SCANIA

11:10-51

Issue 2 **en**

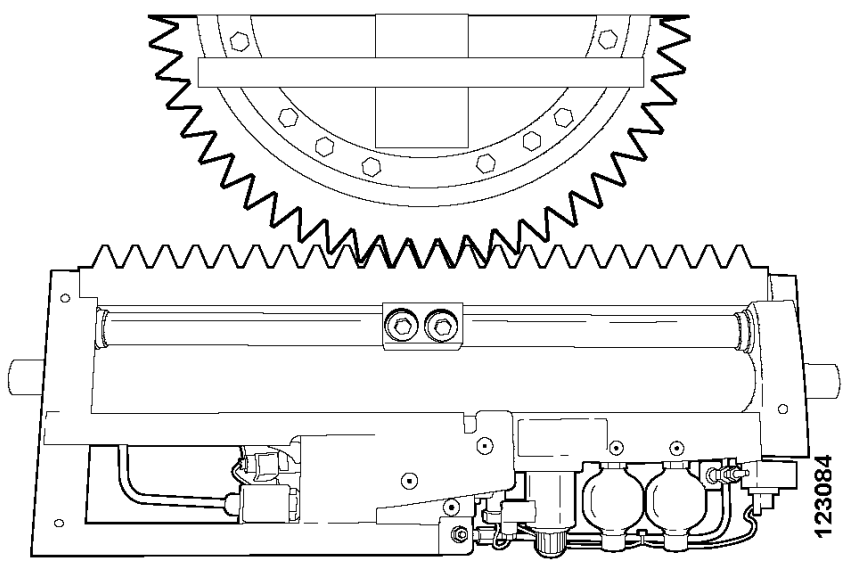
Articulation and articulation control system

Buses with rear-mounted engines

Function description

Work description

Troubleshooting



1 712 122

Contents

Function description

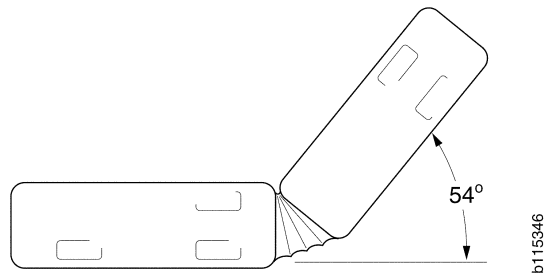
General

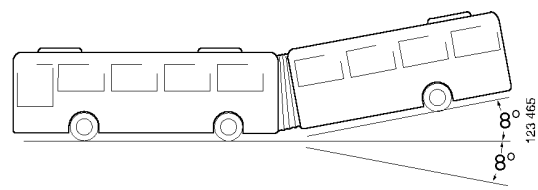
Articulated buses have a rear-mounted engine, driving the rear wheels.

To give articulated buses optimum driving characteristics, they are equipped with a special articulation control system.

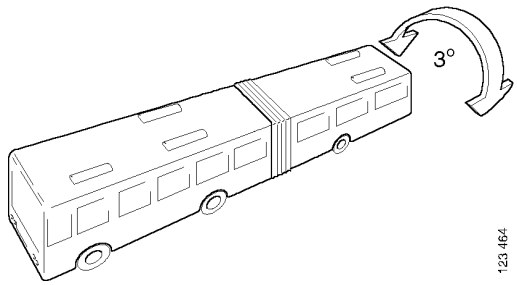
Maximum permissible horizontal articulation angle is 54°. The limit position sensor gives a warning at 47°. At 54° there is a mechanical stop, which prevents the articulation from breaking if the maximum articulation angle should be exceeded e.g. when reversing.

The chassis also permits a vertical angle of 8° in the articulation. This is dependent on the bodywork, and the angle may be smaller. A certain amount of care must therefore be taken when lifting or towing, so that this angle is not exceeded.

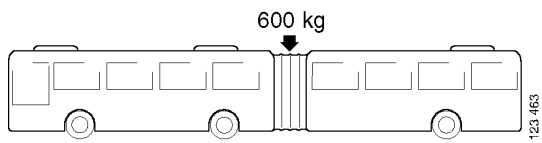




The chassis also permits a rotation angle of 3° in the articulation. This is dependent on the bodywork, and the angle may be smaller.



The chassis has positive articulation pressure, approx. 100-600 kg depending on bus model, i.e. the centre of gravity of the rear chassis section is in front of the rear axle.



Differences between generation 3 and 4

There are two different versions of articulation control system on series 4 buses (generations 3 and 4). This booklet covers both generations. The most major and distinctive differences between them are:

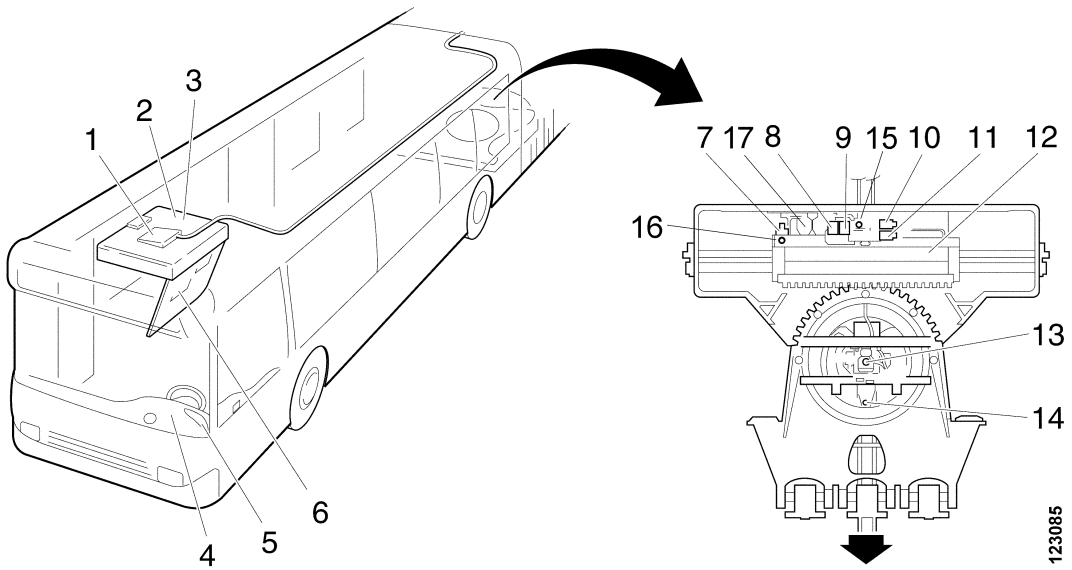
Articulation control system	Generation 3	Generation 4
Engine management	Electric throttle	EDC
Regulation of articulation damping	4 solenoid valves	Proportional valve

In comparison with generation 3, generation 4 also has:

- Modified electronics
- New control system
- New fault codes
- CAN communication with other systems

Articulation control system, generation 3

System design



1 Articulation control unit
2 ABS control unit
3 Engine control unit
4 Warning lamp
5 Switch for disconnecting reverse inhibitor
6 Electric central unit in front central electric unit
7 Pressure monitor, hydraulic system
8 Solenoid valve, medium articulation damping
9 Solenoid valve, soft articulation damping
10 Solenoid valve, right articulation damping
11 Solenoid valve, left articulation damping
12 Hydraulic unit
13 Angle sensor (potentiometer)
14 Limit position sensor
15 Test connection
16 Filler and check hole
17 Accumulator

Positions 8 and 11 are also protection diodes for the solenoid valves

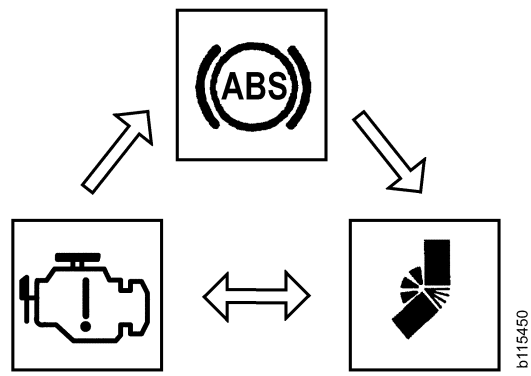
Position 8 and 9. Articulation damping, medium 8 and soft 9 together give hard damping

The articulation control system includes the hydraulic unit, sensors, ABS control unit, engine control unit and articulation control unit. The limit position sensor is an inductive sensor, and the angle sensor is a potentiometer.

The purpose of the hydraulic unit is to brake the horizontal movement of the articulation. The flow in the closed hydraulic system is controlled from the articulation control unit via solenoid valves.

A signal is sent from the engine control unit to the articulation control unit containing information on the current throttle position and fuel volume. The ABS control unit also transmits information about wheel speeds, TC brake control and TC engine control to the articulation control unit.

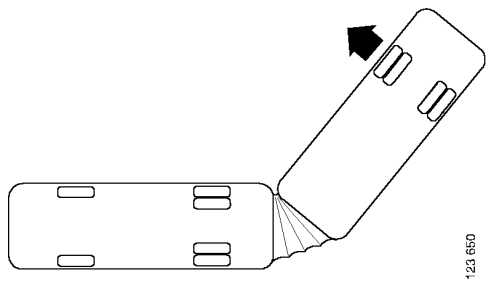
Any request for a reduction in throttle is sent back from the articulation control unit to the engine control unit. This means that engine control information does not go directly to the engine control unit, the articulation control unit decides if engine control information should be sent on to the engine.



Main functions

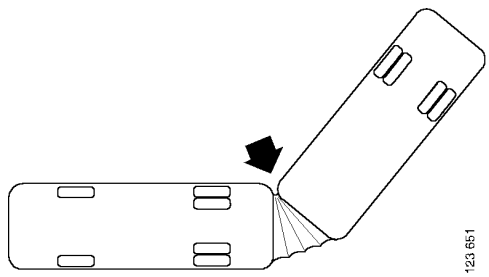
Different wheel speeds

If one or both of the rear (drive) wheels spins freely, a dangerous situation can occur, as the rear part of the bus can loose lateral stability and slide sideways without the driver being aware of it. This situation can occur both at low speeds e.g. when driving away, and at higher speeds, e.g.when negotiating a roundabout.



Skid, the rear of the bus slides sideways

Another dangerous situation can occur if the driver after a turn, applies full throttle at the same time as the rear part of the bus is still turning. If the road surface is slippery, the centre axle may then be pushed out to the side and the bus will fold at the articulation, as a jack-knife.



Jack-knife, the centre of the bus slides sideways

Wheel spin means that the wheel speed on the rear axle is deviating more than permitted and is higher than the wheel speed on the other axles. Jack-knifing means that the wheel speed on the centre-axle is lower than and deviates more than permitted in comparison with the wheel speed on the other axles. Both situations are corrected by engine control and articulation damping.

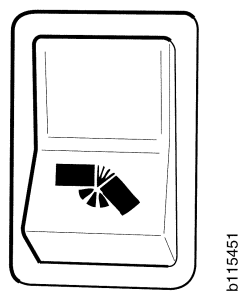
Articulation damping

Damping of the articulation is achieved by restricting the fluid flow in the closed hydraulic system via the proportional valve. The articulation is dampened to give the bus directional stability at high speeds and to prevent jack-knifing under icy conditions. Under normal driving conditions, the articulation is dampened when turning but not when the articulation is straightening out.

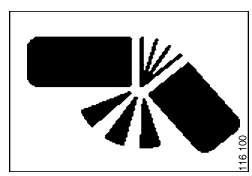
Articulation protection when reversing

If the articulation angle exceeds 47° during reversing the warning lamp comes on and a buzzer will sound. To protect the articulation, further reversing is prevented by the application of the bus stop brake, automatic reduction to idling speed and hard damping of the articulation. The disconnection switch is used when reversing is to continue, despite the reverse inhibitor having been activated.

If the disconnection switch is depressed, the reversing signal ceases or the articulation angle becomes less than 45° the warning signals will cease. If the disconnection switch is held depressed when the limit position is reached, it must be released and depressed again before reversing can continue.



Switch for disconnecting reverse inhibitor.



Warning lamp for articulation control system.

Pressure monitoring

If the pressure in the hydraulic system is too low (< 3 bar) the damping function is reduced and the warning lamp for articulation control comes on while the throttle actuation is decreased to a maximum speed of 50 km/h.

Note: On the first buses, the pressure monitor was set to 4 bar. It can be changed to 3 bar even on these buses to avoid an alarm when the hydraulic pressure is too low during cold weather.

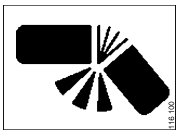
Limp-home mode

A fault in the articulation control system can affect the normal characteristics of the bus, especially under icy conditions. To inform the driver of any faults located, a warning lamp for articulation control comes on and the maximum permitted throttle actuation is reduced. This gives the driver a clear indication that something is wrong, but it is still possible to continue driving safely, at a reduced speed. In addition, all the solenoid valves are opened and the fault codes are stored.

Some fault codes are self-healing, i.e. if the fault ceases, all the functions return to normal and the fault codes are saved.

Articulation control unit

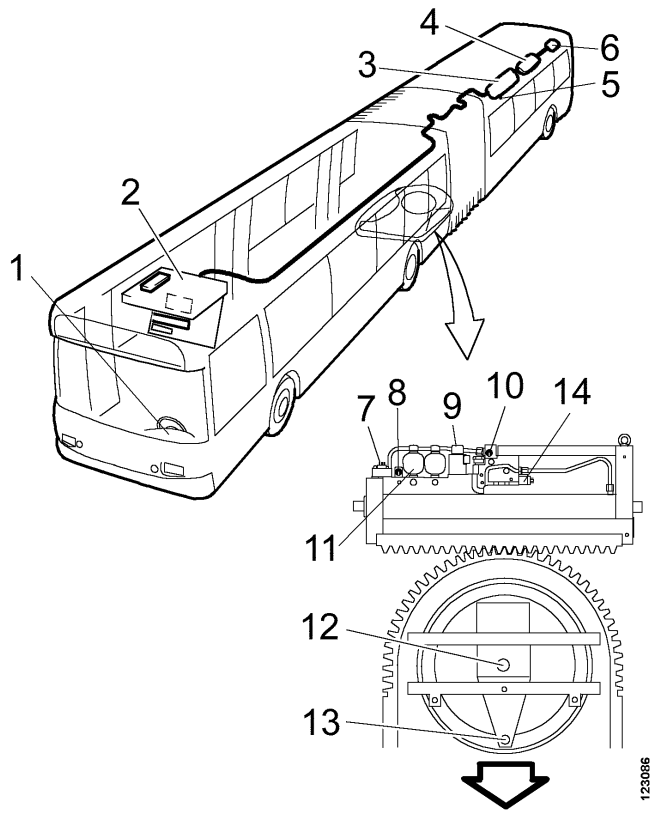
If the articulation control unit detects a fault, the articulation control warning lamp comes on.



Warning lamp for articulation control system.

Articulation control system, generation 4

System design



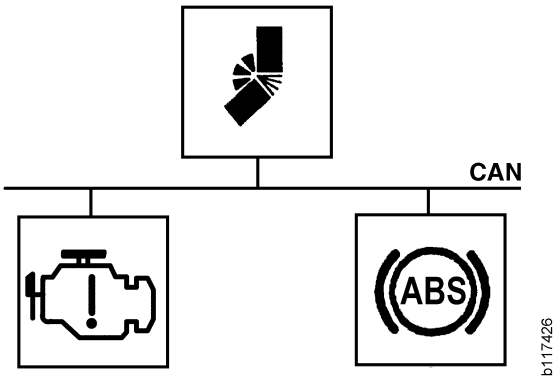
1 Instrument cluster, etc.
2 Front central electric unit
3 Brake control unit
4 Rear central electric unit
5 Articulation control unit
6 Engine control unit
7 Hydraulic pressure monitor (<3 bar)
8 Filler and check hole
9 Proportional valve for articulation damping
10 Test connection
11 Accumulator
12 Angle sensor (potentiometer)
13 Limit position sensor
14 Hydraulic pressure monitor (>50 bar), not used by Scania

The articulation control system comprises an articulation control unit, a hydraulic unit, a number of sensors, a brake control unit (ABS/TC) and an engine control unit (EDC). The limit position sensor is an inductive sensor, and the angle sensor is a potentiometer.

The purpose of the hydraulic unit is to brake the horizontal movement of the articulation. The flow in the closed hydraulic system is limited by the articulation control unit via a proportional valve.

The signals are transmitted between the control units via CAN. A signal is sent from the engine control unit (EDC) to the articulation control unit, containing information on the current regulated fuel volume. The brake control unit (ABS/TC) also transmits information about wheel speeds to the articulation control unit.

Any request for a reduction in throttle is sent from the articulation control unit to the engine control unit. A request for a reduction in throttle is also sent from the brake control unit to the engine control unit. The request from the control unit demanding the highest reduction is carried out.



An explanation of CAN communication

The control units communicate with each other through the CAN cables. The information in the CAN cables cannot be checked by using a multimeter. However, it is still possible to measure at each current consumer that is connected to the control units.

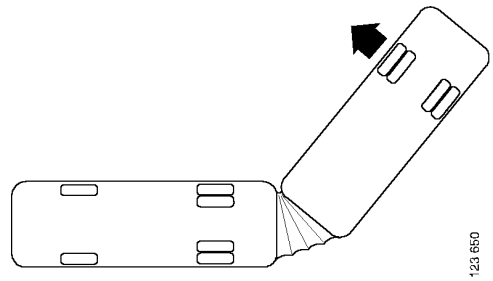
Such information transferred via the CAN cables between the control units, we have chosen to call messages. These leads are used to transfer different messages, between different control units, at different times.

The information that goes to and from the control units in the form of voltage levels we call signals. Each component has its own connection to the control unit.

Main function

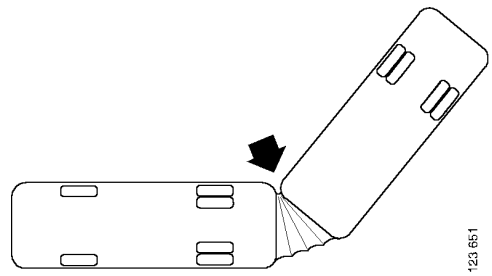
Different wheel speeds

If one or both of the rear (drive) wheels spins freely, a dangerous situation can occur, as the rear part of the bus can lose lateral stability and slide sideways without the driver being aware of it. This situation can occur both at low speeds e.g. when driving away, and at higher speeds, e.g.when negotiating a roundabout.



Skid, the rear of the bus slides sideways

Another dangerous situation can occur if the driver after a turn, applies full throttle at the same time as the rear part of the bus is still turning. If the road surface is slippery, the centre axle may then be pushed out to the side and the bus will fold at the articulation, as a jack-knife.



Jack-knife, the centre of the bus slides sideways

Wheel spin means that the wheel speed on the rear axle is deviating more than permitted and is higher than the wheel speed on the other axles. Jack-knifing means that the wheel speed on the centre-axle is lower than and deviates more than permitted in comparison with the wheel speed on the other axles. Both situations are corrected by engine control and articulation damping.

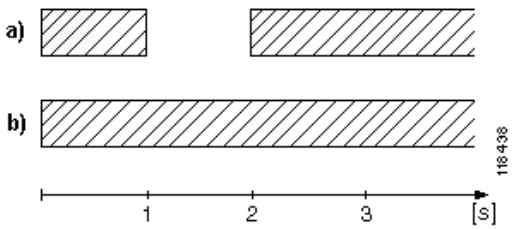
Articulation damping

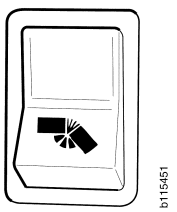
Damping of the articulation is achieved by restricting the fluid flow in the closed hydraulic system via the proportional valve. The articulation is dampened to give the bus directional stability at high speeds and to prevent jack-knifing under icy conditions. Under normal driving conditions, the articulation is dampened when turning but not when the articulation is straightening out.

Articulation protection when reversing

If the articulation angle exceeds 47° during reversing the warning lamp comes on and a buzzer will sound (a) when turning to the left and b) when turning to the right (as illustrated). To protect the articulation, further reversing is prevented by the application of the bus stop brake, automatic reduction to idling speed and hard damping of the articulation. The disconnection switch is used when reversing is to continue, despite the reverse inhibitor having been activated.

If the disconnection switch is depressed, the reversing signal ceases or the articulation angle becomes less than 47° the warning signals will cease. If the disconnection switch is held depressed when the limit position is reached, it must be released and depressed again before reversing can continue.





Switch for disconnecting reverse inhibitor.

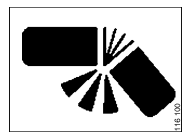
Pressure monitoring

If the pressure in the hydraulic system is too low (< 3 bar) the damping function is reduced and the warning lamp for articulation control comes on while the throttle actuation is decreased to a maximum speed of 50 km/h.

Limp-home mode

A fault in the articulation control system can affect the normal characteristics of the bus, especially under icy conditions. To inform the driver of any faults located, a warning lamp for articulation control comes on and the maximum permitted throttle actuation is reduced. This gives the driver a clear indication that something is wrong, but it is still possible to continue driving safely, at a reduced speed. In addition, the proportional valve is opened and the fault code is stored.

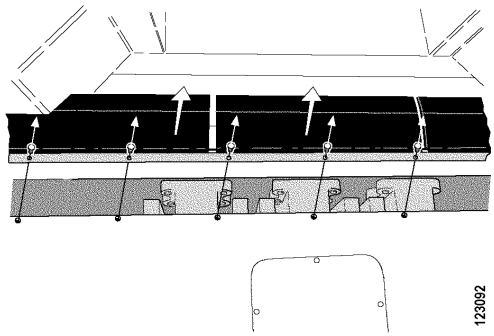
Most fault codes are self-healing, i.e. if the fault ceases, all the functions return to normal and the fault code is saved.



Warning lamp for articulation control system.

Work description

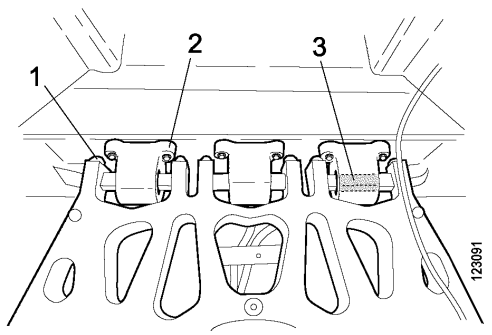
Rubber mounting



Checking

1 Remove the rubber moulding.

2 Check the rubber mounting attachment to the articulation unit 1 and the frame 2. Also check that there are no cracks in the rubber mountings 3. Renew the rubber mountings if they are in poor condition, refer to Removal of rubber mounting.



Note: The rubber mountings should be renewed every 500,000 km.

Specifications

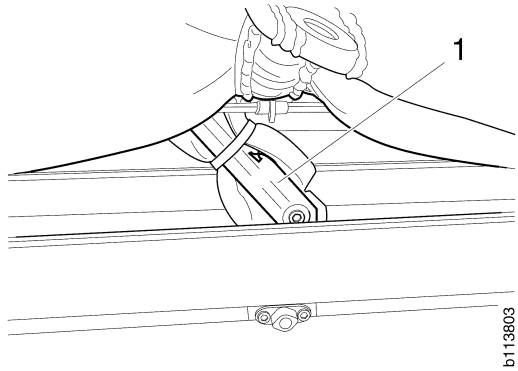
Tightening torques

Rubber mounting attachment to articulation	350 Nm
Rubber mounting attachment to chassis	530 Nm

Note: The work must be carried out over an inspection pit!

Removal

1 Detach the rear edge of the front ceiling covering sufficiently to gain access to the bellows support arms.

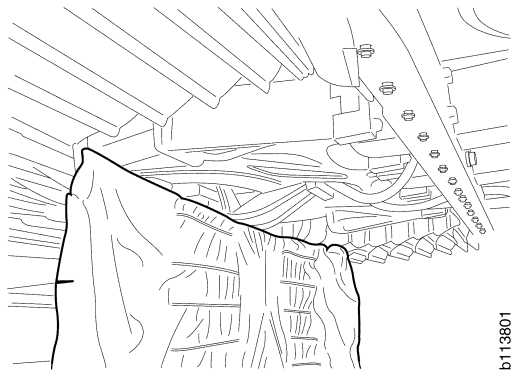


2 Detach the bellows support arms 1.

3 Undo the front of the lower bellows, see main group 18, Bellows or the coachbuilder directions.

4 Support the articulation using two stands at the front and secure using two stands at the rear. Try to support the bus in a position as horizontal as possible.

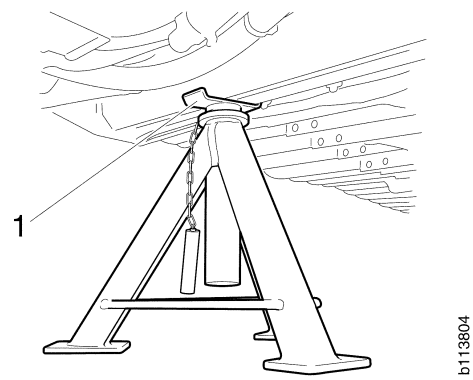
- Position the front stands under the beam just behind the articulation, and approximately 40 cm from the outer edge.



WARNING!

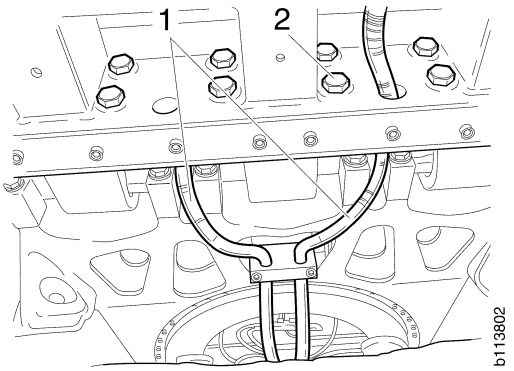
The stand slide protection 1 must be used. It is extremely important that the joint does not slide off the stands.

- Position the rear stands as far back as possible under the beam behind the engine, refer to Main group 0, Lifting and supporting on stands.



WARNING!

Position chocks in front and behind the drive wheels to prevent the rear part of the bus from rolling away.



5 Loosen the cables 1 and remove the attaching bolts 2 for the rubber mountings.

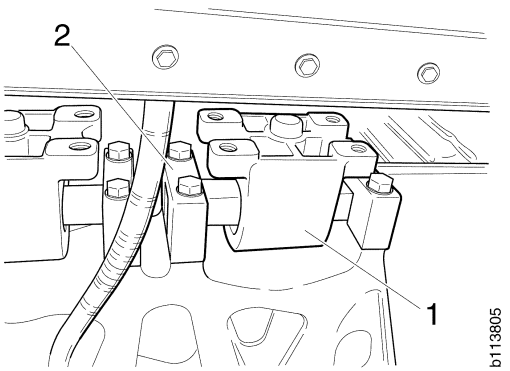
Note: Position chocks approximately 10 cm in front of the front wheels, to prevent the bus from rolling too far forward.

6 Release the parking brake.

7 Carefully roll the front part of the bus forward approximately 10 cm.

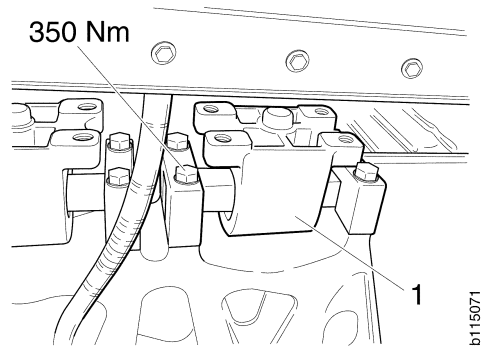
8 Position chocks behind the front wheels so that the bus cannot roll back.

9 Remove the brackets 2 and the rubber mountings 1.



Fitting

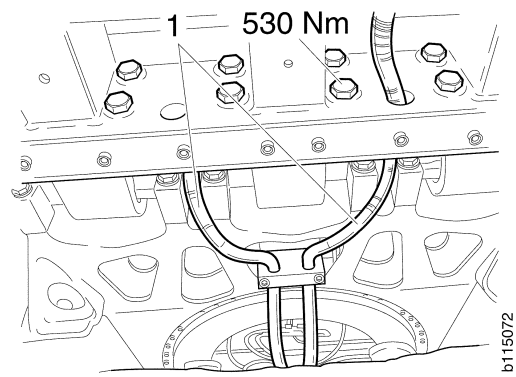
1 Fit the rubber mountings 1 and torque tighten the brackets to 350 Nm.



2 Remove the chocks from behind the front wheels and roll back the bus. Apply the parking brake.

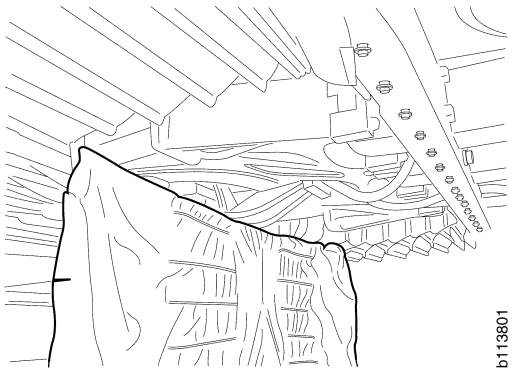
Note: Make sure that nothing is trapped and that the rubber mountings are positioned correctly.

3 Torque tighten the retaining bolts of the rubber mountings to 530 Nm and fit the cables 1.



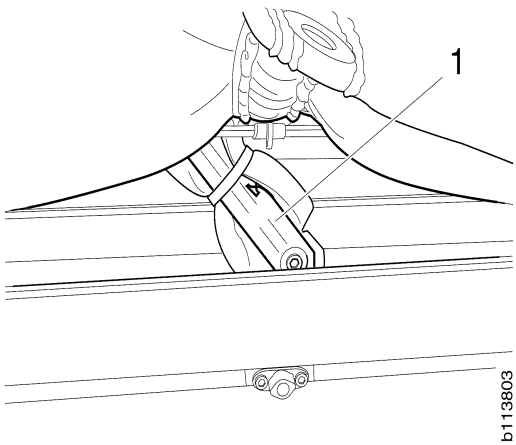
4 Remove the stands.

5 Fit the front of the lower bellows, see main group 18, Bellows or the coachbuilder directions.



6 Fit the bellows support arms 1.

7 Fit the rear edge of the front ceiling covering.



Cable chain

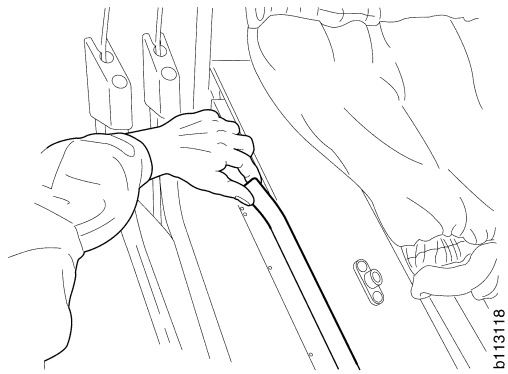
Specifications

Tightening torques

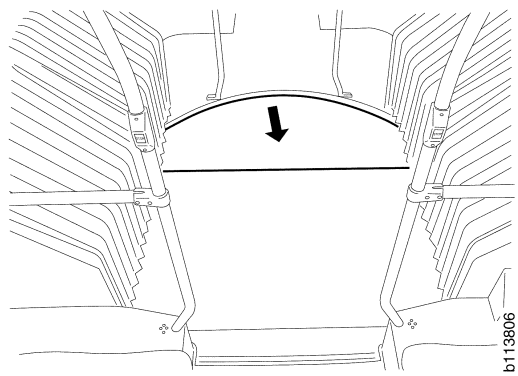
M8 bolts	25 Nm
M10 bolts	30 Nm

Renewal

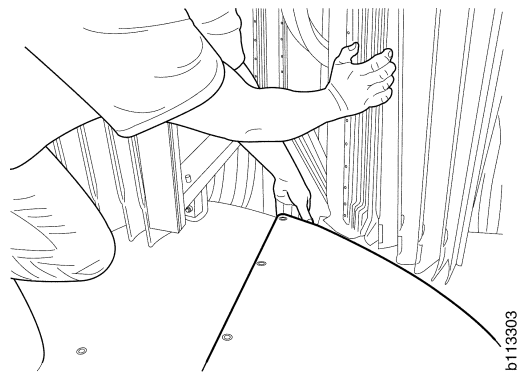
1 Remove the front strip of the rear inner bellows.



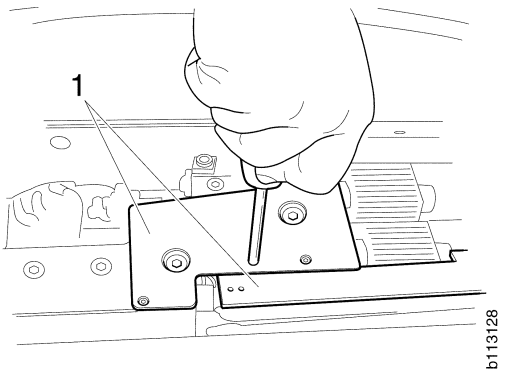
2 Remove the floor strips at the rear floor plate.



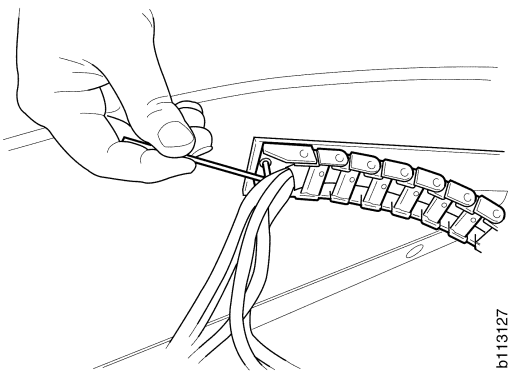
3 Fold the bellows to one side and remove the rear floor plate.



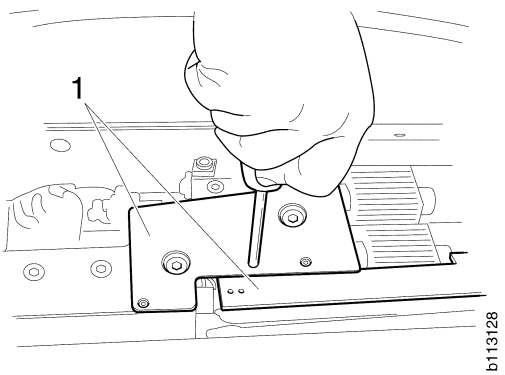
4 Remove the protection plates 1.



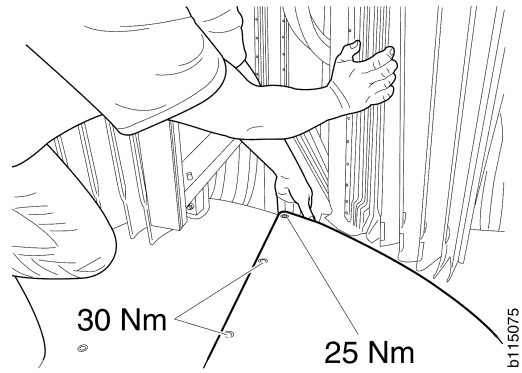
5 Remove the cable chain guide and fit the new one.



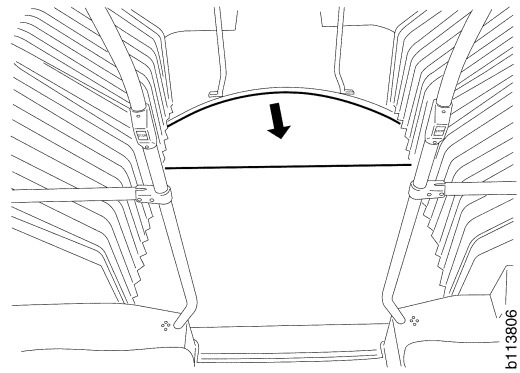
6 Fit the protection plates 1.



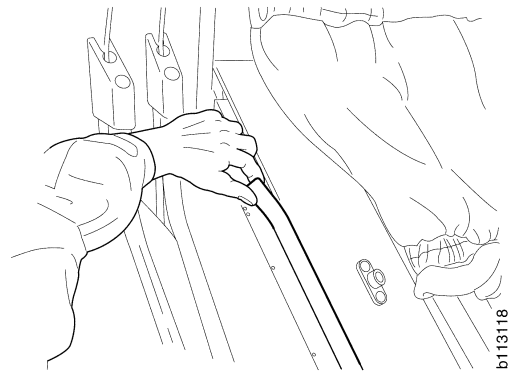
7 Fold the bellows to one side and fit the rear floor plate. Torque tighten the M8 bolts to 25 Nm and the M10 bolts to 30 Nm.



8 Fit the floor strips at the rear floor plate.



9 Fit the front strip of the rear inner bellows.



Hydraulic unit

Specifications

Tightening torques

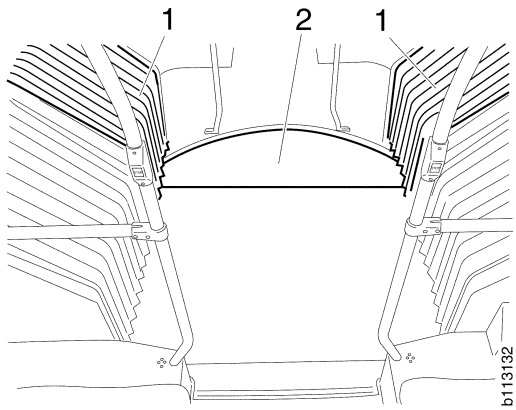
Corner plate, retaining bolts	24 Nm

Removal

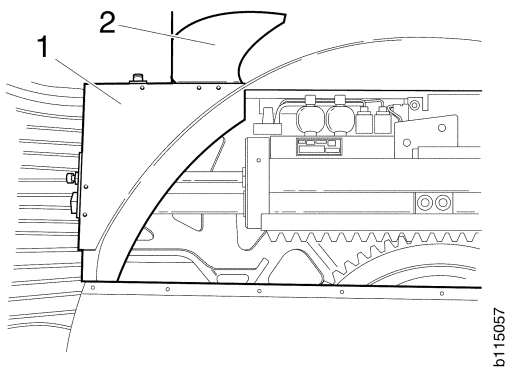
1 Remove the rear inner bellows 1, see main group 18, Bellows or the coachbuilder directions.

2 Remove the floor strips at the rear floor plate 2.

3 Remove the rear floor plate 2.

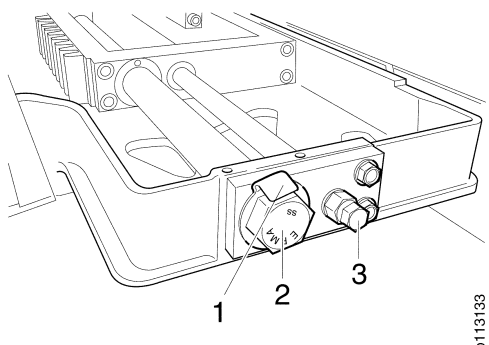


4 Detach the mat 2 at the corners sufficiently to remove the corner plates 1. Remove the corner plates on both sides.



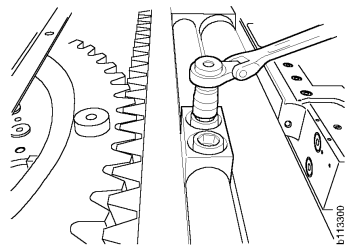
5 Bend up the tab washer 1.

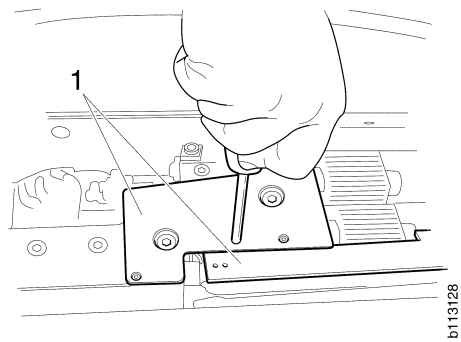
6 Remove the control shaft bolt 2 and the worm screw for the piston 3.



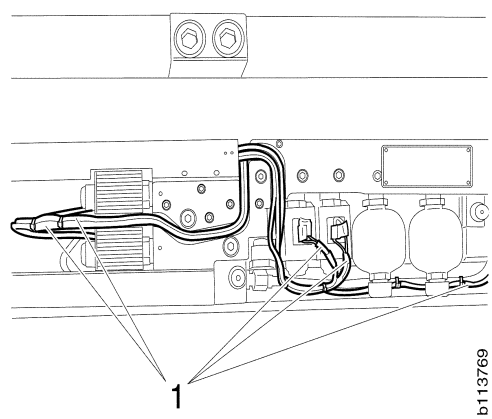
7 Remove the support bearing bolts.

8 Remove the protection plates 1.



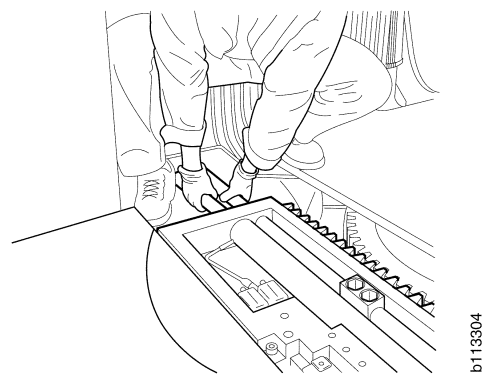


9 Disconnect all cables.



10 Remove the hydraulic unit.

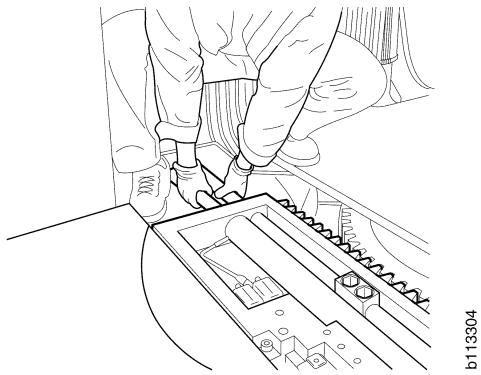
Note: The hydraulic unit weights about 110 kg. Two persons are required, one lifting at each side.



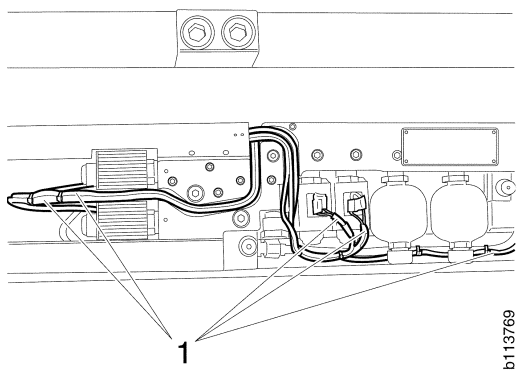
Fitting

1 Fit the hydraulic unit.

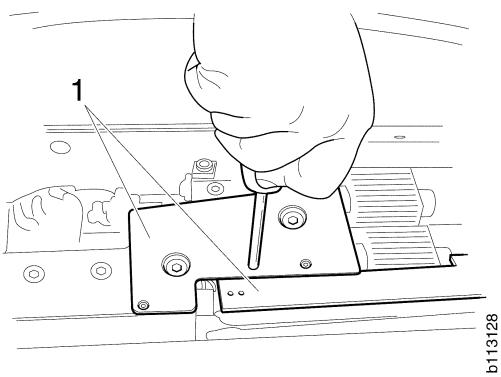
Note: The hydraulic unit weights about 110 kg. Two persons are required, one lifting at each side.



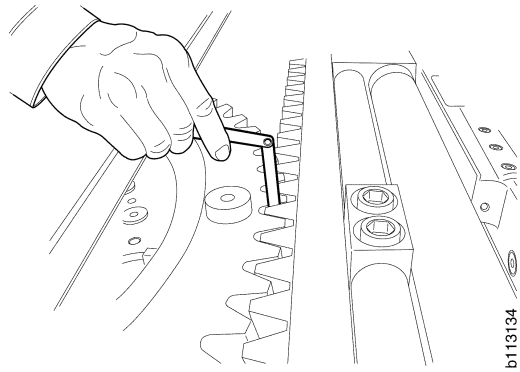
2 Connect all cables 1.



3 Fit the protection plates 1.

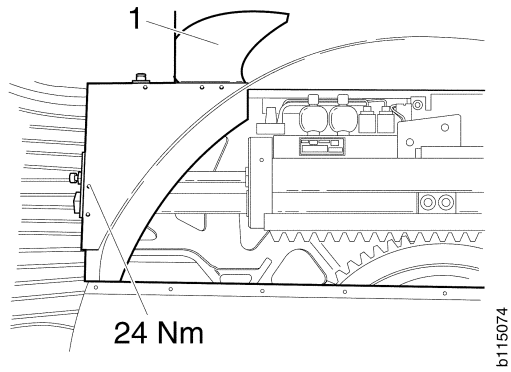


4 Adjust the backlash, refer to Adjustment of backlash, steps 5 - 10.



5 Fit the corner plates to both sides and torque tighten the screws to 24 Nm.

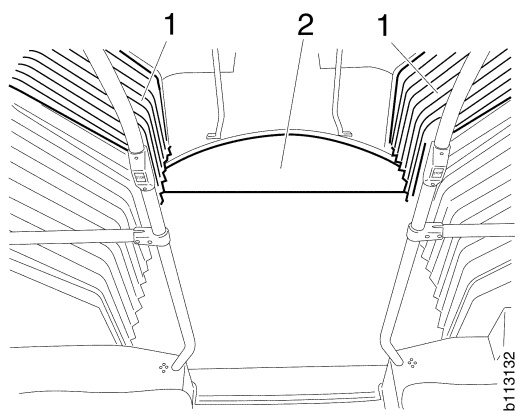
6 Glue the mat 1 to the corner plates.



7 Fit the rear floor plate 2.

8 Fit the floor strips at the rear floor plate 2.

9 Fit the rear inner bellows 1, see Main group 18, Bellows or the coachbuilder directions.



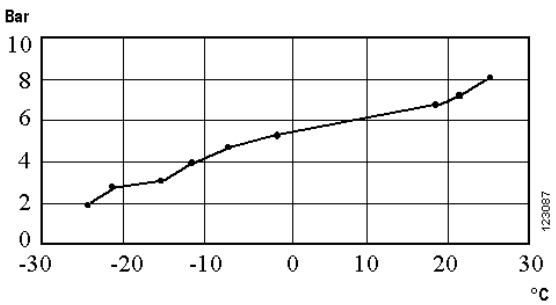
Checking and adjusting hydraulic cylinder pressure

Specifications

Pressure

Hydraulic cylinder	7.0 bar (at 20°C)

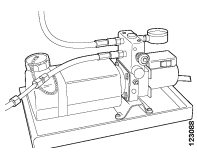
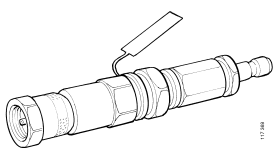
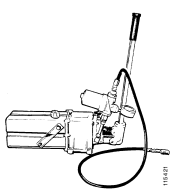
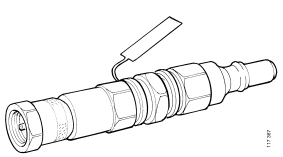
IMPORTANT! The diagram shows how the hydraulic pressure is affected by the oil temperature. Therefore, it is very important to note down the oil temperature when measuring.



Pressure specification of hydraulic cylinder

Equipment

Special tools

Number	Description	Illustration
99 355	Filling equipment	
82 335	Adapter x 2	
639 974	Hand pump	
82 336	Union	

Preparation

Note: The bus must be positioned in a straight line!

1 Remove the rear floor plate, refer to Cable chain guide, steps 1 - 3.

2 Clean the valve block around the pressure gauge connection. Remove the protective cap and connect the pressure gauge.

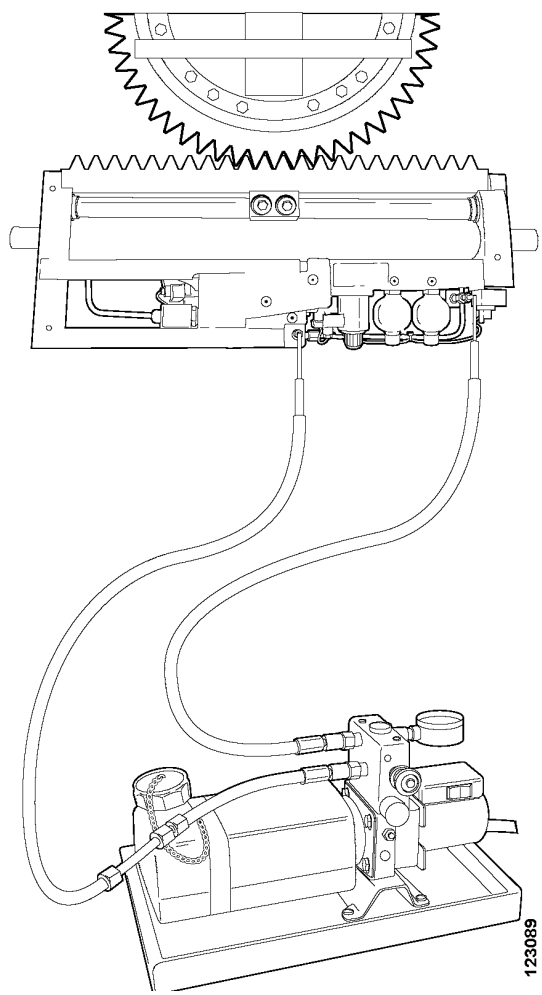
Checking

IMPORTANT! The measuring equipment must not be connected during driving as the pressure rises steeply when the articulation is angled.

3 Check that the pressure is 7.0 bar (at 20°C or according to the diagram). If the pressure is not correct, adjust it according to the diagram: Pressure specification of hydraulic cylinder.

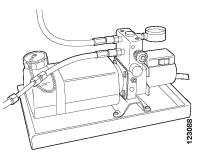
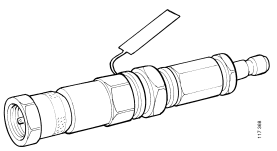
4 Remove the measuring equipment and fit the protective cap.

5 Fit the rear floor plate, refer to Cable chain guide, steps 7 - 9.



Bleeding the hydraulic unit

Special tools

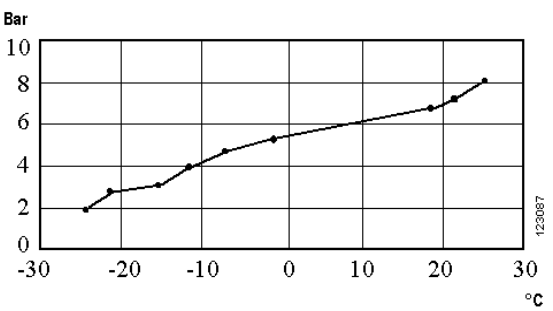
Number	Description	Illustration
99 355	Filling equipment	
82 335	Adapter x 2	

Specifications

Oil	
Articulation control system	See main group 00, Oils, lubricants, liquids

Pressure	
Articulation control system	7.0 bar at 20°C as diagram: Pressure specification of hydraulic cylinder

IMPORTANT! The diagram shows how the hydraulic pressure is affected by the oil temperature. Therefore, it is very important to note down the oil temperature when measuring.



Pressure specification of hydraulic cylinder

Note: The bus must be positioned in a straight line!

1 Remove the rear floor plate, refer to Cable chain guide, steps 1 - 3.

2 Clean the valve block around the two filler and measuring outlets. Remove the protection covers and connect an adapter 82335 to each outlet.

3 Connect the hose from the filling equipment (99 355) to the pressure outlet (marked P) and the RH outlet in the hydraulic unit. Connect the return hose with the transparent plastic pipe to the outlet marked T and to the left-hand outlet in the hydraulic unit. Function description and maintenance of filling equipment 99 355 see 13:00-04

4 Connect the equipment to a suitable 24V power source and START the pump. Allow it to run until there is no air visible in the transparent plastic pipe. STOP the pump. Finish by removing the return (T). Increase the pressure to 3 - 4 bar. Bleed from the four screws one at a time until oil appears.

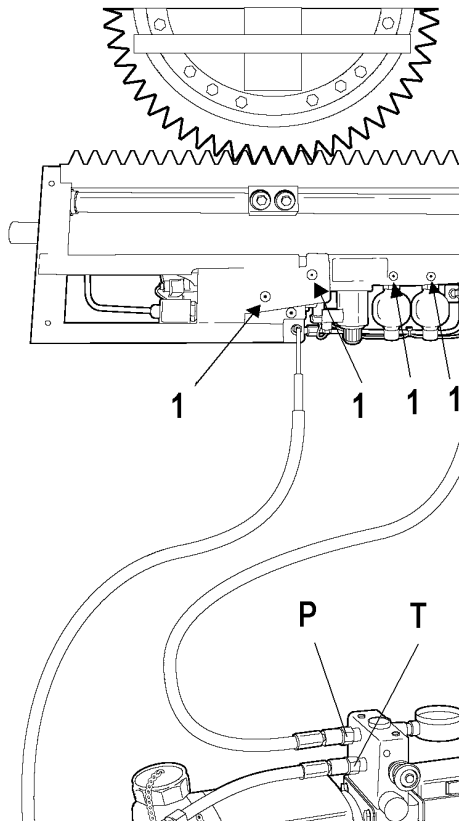
5 Start the pump and adjust the pressure to 7.0 bar at 20°C or according to the diagram. Refer to Pressure specification of hydraulic cylinder.

6 Perform a road test, turning the bus until the articulation reaches both its end positions.

Note: Remove the hoses and adapters 82 335 before performing the road test, pressure surges of up to 250 bar can occur (the nipples can shear against the corner plates when the bus is turned).

7 Check for any leaks. Bleed off any remaining air and adjust the pressure.

8 Fit the rear floor plate, refer to Cable chain guide, steps 7 - 9.



1 = Bleed screws (4)

P = Pressure

T = Return

Filling equipment 99 355 connected to hydraulic unit

Checking and adjusting backlash

Specifications

Tightening torques

Internal hexagon bolts, support bearing	450 Nm
Retaining bolts, adjusting plate	300 Nm
Worm screw, piston	10 Nm
Lock nut, worm	200 Nm
Bolt, control shaft	350 Nm

Backlash when adjusting

Correct backlash	0 - 0.25 mm

Backlash when checked

Maximum permissible backlash	1.0 mm

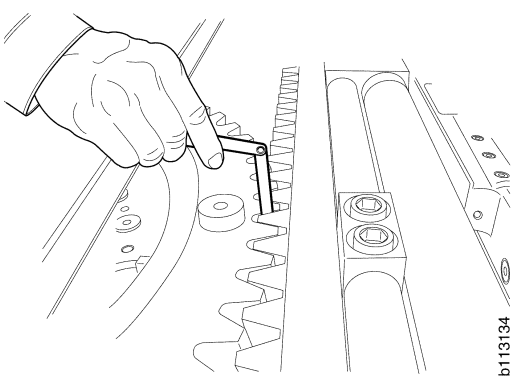
Checking

Note: The bus must be positioned in a straight line!

1 Remove the rear floor plate, refer to Cable chain guide, steps 1 - 3.

2 Check the backlash with a feeler gauge. If the backlash is greater than 1.0 mm, it must be adjusted. Refer to Adjustment of backlash.

3 Fit the rear floor plate, refer to Cable chain guide, steps 7 - 9.



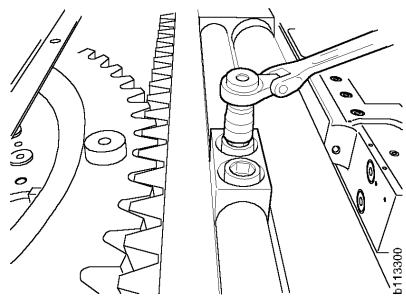
Adjustment of backlash

Inner bellows

1 Remove the rear inner bellows 1, see main group 18, Bellows or the coachbuilder directions.

Tooth flank

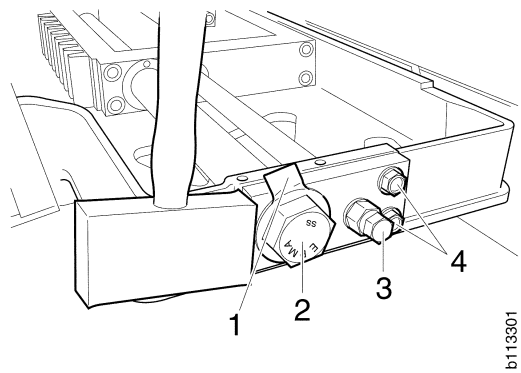
1 Loosen the bolts for the support bearing.



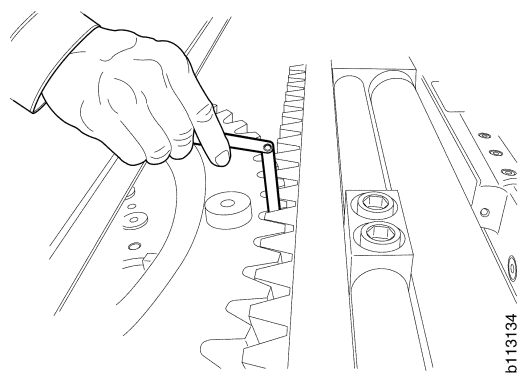
2 Bend up the tab washer 1.

3 Remove the control shaft bolt 2 and the worm screw for the piston 3.

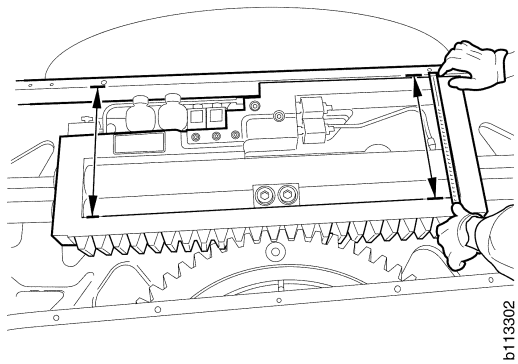
4 Remove the retaining screws 4 for the adjusting plate.



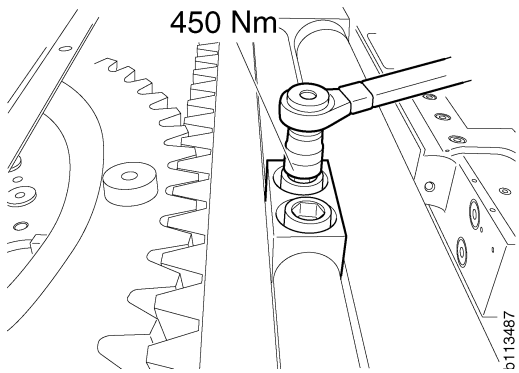
5 Adjust the backlash by tapping the adjusting plate with a rubber mallet. Tap forwards for reduced backlash and backwards for increased backlash. The correct backlash is 0 - 0.25 mm. Measure the play using a feeler gauge.



6 Ensure that the hydraulic unit is parallel to the rear part of the bus. Check by measuring using a tape measure.



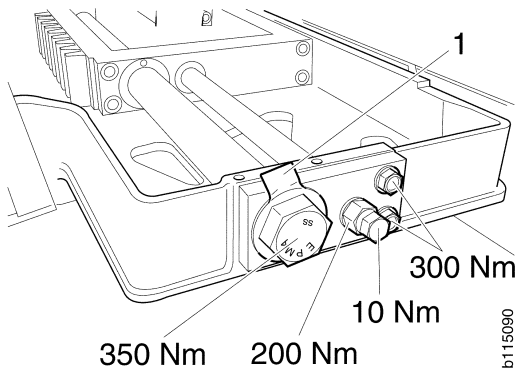
7 Torque tighten the support bearing to 450 Nm.



8 Tighten the adjusting plate retaining bolts to 300 Nm.

9 Tighten the piston worm to 10 Nm and the lock nut to 200 Nm.

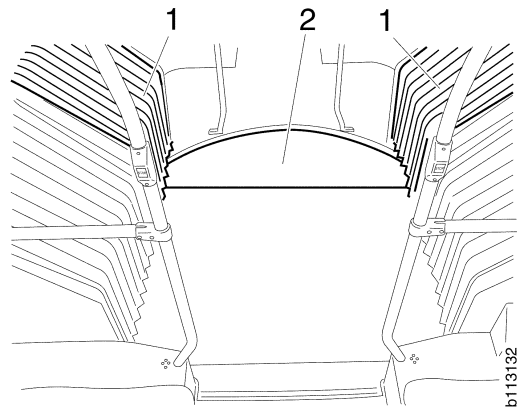
10 Tighten the control shaft bolt to 350 Nm. Secure the bolt by bending the tab washer 1.



11 Fit the rear floor plate 2.

12 Fit the floor strips at the rear floor plate 2.

13 Fit the rear inner bellows 1, see Main group 18, Bellows or the coachbuilder directions.



Checking and adjusting limit position sensor

Specifications

Clearance

Vertical clearance between end position 1 and limit position sensor 2.	3 +/- 2 mm

1 Remove the inspection cover in the centre of the articulation.

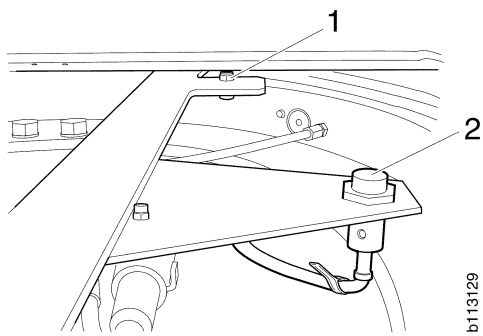
Note: The cables and sensor are very sensitive.

2 Turn the bus sufficiently so that limit position sensor 2 is positioned directly under end position 1.

3 Check that the limit position sensor is lined up with the end position. Adjust the end position if required.

4 Check that the vertical clearance between the limit position sensor and the end position is 3 +/- 2 mm. Adjust the limit position sensor if required.

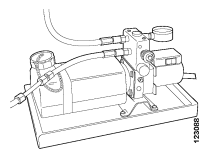
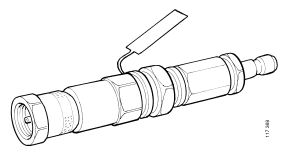
5 Then turn the bus so that the limit position sensor is positioned directly under the end position on the other side and repeat the check and any adjustments, if required.



1 End position
2 Limit position sensor

Renewal of solenoid valve, accumulator or hydraulic monitor

Special tools

Number	Description	Illustration
99 355	Filling equipment	
82 335	Adapter x 2	

Specifications

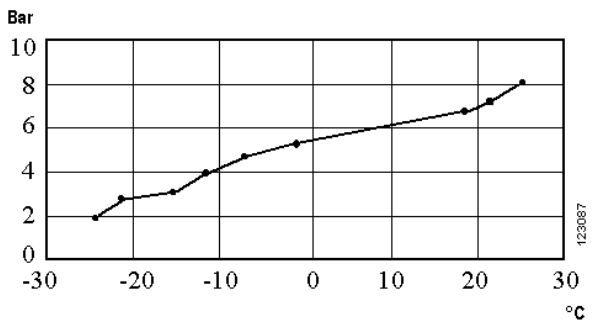
Tightening torques

Internal hexagon bolts, support bearing	450 Nm
Accumulator	80 Nm
Retaining bolts, adjusting plate	300 Nm
Worm screw, piston	10 Nm
Lock nut, worm	200 Nm
Bolt, control shaft	350 Nm

Clearance	
Correct backlash	0 -0.25 mm

Pressure	
Hydraulic cylinder	7 bar at 20°C as diagram: Pressure specification of hydraulic cylinder

IMPORTANT! The diagram shows how the hydraulic pressure is affected by the oil temperature. Therefore, it is very important to note down the oil temperature when measuring.



Pressure specification of hydraulic cylinder

Renewal

Note: The bus must be positioned in a straight line!

1 Remove the rear floor plate, refer to Renewal of cable chain guide, steps 1 - 3.

2 Connect the filling equipment, see Bleeding the hydraulic unit, steps 2 - 3.

3 Release the pressure in the hydraulic unit.

WARNING!

The hydraulic pressure must be released before removing any components.

IMPORTANT! The hydraulic unit must not be drained of oil using compressed air. There is otherwise a risk of air entering the hydraulic system that will be very difficult to clear.

4 Undo the hydraulic unit, see Hydraulic unit removal, steps 4 - 7. Raise the hydraulic unit on one edge.

5 Remove the faulty component and fit a new one.

Note: The proportional valve must not be renewed separately, the entire hydraulic unit must be renewed in one piece. The proportional valve is calibrated together with the hydraulic unit.

6 Fit the hydraulic unit.

7 Adjust backlash. Refer to Adjustment of backlash, steps 5 - 10.

8 Bleed the hydraulic system. See Bleeding the hydraulic unit, steps 3 - 7 and adjust the pressure to 7.0 bar at 20°C or refer to diagram Pressure specification for hydraulic cylinder.

9 Remove the filling equipment and replace the protection covers on the outlets.

10 Fit the rear floor plate, refer to Renewing cable chain guide, steps 7 - 9.

Angle sensor, generation 3

Specifications

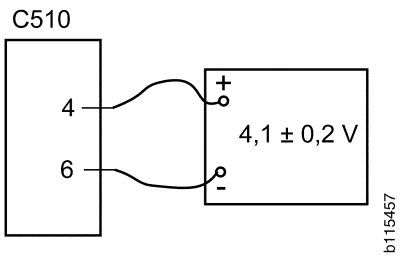
Voltage

Between pin 4 and pin 6 on connector C510	4.1 +/- 0.2 V

1 Remove the inspection cover in the centre of the articulation.

2 Make sure the bus is positioned in a straight line, as this affects the measurement of the angle sensor.

3 Take a reading with a multimeter across control unit pins 54 and 35. Suitable measuring points are across pin 4 (ACS 54 WH) and pin 6 (ACS 35 BK) on connector C510. The connector is located in the front central electric unit. The correct value is 4.1 +/- 0.2 V.



Approximate reference values for angle sensor voltage

Left end lock	Straight ahead position	Right end lock
7 V	4.1 V	1 V

Troubleshooting

Troubleshooting generation 3

Reading of fault codes can be carried out either by using Scania Diagnos or by using the diagnostics lamp in the instrument panel.

Reading fault codes

Switch on the power using the starter key.

If fault codes are present the diagnostic lamp is constantly on.

The diagnostic lamp is out if no codes are present.

1 Press the diagnostics switch. Release it and count the number of times the lamp flashes.

2 Note all fault codes. (The number of flashes indicates the fault code.)
E.g. Fault code 14 = 14 flashes.

3 The faults are flashed one after another, at approx. 2 second intervals.

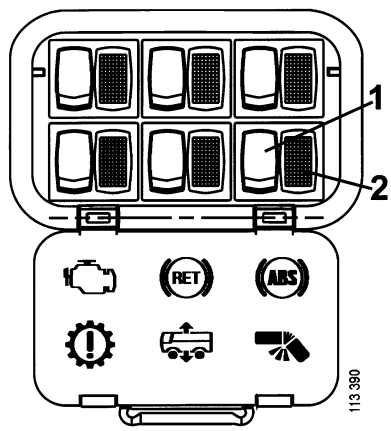
Erasing fault codes

1 Turn off the power supply with the starter key.

2 Press the diagnostics switch and keep it depressed.

3 Turn the starter key into the drive position. Hold the switch depressed for 3 seconds.

4 Release the switch. The lamp goes out. All fault codes will then have been cleared.



1 Diagnostics switch
2 Diagnostics lamp

List of fault codes, generation 3

Fault code 01

Fault

Fault in an integral control unit memory.

Cause

A control calculation of the contents of the EPROM memory did not produce the result expected by the control unit. The EPROM memory contains the software of the control unit.

Remarks

The control unit attempts to generate limp-home mode. The control unit will then only permit a certain amount of throttle actuation and disconnects the solenoid valves. Engine control from the wheel spin control is normal.

Action

Renew the control unit if the fault has occurred repeatedly.

Fault code 02

Fault

Unidentified code plug.

Cause

The control unit is unable to identify the code plug. As a result, the control unit is unable to calculate the permissible degree of throttle actuation in limp-home mode.

Remarks

The code plug is checked when the ignition is turned on. If the code plug is not identified, the control unit generates the limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. The engine control from the wheel spin control is controlled according to code plug 1303 039.

Action

Replace with an approved code plug.

Fault code 03

Fault

Loose connection in the code plug connector.

Cause

The code plug is checked when the ignition is switched on. A fault code is generated if the code plug has been changed during operation.

Remarks

The driver does not get a warning. The control unit registers the fault code but the articulation control system functions as normal.

Action

1 Remove the code plug and check its pins. Refit the code plug. Switch on the ignition using the starter key and check if the fault code is still generated.

2 Remove the code plug and compress the sprung connector pins in the control unit connector for the code plug. Refit the code plug. Switch on the power supply. Renew the code plug if the fault code is still generated.

Fault code 04

Fault

The control unit receives no signal from the ABS control unit.

Cause

The approved signal has been absent for more than five seconds.

Comments

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function and the warning lamp goes out. Engine control from the wheel spin control is de-activated.

Action

Check the wiring and the ABS control unit.

Fault code 05

Fault

The control unit receives no information (DKV signal) about the current throttle pedal position from the engine control unit. This information must be transmitted via the ABS control unit.

Cause

The ABS control unit issues a warning if the information (DKV signal) about the throttle pedal position is absent.

Remarks

The fault is somewhere between the ABS control unit and the engine control unit. Otherwise fault code 4 would also be generated.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

Check the fault codes in the ABS control unit and the engine control unit. Check the ABS and engine system connectors and wiring.

Fault code 06

Fault

One or more wheel speed signals are missing from the ABS control unit.

Cause

There is a fault in the ABS control unit. The approved signal has been absent for more than five seconds.

Remarks

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit does not resume normal function. Engine control from the wheel spin control is de-activated. Automatic calibration of wheel speed has ceased.

Action

Check the fault codes in the ABS system.

Fault codes 7 - 10 are vacant

Fault

-

Cause

-

Remarks

-

Action

-

Fault code 11

Fault

The signal from the angle sensor is missing.

Cause

The angle sensor or the wiring is damaged. The approved signal has been absent for more than one second.

Remarks

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit does not resume normal function. Engine control from the wheel spin control is normal.

Action

Check the connectors, wiring and angle sensor.

Fault code 12

Fault

The calibration of the angle sensor is outside its permitted range.

Cause

The angle sensor is damaged or its electrical or mechanical installation is incorrect.

Remarks

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit does not resume normal function. Engine control from the wheel spin control is normal.

Action

1 Check the connectors, wiring and angle sensor. Check that the angle sensor calibration is within its approved range.

2 Renew the angle sensor.

Fault code 13

Fault

Open-circuit or short-circuit in the circuit for the limit position sensor.

Cause

There may be a short-circuit to 24 volts or an open-circuit in the circuit to the limit position sensor.

Remarks

The fault code is generated after five seconds if the speed exceeds 25 km/h.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit does not resume normal function. Engine control from the wheel spin control is normal.

Action

1 Check the connectors, wiring and limit position sensor.

2 Renew the limit position sensor.

Fault code 14

Fault

Open circuit in the circuit for the pressure monitor in the hydraulic system.

Cause

The control unit does not receive a 24 volts signal at pin 45.

Remarks

The approved signal has been absent for more than five seconds.

A pressure monitor in the hydraulic system breaks the circuit when the pressure drops below approximately 3 bar.

Note: On the first buses, the pressure monitor was set to 4 bar. It can be changed to 3 bar even on these buses to avoid an alarm when the hydraulic pressure is too low during cold weather.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit does not resume normal function. Engine control from the wheel spin control is normal.

Action

1 Check the connector and wiring in the hydraulic system for the damper cylinder.

2 Check the pressure in the hydraulic system.

3 Check or renew the pressure monitor.

Fault code 15

Fault

Open circuit or short circuit in the solenoid valve circuit for soft damping.

Cause

Too low or too high current on control unit pin 6.

Remarks

The fault code is generated after 1 second.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

1 Check the wiring and connectors.

2 Check the solenoid valve, renew if required.

Fault code 16

Fault

Open-circuit or short-circuit in the solenoid valve circuit for medium damping.

Cause

Too low or too high current on control unit pin 5.

Remarks

The fault code is generated after 1 second.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

1 Check the wiring and connectors.

2 Check the solenoid valve, renew if required.

Fault code 17

Fault

Open-circuit or short-circuit in the solenoid valve circuit for left damping.

Cause

Too low or too high current on control unit pin 4.

Remarks

The fault code is generated after 1 second.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

1 Check the wiring and connectors.

2 Check the solenoid valve, renew if required.

Fault code 18

Fault

Open-circuit or short-circuit in the solenoid valve circuit for right damping.

Cause

Too low or too high current on control unit pin 41.

Remarks

The fault code is generated after 1 second.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

1 Check the wiring and connectors.

2 Check the solenoid valve, renew if required.

Fault code 19

Fault

The solenoid valve for left damping is supplied with voltage when it should not be.

Cause

Voltage has been supplied to the output for the solenoid valve on the control unit, even though the control unit has not requested it.

Remarks

The fault code is generated after 5 seconds.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

1 Remove the cable from pin 4 and take a reading with a multimeter.

2 Check the connectors, wiring and the solenoid valve, renew if required.

3 The driver stage in the control unit may be faulty. If this is the case, renew the control unit.

Fault code 20

Fault

The solenoid valve for right damping is supplied with voltage when it should not be.

Cause

Voltage has been supplied to the output for the solenoid valve on the control unit, even though the control unit has not requested it.

Remarks

The fault code is generated after 5 seconds.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. Engine control from the wheel spin control is normal.

Action

1 Remove the cable from pin 41 and take a reading with a multimeter.

2 Check the connectors, wiring and the solenoid valve, renew if required.

3 The driver stage in the control unit may be faulty. If this is the case, renew the control unit.

Fault code 21

Fault

The safety relay in the control unit has received an incorrect activation signal or has received an activation signal when it should not.

Cause

One of the driver stage outputs to the solenoid valves for right and left damping and for the bus stop brake, is short-circuited to 24 volts. Otherwise the safety relay is defective.

Remarks

When the ignition is switched on, the control unit checks that the safety relay functions. The control unit does this by reading off the driver stage outputs to the solenoid valves for right and left damping and for the bus stop brake. If there is a short-circuit to 24V in one or more of the driver stage outputs, a new check is carried out after 6 seconds. A new check is carried out every sixth second until the fault disappears.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. However, the fault code is saved. Engine control from the wheel spin control is normal.

Action

Check the connectors and wiring between the control unit and the solenoid valves for right and left damping.

Fault code 22

Fault

The control unit receives reverse signal voltage when it should not.

Cause

There may be 24 volts at pin 29.

Remarks

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. However, the fault code is saved. Engine control from the wheel spin control is normal.

Action

1 Remove the cable from pin 29 and take a reading with a multimeter.

2 Check the connectors, wiring, the shift selector and the reverse signal relay, renew if required.

Fault code 23

Fault

The control unit receives no information (DKR signal) about TC engine control from the ABS control unit.

Cause

The articulation control unit requests idling speed from the engine control unit (DKR signal). Information about idling speed should then be transmitted from the engine control unit via the ABS control unit back to the articulation control unit (DKV signal). The fault code is generated if the information to the articulation control unit is not received.

Remarks

The control unit carries out an automatic check at start-up. The engine runs at full throttle for half a second. If the permitted throttle actuation is zero, the control unit understands this as correct. The control unit then permits full throttle actuation again. The vehicle driver will not be aware of this check.

The control unit generates limp-home mode. The control unit will only permit a certain amount of throttle actuation and disconnects the solenoid valves. If the fault disappears, the control unit automatically resumes normal function. However, the fault code is saved. Engine control from the wheel spin control is normal.

Action

1 Check the connectors and wiring between the engine control unit and the ABS/TC control unit.

2 Check the engine control unit and the ABS/TC control unit.

Pin connections on articulation control unit, generation 3

The control unit has a 55 pin connector.

Pin	Task
1	Control unit ground.
2	Voltage supply (U15)
3	Voltage supply (U15)
4	Solenoid valve, damping during a left turn.
5	Solenoid valve, medium damping.
6	Solenoid valve, soft damping
8	Limit position sensor
15	Diagnostics lead, "K"
19	Control unit ground.
20	Voltage supply (U15)
22	Output signal to electric throttle (PWM signal)
24	Bus stop brake
28	Disconnecting reverse inhibitor
29	Engaged reverse gear
33	Diagnostics lead, "L"
35	Angle sensor, ground
40	Warning buzzer
41	Solenoid valve, damping during a right turn.
44	- Input signal (earthed pin) from the diagnostics switch - Output signal (earthing) for activation of the warning lamp and diagnostics lamp.
45	Hydraulic pressure sensor
52	Input signal from brake system and engine management system (PWM signal)
53	Angle sensor, positive feed
54	Angle sensor, signal voltage

The other control unit pins are not connected.

Angle sensor, generation 4

Approximate reference values for articulation angle sensor voltage

Left end lock	Straight ahead position	Right end lock
4 V	2.5 V	1 V

With a multimeter, measure between the control unit pins 8 and 26. Suitable measure-ment points are between C885/F1 and C885/F2 in the central electric unit behind the articulation.

Replacing the angle sensor

1 Position the wheels in the straight ahead position.

2 Set the angle sensor centre position using:

Scania Diagnos (from the “Angle sensor calibration” window) or

A multimeter (straight ahead position should correspond to 2.5 ± 0.1 V).

3 Adjust the length of the link until the angle sensor has reached its centre position.

4 Calibrate the angle sensor using Scania Diagnos (this is otherwise done while driving but it takes longer).

Renewing control unit, generation 4

The new control unit automatically learns the straight ahead position and the end positions after some time of driving. This means that no special actions need to be taken in connection with the renewal. To speed things up the following can be done in connection with the renewal:

1 Calibrate the straight ahead position with Scania Diagnos.

2 Reverse to the left and right end lock positions.

Troubleshooting generation 4

Reading of fault codes can be carried out by using Scania Diagnos or the diagnostics lamp in the instrument panel.

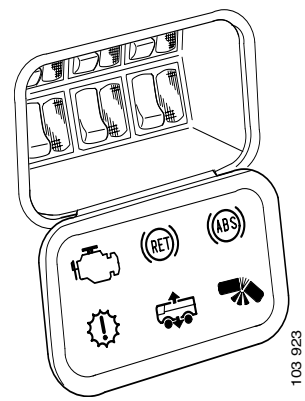
Reading fault codes

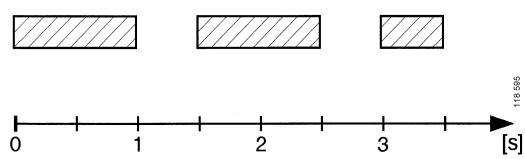
Turn on the power (15 supply).

Depress the diagnostics switch and keep it depressed for 2 seconds.

When reading fault codes, a long flash indicates units of ten and a short flash indicates one unit. Example according to the illustration: Fault code 21 flashes in the following way: Long - long - short. If there are no fault codes registered the lamp will be on for 4 seconds.

Depress the diagnostics switch once again to read another fault code.





Erasing fault codes

Clear all fault codes as follows:

1 Switch off the ignition (15 supply).

2 Press the diagnostics switch and keep it depressed.

3 Switch on the ignition (15 supply) whilst still depressing the diagnostics switch.

List of fault codes, generation 4

Fault code 11

Fault

No communication with the brake control unit.

Cause

The fault code is generated if there is no communication between the brake control unit and the articulation control unit.

Remarks

The control unit activates the limp-home mode. The warning lamp is illuminated. If the fault disappears, the control unit resumes normal function.

Action

Check connectors and wiring.

Check whether a fault code has been generated in the brake control unit.

Fault code 12

Fault

The message from the brake control unit indicates a faulty wheel speed.

Cause

Information from the brake control unit has indicated a faulty wheel speed. The fault code is generated after 5 seconds.

Remarks

The control unit activates the limp-home mode. The warning lamp is illuminated.

If the fault disappears, the control unit resumes normal function.

Action

Check whether a fault code has been generated in the brake control unit.

Fault code 13

Fault

No communication with the engine control unit.

Cause

The fault code is generated if there is no communication between the engine control unit and the articulation control unit.

Remarks

The warning lamp is illuminated. If the fault disappears, the control unit does not resume normal function.

Action

Check connectors and wiring. Check whether a fault code has been generated in the engine control unit.

Fault code 14

Fault

The control unit request for a reduction in throttle has not been confirmed.

Cause

The articulation control unit momentarily reduces the throttle the first time (after starting the engine) the driver accelerates. The fault code is generated if the engine does not respond in the intended way. The most probable cause is that no signal for idle speed request has been transmitted from the articulation control unit (pin 17).

Remarks

The warning lamp is illuminated. If the fault disappears, the control unit does not resume normal function.

Action

Check whether a fault code has been generated in the engine control unit.

Fault code 15

Fault

Impermissible signals from the angle sensor.

Cause

The fault code is generated if the potentiometer voltage lies outside the specified range (pin 8).

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Check connectors, wiring and the angle sensor.

Fault code 16

Fault

Impermissible signal combinations between the angle sensor and the limit position sensor or between the angle sensor and straight ahead position (high speed, approximately 40-50 km/h, implies a straight ahead position).

Cause

The fault code is generated if wrong signal combinations have been present for more than 5 seconds (angle sensor pin 8 and limit position sensor pin 51).

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Check connectors, wiring and the angle sensor.

Fault code 17

Fault

The control unit receives a signal from the limit position sensor when it should not.

Cause

The fault code is generated if the vehicle speed exceeds 25 km/h and the signal from the limit position sensor (pin 51) has been active for more than 30 seconds.

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Check connectors, wiring and the limit position sensor.

Fault code 18

Fault

No signal from the hydraulic system.

Cause

The fault code is generated if the signal from the hydraulic pressure monitor (pin 33) is missing.

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Check if the hydraulic pressure exceeds 3 bar. Check connectors, wiring and the pressure monitor.

Fault code 21

Fault

The proportional valve is incorrectly connected or shorted.

Cause

The fault code is generated when there is a fault in the circuit between pins 2 and 38. The fault can be due to any of the following factors:

1 The proportional valve is not earthed via the control unit

2 The circuit is shorted to 24 V or earth

3 Open circuit in the wiring.

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Check connectors, wiring and the proportional valve.

Fault code 24

Fault

The control unit receives an engaged reverse gear signal from the drive position selector when it should not.

Cause

The fault code is generated if the vehicle speed exceeds 25 km/h and the reversing signal has been active for more than 30 seconds (pin 31).

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Remove the cable from pin 31 and take a reading with a multimeter. Check connectors, wiring, drive position selector and the reverse signal relay.

Fault code 25

Fault

Internal fault in the control unit.

Cause

The fault code is generated when the control unit has lost the ability to save calibrations.

Remarks

If there is a fault, the control unit reverts to preset values.

Action

Clear the fault code memory and check whether the fault code is regenerated.

Renew the control unit if the fault has occurred repeatedly.

Fault code 26

Fault

Incorrect earthing of the proportional valve.

Cause

The proportional valve (pin 38) is earthed outside the control unit (in the wiring). The fault code is generated after 5 seconds.

Remarks

The control unit activates the limp-home mode and the warning lamp illuminates. If the fault disappears, the control unit resumes normal function.

Action

Check the wiring.

Pin connections on articulation control unit, generation 4

The control unit has a 55 pin connector.

Pin	Task
1	Earthing of the control unit
2	Output signal to the proportional valve (high)
8	Input signal from the angle sensor
13	Hydraulic pressure monitor (> 50 bar) –, not used at Scania
15	Diagnos, L cable
17	Output signal +24V for idle speed request
19	Voltage supply +24V to the control unit
20	Earthing of the control unit
26	Earthing of the angle sensor
30	Output signal (earthing) for activation of the warning lamp and diagnostics lamp.
31	Input signal +24V with reverse gear engaged, R on drive position selector
32	Input signal (earthed pin) for disconnecting reverse inhibitor.
33	Input signal from hydraulic pressure monitor (< 3 bar)
37	Voltage supply +24V to the control unit
38	Earthing of proportional valve (low)
39	CAN communication, L cable
40	CAN communication, H cable
44	Voltage supply to the angle sensor
49	Diagnos, K cable
50	Input signal (earthed pin) from the diagnostics switch
51	Input signal from the limit position sensor
52	Output signal for activation of the bus stop brake
55	Output signal for activation of the warning buzzer

The other control unit pins are not connected.