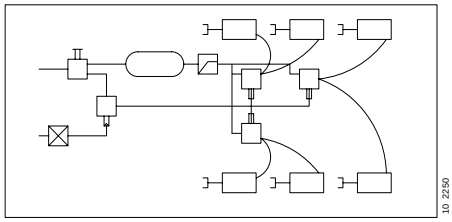
Semi-trailer/trailer

Select the alternative that is the closest representation of the trailer brake system and modify as necessary. You can also draw your own system as alternative 3.

Option 1



Option 2



Option 3

Brief description, e.g. load-sensing valve in series after trailer brake valve or similar system description: .....

.....

Often with load-sensing valve, without pressure increase on the trailer brake valve and without ABS.

.....

Valves:

Type and no. 1

Type and no. 2

Type and no. 3

Type and no. 4

Type and no. 5

Trailer brake valve with manoeuvring valve

Manoeuvring valve

Load-sensing valve

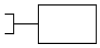
Adaptor valve

Pressure limiting valve

Relay valve

Relay valve integrated with ABS valve

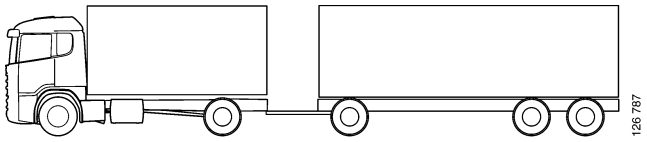
ABS valve



Brake chamber

Compressed air tank

Example 4



Conditions

Roller brake tester of category C without print out.

Truck with trailer.

The theoretical brake adaptation is good.

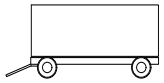
When mapping out the trailer brake system it emerges that the trailer is equipped with larger brake chambers at the front compared to the rear and that an adaptor valve is fitted to the front axle.

Date: *11/5*
Customer data: .....
.....
.....

Truck
Vehicle type/manufacturer: *P113ML4x2*
Total weight: .....*17,500* kg
Registration number: .....
Chassis serial number: .....

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*20*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 2	.....*24*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: (YES) / NO
Setting at test: (Open) / Reduced



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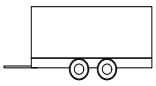

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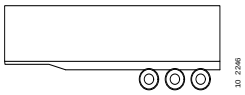


☐

Trailer
Vehicle type/manufacturer: ..... *BRIAB*
Total weight: .....*20,000* kg
Registration number: .....
Chassis serial number: .....

Brake type (trailer): .....*BPW SN36* Brake system Alt. ..... *1* (see page 2)

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*30*”	.....*150* mm	.....*Beral 1517*	... *265/70R 19.5*
Axle 2	.....*24*”	.....*165* mm	.....*Beral 1517*	... *265/70R 19.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: YES (NO)
Setting at test: Open / Reduced

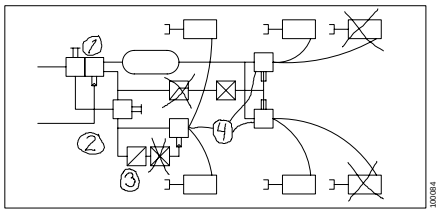
Notes: .....
.....
.....
Tested by: .....*Thomas*

Map out the trailer brake system

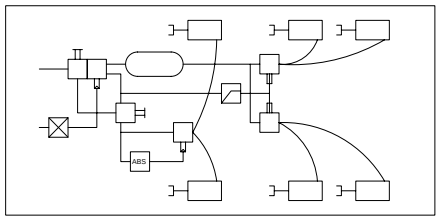
Trailer

Select the alternative that is the closest representation of the trailer brake system and modify as necessary. You can also draw your own system as alternative 3.

Option 1



Option 2



Option 3

Brief description, e.g. load-sensing valve in series after trailer brake valve or similar system description: .....

.....

2-axle trailer with ABS and without load-sensing valve. Note: Adaptor valve on the first axle.

.....

Valves:

Type and no. *Wab 9710020* 1

Type and no. *Wab 463034000* 2

Type and no. *Wab 972085000* 3

Type and no. *Wab 9750010* 4

Type and no. 5

Trailer brake valve with manoeuvring valve

Manoeuvring valve

Load-sensing valve

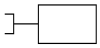
Adaptor valve

Pressure limiting valve

Relay valve

Relay valve integrated with ABS valve

ABS valve



Brake chamber

Compressed air tank

Test using roller brake tester

Tractor														**Trailer**											
Axle 1			Axle 2			Axle 3			Axle 4			Ret.	Pm	Ret.	Axle 1			Axle 2			Axle 3			Axle 4		
Pc	F left	F right	Pc	F left	F right	Pc	F left	F right	Pc	F left	F right	truck		Trailer	Pc	F left	F right	Pc	F left	F right	Pc	F left	F right	Pc	F left	F right
bar	daN	daN	bar	daN	daN	bar	daN	daN	bar	daN	daN	m/s^2	bar	m/s^2	bar	daN	daN	bar	daN	daN	bar	daN	daN	bar	daN	daN
0	50	50	0	75	75							0.1	0.0	0.2	0	75	75	0	75	75						
0.2	50	50	0.2	75	75							0.1	0.53	0.2	0	75	75	0.2	75	75						
0.7	200	200	0.7	300	300							0.6	1.0	0.4	0	75	75	0.7	250	250						
1.2	350	350	1.2	450	350							0.9	1.5	0.5	0.5	100	100	1.2	375	375						
1.7	600	600	1.7	800	800							1.6	2.0	1.3	1.2	500	500	1.7	600	600						
2.2	800	800	2.2	1,000	1,000							2.1	2.5	1.9	2.0	900	900	2.2	800	800						
2.7	1,050	1,050	2.7	1,300	1,300							2.7	3.0	2.7	2.7	1,250	1,250	2.7	1,100	1,100						
3.7	1,400	1,400	3.7	1,800	1,800							3.7	4.0	3.7	3.7	1,800	1,800	3.7	1,400	1,400						
4.2	1,650	1,650											4.5													
													5.0													
													Max.													
													rounded up													

Initial pressure

Truck	Pc		Pm	
	LH	RH	LH	RH
1	0.4	0.3	0.7	0.6
2	0.3	0.5	0.6	0.6
3				
4				
Pm truck			0.6	

Trailer	Pc		Pm	
	LH	RH	LH	RH
1	0.4	0.4	1.0	1.0
2	0.4	0.4	0.7	0.7
3				
4				

Temp. measuring

Axle	LH	RH
1	70	70
2	80	80
3		
4		

Axle	LH	RH
1	40	40
2	80	80
3		
4		

Total weight of truck = kg

Total weight for trailer = kg

The retardation is the total of all braking forces divided by the total weight

(F1left+F1right+.....+F4right) x10

= Retardation

Total weight kg

Load-sensing valve, suspension without air springs

Brake slack adjuster position	Unladen position	Semi-laden position	Laden position
Setting pressure	6 bar	6 bar	6 bar
Pressure reading			
Load-sensing valve, air suspension			
Setting pressure		Initial pressure	Brake pressure
4x2		1.0 bar	min 1.5 bar
6x2		0.5 bar	min 0.8 bar
Pressure reading			

(0.3 on 1st axle)

0.85 Pm trailer - 0.6 Pm truck = 0.15 bar, deviation in start pressure

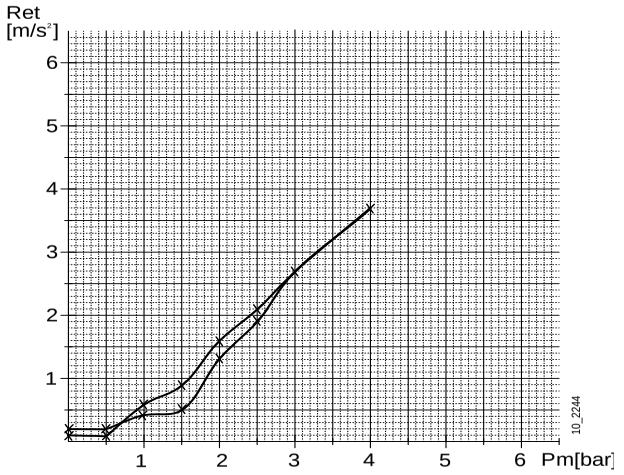
Pm trailer	0.85

The test with the roller brake tester shows that the Pm start pressure is similar on all axles except axle 1 on the trailer. This is normal as the function of the adaptor valve is to reduce the brake force on the front axle at low pressures. It is also clear that the 30" brake chambers on the front axle give greater brake force than the 24" brake chambers on the rear axle at higher pressures.

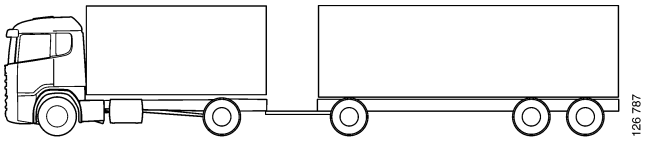
We can see that because of the adaptor valve the trailer retardation is low at low pressures and that it then increases and is close to the vehicle retardation. Now it is extra important to measure the temperature to check if the vehicle brakes have the same temperature. Checking brake lining wear can also reveal if the first axle of the trailer brakes as much as the other axles.

In this case the first axle brakes too little during normal driving. When checking the adaptor valve it became clear that the opening pressure on the valve was outside the manufacturer's tolerance range. Renew or adjust the valve.

Draw the retardation curve for both truck and trailer. This is also a good basis for discussions with the customer.



Example 5



Conditions

No roller brake tester. Truck with trailer

In this case it was not possible to carry out the test on the road or on a roller brake tester.

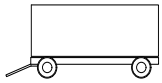
The theoretical adaptation is good and the mapping out of the trailer brake system indicates normal conditions.

Date: *5/4*
Customer data: .....
.....
.....

Truck
Vehicle type/manufacturer: *T113HL6x2*
Total weight: .....*25,000* kg
Registration number: .....
Chassis serial number: .....

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*20*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 2	.....*24*”	.....*165* mm	..... *MM*	.....*12R 22.5*
Axle 3	.....*16*”	.....*130* mm	..... *MM*	.....*12R 22.5*
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: (YES) / NO
Setting at test: (Open) / Reduced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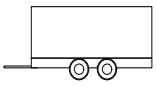
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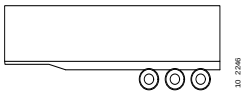
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Trailer
Vehicle type/manufacturer: ..... *Kilafors*
Total weight: .....*20,000* kg
Registration number: .....
Chassis serial number: .....

Brake type (trailer): .....*BPW SN42* Brake system Alt. .....*2* (see page 2)

Equipment:	Brake chamber	Brake slack adjuster length	Type of lining	Tyres
Axle 1	.....*24*”	.....*165* mm	.....*Beral 1517*	..... *12R 22.5*
Axle 2	.....*24*”	.....*165* mm	.....*Beral 1517*	..... *12R 22.5*
Axle 3	.....”	.....mm	.....	.....
Axle 4	.....”	.....mm	.....	.....

Load-sensing valve: (YES) / NO
Setting at test: (Open) / Reduced

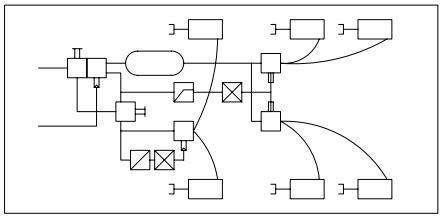
Notes: .....
.....
.....
Tested by: .....*Thomas*

Map out the trailer brake system

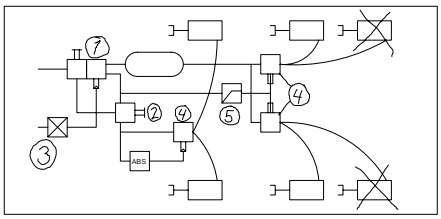
Trailer

Select the alternative that is the closest representation of the trailer brake system and modify as necessary. You can also draw your own system as alternative 3.

Option 1



Option 2



Option 3

Brief description, e.g. load-sensing valve in series after trailer brake valve or similar system description: .....

.....

.....

.....

Valves:

Type and no. *Wab 9710020* 1

Type and no. *Wab 463034000* 2

Type and no. *Wab 4757145000* 3

Type and no. *Wab 4721950200* 4

Type and no. *Wab 4750150* 5

Trailer brake valve with manoeuvring valve

Manoeuvring valve

Load-sensing valve

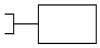
Adaptor valve

Pressure limiting valve

Relay valve

Relay valve integrated with ABS valve

ABS valve



Brake chamber

Compressed air tank

The start pressure was measured according to method 2 where each wheel is raised, rotated and tested separately.

The Pm start pressure is well within the tolerance range.

The load-sensing valve was also checked.

Measuring the temperature is extra important when the test is as limited as this.

Measuring the temperature is extra important when the test is as limited as this.

Note that this type of brake adaptation does not indicate how the brakes are balanced at high brake pressures, e.g. during emergency braking.

Theoretical brake adaptation: Yes No

Results

Start pressure measuring:

Axle	Truck				Trailer			
	Pm		Pc		Pm		Pc	
	LH	RH	LH	RH	LH	RH	LH	RH
1	0.7	0.7	0.4	0.4	0.6	0.6	0.4	0.4
2	0.6	0.6	0.3	0.3	0.6	0.6	0.4	0.4
3	0.7	0.7	0.4	0.4				
4								

Temperature measuring:

Axle	Truck		Trailer	
	LH	RH	LH	RH
1	60	60	60	60
2	70	70	60	60
3	50	50		
4				

Load-sensing valve:

Checking function

Suspension without air springs:

Brake slack adjuster position	0	1/2	1/1
Setting pressure	1.5-1.7	2.7-2.9	5.9-6.0
Pressure reading	1.6	2.8	5.9

Setting pressure	Initial pressure	Brake pressure
4x2	1.0 bar	min 1.5 bar
6x2	0.5 bar	min 0.8 bar
Pressure reading		