



CX45

MAINTENANCE MANUAL



**Cummins ISX EPA2016
Allison WTB500**

Publication No.: H0670en-US_im
(includes American Units, Part No. 11513715A)

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MAINTENANCE MANUAL

CX45⁰⁴ CU

CONSTRUCTION Nos.

SPECIFICATIONS MODEL VERSION "04"

Engine:	CU ISX EPA2016
Transmission:	Allison WTB500
Drive Axle:	DANA G171
Brakes:	Knorr-Bremse SN7...
Multiplex:	KS32-1.X



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EDITION 2

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Introduction The table of contents of the manual lists the manual parts and chapters. For subdivisions of a manual part or chapter, see the list on the “Overview” page at the beginning of that part or chapter.

Modified or added content In a revised edition of the manual, chapters that have been added, or modified since the previous edition, are indicated in the contents table by a + or an x behind the chapter’s date of issue.

+ : added chapter
 x : modified chapter

On the overview page at the beginning of a chapter, there is a list of new and/or modified topics within that chapter.

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Part 0 - Introduction

Overview

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Chapter 1: Preface

Overview

Introduction This chapter deals with the manual format and usage.

Number of pages 8

Chapter publication date 21 September 2016

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About this manual

What does this manual deal with?

This manual deals with information regarding the maintenance of the vehicle model mentioned on the title page. It also contains important safety instructions, technical data, component specifications and general troubleshooting instructions.

Other information

Activities that are not described in this manual, such as repair of drive line components and extensive tests of electronic units, are dealt with in the workshop instructions by Van Hool suppliers. At request, Van Hool can act as an intermediary to supply these publications.

There is also an operating manual available for the vehicle (publication number: replace the initial letter "H" of the maintenance manual publication number by "B")

Who is this manual for?

The manual addresses experienced garage personnel which is familiar with the maintenance of heavy commercial vehicles and the general safety rules involved.

Read, before you begin

Everyone whose task it is to carry out work on the vehicle has to read the pages of this manual applicable to his job, before starting any activity. This applies in particular to the pages containing safety instructions at the beginning of chapter 1.1 and to all safety instructions contained in the text of other chapters.

Follow instructions

Carefully following the instructions in this manual is the prerequisite for traffic safety and operational reliability of your vehicle. Non-compliance with the instructions causes all warranty claims to expire.

Translation

The manuals for Van Hool vehicles are originally written in Dutch and then translated if necessary. A translation may lead to differences in interpretation with regard to the meaning of what is written. Therefore, in case of dispute, only the Dutch version of the text will be taken into account as a reference.

Copyright

No part of this manual may in whatever way be multiplied, published or stored in a computerized data file without prior written permission by Van Hool Ltd.

What if you want a hard copy?

On demand, Van Hool can provide a hard copy. A printed manual is up to date up to the printing date.

A hard copy can be ordered either from your Van Hool representative or directly from the Van Hool After Sales Department at Koningshooikt-Lier.

continued on next page

Please mention the publication number of the manual as well as the number of copies required. The publication number is to be found at the bottom of the title page.

Method of updating

Modifications or additions are only available through the Van Hool customer portal. Therefore, check the customer portal regularly for the latest information. Beside the maintenance manual, you will also find the operating manual and the parts catalogue on the customer portal.

The customer portal is accessible through "www.vanhool.be/service", and only with a code (password) from Van Hool

Disclaimer

Differences from the product described

The data and illustrations in this manual are based upon the newest product information available at the time of printing. Van Hool reserves the right to make changes to its product without prior notice.

Inaccuracies or shortcomings

Great care has been observed in writing this manual. In spite of this fact, the Van Hool company does not accept any liability for damage or discomfort in any sense that could be attributed to errors or shortcomings contained in this manual.

Instruction not mentioned

Failure to mention maintenance instructions in this manual for certain comfort features does not automatically mean that said features require no maintenance. To the extent possible, separate documentation is supplied separately with the documents supplied with the vehicle.

Improper use of the vehicle

Van Hool is not liable for damage or accidents occurring as a result of improper use of the vehicle. This involves: operation under circumstances or for a purpose improper to the vehicle concept, or a driving style abnormal to bus or coach operation.

Spare parts

The use of accessories and spare parts not issued by Van Hool or which are not original Van Hool parts will result in the loss of all guarantee claims.

Manual structure

What is the structure based on?

The manual structure is based on the structure of the vehicle in terms of components and systems.

Parts

There are 16 parts (0 through 15).

Chapters

Each part has been divided into chapters. The chapters are in numeric order within the part they come under. Some numbers may be lacking in the sequence. However, this does not mean that your manual is incomplete. The reason is that your vehicle contains only part of the components the Van Hool numbering system reserves entries for.

Pages

Page numbering is restarted at the beginning of each chapter. All pages within a same chapter bear the same date: the chapter publication date.

Table of contents

Completely at the front, you will find the manual's table of contents. It lists all the parts and chapters present in the manual.

Overview pages

Each part and each chapter begins with an overview page.

The overview page of a...	lists...
part	the name and number of each chapter present in the corresponding part.
chapter	the title and the page number of each topic dealt with in the chapter.

Separate publications with annexes

In a separate publication, you may come across documents that, for their different type of layout or page numbering, could not be fitted into the overall structure of the manual. These are mostly instruction sheets from Van Hool suppliers, presented in their original format.

Illustrations and symbols

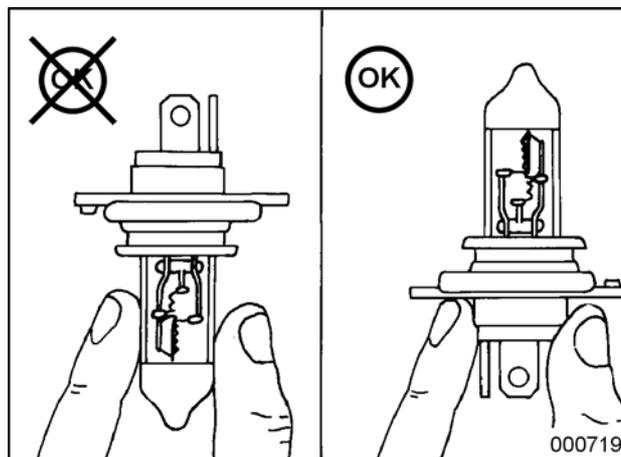
Applicability of the illustrations

Some of the illustrations in this manual are simplified or common. They will not look exactly like the component or equipment found on your vehicle. However, the procedures they illustrate do apply to your vehicle.

Symbols in illustrations

Illustrations may include symbols indicating an acceptable or a not acceptable condition or action.

Example:



Never hold halogen lamps at the bulb.

Danger symbols in the text

Certain areas of text in this manual include danger symbols.

	This symbol points to danger of personal injury, health or even death.
	This symbol points to a risk of damage to components or equipment.

Special tools

List of special tools

At the end of each chapter, you will find a list of all the special tools needed to perform the activities described in that chapter.

Ordering special tools

Tools for which....	you order...
Van Hool order numbers are stated	at our service department, in the same manner as spare parts.
other supplier's order numbers are stated	directly by the respective manufacturer, importer or representative in your country.

Service bulletins

Introduction

As an additional means of informing you on technical items, Van Hool from time to time sends you service bulletins.

Priority

The information passed on in service bulletins always takes priority over information that deviates from and is older than the service bulletin.

Part 1 - Complete vehicle

Overview

Contents

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The following chapters have been *modified* since the former edition:

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Chapter 1: General

Overview

Introduction This chapter deals with general information about the vehicle.

Number of pages 58

Chapter publication date 14 October 2016

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The following subjects have been *added/modified* since the former edition:

Topic	See page
Running-in service	1.1-25

Safety instructions: general

Prevention of accidents and damage

To help prevent accidents and damage, a series of general customary safety rules for dealing with commercial vehicles is provided below. Special warnings have also been provided in various chapters of this manual, referring to work instructions to which they apply.

Read all these rules and warnings attentively, in both your own safety interest and that of the vehicle.

Competent staff

Using the vehicle described in this manual is safe on the condition that the personnel responsible for its operation and maintenance are adequately trained and follow the necessary precautions.

Responsibility

Inclusion of these safety rules does not mean that Van Hool is responsible for the compliance with them in your company. It must also be emphasized that Van Hool cannot possibly anticipate ALL situations or improper actions that could lead to an accident, damage or health problems.

Safety instructions: bodily harm or health damage

Introduction	Below you will find rules to prevent accidents causing bodily harm or health damage.
Before operation	Familiarize yourself with the location and the function of all controls, before you drive the vehicle for the first time.
To start the engine	Always make sure the parking brake has been applied and the transmission is in neutral before starting the engine.
Exhaust emissions	Do not run the engine or operate the coolant heater in a confined space, unless a proper exhaust removing system is used.
Refueling	Due to fire risk refueling is allowed with the engine and the heating system switched off only (coolant heater!).
Roller brake tester	Switch off the ATC-system before carrying out a performance test. Procedure: refer to chapter 11.2, under "Precaution in case of performance tests on roller brake tester".
Working on the vehicle	<ul style="list-style-type: none">• Make sure you have read and understood all applicable instructions before beginning any work.• Before working on parts in the engine compartment, activate the starter-prevention switch (if present) to prevent anyone from turning on the engine. Put warning on steering wheel saying "DO NOT START: MAINTENANCE".• As a rule, maintenance has to be performed, while the engine is not running. If you have to conduct checks, while the engine is running, keep distance from the moving parts (Caution: optical illusion may cause a running fan to look like it is not turning).• Beware that the vehicle superstructure can suddenly drop over 3 in, if someone (intentionally or unintentionally) allows air to escape from the suspension air springs.• Firmly support all heavy vehicle parts, before you unscrew fixing bolts or nuts.• Except when adjusting tire pressure, always fill tires in a safety cage.

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Tools

- For a number of activities the use of special tools is prescribed. If you use different tools in those cases, you do so at your own risk.
- Never use any tools without having learnt how to handle them first.
- Use tools in proper condition only. Worn-out nut wrenches, for example, can slip away dangerously and cause injury.

Jacking

- Before jacking up the vehicle, make sure the brakes have been applied and the wheels remaining on the ground have been secured with wheel chocks.
- Use faultless and suitable jack types only, with sufficient lifting power.
- Never support the vehicle with hydraulic jacks only; always place chassis stands or support blocks, before working under a jacked-up vehicle.

Risks of burns

- Do not touch with bare hands an engine, transmission or retarder that has been operating recently: danger of burns.
- Beware of burns, when draining hot oil. Do not touch oil drain plugs and filters with bare hands.
- Never open the engine cooling or interior heating system, while the coolant is hot. If this is necessary for some compelling reason, however, first release the pressure from the system as indicated under "Safety instructions..." in chapters 2.34 and 8.10.

Systems under pressure

- Do not tighten or loosen pipe or hose connections, while the pipe or hose is under pressure (fuel lines, lubricating oil, hydraulic fluid, compressed air, etc.).
- Do not check pressurized lines for leaks with your hands.
- Safely depressurize devices containing compressed air or liquid under pressure, before opening them.
- Gas struts of body hatches contain gas under dangerously high pressure. Never drill through these struts or open them.

Batteries

- When disconnecting or connecting batteries, always disconnect the negative cable first and reconnect it last (so as to avoid short circuits).
- Batteries contain highly corrosive acid; battery gas is explosive (Refer to chapter 14.2, under "Safety instructions relating to batteries").

Hazardous substances

- Beware of explosion danger, when draining fuel tanks.
- Avoid any contact with the skin and eyes with corrosive substances or irritants. Wear protective clothing, gloves, safety goggles.

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- Avoid ingestion or inhalation and skin contact with toxic substances. Wear protective clothing and, if necessary, a suitable respiration mask.
 - If victims are injured in an accident with corrosive or toxic substances, call for a doctor immediately.
 - Never keep vehicle liquids in packings that could be confused with beverage packings.
 - Make sure the workshop has "safety data sheets" at hand for all hazardous substances used. These sheets indicate the substance properties, precautionary measures in dealing with it and recommendations for first aid in the event of an accident. They are available from the supplier of the hazardous substance.
-

Safety instructions: damage to vehicle or equipment

Introduction

Below you will find rules to prevent damage to the vehicle or equipment.

Defects

Make sure every defect that is identified is fixed as soon as possible to prevent greater damage.

Screws and nuts

- Screws and nuts may be replaced with those having the same part number (or equivalent) only, never use screws or nuts of a lower property class.
- Observe the tightening torques specified in the various chapters of this manual, when tightening screws and nuts.

Electrical system

- Switch off the electric battery switch and wait for the delayed cut-off of the batteries before starting to work on the electrical system of the vehicle. Take into account a waiting time of 90 seconds to be sure that on-board voltage is no more present.
- With the electric battery switch on, do not disconnect connector plugs of any electronic control unit (automatic transmission, ABS/ATC, EDC or E-GAS, speed-limiting device, cruise control, multiplex system etc.).
- With the exception of special cases mentioned further on in the manual, the use of a test lamp for voltage check is not allowed.

Electric welding

Before electric welding on the vehicle, always switch off the electric battery switch first and wait for the delayed cut-off of the batteries. Take into account a waiting time of 90 seconds to be sure that on-board voltage is no more present. Then open the mechanical battery switch and pull the plugs of all the electronic control units. Secure the ground return cable of the welding device as close as possible to the part that is to be welded.

Temperature-sensitive vehicle electronics

The electronic components of the vehicle are unable to function in ambient temperatures above 160 °F.

Exhaust system

The exhaust system can become very hot (the exhaust gas temperature can increase up to 1 500 °F). Therefore make sure that no light flammable materials (such as hay, dry foliage or grass) can come in contact with the exhaust system during driving, engine idling or parking the vehicle.

continued on next page



Engine encapsulation

On vehicles with engine encapsulation, make sure to check after work that no flammable substances are left on the bottom of the engine encapsulation (e.g. diesel fuel after bleeding the fuel system). Regularly clean the inside of the encapsulation. An encapsulation soiled on the inside represents a fire hazard.

Vehicles with raised roof edges or devices mounted on the roof

To prevent fire, regularly clear all the leaves and litter from the roof.

Overheated engine

Never add cold coolant when the engine is overheated.

Jacking

Jack up the chassis frame under the jack support points provided for this purpose only. These points have been indicated under "Lifting instructions" further on in this chapter.

Safety instructions: environmental protection

Introduction

Below you will find rules to prevent damage to the environment we live in.

Toxins or pollutants

Do not dump any toxins or pollutants into the environment. Lubricants, anti-freeze, liquids for hydraulic systems, diesel exhaust fluid, battery acid, batteries, fuel and oil filters, asbestos are "special waste" and may be disposed of in a manner permitted by law only. Check with the environmental protection authorities to find out about the regulations applicable to your country (or region).

Exhaust gases

Do not unnecessarily idle the vehicle engine. exhaust gases cause environmental pollution.

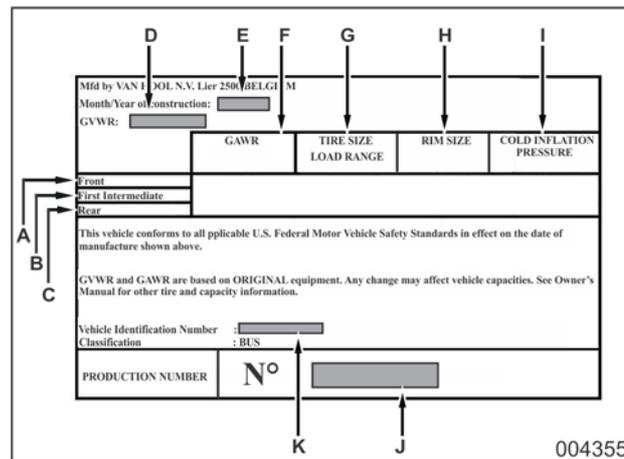
Vehicle identification

Vehicle identification plate

The vehicle identification plate is located in the step well of the vehicle.



Figure: vehicle identification plate

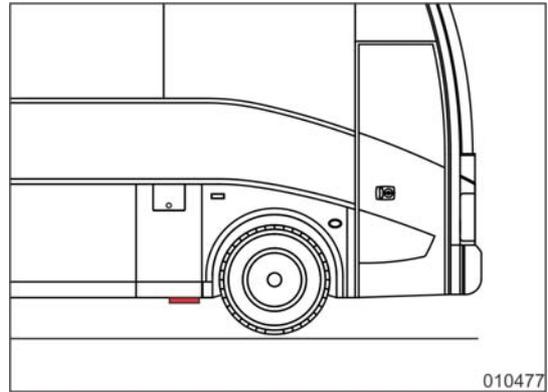


- A 1st axle
- B 2nd axle
- C 3rd axle
- D Gross vehicle weight rating
- E Manufacturing date
- F Gross axle weight rating
- G Tire size
- H Rim size
- I Tire inflation pressure (cold tires)
- J Production number
- K Chassis number

continued on next page

Chassis number

The chassis number has been stamped on the chassis side member behind the right-hand front wheel and is accessible from under the vehicle.



010477

Engine identification plate

Engine	Location
Detroit Diesel DD13	<p>008366</p>
Cummins ISX	<p>009035</p>

Vehicle characteristics

Engine

Make	Cummins
Type	ISX 12 CM2350 (EPA2016)
Maximum power	• 425 hp at 2 100 rpm
Maximum torque	• 1 650 ft.lbf at 1 200 rpm

Brakes

Make	Knorr-Bremse
Type	Disc brakes SN7...

Transmission

Allison	WTB500(R)
ZF	Astronic

Multiplex system

Make	Siemens VDO
Type	KS32-X.X

Front axle

Make	Van Hool
Type	Independent wheel suspension

Drive axle

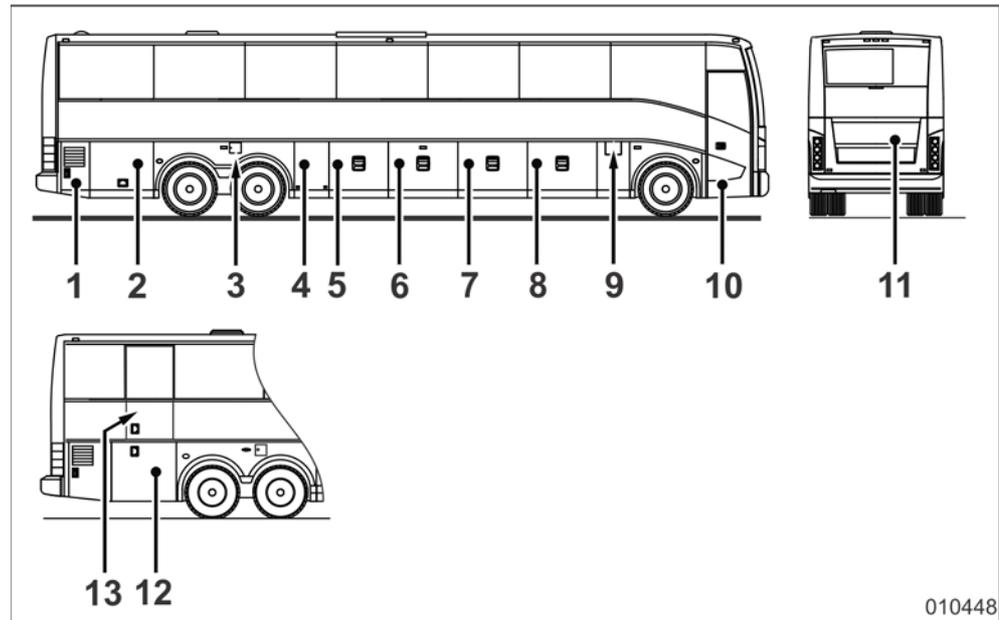
Make	Dana
Type	G171

Trailing axle

Make	Van Hool
Type	Independent wheel suspension

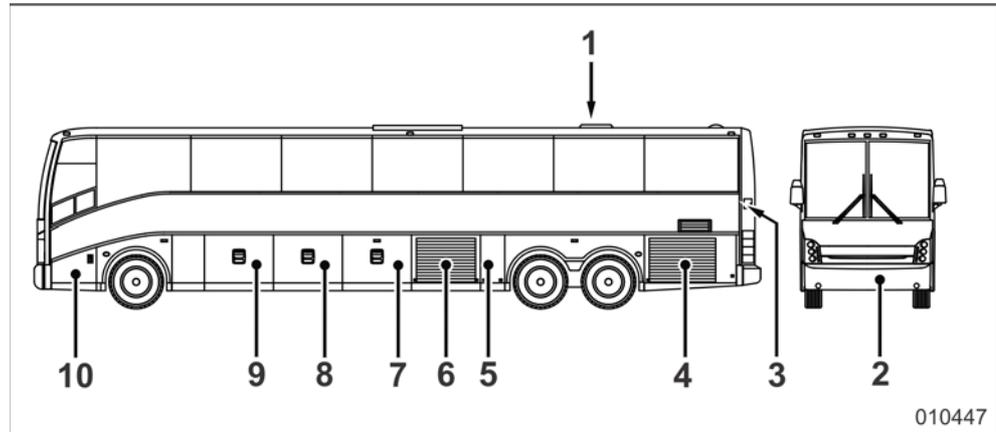
Access doors and controls on the outside of the CX45

Figure: right-hand side view and rear view



- 1 Power steering fluid tank, waste water tank dump valve, toilet tank dump valve
- 2 Luggage compartment
- 3 DEF filler opening (DEF is short for "Diesel Exhaust Fluid")
- 4 Batteries, mechanical battery isolation switch
- 5 Luggage compartment, access to junction box EKB, access to box with compressed-air switches and sensors
- 6 Luggage compartment
- 7 Luggage compartment
- 8 Luggage compartment
- 9 Fuel filler opening, solenoid shut-off valves of fuel lines
- 10 Passenger door
- 11 Engine compartment
- 12 Lower lift door
- 13 Upper lift door

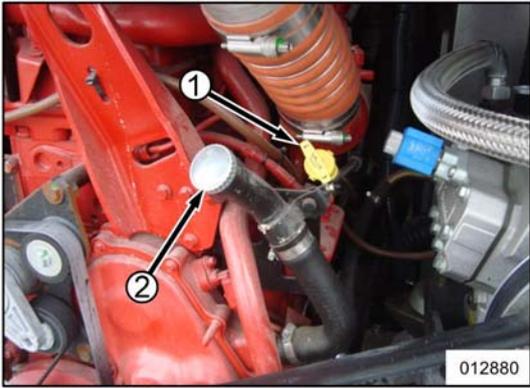
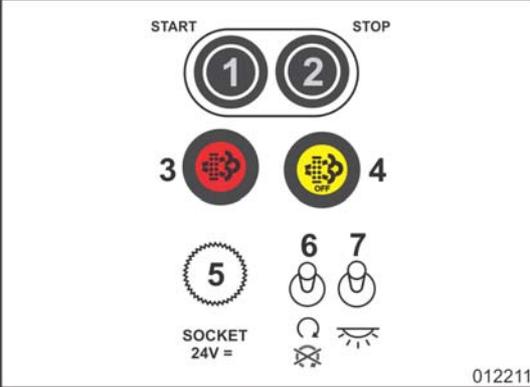
Figure: left-hand side view and front view



- 1 Roof hatch
- 2 Spare wheel, compressed-air system fill connection
- 3 Coolant filler cap
- 4 Air filter, air-filter service indicator
- 5 Coolant heater, main shut-off valve in interior heating supply line, main shut-off valve in interior heating return line, interior heating valve block
- 6 Climate-control condenser compartment
- 7 Luggage compartment
- 8 Luggage compartment
- 9 Luggage compartment, access to main junction box
- 10 Windshield washer tank, front-bumper release lever

In engine compartment

Element	Location
Coolant level sight glass	

Element	Location
<ol style="list-style-type: none"> 1 Engine oil dipstick 2 Engine oil filler cap 	
<ol style="list-style-type: none"> 1 Transmission oil filler cap 2 Transmission oil dipstick 	
<p>Control panel</p> <ol style="list-style-type: none"> 1 Engine start button 2 Engine stop button 3 "Stationary regeneration request" push-button (with integrated lamp) 4 "Regeneration inhibited" push-button (with integrated lamp) 5 Socket for portable lamp (24 volt) 6 Starting interlock switch 7 Engine-compartment lighting switch 	

Element	Location
Jump-starting terminals 1 "+" terminal 2 Ground terminal	

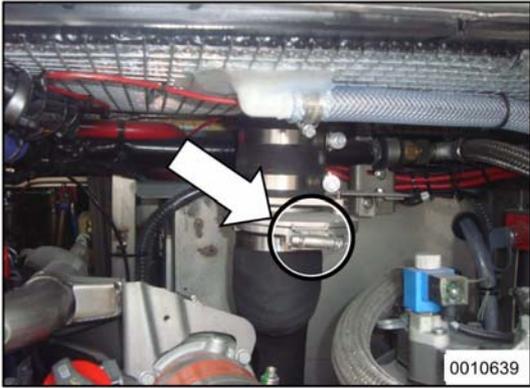
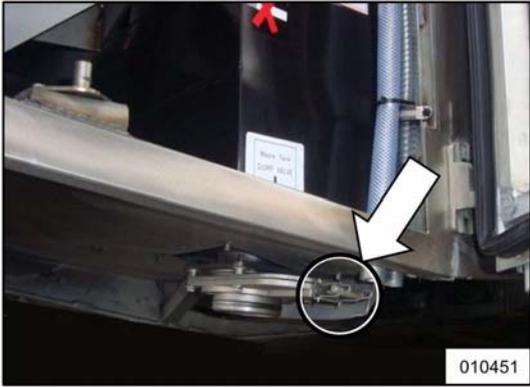
In front of
right-hand
wheel of drive
axle

Element	Location
Mechanical battery switch 1 Batteries disconnected 2 Batteries connected	

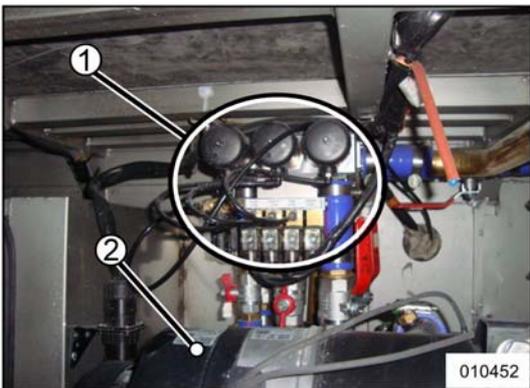
At right-hand
side at very
rear

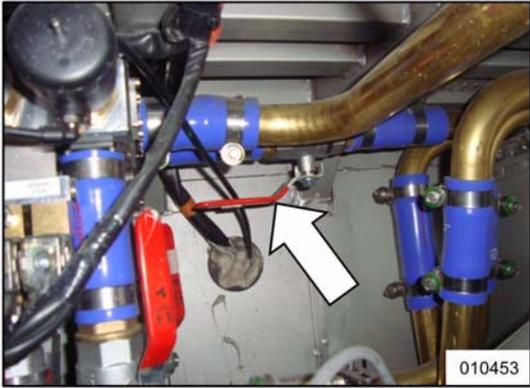
Element	Location
Power steering fluid tank	

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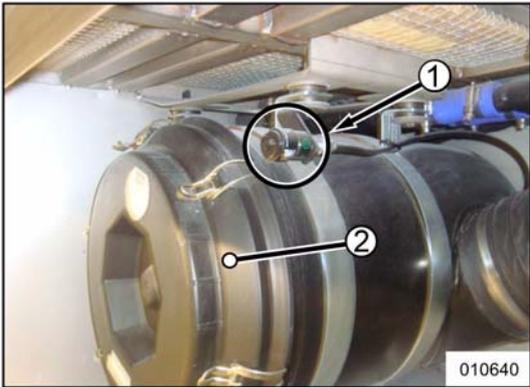
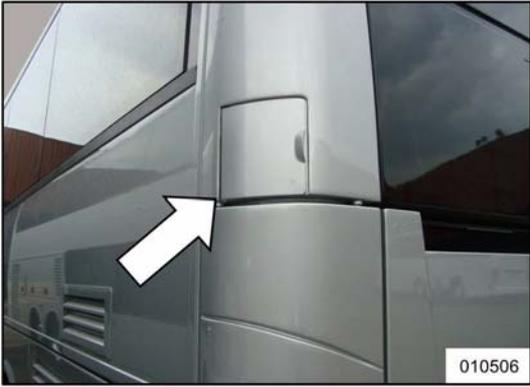
Element	Location
Toilet tank dump valve	
Waste-water tank dump valve	

In front of left-hand wheel of drive axle

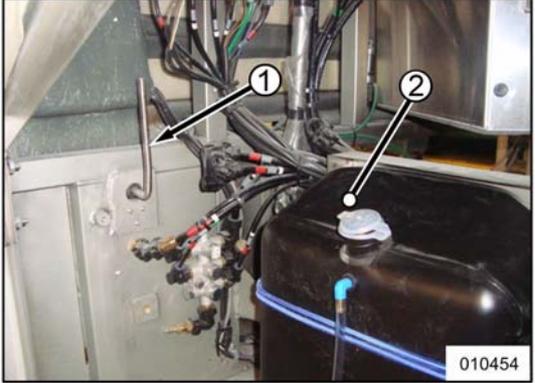
Element	Location
1 Interior heating valve block 2 Coolant heater	

Element	Location
<p>Main shut-off valve in interior-heating return line</p> <p><i>NOTE: The main shut-off valve in the interior-heating supply line is located behind the coolant heater.</i></p>	

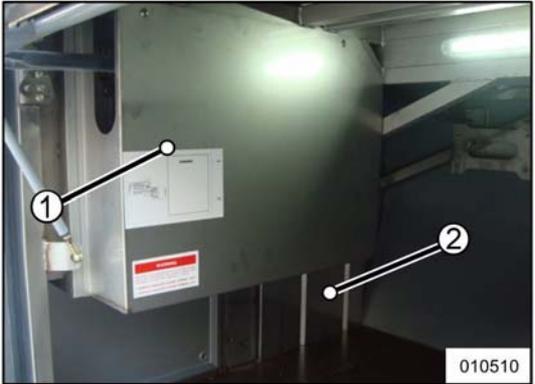
At left-hand side at very rear

Element	Location
<p>1 Air-filter service indicator</p> <p>2 Air filter</p>	
<p>Access to coolant filler cap</p>	

At left-hand side at very front

Element	Location
<ol style="list-style-type: none"> 1 Front-bumper release lever 2 Windshield-washer tank 	

In the luggage compartment ahead of the right-hand drive axle wheel

Element	Location
<ol style="list-style-type: none"> 1 Junction box EKB 2 Box with compressed-air switches and sensors 	

Behind the body lid to the rear of the right-hand front wheel

Element	Location
<ol style="list-style-type: none"> 1 Solenoid shut-off valve in fuel line to coolant heater 2 Solenoid shut-off valve in fuel line to engine 	

At the left, behind front bumper

Element	Location
Compressed-air system fill coupling	

Fluids and lubricants

Fuel tank

Capacity	Specifications ^a
approx. 238 gallons	ULSD-diesel oil ^b meeting the requirements of ASTM D 975 No. 2D.

a. For more information, refer to Cummins Service Bulletin 3379001.

b. ULSD stands for "Ultra-Low Sulfur Diesel" (sulphur content not more than 15 ppm)

DEF tank

NOTE: DEF is short for "Diesel Exhaust Fluid".

Capacity	Specifications
approx. 23 gallons	Has to meet DIN 70070 or ISO 22241-1 standard.

Engine oil pan

Capacity	Specifications ^a
<ul style="list-style-type: none"> Maximum level: approx. 11 gallons Minimum level: approx. 9 gallons 	Engine oil that meets the requirements of "Cummins Engineering Specifications" CES 20081. Viscosity depending at outside temperature.

a. For more information, refer to Cummins Service Bulletin 3810340.

Transmission

Type	Capacity	Specifications
Allison WTB500(R) <ul style="list-style-type: none"> Refill after oil change Initial fill 	approx. 31 U.S. Qts approx. 40 U.S. Qts	Oil to Allison lubricants list TES 295 ^{ab}
ZF Astronic	approx. 11.6 U.S. Qts	Oil to ZF lubricants list TE-ML 02, class 02E or 02L ^{cd} .

a. The Allison transmission has been factory filled with CASTROL TranSynd or with SHELL Spirax S6 ATF A295.

b. On the "www.allisontransmission.com" website you find a list with approved TES 295 lubricants.

continued on next page

- c. The ZF Astronic transmission has been factory filled with CASTROL Syntrans Max 75W-80 or with TOTAL Transmission Gear 9 FE 75W-80 (former name: TOTAL Transmissions XS FE 75W-80).
- d. On the "www.vanhool.be" website, under the "service" menu item, you will find links to lists with approved fluids and lubricants on the website of ZF.

Drive axle

Capacity	Specifications
approx. 4.5 gallons	Transmission oil meeting MIL-L-2105D requirements ^a . Viscosity depending at the outside temperature <div style="text-align: center; margin-top: 10px;"> <p>005802im</p> </div>

- a. The drive axle has been factory filled with SAE 85W-140 mineral oil.

Power steering system

Capacity	Specifications
approx. 9.5 U.S. Qts	Automatic transmission fluid, to ZF lubricants list TE-ML 09 ^a .

- a. On the "www.vanhool.be" website, under the "service" menu item, you will find links to lists with approved fluids and lubricants on the website of ZF.

Engine cooling and interior heating system

Capacity	Specifications
approx. 46 gallons	<p>The whole year through, a mixture^a of water^b and one of the following antifreezes:</p> <ul style="list-style-type: none"> • TEXACO Havoline XLC • CHEVRON Havoline XLC • TOTAL Coolelf Auto Supra -37 °C • CHEVRON Delo Extended Life Coolant Nitrite Free • TEXACO Extended Life Coolant Nitrite Free

a. Preferably fill with a fully formulated mixture of water and antifreeze. Use a mixture of 50% antifreeze and 50% water.

b. If you mix water with antifreeze yourself, prepare this mixture beforehand and only use deionized or demineralized water.

Refrigerant system

Refrigerant R134a

Climate-control compressor oil pan

Capacity	Specifications
Carrier O5G compressor: approx. 3.4 U.S. Qts	<ul style="list-style-type: none"> • CASTROL Icematic SW68 • MOBIL Eal Arctic 68 • ICI Emkerate RL68H
Bitzer compressor: approx. 2.6 U.S. Qts	<ul style="list-style-type: none"> • BITZER BSE55 • FUCHS SEZ55 • CASTROL Icematic SW68 • MOBIL Eal Arctic 68 • ICI Emkerate RL68H

Windshield-washer tank

Capacity	Specifications
approx. 5.3 gallons	Water with windshield-washer antifreeze

continued on next page

Greasing points

Application	Specifications
All lubricators for manual lubrication on chassis and body, unless otherwise stated.	Multipurpose grease: NLGI No. 2 consistence, lithium based, with EP and corrosion inhibiting additives, drop point not below 380°F
Propeller shaft	Special high temperature grease: <ul style="list-style-type: none"> • SHELL Gadus S3 V220C 2^a • FUCHS Renolit Duraplex GWB • RHENUS Norplex LKP 2
Front axle: king-pin bearings	FUCHS Renolit LX-OTP 2
Splash-water protective cover on steering-gear output shaft	Special grease: TEXACO Texando FO 20
Automatic passenger-door spindle	NLGI No. 2 high-temperature grease with molybdenum disulphide (MoS ₂)

a. Former name: SHELL Retinax LX 2.

Running-in service

This schedule applies to

Vehicles with:

Component	Make/type
Engine	<ul style="list-style-type: none"> Cummins ISX CM2350 Detroit Diesel DD13 DDEC 13
Emission standard	EPA2016
Transmission	<ul style="list-style-type: none"> Allison WTB500(R) ZF Astronic
Drive axle	Dana G171
Brakes	Knorr-Bremse SN7...

Fluids and lubricants

Refer to "Fluids and lubricants" earlier in this chapter.

After first 30 miles

And again after the next 60 miles, retighten the wheel nuts with a torque wrench. After that, check the torque daily until finally tight.

After first 1 000 miles

Action	Component	Refer to chapter...
Retighten	Wheel nuts	
	Engine cooling system, interior-heating system: standard hose clamps (Do not retighten constant torque hose clamps!)	2.34
	Trailing axle: nut of kingpin fit screws ^a	12.14

continued on next page

Action	Component	Refer to chapter...
Check	V-belts: tension (with gauge)	2.46
	Engine: air-intake ductings for security, damage, leakage	
	Tires: pressure	3.38
	Air springs: height	3.6
	Emergency exits (emergency side windows and roof hatches): whether they can be opened, closed and latched properly.	
	Starter motor, alternators, ground points: security of electrical connections	
	Electrical cables: security of connections, attachment, chafing	

a. Only on TD925US with steered trailing axle.

After first 3 000 miles

Action	Component	Refer to chapter...
Change	Drive axle: oil	12.10
Renew	Cummins engine: coolant filter ^a	2.34
Lubricate	Propeller shaft: universal joints	4.10
	Front axle steering: intermediate lever	7.6
	Climate-control compressor: seat bearings	2.46
Retighten	Wheel nuts	3.34
	Propeller shaft: fixing bolts	4.10

continued on next page

Action	Component	Refer to chapter...
Check	V-belts: tension (with gauge)	2.46
	Drive axle: breather for freedom of obstruction	12.10
	Air suspension: height, leakage	3.6
	Batteries: fluid level	14.2
	Brake chambers: damage, leakage	5.10
	Compressed-air valves of brake system: air tightness and exhaust function	5.10
	Engine and transmission: security in chassis	
	Wheel suspensions: threaded-fastener joints	3.10, 3.14, 3.18, 12.6, 12.10 and 12.14
	Front axle steering: threaded-fastener joints	7.6
	Trailing axle steering: threaded-fastener joints ^b	7.10
	Compressed-air tanks: security	13.17
Dashboard gauges and warning lights: operation		
Test	Service brake circuits: air tightness	5.10

a. Replace the factory-mounted filter by a Fleetguard WF2123 "Non-chemical" coolant filter.

b. Only on TD925US with steered trailing axle.

Maintenance schedule

This schedule applies to

Vehicles with:

Component	Make/type
Engine	<ul style="list-style-type: none"> Cummins ISX 12 Detroit Diesel DD13
Emission standard	EPA2016
Transmission	<ul style="list-style-type: none"> Allison WTB500(R) ZF Astronic
Drive axle	Dana G171
Brakes	Knorr-Bremse SN7...

Fluids and lubricants

Refer to "Fluids and lubricants" earlier in this chapter.

Additional grease interval

After interim cleaning of the chassis with a steam cleaner, perform an additional greasing service at the following points:

- Propeller shaft universal joints;
- Front axle king-pin bearings;
- Only on TD925US/TDX25US with steered trailing axle: kingpin bearings of trailing axle;
- Intermediate lever(s) of front-axle steering.

Detroit Diesel: particulate filter of exhaust after-treatment device

Change/clean the particulate filter of the exhaust aftertreatment device if "CHECK ENGINE" appears on the dashboard display and if, when reading the fault memory, the active fault "Clean DPF" appears. Normal cleaning interval: 300 000 to 400 000 miles

continued on next page

Daily

Action	Component	Refer to chapter...
Check	Engine: oil level	2.38
	Engine: coolant level	2.34
	Engine: DEF level	
	Detroit Diesel engine: water level in fuel/water separator (via dashboard display)	
	Engine: air-filter service indicator	2.22
	Engine: air intake ductings for security, damage and leakage (visually)	
	Cummins engine: freedom of obstruction of crankcase breather duct	
	Allison WTB500(R) transmission: oil level	6.10
	Front axle steering: fluid level	7.6
	Trailing axle steering: fluid level (via dashboard display) ^a	
	V-belts: tension, wear	2.46
	All pipes and hoses for security, damage, chafing and leakage (also of the exhaust system)	
	Presence of fluid leaks in engine compartment, at wheel hubs,...	
	Tires: pressure, damage	3.38
	Wheel nuts: security (visually)	
	Wheels for cracks and deformations	3.34
	Visually: body ground clearance (air suspension operation)	
Emergency side windows: whether they are closed and latched		

a. Only on TD925US/TDX25US with steered trailing axle.

Monthly

Action	Component	Refer to chapter...
Test	120 VAC system: ground-fault circuit interruptors	14.10

continued on next page

**Every
3 000 miles**

Action	Component	Refer to chapter...
Lubricate	Trailing axle: king-pin bearings ^a	12.14

a. Only on TD925US/TDX25US with steered trailing axle.

**Every
12 500 miles**

Action	Component	Refer to chapter...
Retighten	Wheel nuts (with torque wrench)	3.34
	Engine cooling system, interior-heating system: standard hose clamps (Do not retighten constant torque hose clamps!)	2.34
Lubricate	Front axle steering: intermediate lever(s)	7.6
	Trailing axle steering: bearing in steering-cylinder fixing hole ^a	7.10
	Climate-control compressor: seat bearings	2.46
	Bodywork hinges and locks	
	Windshield wipers: pivot points of linkage (with oil)	

continued on next page

Action	Component	Refer to chapter...
Check	Cummins engine: visually, contamination of Fuel Pro fuel filter (if necessary, change filter element)	2.10
	Detroit Diesel engine: visually, contamination of Fuel Pro fuel filter (if necessary, change filter element) (if installed)	2.10
	Engine: adjustment of rear rubber-metal mounts of engine suspension	2.6
	Engine: exhaust aftertreatment for security, damage, leakage	
	Windshield washer: fluid level	
	Batteries: fluid level and charge, cleanliness of terminals	14.2
	Engine cooling system: mesh screen of radiator compartment (clean, if necessary)	2.34
	V-belts: tension, wear	2.46
	Air springs: height (measure)	3.6
	Compressed-air supply: compressed-air tanks for absence of moisture	13.17
	Wheel suspensions: threaded-fastener joints	3.10, 3.14, 3.18, 12.6, 12.10 and 12.14
	Tires: pressure (with tire pressure gauge)	3.38
	Emergency exits (windows and roof hatches): whether they can be opened, closed and latched properly.	
	Indicator lights and gauges: operation	
	ZF Astronic transmission: oil level	6.10
	Wheel suspensions: exterior condition of air springs, air tightness	3.6
	Check	Brakes: brake pad wear ^b
Brakes: general condition ^c		5.10
Brakes: brake chambers for damage, leakage		5.10
Brakes: valves, lines and couplings for air tightness		5.10
Brakes: foot brake valve operating mechanism		5.10

continued on next page

Action	Component	Refer to chapter...
Check	Front axle steering: steering ball-joints for backlash, condition of ball-joint protection covers	7.6
	Trailing axle steering: steering ball-joints for backlash, condition of ball-joint protection covers	7.10
	Front axle steering: threaded-fastener joints	7.6
	Trailing axle steering: threaded-fastener joints	7.10
	Electricity: condition of the electrical wiring (insulation, loose or oxidized connections)	
	Exterior lighting: operation	
	Exterior lighting: headlamps adjustment	10.2
	Passenger door: operation and adjustment	10.62
	Toilet: operation	
	Windshield wipers: wiping area, wiper blades condition	

a. Only on TD925US/TDX25US with steered trailing axle.

b. At least every 3 months.

c. At least once a year.

Every 25 000 miles

Action	Component	Refer to chapter...
Retighten	Trailing axle: nut of kingpin fit screws ^a	12.14
Change	Cummins engine: oil ^b	2.38
	Detroit Diesel engine: oil ^c	2.38
Renew	Cummins engine: oil filter ^d	2.38
	Detroit Diesel engine: oil filter ^e	2.38
	Cummins engine: fuel filter	2.10
	Detroit Diesel engine: fuel filters (pre-filter, fuel/water separator, final filter) ^f	2.10

continued on next page

Action	Component	Refer to chapter...
Lubricate	Propeller shaft: universal joints	4.10
	Passenger door: ball-joints of upper and lower guide arms	10.62
	Emergency side windows: unlatching mechanism	
Apply	Passenger door: vaseline on the locking cams	10.62
	Passenger door: silicone grease on rubber door seals ^g	10.62
Clean	Engine: radiator and charge-air cooler	2.22 and 2.34
Carry out	Compressed-air brakes: function test	
Check	Engine: security	2.6
	Transmission: security	
	Transmission and drive axle: breather for freedom of obstruction	
	Water hoses for signs of deterioration (change as necessary)	
	Wheels: damages	3.34
	Front axle: toe	12.6
	Trailing axle: toe	12.14
	Wheel suspensions: leveling valves for wear and damage	3.6
	Emergency windows: force to operate unlatching lever (20 lbs)	
	Compressed-air system: security of air compressor	

- a. Only on TD925US/TDX25US with steered trailing axle.
- b. The interval applies to "Normal Duty". These vehicles have an average fuel consumption of between 6 and 7 miles/gallon.
- c. The interval applies to "Severe Service". These vehicles travel up to 30 000 miles/year and have an average fuel consumption of less than 5 miles/gallon.
- d. See b.
- e. Refer to c.
- f. Refer to c.
- g. Repeat monthly in winter

continued on next page

**Every
35 000 miles**

Action	Component	Refer to chapter...
Change	Cummins engine: oil ^a	2.38
	Detroit Diesel engine: oil ^b	2.38
	Cummins engine: oil filter ^c	2.38
	Detroit Diesel engine: oil filter ^d	2.38
	Detroit Diesel engine: fuel filters (pre-filter, fuel/water separator, final filter) ^e	2.10

- a. The interval applies to "Light Duty". These vehicles have an average fuel consumption of more than 6 miles/gallon.
- b. The interval applies to "Short-haul Service". These vehicles travel between 30 000 and 60 000 miles/year and have an average fuel consumption of between 5.1 and 5.9 miles/gallon.
- c. See a.
- d. See b.
- e. See b.

**Every
50 000 miles**

Action	Component	Refer to chapter...
Change	Detroit Diesel engine: oil ^a	2.38
Renew	Detroit Diesel engine: oil filter ^b	2.38
	Detroit Diesel engine: fuel filters (pre-filter, fuel/water separator, final filter) ^c	2.10
Lubricate	Front axle: king-pin bearings ^d	12.6
	Passenger door: door spindle	10.62
Check	Wheel bearing end-play ^e	12.6, 12.10, 12.14

- a. The interval applies to "Long-haul Service". These vehicles travel more than 60 000 miles/year and have an average fuel consumption of more than 6 miles/gallon and minimal city "stop-and-go" operation.
- b. See a.
- c. See a.
- d. At least once a year.
- e.

On vehicles covering less than 50 000 miles per year: at least once a year. On vehicles covering more than 50 000 miles per year: at least every 6 months. Also carry out this check after working on the brakes or on any other component on the axle end.

continued on next page

**Every
60 000 miles**

Action	Component	Refer to chapter...
Renew	Compressed-air dryer: cartridge ^a	13.9
	Steering system: filter in fluid tank	7.6
	Air suspension: line filters	3.6
Carry out	Propeller shaft: minor inspection ^b	4.10
Check	Engine: turbocharger security and leakage	
	Passenger door: locking cams wear	
	Front axle: hub unit wear ^c	12.6
	Trailing axle: hub unit wear ^d	12.14
	Front axle: clearance between steering knuckle and axle end	12.6
	Compressed-air system: setting of overflow valves	
	Alternator brushes	14.2

a. At least once a year.

b. At least once a year.

c. At least once a year.

d. Only on vehicles with non-steered trailing axle: At least once a year.

**Every
100 000 miles**

Action	Component	Refer to chapter...
Change	Drive axle: oil ^a	12.10
Check	Detroit Diesel engine: valve clearance ^b	

a. At least once a year. The 100 000 miles interval applies to mineral oil. If a synthetic oil approved by Dana is used, the interval can be extended to 240 000 miles or every three years.

b. The second time after 500 000 miles. After that each 500 000 miles.

continued on next page

**Every
125 000 miles**

Action	Component	Refer to chapter...
Check	Brakes: brake clearance, condition and security of end caps of guide sleeve screws and adjuster protective cap ^a	5.10
	Brakes: operation of adjusting mechanism; brake caliper sliding system; condition and security of pistons dust boots, adjuster protective cap and other blanking elements ^b	5.10
	Brakes: condition of brake disk, thickness of brake disk, run-out of brake disk ^c	5.10

a. At least once a year.

b. At least with every brake-pad replacement.

c. At least once a year.

**Every
150 000 miles**

Action	Component	Refer to chapter...
Renew	Cummins engine: filter element of crankcase breather	
	Cummins engine: coolant filter ^a	2.34
	Detroit Diesel engine, exhaust after-treatment system: DEF filter in pump unit ^b	2.30
Clean	Cummins engine: fuel injector of exhaust aftertreatment system	

a. At least once a year.

b. The interval applies to "Severe Service". These vehicles travel up to 30 000 miles/year and have an average fuel consumption of less than 5 miles/gallon.

**Every
175 000 miles**

Action	Component	Refer to chapter...
Change	ZF Astronic transmission: oil ^a	6.10

continued on next page

Action	Component	Refer to chapter...
Renew	Engine cooling system: filler cap and pressure relief cap of expansion tank	
	Detroit Diesel engine, exhaust after-treatment system: DEF filter in pump unit ^b	2.30
	ZF Astronic transmission: oil filter ^c	6.10
	Compressed-air system: governor	
Carry out	Propeller shaft: major inspection ^d	4.10
	Front axle steering: major inspection ^e (content: refer to "Maintenance schedule additional information" further in this chapter)	
Check	Compressed-air system: air-compressor discharge line for carbon deposit	13.25
	Compressed-air system: condition of air-compressor unloader valves	
	Cummins engine: crankshaft vibration damper	

a. At least every 2 years. The 175 000 miles interval is valid for class 02L oil of ZF lubricants list TE-ML 02.

When using oil from class 02E, the interval can be prolonged to 330 000 miles or 3 years, on the condition that the transmission breather is connected to a dry compartment by means of a line. If this is not the case, the interval for 02L oil is valid.

b. The interval applies to "Short-haul Service". These vehicles travel between 30 000 and 60 000 miles/year and have an average fuel consumption of between 5.1 and 5.9 miles/gallon.

c. With each oil change.

d. At least every 3 years.

e. First time after 480 000 km

**Every
200 000 miles**

Action	Component	Refer to chapter...
Renew	Cummins engine, exhaust aftertreatment system: DEF filter in pump unit	2.30

continued on next page

**Every
250 000 miles**

Action	Component	Refer to chapter...
Renew	Detroit Diesel engine, exhaust after-treatment system: DEF filter in pump unit ^a	2.30
Check	Cummins engine: crankshaft vibration damper	
	Cummins engine: valve clearance (adjust if necessary)	

a. The interval applies to "Long-haul Service". These vehicles travel more than 60 000 miles/year and have an average fuel consumption of more than 6 miles/gallon and minimal city "stop-and-go" operation.

**Every
300 000 miles**

Action	Component	Refer to chapter...
To change/to clean	Cummins engine, exhaust aftertreatment system: particulate filter	2.30

**Every
400 000 miles**

Action	Component	Refer to chapter...
Change	Engine, cooling circuit and interior heating: coolant ^a	2.34

a. At least every 4 years.

**Every
6 months**

Action	Component	Refer to chapter...
Check	Trailing axle steering: security, corrosion, leaks ^a	7.10

a. Only on TD925US/TDX25US with steered trailing axle.

Yearly

Action	Component	Refer to chapter...
Renew	Engine: air-filter element	2.22

continued on next page

Action	Component	Refer to chapter...
Clean	Underside of the vehicle; afterwards inspect anti-corrosion coating and re-apply where necessary ^a	10.1
Check	Coolant: antifreeze concentration ^b	
	Engine cooling system: condition of sealing around cooling radiator (change if necessary)	
	Engine cooling system: condition of sealing in feed-through apertures for air intake tubes in radiator compartment (change if necessary)	
	ZF Astronic transmission: breather line for security, damage and chafing ^c	

a. End of the cold season.

b. Start of the cold season.

c. Change the transmission oil immediately if the line has been damaged to such an extent that there is a risk of penetration of dirt or water (pulled off, ruptured or cracked line).

Every 2 years

Action	Component	Refer to chapter...
Change	Trailing axle steering: fluid ^a	7.10
Renew	Trailing axle steering: filter in fluid tank ^b	7.10
Inject	With rust-preventing oil: all open frame tubes located below floor level	10.1

a. Only on TD925US/TDX25US with steered trailing axle.

b. Only on TD925US/TDX25US with steered trailing axle.

Every 4 years

Action	Component	Refer to chapter...
Renew	Trailing axle steering: pressure accumulator ^a	7.10

a. Only on TD925US/TDX25US with steered trailing axle.

continued on next page

Every 5 years

Action	Component	Refer to chapter...
Change	Allison WTB500 transmission: oil ^a	6.10
Renew	Allison WTB500 transmission: oil filters ("MAIN" and "LUBE" filters) ^b	6.10

- a. Also change the oil when the service indicator on the range selector display comes on because the oil has to be changed. Renew the "MAIN" and "LUBE" oil filters at the same time.
- b. Also renew the oil filters when the service indicator on the range selector display comes on because the oil filters have to be replaced.
-

Maintenance schedule additional information

"Steering system major inspection" contains:

- To check maximum steering pump pressure.
 - To check steering pump flow.
 - To check/set hydraulic steering lock.
 - To check steering gear pressure.
 - To check steering gear for internal leakage.
 - To check return time of power steering valve.
 - To check play on steering wheel.
 - To check steering gear mesh load.
 - To check straight-ahead position of wheels.
 - To check steering lock angles.
 - To check steering column bearings for play.
 - To check universal joints and flex couplings.
-

Maintenance schedule for the climate-control system



WARNING!

Maintenance and repair works on the refrigerant circuit should only be carried out by a refrigeration technician.



WARNING!

Vehicles with coolant heater: have the heater checked annually, at the start of the cold season, by a specialized technician.

Fluids and lubricants

See earlier in this chapter.

Vehicles with coolant heater

- Check the outlet of the coolant heater at every service. The outlet must be unobstructed, otherwise it will disrupt proper operation of the coolant heater, which could be the cause of damage.
- As a precautionary measure, operate the heater for about 10 minutes at least once a month, even during the hot season, while the combustion engine is cold.

Eberspächer coolant heater: every 600 working hours or yearly

	Action
Coolant heater	Replace the injector.

Eberspächer coolant heater: every 3000 working hours

	Action
Coolant heater	Replace the burner head.

continued on next page

**Eberspächer
coolant
heater: every
5000 working
hours**

	Action
Coolant heater	Replace the heat exchanger.

Monthly

	Action
Airside systems	Check/replace the air filters ^a .
	Check the operation and the tightness of the air flaps.
Water circuit	Check the operation of the coolant heater.

a. Depending on the operating conditions (a lot of dust, pollen), decrease the interval.

**Every
6 months**

	Action
Airside systems	Check the operation of all fans.
	Check/clean the drain lines of the drain pans under the evaporators.
Refrigerant circuit	Check the hoses for leaking climate-control compressor oil or refrigerant.
	Check the sight-glass to see if the system has sufficient refrigerant.
	Check/clean the condenser cooling fins. ^a
Water circuit	Check the condition of the water hoses.
Control system	Check the condition of the electric wiring and plugs.

a. Depending on the operating conditions (a lot of dust, pollen), carry out more often.

**Annually
(before the hot
season)**

	Action
Complete climate-control unit	Check operation of locks and condition of seals.
Airside systems	Check/clean the fins of the radiators and the evaporators.
	Check/clean the fins of the convectors and the radiators in the vehicle interior.

continued on next page

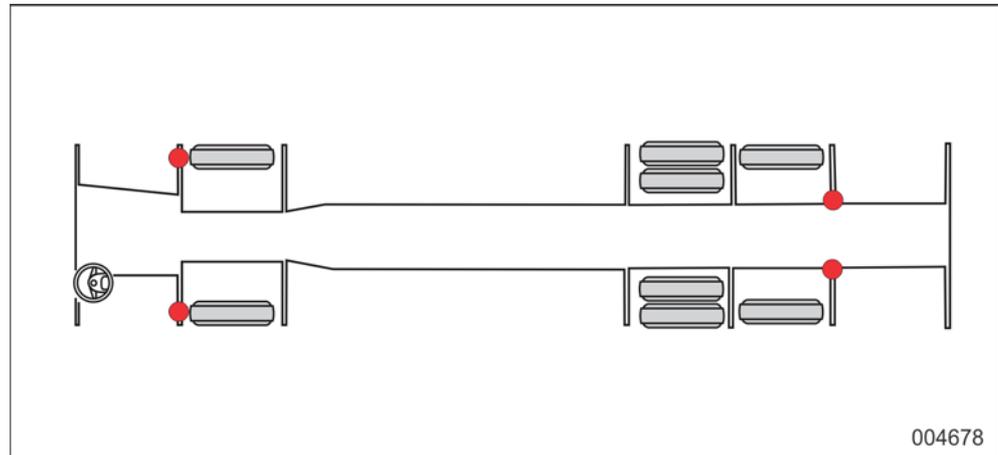
	Action
Water circuit	Check the operation of the circulating pump(s).
Refrigerant circuit	Check operating pressures and performance.
	Check the climate-control compressor clutch bearing.
	Check the tension of the drive belt of the climate-control compressor.
	Check the condenser cooling fans.
	Check the operation of the high- and low-pressure switches.
	Replace the filter dryer.
	Check the refrigerant lines and line couplings. Tighten the couplings if necessary.
	Check condition and security of suspension rubbers of climate-control compressor.
	Check the level and the color of the climate-control compressor oil. Change the oil if it has a darkish color.
Control system	Check that the system can perform all of the basic functions.
	Check the operation of the capacity control.
	Carry out a complete function test.
	With compressed air, blow through the inside-air temperature sensor(s) through the openings in the housing.

**Annually
(before the
cold season)**

	Action
Coolant heater	Have the heater checked by a specialized technician.
	Replace the fuel filter.

Lifting instructions

Figure:
chassis-frame
jacking points



WARNING!

Never support the vehicle with hydraulic jacks only; always place chassis stands or support blocks, before working under a jacked-up vehicle.



WARNING!

Put the air suspension system in "lowered" position or depressurize it before you lift the vehicle.

To lift under
chassis frame



CAUTION!

Disregarding the following instructions can cause serious damage to chassis sections:

- If the vehicle has to be raised by means of jacks under the chassis frame, position the jacking ram under the points indicated in the figure only.
- Always jack simultaneously at both front or both rear jacking points.
- Equally, when placing the vehicle on support stands (e.g. when lifting columns have been used to raise the vehicle), position the stands under the above mentioned points only.

continued on next page

To raise the vehicle with lifting columns



WARNING!

The four (or six) lifting columns have to move at the same speed, so that the vehicle remains level while it is being raised or lowered

To raise the vehicle under the drive axle

If the drive axle has to be raised, it is best to place a central jack with a dished head under the middle of the axle banjo.

To raise the vehicle under the front axle

If an axle end of the front suspension has to be raised, place the jack inside the recess in the steering knuckle carrier, indicated on the figure.

Figure: recess for jack in steering knuckle carrier



To raise an axle end of the front suspension, place jack here.

Towing instructions

Guidelines

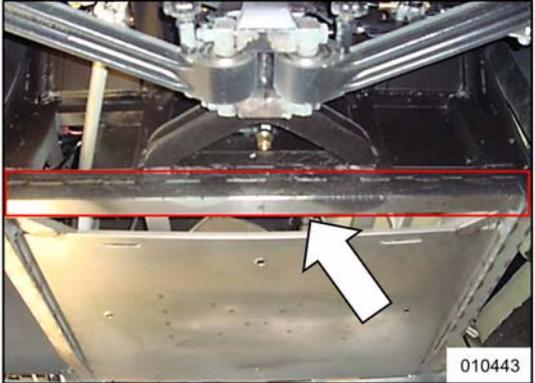
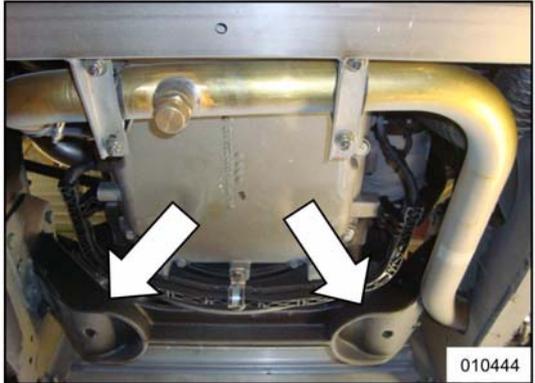
-
- Before towing, always disconnect the propeller shaft at the drive axle end or remove the two drive-axle half shafts. In case of damage inside the drive axle, the vehicle has to be towed from the back.
 - During the towing procedure, the vehicle air system can be supplied with compressed air by the towing vehicle through a hose coupling (refer to "To charge compressed-air tanks externally").
-

To lift and tow vehicle with recovery vehicle equipped with under-arm lift

Equipment condition

To read towing conditions (refer to "Towing instructions").

To lift where?

If you...	you have to place the lifting-system forks under...
lift the vehicle at the front	<p>the reinforced cross beam in front of the front axle.</p>  <p>010443</p>
lift the vehicle at the back	<p>the anchor points under the reinforced cross beam under the engine.</p>  <p>010444</p>



WARNING!

Do not carry out towing procedures that may be hazardous to other road users or that may cause damage to the vehicle.



WARNING!

Follow the legislation that applies to towed vehicles.

Procedure

Step	Action
1	Manoeuvre frame of under-arm lift under reinforced cross beam.
2	Lift the vehicle.

External cleaning of vehicle units

Introduction

The cleaning of vehicle units with a pressure washer and mains water to which a suitable cleaning agent has been added is permitted if you follow the instructions below.

NOTE: The instructions for cleaning the vehicle bodywork are given in chapter 10.1.

Cleaning equipment

Allowed	Not allowed
Pressure washers with flat-jet nozzle, 25° spray angle.	Power jets, rotary (turbo) jets and water cannons (equipment with very high flow rate, "fire-fighting" type).



WARNING!

To avoid accidents, read the safety precautions and instructions for use supplied by the manufacturer of the pressure washer.

Spraying distance

Minimum distance of spray lance nozzle to object: 20 in.

Operating pressure

Max. 725 psi at spray lance nozzle.

Water temperature

Unheated (cold) or max. 140 °F at spray lance nozzle.

NOTE: Cleaning takes less time with hot water because oil and grease dissolve better in water at high temperatures.

Cleaning agents

NOTE: Hard water can halve the effectiveness of cleaning agents.

Allowed	Not allowed
Neutral or slightly alkaline cleaners in a concentration of 1 to 5 %. pH-value of a 1 % solution: not higher than 9,5.	<ul style="list-style-type: none"> • "Cold cleaners" based on hydrocarbons (cleaning grade spirits, white spirit, kerosene) and other solvent-containing cleaning agents added to water. • Acidic or strongly alkaline agents.

continued on next page

**WARNING!**

To avoid health problems, read the safety precautions and instructions for use supplied by the manufacturer of the cleaning agent.

Do not point the spray lance of the pressure washer at ...

- opening(s) or flexible pipe joints of the engine air-intake system;
 - pump modules on diesel engines with Unit Pump System (UPS);
 - soft seals (dust caps and the like);
 - oil filler caps (of engine, transmission, etc.), especially not upwards from below;
 - breathers (on engine crankcase, transmission, drive axle, etc.);
 - bearings (of pulleys and belt tensioners, universal joints, steering system articulations, etc.);
 - lubricators;
 - radiator, charge-air cooler, climate-control condensor and other finned heat exchangers;
 - clutch and pressure switches (pressostats) of climate-control compressor;
 - electrical equipment such as batteries, starter motor, alternator(s), electronic control units, sensors, etc.;
 - electrical connections (connectors, etc.);
 - ignition coils, distributor, sparkplugs (if vehicle with gas engine);
 - electrical high-voltage components (in case of a trolley bus, hybrid vehicle or electric vehicle);
 - hydraulic components.
-

Used cleaning water

Used cleaning water should be treated and disposed of in accordance with the environment regulations of your country or region (use an oil separator).

On-board diagnostics system: to read active fault codes (DM1) on dashboard display

ECU?

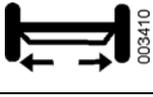
ECU is short for "Electronic Control Unit".

"DM1/DM4" messages

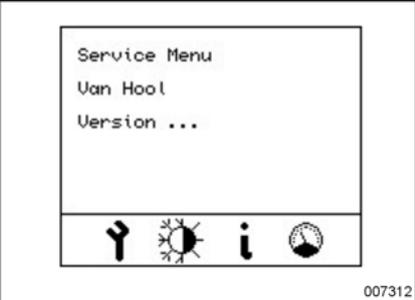
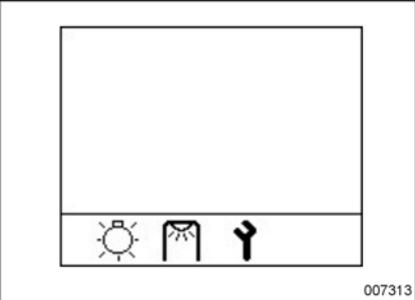
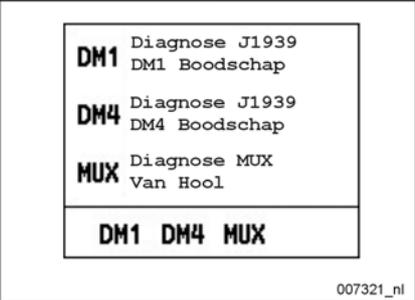
DM is short for "Diagnostic Message".

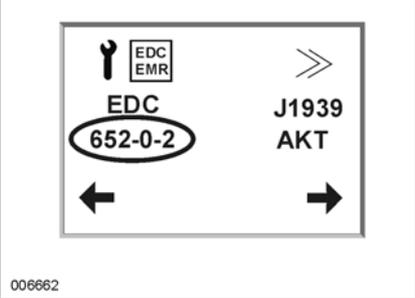
DM1	Are the active faults on the SAE J1939 CAN bus of all the control units that support "DM1"
DM4	Are the stored faults on the SAE J1939 CAN bus of the selected control unit.

Overview of the ECU's that support "DM1-DM4"

Symbol	Explanation
	Engine: control unit
	Engine: vehicle main processor (only with MAN engine)
	Engine: exhaust aftertreatment (only with Paccar-Daf engine)
	Transmission
	Retarder
	Trailing axle steering (only on coaches with a steered trailing axle)

To read the active faults (DM1)

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p>  <p>007312</p>
2	Press the button under the wrench symbol.	<p>The on-board diagnosis menu appears on the display.</p>  <p>007313</p>
3	Press the button under the wrench symbol.	<p>The menu below appears on the display.</p>  <p>007321_nl</p>

Step	Action	Result
4	<p>Press the button under "DM1".</p> <p><i>NOTE: Stored faults (DM4) cannot be read by means of the dashboard display. Pressing the button under "DM4" always results in the message "ECU unavailable".</i></p>	<p>On the display appears:</p> <ul style="list-style-type: none"> "No more DM1 messages available" or... a fault code. Example: 652-0-2 of EDC <div style="border: 1px solid black; padding: 5px; margin: 10px 0;">  </div> <p><i>NOTE: The presence of multiple faults is indicated by the ">>" symbol. In that case, use the buttons under the arrows to scroll through the fault codes.</i></p>

Fault codes explanation

Contact Van Hool.

To exit the diagnostics menu

Momentarily press the far left button under the dashboard display as many times as necessary to return to the service menu.

To erase faults

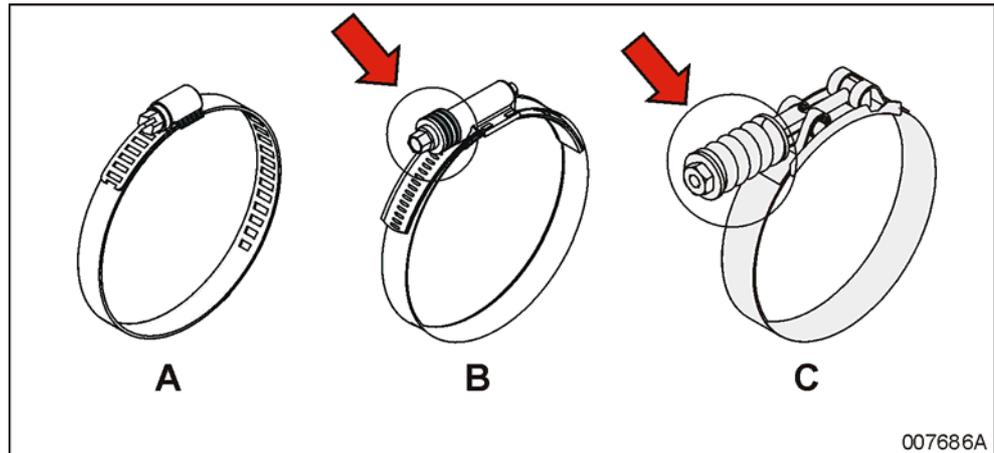
You need special equipment to erase the fault memory.

General mounting guidelines: hose clamps

Introduction

Besides standard screw hose clamps, constant torque hose clamps have also been mounted on your vehicle.

Figure: hose clamp types



A Standard hose clamp

B Constant torque hose clamp with conical spring washers

C Constant torque hose clamp with coil spring

Tightening torques

Refer to "Technical data" at the end of the chapters where hose clamps are used.

To mount standard screw hose clamps

Step	Action
1	Install the hose clamp.
2	Tighten the screw of the hose clamp to the prescribed torque.

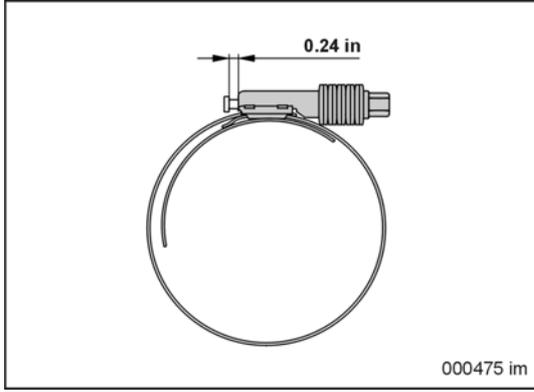
Retorque standard screw hose clamps?

Standard screw hose clamps have to be retightened at the intervals indicated in the maintenance schedule.

To mount constant torque hose clamp

Step	Action
1	Install the hose clamp.

continued on next page

Step	Action
<p>2</p>	<p>Tighten the screw of the hose clamp to the prescribed torque.</p> <p>Visual torque check: the screw tip of a properly torqued constant torque clamp with conical spring washers extends approximately 0.24 in beyond the housing.</p> <div data-bbox="734 504 1268 896" style="text-align: center;">  <p>0.24 in</p> <p>000475 im</p> </div>
<p>3</p>	<p>Take a ride to warm the vehicle.</p>
<p>4</p>	<p>Let the vehicle cool during 1 hour.</p>
<p>5</p>	<p>Tighten the screw of the hose clamp to the prescribed torque.</p>

Retorque constant torque hose clamps?

It is not permitted to retighten constant torque hose clamps.

General mounting guidelines: self-locking nuts

Fully metal self-locking nuts

- if used on clamps of drag link or tie rod, should not be retightened after loosening, but thrown away with corresponding bolt and changed by a new identical one.
- in other applications, should not be loosened and retightened more than two times. After loosening a third time, throw away the nut with the corresponding bolt and change by a new identical one.
- if removed from a bolt, should never be used again, but thrown away with the bolt and changed by a new identical one.

Self-locking nuts with nylon insert

should be thrown away after loosening and changed by a new identical one.



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Part 2 - Traction engine

Overview

Contents

Chapter	See page
Chapter 6: Engine suspension	2.6-1
Chapter 10: Fuel system	2.10-1
Chapter 22: Air intake system	2.22-1
Chapter 30: Exhaust system	2.30-1
Chapter 34: Cooling system	2.34-1
Chapter 38: Lubrication system	2.38-1
Chapter 46: Accessory drive systems	2.46-1

The following chapters have been *modified* since the former edition:

Chapter	See page
Chapter 38: Lubrication system	2.38-1
Chapter 46: Accessory drive systems	2.46-1

Chapter 6: Engine suspension

Overview

Introduction

This chapter deals with the engine suspension.

Number of pages

4

Chapter publication date

21 September 2016

Contents

Topic	See page
To check engine security	2.6-2
To check adjustment of displacement limiter of rear rubber-metal mounts	2.6-3
Technical data: engine suspension	2.6-4

To check engine security

Tightening torques

Refer to "Technical data" at the end of this chapter.

To check adjustment of displacement limiter of rear rubber-metal mounts

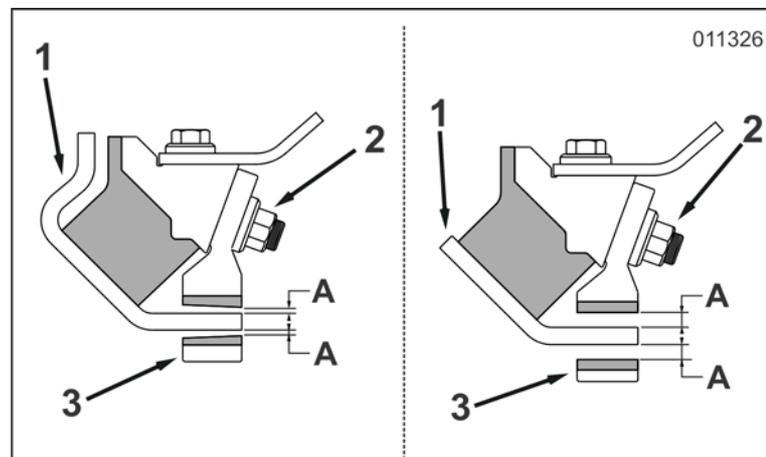
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

To check what?

Measure the distances "A" indicated in the figure. The distance "A" between rubber-metal mount (1) and displacement limiter (3) must be equal on top and underneath.

Figure: rear engine bracket



Left: first design; right: second design

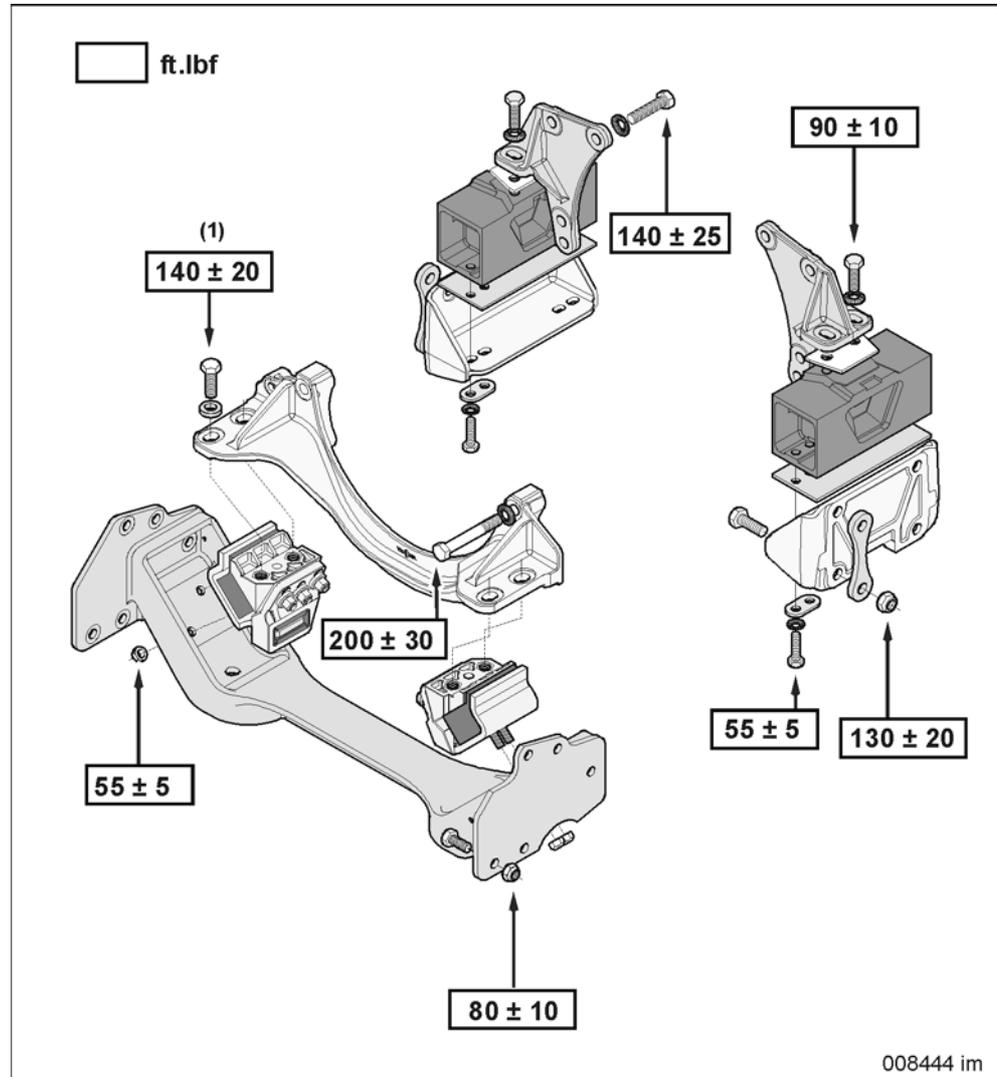
- 1 Rubber-metal mount
- 2 Self-locking nut
- 3 Displacement limiter

How to adjust?

Step	Action
1	Loosen nuts (2).
2	Put displacement limiter (3) in the mid-position and tighten nuts (2) to the prescribed torque.

Technical data: engine suspension

Figure:
tightening
torques



Security of engine.

(1) Screws locked with Loctite 243 or equivalent

Chapter 10: Fuel system

Overview

Number of pages

10

Chapter publication date

21 September 2016

Contents

Topic	See page
EDC system: self-diagnosis	2.10-2
Fuel Pro fuel filter: to drain water	2.10-3
Fuel Pro fuel filter: to change filter element	2.10-5
To change fuel filter	2.10-8
Special tools: fuel system	2.10-10

EDC system: self-diagnosis

Introduction

The electronic control unit contains a self-diagnostic feature. The electronics constantly monitor the correct operation of the system and faults are stored in a memory. The self-diagnosis feature makes troubleshooting easier.

How to read fault memory?

You can read the fault memory with a special diagnostic tool from Cummins (refer to Cummins service literature).

Fuel Pro fuel filter: to drain water

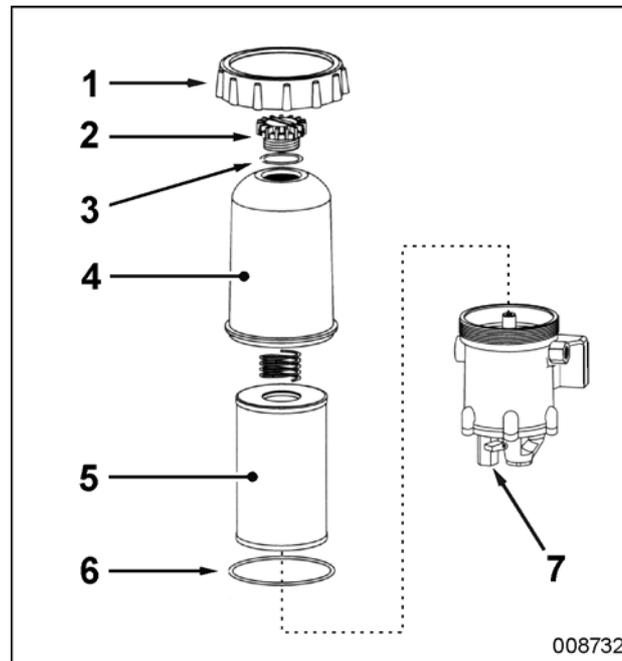
Special tools

Wrench to loosen the vent plug	<ul style="list-style-type: none"> • Fleetguard No. 3944451 S (plastic) • Fleetguard No. 3944448 S (metal)
--------------------------------	--

Equipment conditions

- Engine stopped
- Direct surroundings of the filter well cleaned

Figure: Fuel Pro fuel filter, exploded view



- 1 Securing ring
- 2 Plug
- 3 Gasket
- 4 Transparent bowl
- 5 Filter element
- 6 O-ring
- 7 Drain cock

**CAUTION!**

When working on the fuel system, absolute cleanliness must be observed. Dirt introduced into the fuel system can cause a lot of damage.

**WARNING!**

The water in the filter is toxic and carcinogenic. Avoid contact with skin. Collect the water into a container and dispose of it in accordance with environmental regulations.

Procedure

Step	Action
1	Let the overpressure in the fuel tank escape by opening the tank filler valve.
2	Turn the handle of the shut-off valve in the fuel suction line square to the line.
3	Make sure that you can safely collect the water from drain cock (7). Open drain cock (7).
4	By means of the special wrench, loosen plug (2) by a few revolutions until water runs from drain cock (7).
5	Close drain cock (7) as soon as nothing but clean fuel comes out.
6	Tighten plug (2) by hand.
7	Turn the handle of the shut-off valve in the fuel suction line until parallel to the line.
8	Start the engine and let it run at high idle during 1 minute to bleed the system.

Fuel Pro fuel filter: to change filter element

When to change?

Figure	Fuel level	Action
	Not at the top of the transparent bowl	Normal. Do not change filter element.
	At the top of the transparent bowl	Change the filter element.

Consumables

Filter element (with sealing rings)	Fleetguard No. FS19764
-------------------------------------	------------------------

Special tools

Wrench to loosen the securing ring of the transparent bowl and the vent plug.	<ul style="list-style-type: none"> Fleetguard No. 3944451 S (plastic) Fleetguard No. 3944448 S (metal)
---	--

Equipment conditions

- Vehicle parked on level ground
- Direct surroundings of the filter well cleaned

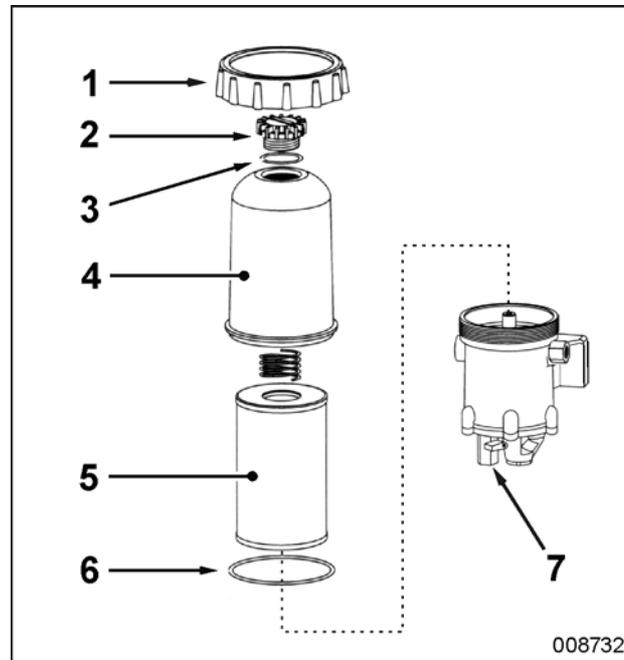


CAUTION!

When working on the fuel system, absolute cleanliness must be observed. Dirt introduced into the fuel system can cause a lot of damage.

continued on next page

**Figure: Fuel
Pro fuel filter,
exploded view**



- 1 Securing ring
- 2 Plug
- 3 Gasket
- 4 Transparent bowl
- 5 Filter element
- 6 O-ring
- 7 Drain cock

**To drain fuel
from filter**

Step	Action
1	Let the overpressure in the fuel tank escape by opening the tank filler valve.
2	Turn the handle of the shut-off valve in the fuel suction line square to the line.
3	Make sure that you can collect the fuel from drain cock (7). Open drain cock (7).
4	By means of the special wrench, loosen plug (2) by a few revolutions until fuel runs from drain cock (7).
5	Close drain cock (7) again when the fuel level is lower than the securing ring of transparent bowl (4).

To remove filter element

Step	Action
1	By means of the special wrench, loosen securing ring (1) of transparent bowl (4).
2	Remove transparent bowl (4).
3	Remove O-ring (6).
4	With a light twist, pull filter element (5) from the neck. <i>NOTE: The filter-element sealing ring may be stuck to the neck. Make sure it is removed before installing the new filter element.</i>

To install the filter element

Step	Action
1	Install a new O-ring (6).
2	With a light twist, push new filter element (1) onto the neck.
3	Install transparent bowl (4) and tighten securing ring (1) by hand.
4	Remove plug (2).
5	Fill transparent bowl (4) up to halfway with clean fuel.
6	Install plug (2) with a new sealing ring and tighten it by hand.
7	Turn the handle of the shut-off valve in the fuel suction line until parallel to the line.
8	Start the engine.

To change fuel filter

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Consumables

Filter element	Cummins No.
----------------	-------------

Equipment conditions

Area around filter holder cleaned

Figure: fuel filter



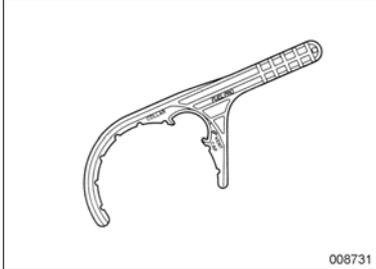
To change fuel filter

Step	Action
1	Unscrew and remove the filter element using a strap wrench.
2	 <p>WARNING! Dispose of the fuel from the old filter element in accordance with environmental regulations. Empty the old filter element into a container.</p>
3	Wet the sealing-ring of the new filter element with lubricating oil.
4	Fill the new filter element with clean fuel.
5	Screw the new filter on its holder. Follow the instructions from the filter manufacturer.

continued on next page

Step	Action
6	Start the engine and check for leaks.

Special tools: fuel system

Ordering number	Description	Figure
<ul style="list-style-type: none"><li data-bbox="197 568 504 636">• Fleetguard 3944451 S (plastic)<li data-bbox="197 651 504 719">• Fleetguard 3944448 S (metal)	"Fuel Pro" fuel filter: wrench to loosen the securing ring of the transparent bowl and the vent plug	 008731

Chapter 22: Air intake system

Overview

Introduction This chapter deals with the air intake system.

Number of pages 12

Chapter publication date 21 September 2016

Contents

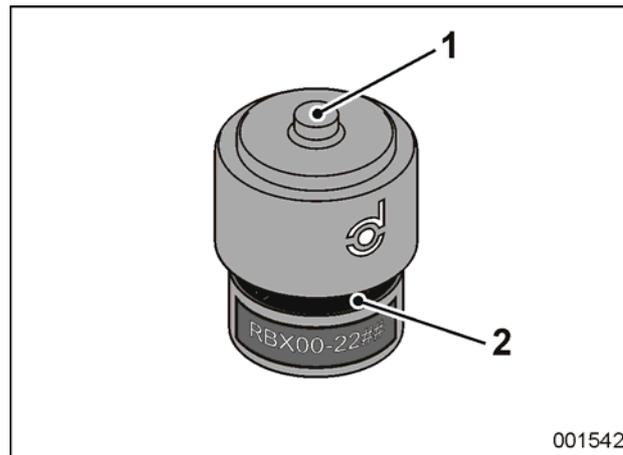
Topic	See page
To check air filter condition	2.22-2
To check air-filter service indicator	2.22-3
To check air-filter dust evacuation valve	2.22-5
To change air-filter element	2.22-6
Hose clamps	2.22-8
To clean exterior of charge-air cooler	2.22-9
Technical data: air intake system	2.22-11
Special tools: air intake system	2.22-12

To check air filter condition

To be carried out when?

Before commencing daily service.

Figure: air-filter service indicator



1 Reset button

2 Window

Procedure

Check the condition of the air filter by observing the service indicator.

If...	then ...
, with the engine off, the red plunger appears in window (2),	the air-filter element should be changed as soon as possible.

To check air-filter service indicator

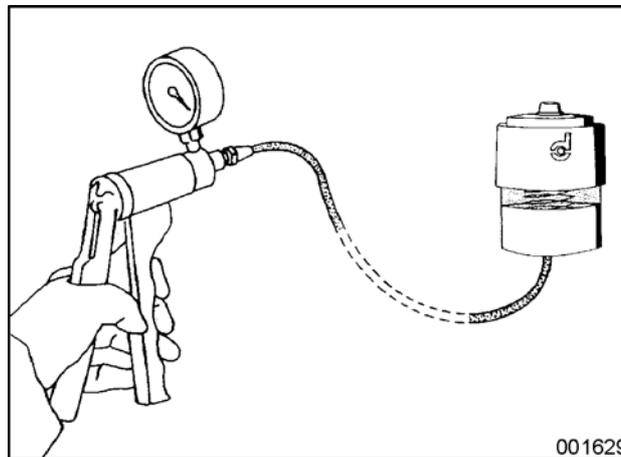
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Checking values

Refer to "Technical data" at the end of this chapter.

Figure: to check air-filter service indicator

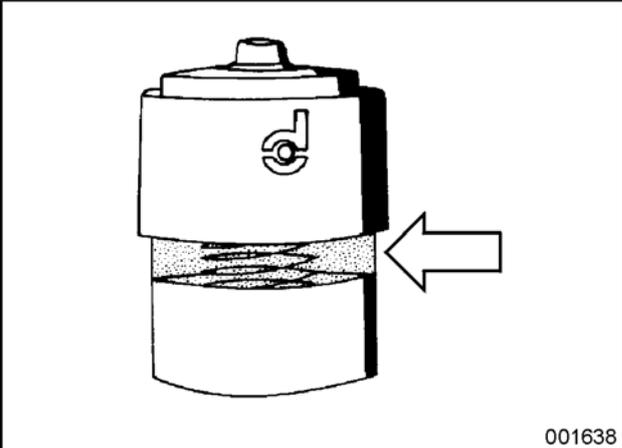


001629

Procedure

Step	Action
1	Disconnect the hose of air-filter service indicator at the air-filter outlet.
2	Connect the hose end to a small vacuum pump (available from retail trade).

continued on next page

Step	Action
3	<p>Actuate the pump until the pressure gauge of the pump registers the pressure indicated in the technical data.</p> <p>A red plunger should rise in the window of the service indicator.</p> <div data-bbox="694 470 1316 918" style="text-align: center;"><p>001638</p></div>
4	<p>Disconnect the vacuum pump. The atmospheric pressure is restored at the service indicator.</p> <p>The red plunger should stay in the window.</p>
5	<p>Change indicator, if red plunger responds too soon, too late or not at all.</p> <p><i>NOTE: The field in the window must not be red anymore when the service indicator is put back into service after checking. Press the service indicator reset button to clear the window again as necessary.</i></p>

To check air-filter dust evacuation valve

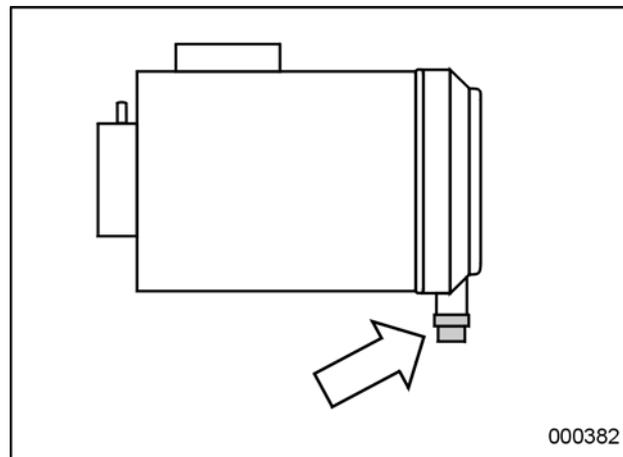
To be carried out when?

Regularly

Function of dust evacuation valve

The dust evacuation valve automatically expels the dust collected in the filter while the engine is running.

Figure: air-filter dust evacuation valve



Procedure

Squeeze the rubber valve by hand regularly to open the evacuation slot. This way you prevent the slot from sticking shut due to air humidity.

To change air-filter element

To be carried out when?

When the air restriction indicator's red signal remains visible after engine shutdown. The element should be discarded in any case after 1 year.

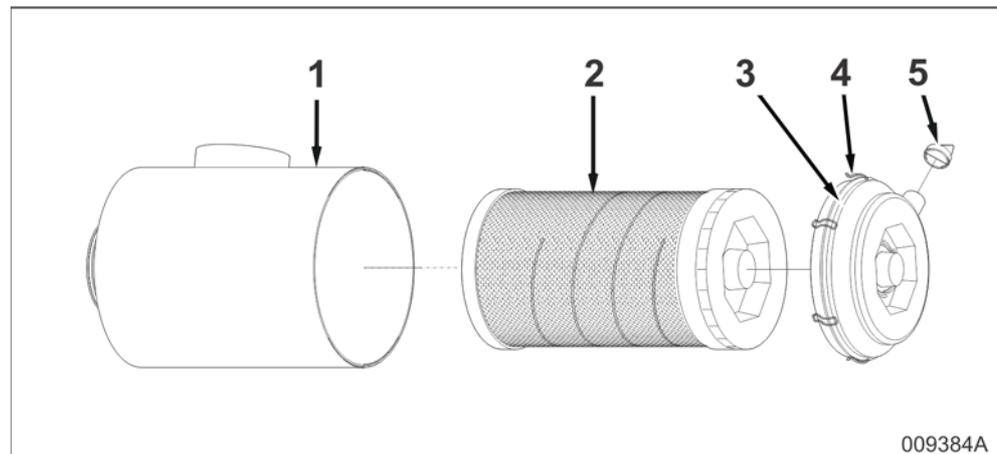
Consumables

Refer to Van Hool spare parts manual.

Equipment condition

Engine stopped

Figure: air filter



- 1 Filter housing
- 2 Filter element
- 3 Dust pan
- 4 Toggle clips
- 5 Dump valve



CAUTION!

Filter element cleaning is not allowed.

Procedure

Step	Action
1	Release toggle clips (4) and remove dust pan (3).

Step	Action
2	<p><i>NOTE: Sometimes the rubber O-ring of the filter element sticks somewhat to the filter housing. To detach the O-ring, turn the filter element alternately to the left and to the right.</i></p> <p>Pull air-filter element off outlet tube and remove from air-filter housing.</p>
3	<p>Check the old filter element. A stripe of dust at the inside of the element means that there is something wrong. In that case, first determine the cause before mounting a new element.</p>
4	<p>Clean the inside of the air-filter housing and outlet tube with a damp cloth.</p>
5	<div data-bbox="579 712 667 797" style="display: inline-block; vertical-align: middle;"> </div> <p style="margin-left: 20px;">CAUTION!</p> <p>Only apply pressure at the reinforced outer rim of the bottom of the filter element, not in the center.</p> <p>Inspect the new filter element for damage. Install the element in the filter housing and push it onto the filter-outlet collar.</p>
6	<p>Install the dust pan onto the filter housing so that dump valve (5) is pointing downward and close toggle clips (4).</p>
7	<p>Press button (1) of the service indicator to make the red plunger inside window (2) disappear.</p> <div data-bbox="692 1176 1318 1630" style="text-align: center;"> </div> <p style="text-align: right; margin-right: 20px;">001542</p>

Hose clamps

Cross- reference

Refer to chapter 1.1, "General mounting guidelines: hose clamps".

To clean exterior of charge-air cooler

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Cleaning product

Detergent P3-Grato 12 by Henkel, or similar product

Special tools

Cleaning tool	Van Hool No.10527208
---------------	----------------------



WARNING!

Wear a dust mask, when cleaning with compressed air.

Nature of dirt

Nature of dirt	Cleaning medium
Dry dust or sand	Compressed air (approximately 115 psi)
Tenacious dirt	Water + detergent. <i>NOTE: Van Hool recommend the use of P3-Grato 12 by Henkel.</i>

To use P3-Grato 12

Mix a quantity of P3-Grato 12 with a similar volume of water. Follow the instructions on the packaging.

NOTE: According to its manufacturer this detergent contains neither corrosive nor toxic agents.

Procedure

Step	Action
1	Carry out steps 1 up to and including 5, as mentioned in chapter 2.34 "To clean exterior of radiator".
2	Insert T-headed cleaning tool (with holes towards charge-air cooler, this means to front of vehicle) into gap between radiator and charge-air cooler.

continued on next page

Step	Action
3	 CAUTION! If the cleaning tool is not flat against the radiator surface when you open the pressure supply, the reaction force of the pressure jets will make the tool lash backward and the radiator will be damaged. Hold tool flat against front of radiator and open pressure supply.
4	Move the cleaning tool back and forth while holding it flat against the radiator.

Technical data: air intake system

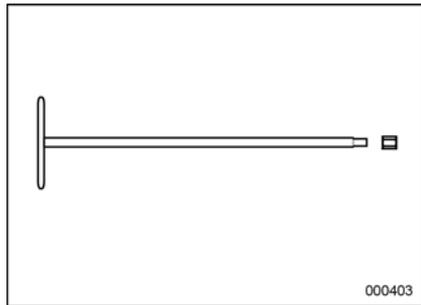
Air-filter service indicator

Preset restriction limit	25 in H ₂ O
--------------------------	------------------------

Tightening torques

Standard hose clamps, clamping range up to 0.9 in dia.	2.2 ± 0.4 ft.lbf
Standard hose clamps, clamping range up to 1.06 in dia.	3.3 + 0.4 ft.lbf
Constant torque hose clamps with five conical spring washers	6.6 + 0.7 ft.lbf
Constant torque hose clamps with coil spring	6.6 + 0.7 ft.lbf

Special tools: air intake system

Ordering number	Description	Figure
Van Hool 10527208	Cleaning tool for radiator and charge-air cooler	

Chapter 30: Exhaust system

Overview

Introduction This chapter deals with the exhaust system.

Number of pages 8

Chapter publication date 21 September 2016

Contents

Topic	See page
Exhaust aftertreatment system: to change pump-unit DEF filter	2.30-2
Exhaust aftertreatment system: to regenerate particulate filter (DPF)	2.30-3
Exhaust aftertreatment system: system: to change particulate filter (DPF)	2.30-8

Exhaust aftertreatment system: to change pump-unit DEF filter

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

**Figure:
location of
DEF filter**



Near the trailing axle, accessible through the bottom of the vehicle.

Procedure

Follow the instructions mentioned in the Cummins literature.

Exhaust aftertreatment system: to regenerate particulate filter (DPF)

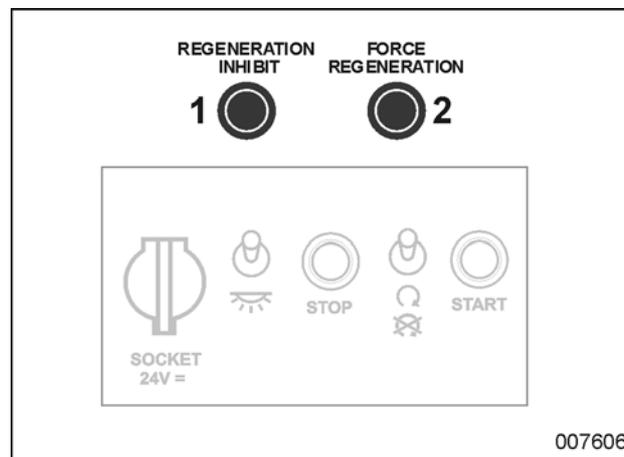
What is regeneration?

Refer to "Exhaust aftertreatment system: principle".

Messages on dashboard display

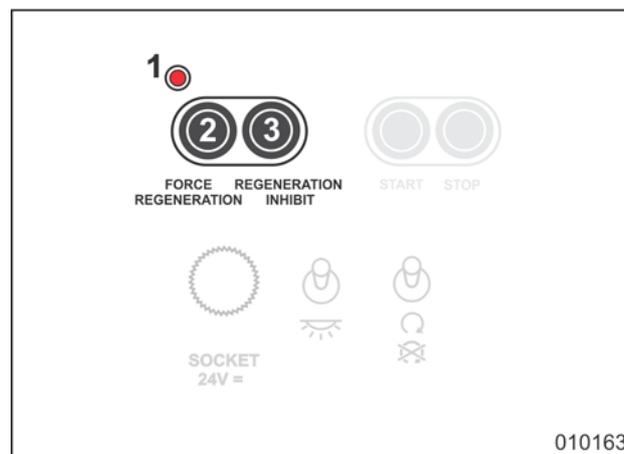
Symbol	Message
	<p>DPF regeneration required</p> <p>Also appears for a few seconds when ignition is switched on.</p>
	<p>High exhaust temperature.</p> <p>The fact that this symbol appears does not mean that there is an engine problem. It only warns you of a high exhaust temperature due to a regeneration.</p> <p>Make sure the exhaust pipe is not directed toward a surface that will burn or melt at high temperature (grass, ..., asphalt!)</p> <p><i>NOTE: Only appears at low vehicle speed.</i></p> <p>Also appears for a few seconds when ignition is switched on.</p>
DPF REGENERATION ACTIVE	The particulate filter goes through a stationary regeneration
DPF REGENERATION INHIBITED	Regeneration inhibited

**Figure: regen-
eration
controls in
engine com-
partment,
type 1**



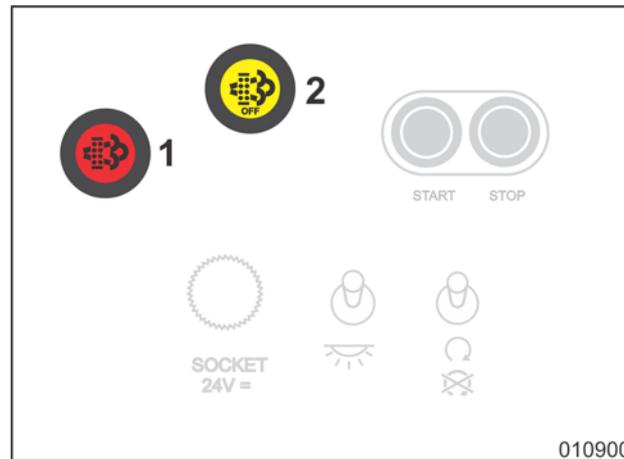
- 1 "Regeneration inhibited" push-button (with integrated lamp)
- 2 "Stationary regeneration request" push-button

**Figure: regen-
eration
controls in
engine com-
partment,
type 2**



- 1 "Regeneration inhibited" lamp
- 2 "Stationary regeneration request" push-button
- 3 "Regeneration inhibition" push-button

Figure: regeneration controls in engine compartment, type 3



- 1 "Stationary regeneration request" push-button (with integrated lamp)
2 "Regeneration inhibited" push-button (with integrated lamp)

When to regenerate?

If the particulate filter...	then ...
reaches the self-cleaning temperature while driving	regeneration takes place automatically. You don't have to take any action yourself.
does not reach the self-cleaning temperature while driving (e.g. due to frequent stopping)	the "DPF regeneration" symbol will appear after a while. This means that you have to intervene to start the regeneration.

"DPF regeneration" symbol: warning phases

There are four warning phases:

- Phase 1: The "DPF regeneration" symbol appears in order to indicate that the particulate filter has to be regenerated at the next opportunity.
- Phase 2: The "DPF regeneration" symbol flashes to indicate that regeneration has to be performed immediately.
- Phase 3: The "DPF regeneration" symbol flashes together with the "ENGINE WARNING" message. Regeneration has to be performed immediately. Engine power is reduced automatically.
- Phase 4: If you wait any longer, the "STOP ENGINE" message appears. Switch off the engine and call for technical assistance.

How to start regeneration?

- Go for a ride maintaining a high speed for at least 20 minutes (highway) or...
- perform a stationary regeneration.

continued on next page

To perform a stationary regeneration



WARNING!

During a stationary regeneration, engine speed can increase up to 1 000 to 1 500 rpm.

NOTE: Only carry out stationary regeneration with warm engine (coolant temperature above 185°F).

Step	Action
1	Select an appropriate location to park the vehicle. Refer to "Appropriate location for stationary regeneration".
2	Apply the parking brake.
3	Make sure the transmission is in neutral position.
4	Put chocks in front of and behind the wheels.
5	Set up a safety area around the exhaust. Refer to "Safety area around exhaust".
6	Shut off the climate-control system.
7	Press the "Stationary regeneration request" button and hold it for at least 2 seconds. If allowed by engine electronics, the stationary regeneration is started. The engine speed increases. The "DPF regeneration" symbol disappears from the dashboard display and the "DPF REGENERATION ACTIVE" message appears.
8	 <h4>WARNING!</h4> <p>If an unsafe situation occurs, stop the regeneration process immediately by pushing the brake pedal or by switching off the engine. The regeneration process is also stopped if you momentarily press the "Regeneration inhibition" button.</p> <p>Observe the vehicle and its immediate surroundings during regeneration.</p> <p>The regeneration process takes 20 to 40 minutes. The regeneration has succeeded if the engine speed automatically returns to idling speed and if the "DPF regeneration" symbol does not reappear.</p> <p>If the "DPF regeneration" symbol reappears, the regeneration process has failed. In that case, ask for technical assistance.</p>

continued on next page

**To inhibit/
interrupt
regeneration**

If regeneration causes hazardous situations, you can inhibit/interrupt the regeneration process. To this end, momentarily press the "Regeneration inhibition" button.

The "Regeneration inhibited" lamp comes on. On the dashboard display appears the text "DPF REGENERATION INHIBITED". Only use this function in special circumstances and for a short while.

**Appropriate
location for
stationary
regeneration**

- Surface that will not start to burn or to melt under high temperatures (such as clean concrete; no grass or asphalt!);
- Away from anything that can burn, melt or explode;
- Not near gas or vapors that can ignite, explode or contribute to a fire (such as LPG, diesel vapors, ...).

**Safety area
around
exhaust**

- If bystanders can access the area, set up barriers at least 5 ft away from the exhaust.
 - If regeneration takes place in a confined space, connect an exhaust gas evacuation system to the exhaust pipe. The evacuation system has to resist temperatures of at least 1500°F.
 - Keep a fire extinguisher nearby.
-

Exhaust aftertreatment system: system: to change particulate filter (DPF)

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

Exhaust aftertreatment device cold

Procedure

Follow the instructions mentioned in the Cummins literature.

Chapter 34: Cooling system

Overview

Introduction This chapter deals with the cooling system.

Number of pages 26

Chapter publication date 21 September 2016

Contents

Topic	See page
Safety instructions regarding the cooling system	2.34-2
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To check coolant level	2.34-5
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To change coolant filter	2.34-10
To drain engine cooling circuit	2.34-12
To fill and bleed engine cooling circuit	2.34-14
To check/clean radiator compartment mesh screen	2.34-15
To clean radiator exterior	2.34-16
To check coolant hoses	2.34-18
Hose clamps	2.34-19
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To determine remaining service life span of fan clutch	2.34-23
Technical data: cooling system	2.34-25
Special tools: cooling system	2.34-26

Safety instructions regarding the cooling system



WARNING!

Antifreeze and coolant with antifreeze contain the toxic chemical ethylene glycol. Hazardous for ingestion or inhalation of fumes. Causes irritation upon contact with the eyes. In the event of ingestion, have a first-aider cause the victim to vomit (if conscious); in the event of inhalation, move the victim into the open air. Seek medical assistance in both cases. In the event of contact with the eyes, rinse the eyes with ample water. If eye irritation develops, consult an eye doctor.



WARNING!

Never open the coolant expansion tank filler cap or pressure relief cap if the coolant temperature gauge indicates more than 122 °F. The pressure could cause hot water to squirt outward and cause scalds.



WARNING!

If the expansion tank filler cap or pressure relief cap has to be opened, first turn it carefully counterclockwise to the first stop and let the pressure escape. Then turn to the second stop and remove the cap.



CAUTION!

Never add cold coolant, when the engine is hot. The sudden cooling could cause parts of the engine block to crack.

Protection against frost, deposits and corrosion



WARNING!

Antifreeze and coolant with antifreeze contain the toxic substance ethylene glycol. Hazardous for ingestion or inhalation of fumes. Causes irritation upon contact with the eyes. In case of ingestion, rinse the mouth immediately, consequently drink water abundantly and seek medical assistance; administer 1.7 ounce of pure ethanol (antidote) in a drinkable concentration. In case of inhalation, move the victim into the open air and seek medical assistance. In case of contact with the eyes, rinse them during at least 15 minutes under running water with eyes wide open. If eye irritation occurs, consult an eye doctor. In case of contact with the skin, wash it thoroughly with soap and water. Take off soiled clothing immediately.

What antifreeze to use?

Refer to "Fluids and lubricants" earlier in chapter 1.1.

Antifreeze concentration

To protect the installation against corrosion and deposits, at least 50% of the coolant volume has to consist of antifreeze, both winter and summer. This concentration protects against frost up to approximately -31°F and offers better corrosion protection than a mixture of 40% antifreeze and 60% water. Avoid antifreeze concentrations above 50%.

Water of good quality

Preferably use a fully formulated mixture of water and antifreeze.

If you mix antifreeze with water yourself, prepare this mixture beforehand and only use deionized or demineralized water.

When to change coolant?

- As antifreeze loses its protective qualities after a certain time in service, the mixture of water and antifreeze must be changed after 400 000 miles (or 4 years, whichever comes first).
- Also change all coolant (engine cooling and interior heating circuit) after mounting a new engine, radiator or water-cooled retarder. The reason is that only fresh antifreeze contains sufficient additives to create an effective basic protective layer on new metal parts.

continued on next page



**To dispose of
coolant**

Do not dispose of antifreeze or coolant with antifreeze through the sewer system; evacuate it in accordance with the environment regulations of your country or region.

To check coolant level

Equipment conditions

Cold engine



WARNING!

Never open the filler cap if the coolant thermometer indicates more than 122°F. The pressure may cause hot water to squirt out and cause scalds.



WARNING!

If the filler cap has to be opened with hot engine, first carefully turn it counterclockwise to the first stop to relieve the pressure. Then turn it to the second stop and remove it.



CAUTION!

Never pour cold coolant into the expansion tank when the engine is hot. The sudden cooling may cause parts of the engine block to crack.



CAUTION!

If the coolant consumption exceeds 1 quart per day, or if you determine that the total consumption exceeds 10 quarts in less than a year, this indicates important leaks that need to be located and remedied immediately.

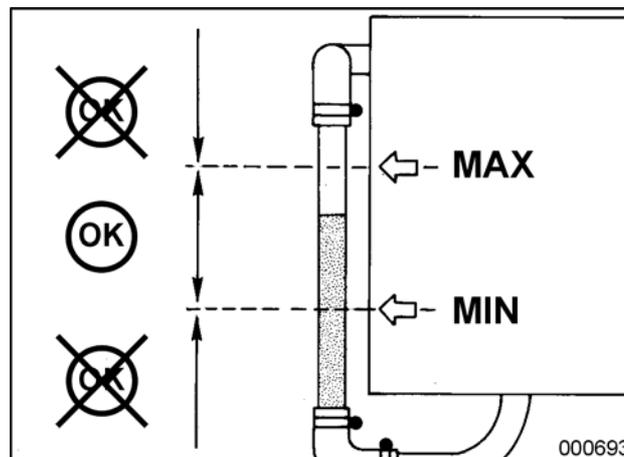


CAUTION!

A coolant leak in a heat exchanger of the engine (cooler of exhaust gases, oil cooler, ...) that is not timely determined and repaired can cause serious engine damage.

continued on next page

**Figure:
coolant level**



The coolant expansion tank is located in the engine compartment.

**Correct
coolant level**

The coolant level is correct if it is between the "MIN" and "MAX" marks on the expansion tank.

**Location of
expansion
tank filler cap**

Refer to "Access doors and controls at the outside".

**To top up with
coolant**

Always top up with the prescribed coolant. Preferably use a fully formulated mixture of water and antifreeze. If you mix antifreeze with water yourself, prepare this mixture beforehand and only use deionized or demineralized water.

If you were to add "clear" water, the concentration of the protective agents in the system would be reduced, thus increasing the risk of deposits, corrosion and freezing.

Prescribed coolant: refer to "Fluids and lubricants" in chapter 9 of the operating manual, or in chapter 1.1 of the maintenance manual.

**Do you have to
add coolant
frequently?**

If the coolant consumption exceeds 1 quart per day, or if you determine that the total consumption exceeds 10 quarts in less than a year:

- First check the cooling circuit and the interior heating circuit for external leaks and traces of leakage.
- If you suspect that coolant has penetrated the engine (via a heat exchanger), an analysis of the engine oil by an approved organism can give you a definite answer. A sodium content of 100 ppm or more indicates

continued on next page

a coolant leak. To prevent the situation from deteriorating, the leaking heat exchanger has to be repaired without delay by an authorized workshop.

- After repair: change engine oil and oil filter(s).

NOTE: If the coolant in the cooling circuit or in the interior heating circuit has been changed completely or partially, it is normal that you will have to top up coolant in the next days (as soon as the vehicle is in operation).

To take coolant sample

When?

Refer to chapter 1.1, "Maintenance schedule".

NOTE: If the coolant sample is taken during the hot season (little or no use of heating system), first run the engine warm with interior-heating hot-water valves open and interior-heating circulating pump on (refer to chapter 8.2, under "Passenger compartment control system: to troubleshoot using the dashboard display"). This way, the coolant sample gives an image of the entire coolant circuit.

Special tools

Hose coupling for drain nipple	Van Hool No. 10772040
--------------------------------	-----------------------

Equipment condition

- Parking brake applied
- Transmission in neutral

Drain hose

You can make the drain hose mentioned in the procedure yourself. It consists of a hose with an inner diameter of 19 mm and a special coupling (refer to "Special tools").

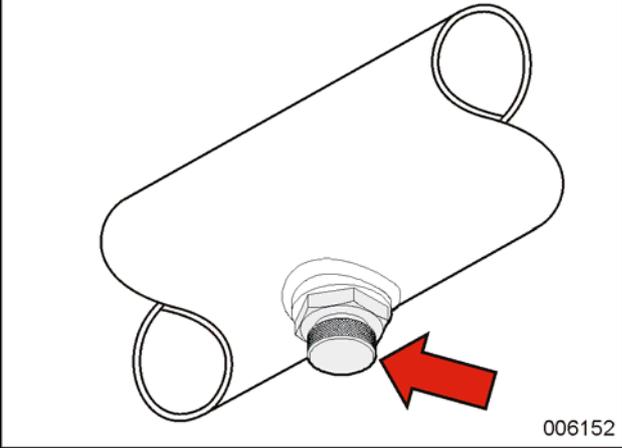
Procedure



WARNING!

Do not take a coolant sample if the coolant thermometer indicates more than 122 °F. The pressure could cause hot water to squirt outward and cause scalds.

Step	Action
1	Let the installation cool to below 122 °F.

Step	Action
2	<p>Remove the protective cap from the drain nipple on the water pipe. The drain nipple is located in the radiator return line or near the transmission.</p> <div data-bbox="694 459 1316 907" style="text-align: center;">  </div>
3	<p>Screw the drain hose onto the drain nipple. The drain nipple for the drain hose is fitted with a non-return valve that opens when you screw the hose onto the nipple.</p>
4	<p>Remove the drain hose from the drain nipple as soon as you have sufficient coolant.</p>
5	<p>Screw the protective cap on the drain nipple.</p>

To change coolant filter

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

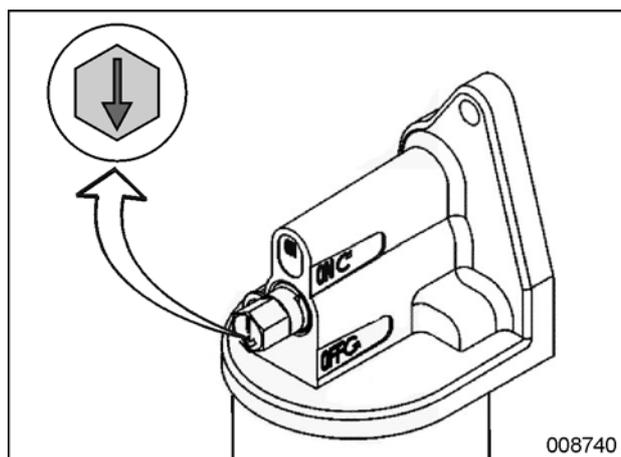
Consumables

Element of the coolant filter	Fleetguard No. WF2123
-------------------------------	-----------------------

Equipment conditions

- Cold engine
- Area around filter holder cleaned

Figure: coolant-filter valve



Procedure

Step	Action
1	 WARNING! When removing the expansion tank filler cap, first carefully turn it counterclockwise until the first stop and allow the pressure to escape. Only then turn to the second stop. Remove the filler cap from the coolant expansion tank.
2	Turn the arrow on the coolant-filter valve horizontally. The valve is now closed.
3	Screw the element from its holder using a strap wrench. Clean the element seat on the holder.

continued on next page

Step	Action
4	Apply a light film of engine oil to the sealing ring of the new element.
5	 <p>CAUTION! Do not use any tools while tightening the element. Overtightening of the element can distort the threads or the holder.</p> <p>Screw the element onto the holder until it touches. Turn the element another 1/2 to 3/4 turn to seal it, or follow the instructions of the filter manufacturer.</p>
6	Turn the arrow on the coolant-filter valve vertically. The valve is now open again.
7	Screw the filler cap onto the coolant expansion tank.
8	Start the engine and check for leaks.

To drain engine cooling circuit

Introduction

The procedure below only describes the draining of the engine cooling circuit, which means that the isolating valves of the interior heating circuit remain closed while draining.

If both the engine cooling circuit and the heating circuit should be drained, follow the instructions under "To drain engine cooling and heating circuit" in chapter 8.10.

Special tools

Hose coupling for drain nipple	Van Hool No. 10772040
--------------------------------	-----------------------

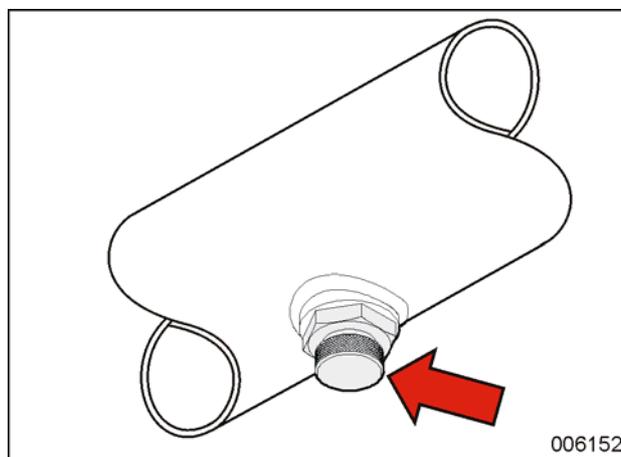
Equipment condition

Cold engine

Drain nipple

To simplify draining, a water pipe near the radiator has been provided with a drain nipple that can be connected with a hose.

Figure: drain nipple in cooling circuit water pipe



Drain hose

You can make the drain hose mentioned in the procedure yourself. It consists of a special coupling (refer to "Special tools") and a hose with an inner diameter of 3/4 inch (19 mm).

Procedure

Step	Action
1	Close both the interior heating circuit isolating valves (refer to "To operate interior heating circuit isolating valves" in chapter 8.10).
2	Unscrew the expansion tank filler cap and remove it.
3	Hang the end of the drain hose in a container.
4	Remove the protective cap from the drain nipple. Screw the drain hose onto the nipple. The engine cooling circuit is now draining.
5	If present, remove all the drain plugs in the cooling circuit water pipes and collect the coolant.

To fill and bleed engine cooling circuit

Introduction

The procedure below only describes the filling and bleeding of the engine cooling circuit, meaning that the isolating valves of the interior heating circuit have remained closed while draining.

If both the engine cooling circuit and the heating circuit have been drained, follow the instructions under "To fill and bleed engine cooling and heating circuit" in chapter 8.10.

Procedure

Step	Action
1	Remove the drain hose (refer to "To drain engine cooling circuit"). Screw the protective cap on the drain nipple.
2	If present, install all the cooling circuit drain plugs.
3	Slowly pour coolant in the expansion tank until just above the "MAX" mark on the expansion tank.
4	Observe the coolant level and top up until (after approximately a quarter of an hour) you notice that the level is not dropping anymore.
5	Start the engine and let it run at high idle (do not exceed 1 000 rpm) Top up with coolant as the level in the expansion tank drops. If the level no longer drops, and the coolant no longer foams, the engine cooling circuit is completely bled.
6	Open the interior heating circuit isolating valves (refer to "To operate interior heating circuit isolating valves" in chapter 8.10).
7	Drive the engine at operating temperature.
8	Stop the engine and check the coolant level as soon as the system has cooled down completely. If necessary, top up with coolant.

To check/clean radiator compartment mesh screen

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Function of mesh screen

The mesh screen prevents bigger dirt particles from being sucked in by the fan.

Figure: mesh screen



WARNING!

Wear a dust mask, when cleaning mesh screen with compressed air.

How to clean?

Depending on dirt nature, clean mesh screen with vacuum cleaner, with compressed air or with water or steam jet.

To clean radiator exterior

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Cleaning product

Detergent P3-Grato 12 by Henkel, or similar product

Special tools

Cleaning tool	Van Hool No. 10527208
---------------	-----------------------



WARNING!

Wear a dust mask, when cleaning with compressed air.

Nature of dirt

Nature of dirt	Cleaning medium
Dry dust or sand	Compressed air (approximately 116 psi)
Tenacious dirt	Water + detergent <i>NOTE: Van Hool recommend the use of P3-Grato 12 by Henkel.</i>

To use P3-Grato 12

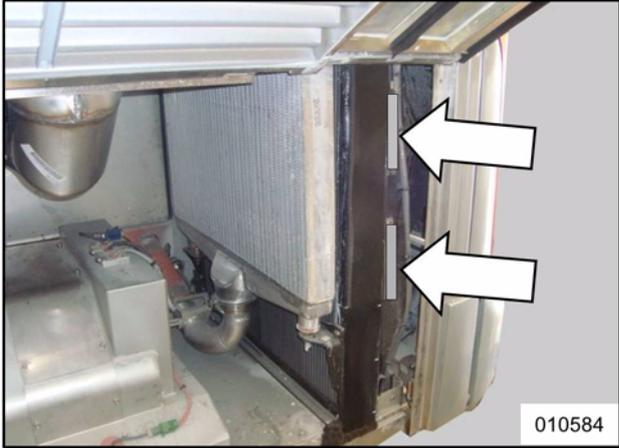
Mix a quantity of P3-Grato 12 with a similar volume of water. Follow the instructions on the packaging.

NOTE: According to its manufacturer this detergent contains neither corrosive nor toxic agents.

Procedure

Step	Action
1	Open the exterior door on the left-hand side at the very rear.
2	Use compressed air to blow all leaves, paper and other debris from the spaces between the radiator and the charge-air cooler.

continued on next page

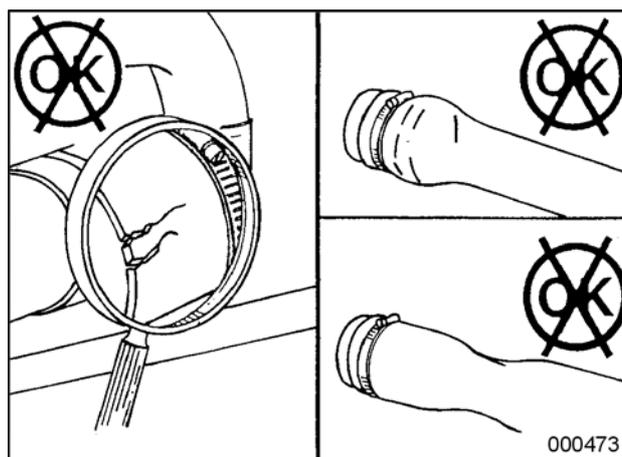
Step	Action
3	<p>Connect cleaning tool to an air hose or a high-pressure cleaner, depending on dirt nature and severity.</p> <p><i>NOTE: If you have to clean with water, set high-pressure cleaner to 140 to 176 °F and make sure pressure does not exceed 1450 psi.</i></p>
4	<p>Insert T-headed cleaning tool with holes towards radiator (this means towards vehicle front) into the gaps in the fan shroud. Move the cleaning tool back and forth.</p> <div data-bbox="694 656 1313 1104" style="text-align: center;">  </div>
5	<p>Remove dirt from the space between radiator and charge-air cooler.</p>
6	<p>Clean the charge-air cooler, refer to "To clean exterior of charge-air cooler" in chapter 2.22.</p>
7	<p>Insert T-headed cleaning tool into gap between radiator and charge-air cooler, so that the holes are directed towards the radiator (i.e. the back of the vehicle).</p>
8	<div style="display: flex; align-items: center;">  <div> <p>CAUTION!</p> <p>When opening the pressure supply, the cleaning tool must be placed flat against the charge-air cooler, otherwise the reaction force of the pressure jets will cause the tool to lash backward and damage the charge-air cooler.</p> <p>Hold tool flat against back of charge-air cooler and open pressure supply.</p> </div> </div>
9	<p>Move the cleaning tool back and forth while holding it flat against the charge-air cooler.</p>
10	<p>If necessary, repeat the procedure until all air passages are open.</p>

To check coolant hoses

To be carried out when?

On fixed intervals according to maintenance schedule, refer to chapter 1.1

Figure: hose defects



When to change coolant hoses?

Change cracked, cut, bulging or collapsed hoses (see figure).

Hose clamps

**Cross-
reference**

Refer to chapter 1.1, "General mounting guidelines: hose clamps".

Fan clutch types

What clutch type on your vehicle?

Your vehicle can be equipped with a 2-speed (one step) or 3-speed (two step) clutch.

Clutch type	Identification
2-speed	One single connector on the clutch unit.
3-speed	Two connectors on the clutch unit (one for each clutch step).

Fan clutch operation

Introduction

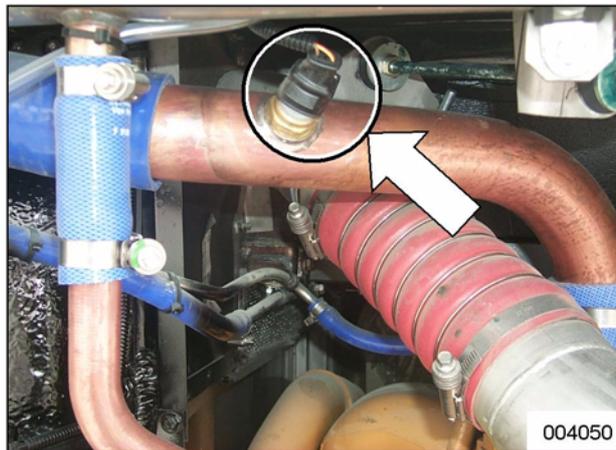
The fan clutch switches in and out according to:

- coolant temperature and...
- intake-air temperature.

Coolant temperature as well as intake-air temperature are measured by sensors of the engine management system. It is the control unit of the engine management system that switches on the fan clutch if the temperature becomes too high.

NOTE: Vehicles with an Allison WTB500R or ZF Astronic transmission have a supplementary temperature switch in the water pipe to the radiator.

Figure: temperature switch



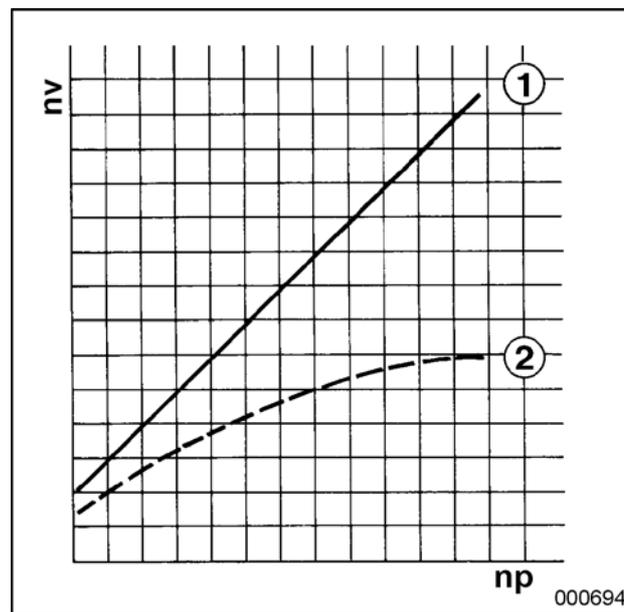
In the water pipe to the radiator

Operation

If...	then ...
the electrical circuit of the clutch is dead	the fan will be taken along by the permanent magnetic force of the drive part of the clutch. There is no mechanical connection (eddy current system). Fan speed is lower than drive pulley speed due to slip between clutch parts.
the electrical circuit of the magnetic coils closes	the clutch parts will be pressed together, forming a rigid mechanical drive. In this condition the fan speed equals the drive pulley speed.

continued on next page

Figure:
diagram of
operation



Relation between fan speed and fan drive speed

1 Clutch closed

2 Clutch open

n_v fan speed

n_p drive pulley speed

To determine remaining service life span of fan clutch

Introduction

As the Linnig clutch wears progressively, the air gap between the clutch plates will become larger. The larger the air gap, the stronger the magnetic field – and therefore the higher the voltage – needed to bring the plates together. The remaining service life span of the fan clutch unit can be determined by measuring this cut-in voltage.

Clutch types

Refer to 'Fan clutch types'.

Tools

DC electrical power supply with a voltage range of 10 to approx. 30 V and an amp rating of at least 3 A.

Procedure for 2-speed clutch

Step	Action
1	Disconnect connector of fan clutch.
2	Connect power supply to fan clutch.
3	Set adjustable power supply to 10 V.
4	As you are turning the fan to and fro by hand, slowly increase voltage, until at one particular point you feel the fan clutch impede or lock the fan (clutch engaged with an audible clicking).
5	Take note of cut-in voltage value and look up remaining service life span (in percentage) in table.
6	Calculate remaining life span in miles (see example).

Procedure for 3-speed clutch

Step	Action
1	Disconnect both connectors on fan clutch.
2	Connect power supply to connector of coupling 1 (first step).
3	Carry out steps 3, 4 and 5 of "Procedure for 2-speed clutch".
4	Connect power supply to connector of coupling 2 (second step).
5	Carry out steps 3, 4 and 5 of "Procedure for 2-speed clutch".
6	Calculate remaining service life span in miles for both couplings. The coupling showing most wear is indicative of the remaining service life-span of the clutch unit.

continued on next page

Table: relation between cut-in voltage and service life span

The table below shows the remaining service life span (in percentage) of the fan clutch according to cut-in voltage, both with a cold clutch and with clutch at operating temperature.

Cut-in voltage measured with		Remaining service life of fan clutch
cold ^a clutch	clutch at operating temperature ^b	
10 V	12 V	100%
11 V	13 V	88%
12 V	14 V	80%
13 V	15 V	72%
14 V	16 V	64%
15 V	17 V	56%
16 V	18 V	48%
17 V	19 V	40%
18 V	20 V	32%
19 V	21 V	24%
20 V	22 V	16%
21 V	23 V	8%
22 V	24 V	0%

a. Clutch at temperature between 50 and 86 °F.

b. Engine at operating temperature, or clutch which has been energised at 24 V-voltage for about 15 to 20 minutes.

Calculation example

Suppose you measure a cut-in voltage of 17 V with a cold clutch. In such case you will learn from the table that the clutch still has 40 % of total service life to go (meaning clutch is 60 % worn). For example: if the vehicle has travelled 150 000 miles with the clutch, it will last for another

150 000 miles x (40:60)= 100 000 miles approximately

Change clutch when?

Change clutch if cut-in voltage is approximately 28 V with running engine, in an emergency situation you may keep clutch in operation for another while, as long as cut-in voltage is between 24 V and 28 V.

No new clutch available immediately?

As on-board voltage is approximately 28 V with running engine, in an emergency situation you may keep clutch in operation for another while, as long as cut-in voltage is between 24 V and 28 V.

Technical data: cooling system

Thermostats

On vehicles with Allison WTB500 transmission.

Make	Cummins
Number	1
Start to open at	180 ± 3 °F
At least 0.435 in open at	202 °F

Thermostats

On vehicles with Allison WTB500R or ZF Astronic transmission.

Make	Wahler
Number	2
Start to open at	181 ± 3 °F
At least 0.315 in open at	203 °F

Expansion tank pressure-relief cap

Valve opens at 17.4 psi overpressure

Expansion tank filler cap

Valve opens at 21.8 psi overpressure

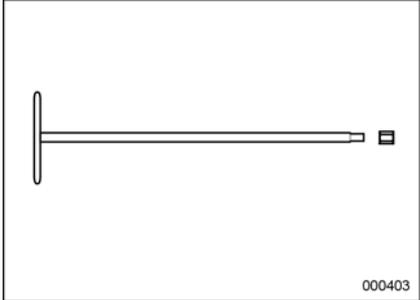
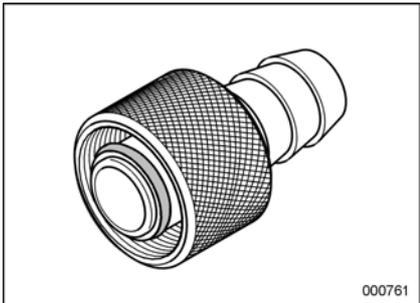
Thermal fan drive clutch

Make/type	Linnig 2 speed
Temperature switch cut-in (only on vehicles with an Allison WTB500R or ZF Astronic transmission)	200 °F coolant temperature

Tightening torques

Standard hose clamps, clamping range up to 0.9 in dia.	2.2 ± 0.4 ft.lbf
Standard hose clamps, clamping range up to 1.06 in dia.	3.3 + 0.4 ft.lbf
Constant torque hose clamps with four conical spring washers	5.2 ± 0.4 ft.lbf

Special tools: cooling system

Ordering number	Description	Figure
Van Hool 10527208	Cleaning tool for radiator and charge-air cooler	 000403
Van Hool 10772040	Coupling for drain nipple on coolant pipe of engine cooling circuit	 000761

Chapter 38: Lubrication system

Overview

Introduction

This chapter deals with the lubrication system.

Number of pages

8

Chapter publication date

14 October 2016

Contents

Topic	See page
To check engine oil level	2.38-2
To change oil	2.38-4
To change oil filter	2.38-6

The following subjects have been *added/modified* since the former edition:

Topic	See page
To check engine oil level	2.38-2

To check engine oil level

To be carried out when?

Before commencing daily service.

Oil type

Refer to chapter 1.1, "Fluids and lubricants".

Equipment conditions

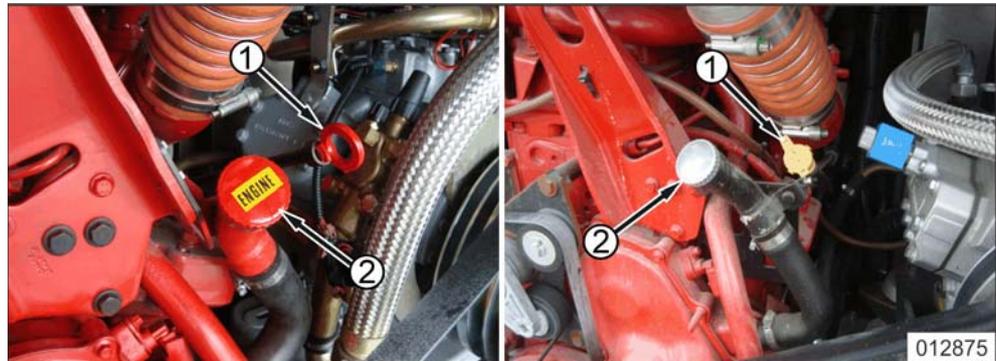
- Vehicle on level ground
- Engine should have been off for at least 20 minutes to give the oil time to return to the oil pan.



CAUTION!

Never operate the engine with the oil level below the "L" (Low) mark or above the "H" (High) mark on the dipstick.

Figure: oil filler cap and dipstick

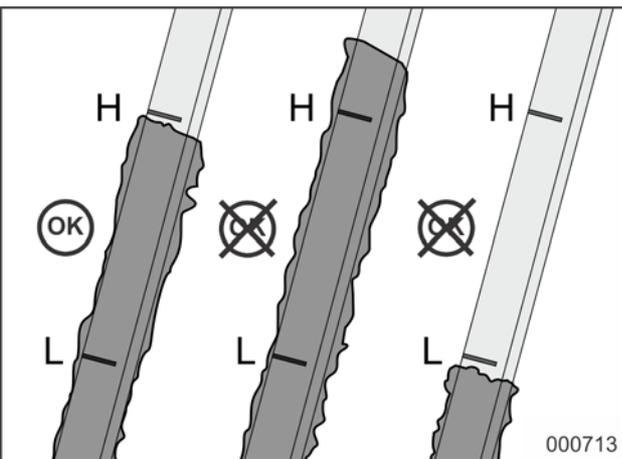


- 1 Oil dipstick
- 2 Oil filler cap

Procedure

Step	Action
1	<p>Pull out the dipstick from its holder as follows.</p> <ul style="list-style-type: none"> • First design: pull out the dipstick from its holder. • Second design: turn handle a quarter of a turn counter-clockwise to unlock it. Pull out the dipstick from its holder.

continued on next page

Step	Action
2	<p>Wipe the dipstick clean with a cloth and reinsert it.</p> <p><i>NOTE: Second design only: After having reinserted it, turn the dipstick a quarter of a turn clockwise to lock it.</i></p>
3	<p>Pull out the dipstick from its holder.</p> <p>The oil level should be between the "L" (Low) and the "H" (High) marks on the dipstick.</p> <div data-bbox="694 593 1316 1052" style="text-align: center;">  </div>
4	<p>If oil level is too low, top up with oil through filler tube.</p>

To change oil

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Oil type

Refer to chapter 1.1, "Fluids and lubricants".

Consumables

Sealing-ring for engine oil drain plug	
--	--

Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment condition

Warm engine (coolant temperature 140 °F)



WARNING!

Used engine oil is toxic and carcinogenic. Avoid prolonged contact with the skin and inhalation of the fumes.



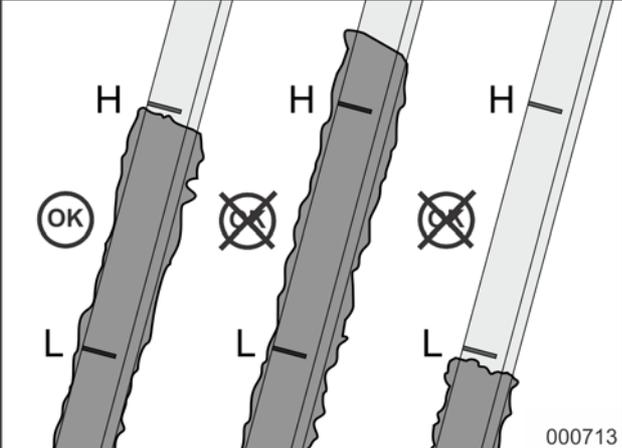
WARNING!

Hot oil flowing out of the oil pan can cause scalds. Avoid contact with the skin.

Procedure

Step	Action
1	 <p>WARNING! Dispose of the used engine oil in accordance with environmental regulations. Remove the drain plug from the oil pan and allow oil to drain.</p>

continued on next page

Step	Action
2	Clean the drain plug. Screw the drain plug with a new sealing-ring back into the oil pan and tighten to the prescribed torque.
3	Change the oil filter (refer to "To change oil filter").
4	Fill oil pan with clean oil through filler tube, until "H" (High) mark on dipstick is reached.
5	Start the engine.
6	Check the drain plug and oil filter for leaks.
7	<p>Stop the engine. Wait a few minutes and check the oil level with the dipstick. If necessary, add oil, until the level reaches "H" (High) mark on the dipstick.</p> <div data-bbox="694 750 1316 1198" style="text-align: center;">  </div>

To change oil filter

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Consumables

Filter element	Cummins No. 2882674
----------------	---------------------

Equipment conditions

- Cold engine
- Area around filter holder cleaned

Figure: oil filter



Procedure

Step	Action
1	Unscrew and remove the filter using a strap wrench.
2	<i>NOTE: The sealing ring of the filter element may be stuck to the holder. Make sure it is removed before installing the new filter element.</i> Clean the contact surface on the filter support.
3	Fill the new filter element with clean lubricating oil.
4	Apply a light film of lubricating oil to the sealing ring of the new filter element.

continued on next page

Step	Action
5	<div data-bbox="579 320 667 405" data-label="Image"> </div> <p data-bbox="699 376 879 409">CAUTION!</p> <p data-bbox="579 423 1398 495">Overtightening the filter element can distort the threads or damage the sealing ring.</p> <p data-bbox="579 512 1426 577">Install filter element on the holder. Follow the instructions from the filter manufacturer.</p>



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Chapter 46: Accessory drive systems

Overview

Introduction This chapter deals with the accessory drive systems.

Number of pages 28

Chapter publication date 14 October 2016

Contents

Topic	See page
Belt types	2.46-3
To check belt tension	2.46-4
To check condition of V-belts	2.46-7
To check condition of V-ribbed belt	2.46-8
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Climate-control compressor: to adjust belt	2.46-11
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Fan: to adjust belts	2.46-17
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Technical data: accessory drive systems	2.46-26
Special tools: accessory drive systems	2.46-27

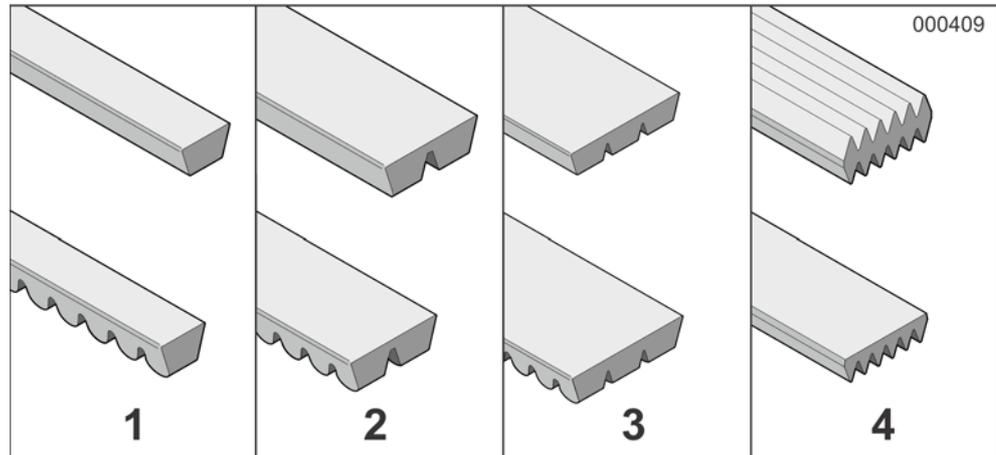
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The following subjects have been *added/modified* since the former edition:

Topic	See page
Technical data: accessory drive systems	2.46-26

Belt types

Figure: belt types



Most common belt types on Van Hool vehicles

- 1 Single V-belt
- 2 Dual V-belt
- 3 Triple V-belt
- 4 V-ribbed belt

To check belt tension

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

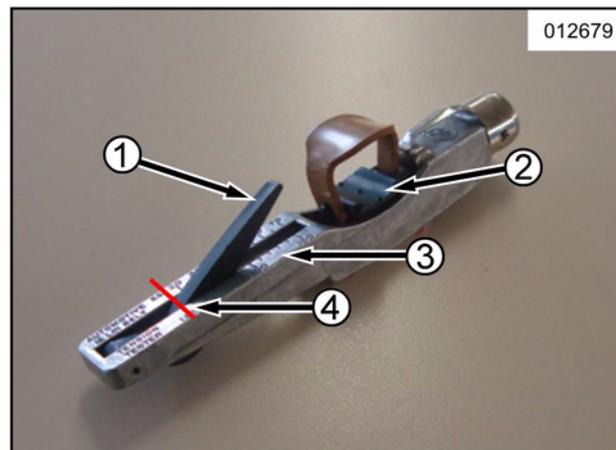
Special tools

Tension gauge	Gates No.	For use on
Krikit I	740100071	Single V-belts
Krikit II	740100072	V-ribbed belts or multi-V-belts

Checking values

Refer to "Technical data" at the end of this chapter.

Figure: "Krikit I"

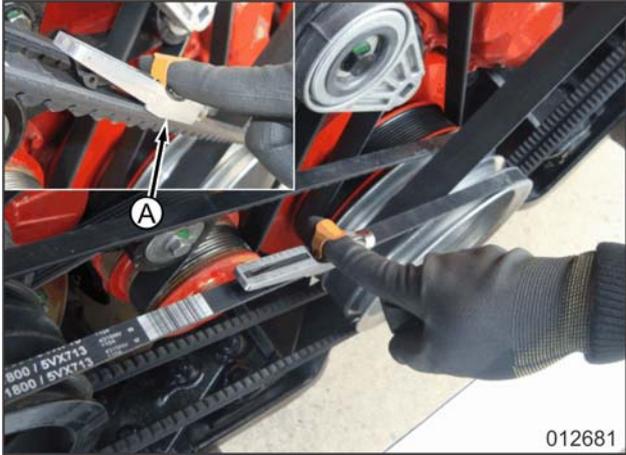
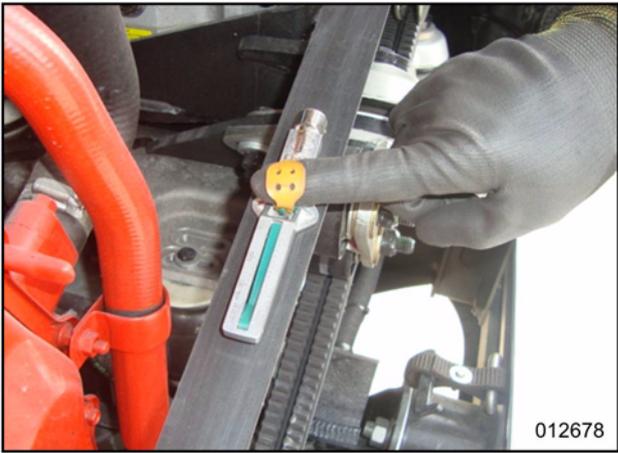


- 1 Indicator arm
- 2 Pressure pad
- 3 Tension scale
- 4 Point of intersection

Which belts should be checked?

Measure the tension of each belt of each drive.

Procedure

Step	Action
1	Adjust the tension gauge to zero by pushing the indicator arm (1) down as far as possible.
2	<p>Kriket I: place the gauge on the belt, halfway between the pulleys. Make sure the gauge lip (A) touches the belt.</p>  <p style="text-align: right;">012681</p>
3	<p>Kriket II: place the gauge on the belt, halfway between the pulleys. Make sure that the gauge is located in the middle of the belt and that the sides of the gauge are parallel to the sides of the belt.</p>  <p style="text-align: right;">012678</p>
4	Now slowly push the pressure pad (2) at a right angle towards the belt surface, until the gauge makes a click sound. Do not keep pushing after hearing this click sound, otherwise the gauge will provide an incorrect reading. Note that the indicator arm (1) must stay in position until step 5 has been completed.
5	Read the tension value at the point of intersection between the upper side of the indicator arm (1) and the tension scale (3). Arrow 4 in the figure indicates this point of intersection.

continued on next page



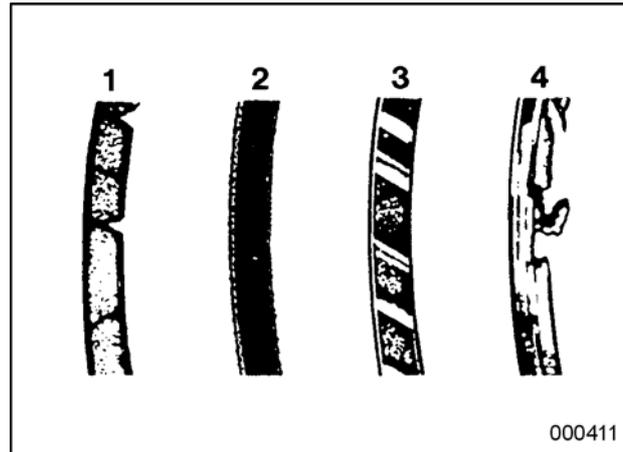
Step	Action
6	Compare the read value to the prescribed tension.

To check condition of V-belts

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: belt damage



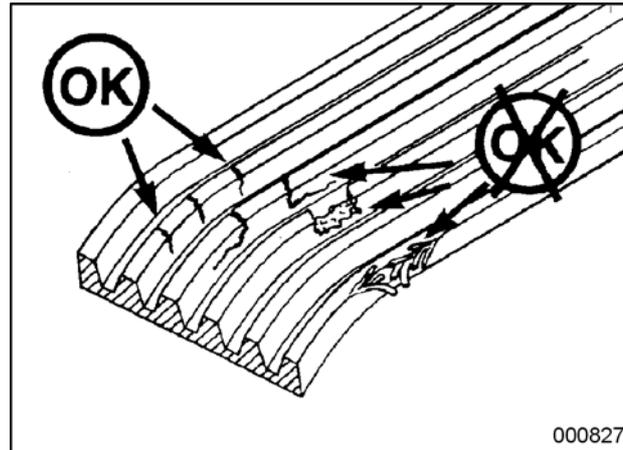
- 1 Cracks in sides or bottom
- 2 Soft, sticky sides; sometimes flaking. Swollen profile (rubber affected by grease or oil)
- 3 Glazed (burnt) sides
- 4 Cuts or tears

To check condition of V-ribbed belt

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: belt defects



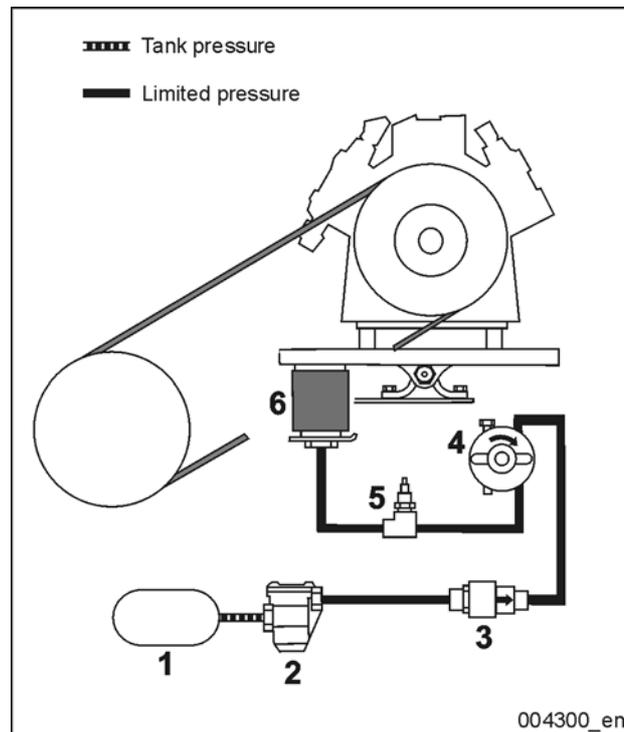
Allowable or not allowable?

Check belt for cracks and damage. Use table below to evaluate whether you should change the belt.

Wear pattern	Evaluation
Cracks across the width	Allowed
Cracks in the direction of the length that intersect the cracks across the width	Not allowed
Fraying belt	Not allowed
Torn out pieces	Not allowed

Climate-control compressor: operation of tensioning system

Figure:
tensioning
system



The figure shows the tensioning system in the running position

- 1 Accessories air tank
- 2 Pressure reducing valve
- 3 Single check valve
- 4 Cock
- 5 Test fitting
- 6 Air bag

Running position

The tensioning system is in the running position if the handle of cock (4) is fully turned counterclockwise.

Service position

The tensioning system is in the service position if the handle of cock (4) is turned fully clockwise. Air bag (6) is connected to the atmosphere through cock (4). This is the position to change the belts.



Operation in running position

In the running position the air bag (6) receives compressed air from the accessories air tank, through pressure reducing valve (2), check valve (3), and cock (4). The pressure reducing valve ensures that the pressure in the air bag remains constant. This way the belt tension is kept constant as well.

Climate-control compressor: to adjust belt

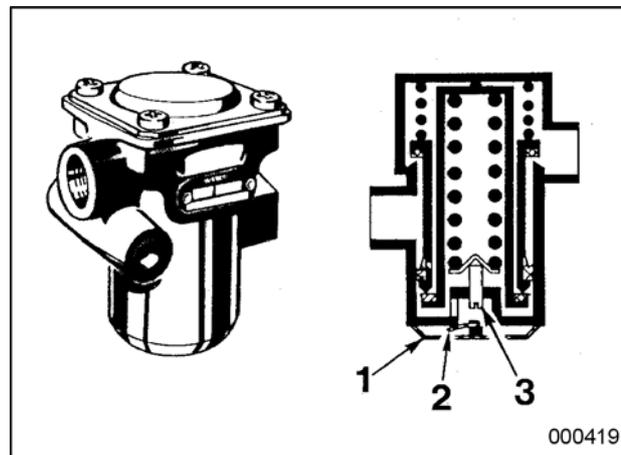
Setting values

Refer to "Technical data" at the end of this chapter.

Equipment condition

- Air system charged to maximum operating pressure
- Handle of cock in compressed-air line of tensioning system turned fully counterclockwise (running position).

Figure: pressure reducing valve



- 1 Protection cover
2 Exhaust valve
3 Adjusting screw

Procedure

Step	Action
1	Turn protection cover (1) until the attachments inside are free. Remove the cover of the pressure reducing valve.
2	Turn adjusting screw (3), until prescribed belt tension is reached: <ul style="list-style-type: none"> • to increase tension: clockwise. • to diminish tension: counterclockwise.
3	Check if rubber exhaust valve (2) is positioned correctly.
4	Re-install cover (1).

Climate-control compressor: to replace belt

To be changed when?

Replace the belt if it looks frayed (worn out), or if you notice a defect (refer to "To check condition of V-belts").

Consumables

Refer to Van Hool spare parts manual

Equipment conditions

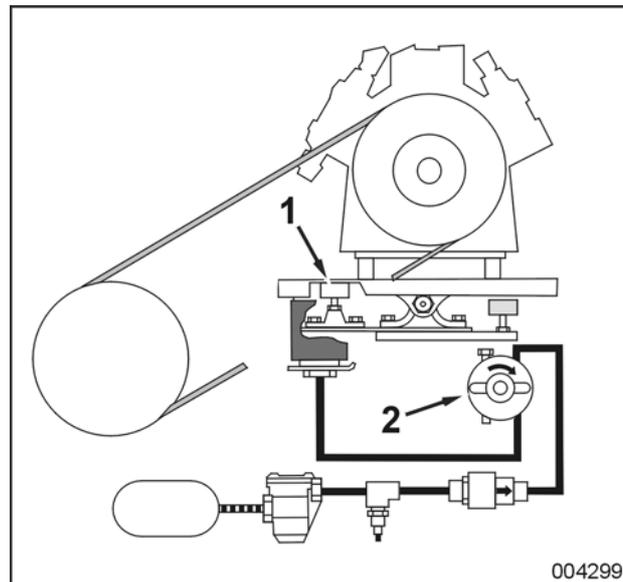
System charged to maximum operating pressure



CAUTION!

Never twist or roll a belt over the edge of the pulley. Even if this action does not cause immediate visible damage, it does shorten belt life.

Figure:
tensioner



1 Rubber stop

2 Cock

Procedure

Step	Action
1	Screw rubber stop (1) down as far as it will go.

continued on next page

Step	Action
2	Turn the handle of cock (2) fully clockwise. The air bag of the tensioning system is now without pressure.
3	Remove belt.
4	Install the new belt.
5	Turn the handle of cock (2) fully counterclockwise (running position).
6	Adjust the height of rubber stop (1), refer to "Climate-control compressor: to check/adjust stops of climate-control compressor seat".

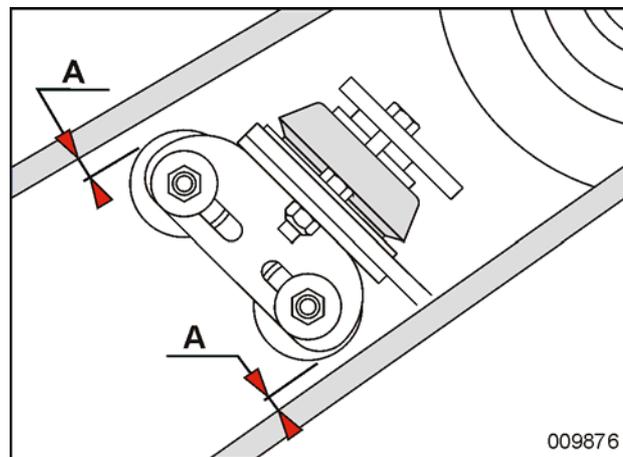
Climate-control compressor: to check/adjust belt stop

To check when?

Immediately after replacing the belt(s), and then a few times during the next 6000 miles.

Equipment condition

Maximum operating pressure in compressed-air tanks

Figure: belt stop

A Clearance between roller and belt

How to check/adjust stop?

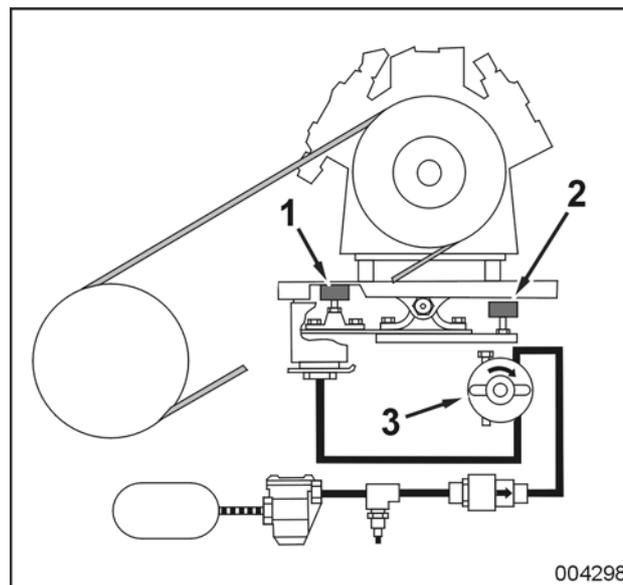
The rollers of the belt stop are properly adjusted if there is a clearance of 0.4 to 0.6 inch between the roller and the belt. If necessary, adjust by repositioning the roller on the support.

Climate-control compressor: to check/adjust stops of compressor seat

To check when?

Immediately after replacing the belt(s), and then a few times during the next 6 000 miles.

Figure: compressor set-up



- 1 Rubber stop
- 2 Rubber stop
- 3 Cock

Equipment condition

- System charged to maximum operating pressure;
- Cock (3) turned fully counterclockwise (running position).

How to check/adjust rubber stop (1)?

Rubber stop (1) is properly adjusted if there is a distance of approximately 0.08 inch between the top of the rubber stop and the bottom of the compressor seat. If necessary, adjust by screwing in or out the rubber stop.

How to check/adjust rubber stop (2)?

Rubber stop (2) is properly adjusted if there is a distance of approximately 0.4 inch between the top of the rubber stop and the bottom of the compressor seat. If necessary, adjust by screwing in or out the rubber stop.

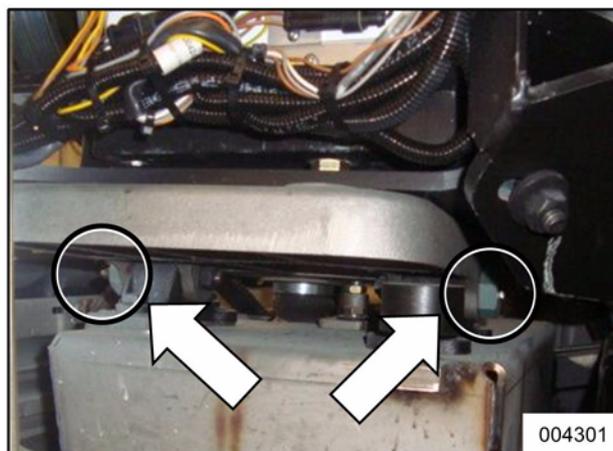
Climate-control compressor: to grease compressor seat bearings

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Grease type

Refer to chapter 1.1, "Fluids and lubricants".

Figure: grease nipples

Procedure

Push grease in the grease nipples until new grease escapes.

Fan: to adjust belts

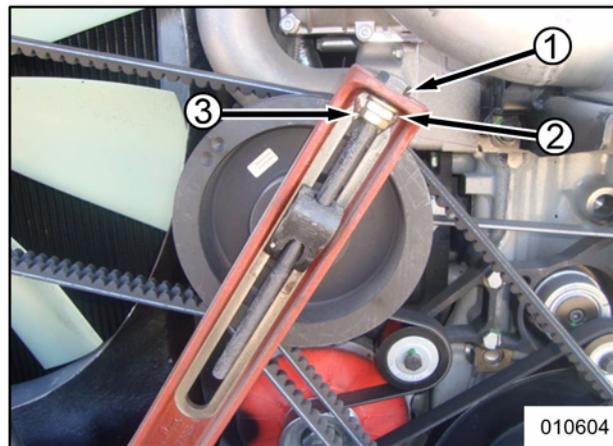
Setting values

Refer to "Technical data" at the end of this chapter.

Tightening torques

Refer to "Technical data" at the end of this chapter.

Figure: tensioner



- 1 Adjusting hexagon
- 2 Locknut
- 3 Locknut

Where to measure?

Measure the tension of the fan drive belts between the tensioning idler and the fan pulley.

Procedure

Step	Action
1	Loosen the nut of the tensioning idler shaft. <i>NOTE: This nut is not visible in the figure as it is located at the rear.</i>
2	Loosen locknuts (2) and (3).
3	Turn adjusting hexagon (1), until prescribed tension is reached. <ul style="list-style-type: none"> • to increase belt tension: turn clockwise • to decrease belt tension: turn counterclockwise
4	Tighten locknuts (2) and (3).

continued on next page



Step	Action
5	Tighten the nut of the tensioning idler shaft to the prescribed torque.

Fan: to replace belts

Consumables Refer to Van Hool spare parts manual

To be changed when? Replace the belts if they look frayed (worn out), or if you notice a defect (refer to "To check condition of V-belts").



CAUTION!

Never twist or roll the belt over the edge of the pulley. Even if this action does not cause immediate visible damage, it does shorten belt life.

Procedure Belts of the same drive must always be changed as a pair.

Step	Action
1	Slacken the tensioning system as far as possible; refer to "Fan: to adjust belts".
2	Remove the belts.
3	Install the new belts.
4	Set the belt tension, refer to "Fan: to adjust belts".

Retensioning During run-in, a part of the tension will be lost because the new belts will stretch and fall deeper in the grooves of the pulleys. Therefore, re-adjust belt tension to its initial value after the first 20 minutes of operation.

Alternator secured to engine block: to adjust tension arm of automatic belt tensioner after installing a new belt

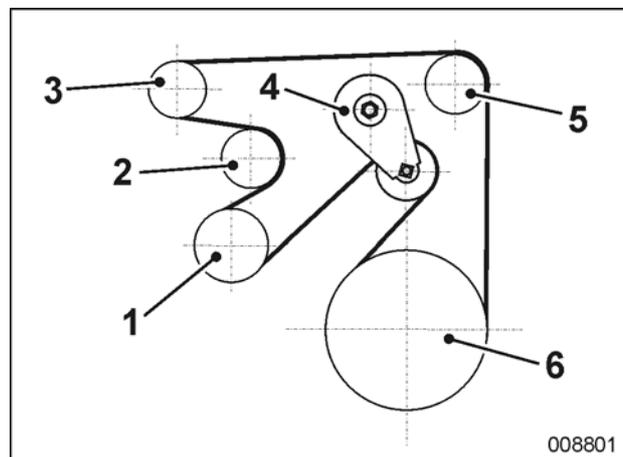
Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment conditions

Engine stopped

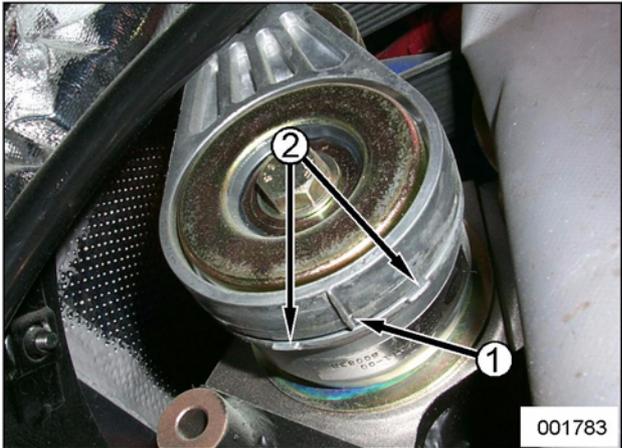
Figure: belt loop



- 1 Pulley on water pump
- 2 Adjustable guide roller
- 3 Pulley on alternator
- 4 Automatic belt tensioner
- 5 Guide roller
- 6 Pulley on engine crankshaft

To install a new belt

Step	Action
1	Install the new belt.

Step	Action
2	<p>Check position of tension arm.</p> <p>The tension arm must be in the middle of its adjustment range. This means that mark (1) is across the middle of the arc between cams (2). The figure shows an example.</p> 
3	<p>If necessary, adjust position of tension arm according to instructions under "To adjust position of tension arm".</p>

To adjust position of tension arm

Step	Action
1	Remove belt.
2	Loosen the nut securing the spindle of the adjustable guide roller to the support plate.
3	Slide the guide roller in the slotted hole of the support plate. Tighten the nut on the guiding-roller spindle to the prescribed torque.
4	Install the belt.
5	Check position of tension arm.

Retensioning

During the run-in period the belt will stretch, which will cause the arm of the automatic belt tensioner to change position. Therefore, recheck the position of the tension arm after approximately 20 minutes of operation.

Alternator secured to engine block: to change a belt

To be changed when?

Refer to "To check condition of V-ribbed belt".

Consumables

Refer to Van Hool spare parts manual.



CAUTION!

Never twist or roll the belt over the edge of a pulley. Even if this action does not cause immediate visible damage, it does shorten belt life.

Procedure

Step	Action
1	Insert a ratchet wrench with 1/2 inch square drive into the hole of the automatic belt tensioner (4).
2	Relieve the belt tension by turning the ratchet wrench in the opposite direction to the spring tension of the automatic belt tensioner.
3	Remove the belt. Carefully let the automatic belt tensioner return to the stop.
4	Check all pulleys for damage.
5	Loop the new belt over the pulleys.
6	Tighten the automatic belt tensioner. Loop the belt over the drive pulley. Carefully release the automatic belt tensioner against the new belt.
7	Check that the belt rides in the grooves of all the pulleys.
8	Adjust the position of the automatic belt tensioner (refer to "Alternator secured to engine block: to adjust tension arm of automatic belt tensioner after installing a new belt").

Alternator secured to climate-control compressor, automatic belt tensioner: to adjust tension arm of automatic belt tensioner after installing a new belt

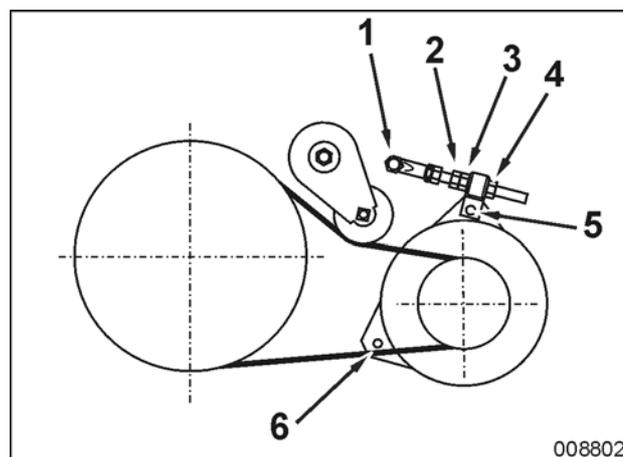
Applicable vehicles

Vehicles with one alternator secured to the climate-control compressor. On vehicles with two alternators secured to the climate-control compressor, no adjustment is required.

Equipment conditions

Engine stopped

Figure: adjusting system

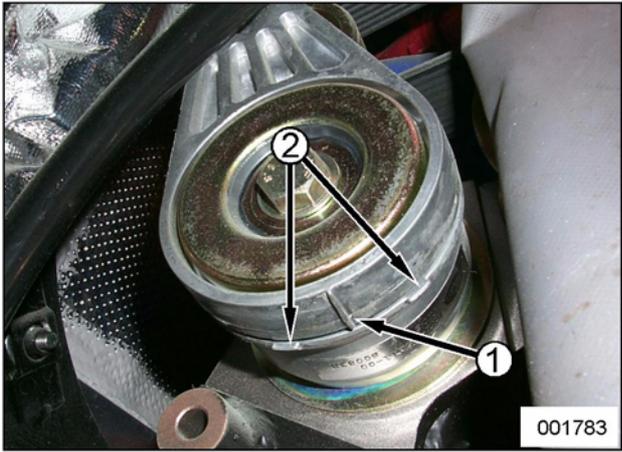


- 1 Screw
- 2 Locknut
- 3 Adjusting nut
- 4 Nut
- 5 Screw
- 6 Pivot fasteners

Procedure

The alternator drive is fitted with an adjuster which enables you to change the position of the tension arm of the automatic belt tensioner.

Step	Action
1	Loosen front and rear pivot fasteners (6) of the alternator.
2	Loosen screw (1) and screw (5).
3	Loosen nut (2) and nut (4).

Step	Action
4	<p>Turn the adjusting nut of the adjusting system, until the arm of the automatic belt tensioner is in the middle of its adjustment range. This means that mark (1) is across the middle of the arc between cams (2). The figure shows an example.</p> 
5	Tighten screw (2) and nut (4).
6	Tighten screw (1) and screw (5).
7	Tighten alternator pivot fasteners (6).

Retensioning

During the run-in period the belt will stretch, which will cause the arm of the automatic belt tensioner to change position. Therefore, recheck the position of the tension arm after approximately 20 minutes of operation.

Alternator secured to climate-control compressor, automatic belt tensioner: to change a belt

To be replaced when?

Refer to "To check condition of V-ribbed belt".

Consumables

Refer to Van Hool spare parts manual.



CAUTION!

Never twist or roll the belt over the edge of a pulley. Even if this action does not cause immediate visible damage, it does shorten belt life.

Procedure

Step	Action
1	Insert a ratchet wrench with 1/2 inch square drive into the hole of the automatic belt pretensioner (4).
2	Relieve the belt tension by turning the ratchet wrench in the opposite direction to the spring tension of the automatic belt pretensioner.
3	Remove the belt. Carefully let the automatic belt pretensioner return to the stop.
4	Check all pulleys for damage.
5	Loop the new belt over the alternator pulley.
6	Tighten the automatic belt pretensioner. Loop the belt over the drive pulley. Carefully release the automatic belt pretensioner against the new belt.
7	Check that the belt rides in the grooves of all the pulleys.
8	Adjust the position of the automatic belt pretensioner (refer to "Alternator secured to climate-control compressor, automatic belt pretensioner: to adjust tensioning arm of automatic belt tensioner after installing a new belt").

Technical data: accessory drive systems

Belt tension

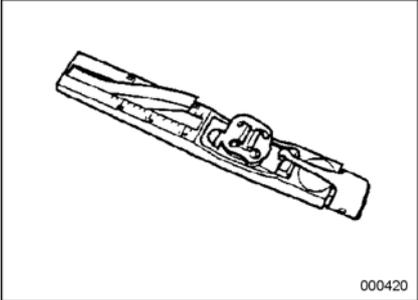
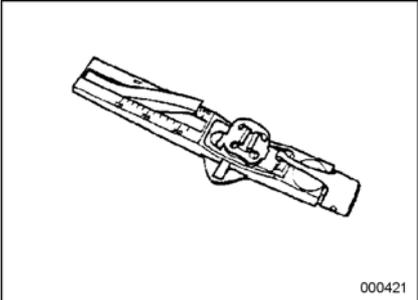
The table below shows the tension per belt.

Drive	Tension of a new belt	Tension at routine checks according to maintenance schedule
alternator secured to engine block	Automatic belt tensioner	
alternator(s) secured to climate-control compressor, tensioning system with automatic belt tensioner	Automatic belt tensioner	
alternator secured to climate-control compressor, tensioning system with mechanic belt tensioner	100 ± 10 lbf	90 ± 10 lbf
fan	120 ± 10 lbf	110 ± 10 lbf
climate-control compressor		
• in the case of two single V-belts	110 ± 10 lbf	110 ± 10 lbf
• in the case of a dual V-belt	220 ± 20 lbf	220 ± 20 lbf

Tightening torques

Nut on shaft of fan belts tensioning pulley	50 ± 7 ft.lbf
Alternator secured to engine block: bolt of adjustable guide roller	30 ± 5 ft.lbf
Only in case of two alternators secured to the climate-control compressor: bolt of adjustable guide roller	45 ± 6 ft.lbf

Special tools: accessory drive systems

Ordering number	Description	Figure
Gates 740100071	Belt tension gauge "Krikrit I"	 <p style="text-align: right; font-size: small;">000420</p>
Gates 740100072	Belt tension gauge "Krikrit II"	 <p style="text-align: right; font-size: small;">000421</p>



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Part 3 - Suspension

Overview

Contents

Chapter	See page
Chapter 6: Air suspension	3.6-1
Chapter 10: Front axle suspension	3.10-1
Chapter 14: Drive axle suspension	3.14-1
Chapter 18: Trailing axle suspension	3.18-1
Chapter 34: Wheels	3.34-1
Chapter 38: Tires	3.38-1

The following chapters have been *modified* since the former edition:

Chapter	See page
Chapter 10: Front axle suspension	3.10-1
Chapter 14: Drive axle suspension	3.14-1
Chapter 18: Trailing axle suspension	3.18-1

Chapter 6: Air suspension

Overview

Introduction This chapter deals with the air suspension.

Number of pages 18

Chapter publication date 21 September 2016

Contents

Topic	See page
Safety precautions concerning compressed air	3.6-2
Air line color codes	3.6-3
Visual identification: air suspension components	3.6-4
Location of air suspension components	3.6-8
To check operation of air suspension visually.	3.6-9
To check air spring height	3.6-10
To adjust air spring height	3.6-11
To check air bag condition	3.6-13
To check air springs for leaks	3.6-14
To check leveling valve	3.6-15
To clean/change line filters	3.6-16
Technical data: air suspension	3.6-18

Safety precautions concerning compressed air

**Cross-
reference**

Refer to chapter 13.1, "Complete compressed-air system".

Air line color codes

**Cross-
reference**

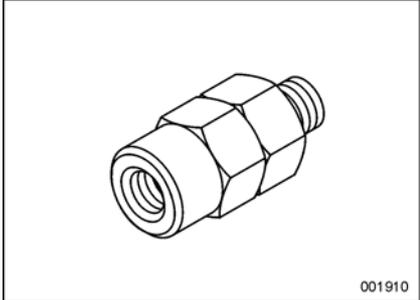
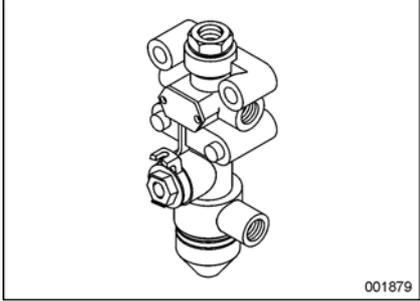
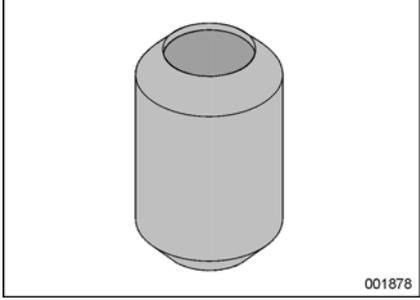
Refer to chapter 13.25, "Air lines".

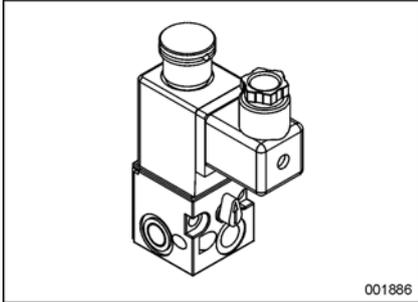
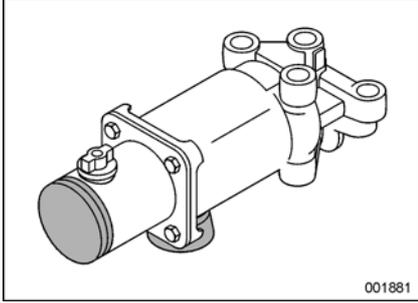
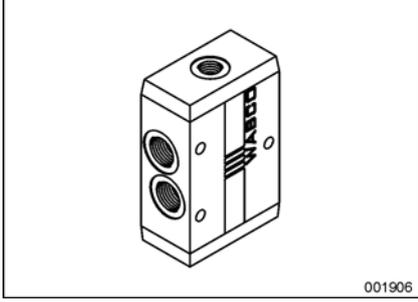
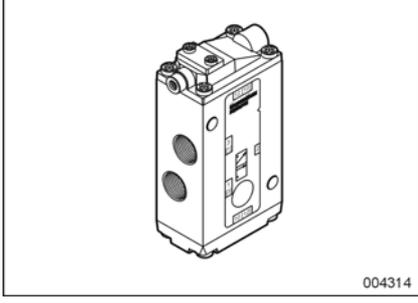
Visual identification: air suspension components

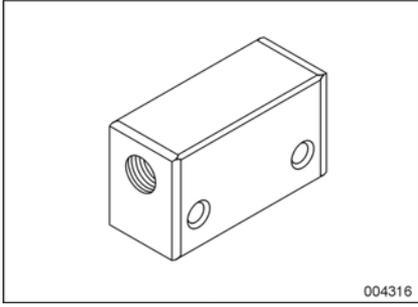
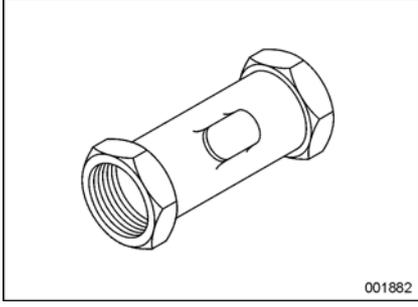
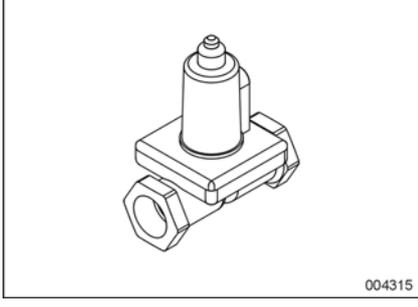
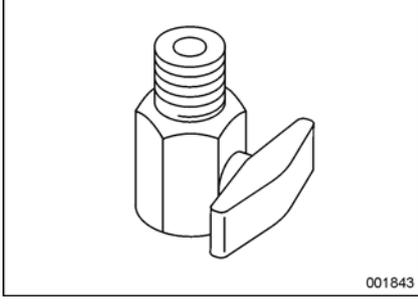
Applicable vehicles

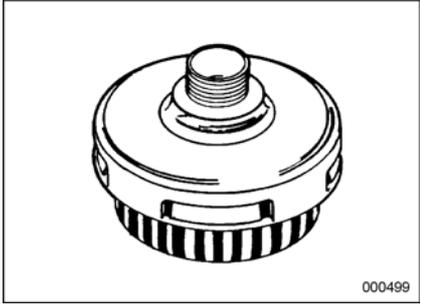
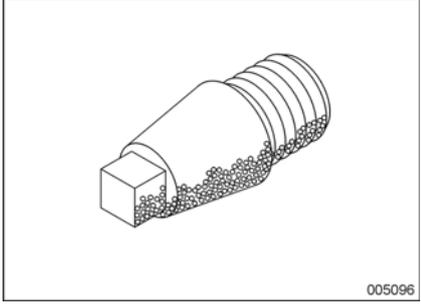
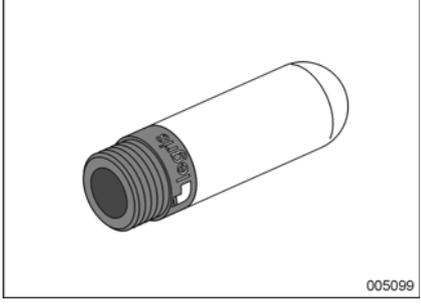
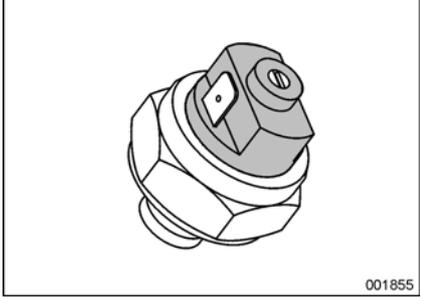
Vehicles without electronically controlled air suspension (ELC)

Components

Denomination	Figure
Line filter	 <p>001910</p>
Leveling valve	 <p>001879</p>
Air bag	 <p>001878</p>

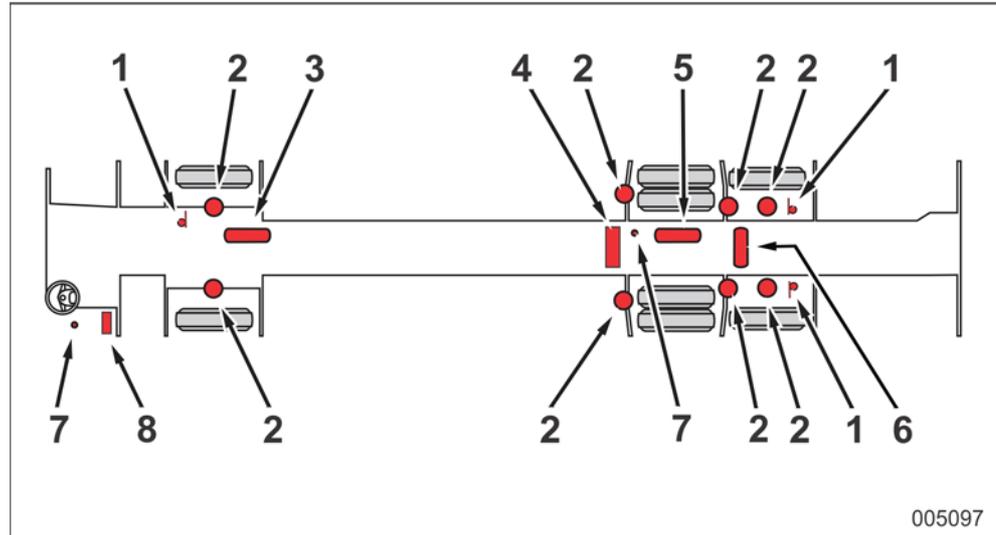
Denomination	Figure
3/2-way valve, electrically operated	 <p>001886</p>
4/2-way valve, electrically operated	 <p>001881</p>
3/2-way valve, pneumatically operated (Wabco)	 <p>001906</p>
3/2-way valve, pneumatically operated (Mannesmann Rexroth))	 <p>004314</p>

Denomination	Figure
Double check valve	 <p style="text-align: right;">004316</p>
Single check valve	 <p style="text-align: right;">001882</p>
Overflow valve with limited return	 <p style="text-align: right;">004315</p>
Compressed-air tank drain valve	 <p style="text-align: right;">001843</p>

Denomination	Figure
Muffler	 <p style="text-align: right;">000499</p>
Muffler	 <p style="text-align: right;">005096</p>
Muffler	 <p style="text-align: right;">005099</p>
Pressure switch	 <p style="text-align: right;">001855</p>

Location of air suspension components

Figure:
location of air
suspension
components



- 1 Leveling valve
- 2 Air spring
- 3 Kneeling system compressed-air tank
- 4 Compressed-air valves of raising system, lowering system and rear raising system
- 5 Accessories compressed-air tank
- 6 Rear raising system compressed-air tank
- 7 Line filter
- 8 Compressed-air valves of kneeling system

To check operation of air suspension visually.

To be carried out when?

Before commencing daily service.

Equipment condition

-
- Normal operating pressure in the air system
 - Vehicle on level ground

Procedure

Visually check that normal body ground clearance is maintained at both ends and sides of the vehicle: the body should not lean over.

To check air spring height

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Checking values

Refer to "Technical data" at the end of this chapter.

Equipment condition

- Empty vehicle on a flat level surface, over an inspection pit
 - Tires equally worn and at the correct inflation pressure
 - Air system charged to maximum operating pressure (let the engine idle)
 - Vehicles equipped with a kneeling, raising or lowering system: air suspension in normal "ride" position
-

Which air springs should be checked?

Check:

- height of left air spring front suspension, and...
 - height of left and right rear air springs of drive axle suspension.
-

Procedure

It is essential to hold the gauge parallel to the spring axis (refer to the figures in "Technical data" at the end of this chapter).

To adjust air spring height

Applicable vehicles

Vehicles without electronically controlled air suspension (ELC)

Introduction

Air spring height is adjusted by altering the effective length of the leveling valve vertical rod. Any adjustment is to be made from "low" to "high". This means that the air bag is first deflated, then re-inflated until the prescribed height is reached.

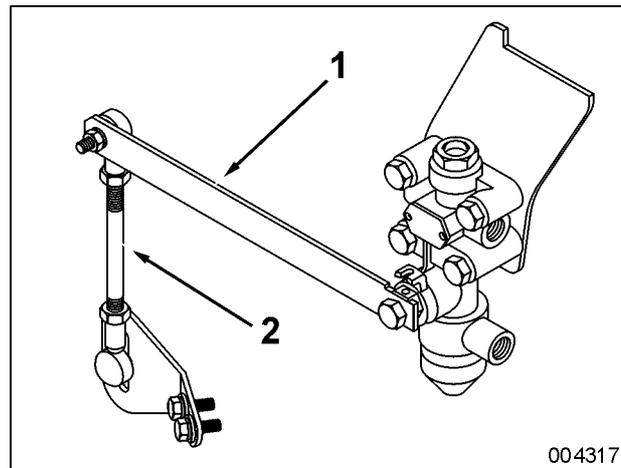
Setting values

Refer to "Technical data" at the end of this chapter.

Equipment conditions

- Empty vehicle on a flat level surface, over an inspection pit
- Air system charged to maximum operating pressure (let the engine idle)

Figure: leveling valve



- 1 Valve actuating lever
2 Connection rod between valve and axle assembly

Procedure

NOTE: The setting value listed under "Technical data" applies to the air suspension in normal drive position: if your vehicle is equipped with a raising/lowering system, this system should not be activated.

Step	Action
1	Disconnect the leveling valve connecting rod from its lower mounting support.

continued on next page

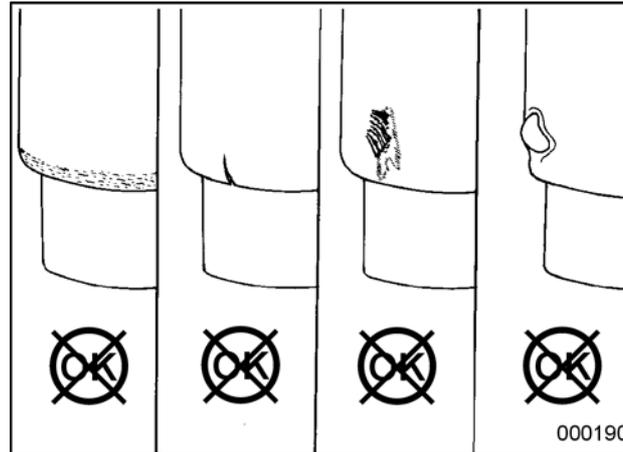
Step	Action
2	Lower the body by pulling the rod down, by which the air bag is deflated.
3	Re-inflate the air bag by moving the rod slowly up. As soon as correct height setting is obtained, instantly return leveling valve actuating lever to its horizontal position to stop inflation.
4	<p>While retaining the valve actuating lever horizontal, secure the connection rod to the bottom attachment bracket.</p> <p><i>NOTE: You can use a pin (1) to block the valve actuating lever in the horizontal position (position without inflation or deflation) while you detach or attach the connection rod. Stick this pin between the lugs on the valve housing into the hole of the valve spindle. Do not forget to remove pin before driving vehicle!</i></p> <div data-bbox="694 795 1316 1400" data-label="Image"> </div>
5	Test drive the vehicle on a winding road and readjust, if necessary, the height of the air springs.

To check air bag condition

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: air bag failure



When to change the air bag?

Air bag should be changed, if:

- torque cracks on "down-rolling" part down to casing fabric;
- cuttings damage down to casing fabric;
- chafings damage down to casing fabric;
- blisters occur.

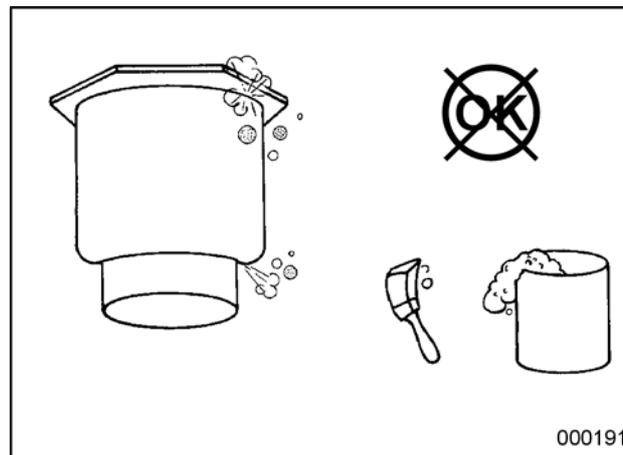
To check air springs for leaks

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

Air system charged to maximum operating pressure

Figure: checking air spring for leaks

Procedure

Coat the bag beads and sidewalls with a soap solution to check the airtightness of the bags. No soap bubbles should appear. Demount leaking bags from the suspension for further inspection.

To check leveling valve

Applicable vehicles

Vehicles without electronically controlled air suspension (ELC)

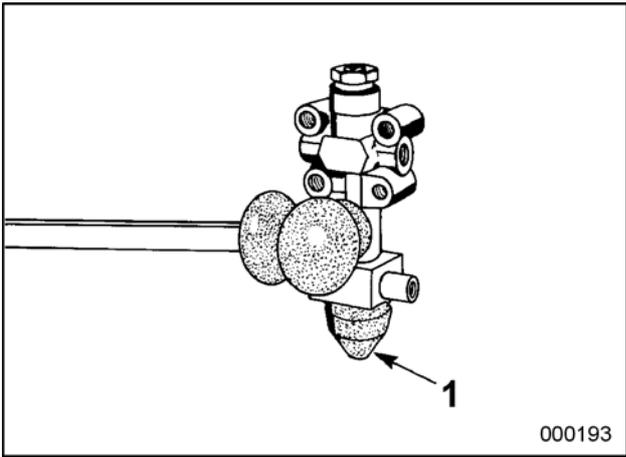
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

Maximum pressure (115 to 130 psi) in the air tanks

Procedure

Step	Action
1	<p>Clean the rubber protection cover (1) on the exhaust of the valve, and brush soapy water on it. Look for soap bubbles.</p> <div data-bbox="692 1016 1318 1473" style="text-align: center;">  <p>000193</p> </div>
2	<p>If the valve leaks, remove it for repair.</p>

To clean/change line filters

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

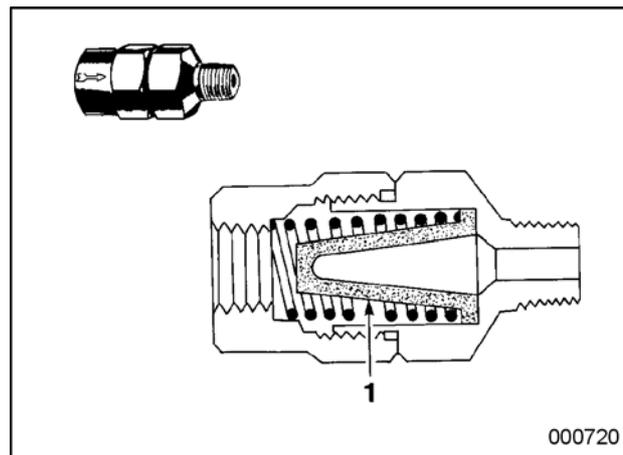
Consumables

Screen	Bendix No. 236562
Gasket	Bendix No. 234972
Special grease	Bendix No. BW-204-M

Location of line filters

Refer to "Location of air suspension components".

Figure: line filter



1 Screen



WARNING!

Do not remove the filter with the air system pressurized.

Procedure

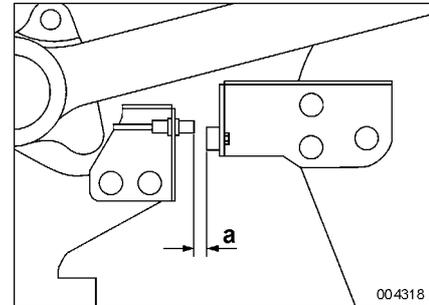
Step	Action
1	Release pressure from air system by actuating drain valve on accessories air tank. For the location of the air tanks refer to "Location of air tanks" in chapter 13.17.
2	Disconnect air lines from filter body and remove filter.
3	Disassemble filter body in vise.
4	Clean or change filter screen.
5	Reassemble new or cleaned filter screen into filter body. Apply thin film of special grease to new gasket.
6	Re-install filter in air lines.

Technical data: air suspension

Kneeling system

Sensor adjustment:

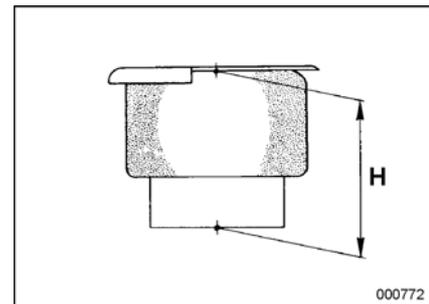
- $a = 0.3 \text{ à } 0.4 \text{ in}$



Air spring

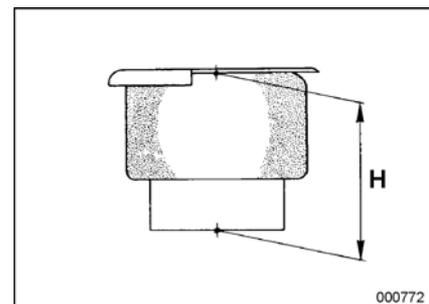
Air spring height on front axle

$H = 11 + 0.4 \text{ in}$



Air spring height on drive axle

$H = 11 + 0.4 \text{ in}$



Chapter 10: Front axle suspension

Overview

Introduction This chapter deals with the front axle suspension.

Number of pages 4

Chapter publication date 14 October 2016

Contents

Topic	See page
To check security of suspension components	3.10-2
To check shock absorbers for damage and leakage	3.10-3
Technical data: front axle suspension	3.10-4

The following subjects have been *added/modified* since the former edition:

Topic	See page
Technical data: front axle suspension	3.10-4

To check security of suspension components

Tightening torques

Refer to “Technical data” at the end of this chapter.

Procedure

Visually check those bolts, screws and nuts that are locked by means of a cotter pin, a locking plate or locking adhesive (Loctite). The security of all others must be checked mechanically. Retighten, if necessary.



WARNING!

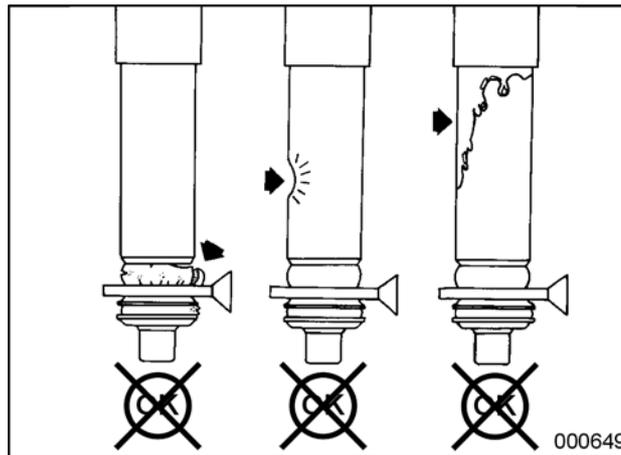
Never retighten bolts, screws or nuts that are fitted with locking adhesive, as this would destroy locking properties.

To check shock absorbers for damage and leakage

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: shock absorber failure



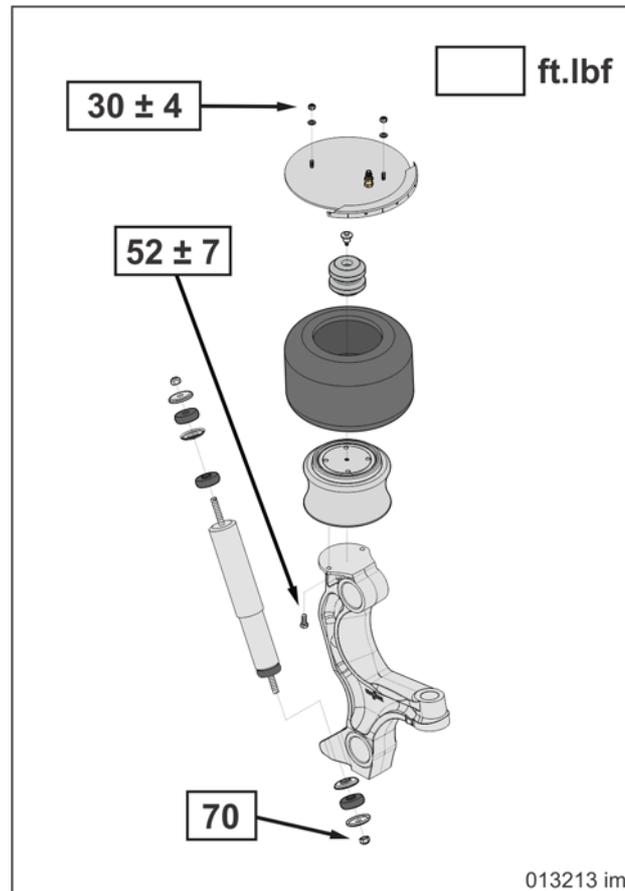
What to check?

Check the shock absorber for:

- fatigue cracks on rubbers;
- damage at housing;
- oil leaks.

Technical data: front axle suspension

Figure:
tightening
torques



Fixation of air bag plate, air bag piston and shock absorber

Chapter 14: Drive axle suspension

Overview

Introduction This chapter deals with the drive axle suspension.

Number of pages 8

Chapter publication date 14 October 2016

Contents

Topic	See page
To check security of suspension components	3.14-2
To work on or nearby the leaf spring	3.14-3
To check shock absorbers for damage and leakage	3.14-4
Technical data: drive axle suspension	3.14-5

The following subjects have been *added/modified* since the former edition:

Topic	See page
Technical data: drive axle suspension	3.14-5

To check security of suspension components

Tightening torques

Refer to "Technical data" at the end of this chapter.

Procedure

Visually check those bolts, screws and nuts that are locked by means of a cotter pin, a locking plate or locking adhesive (Loctite). The security of all others must be checked mechanically. Retighten, if necessary.



WARNING!

Never retighten bolts, screws or nuts that are fitted with locking adhesive, as this would destroy locking properties.

To work on or nearby the leaf spring



WARNING!

The leaf spring is made of high-carbon steel which makes it extremely vulnerable to chipping, impact and high temperatures. Do not weld, grind or drill. Never use a hammer to dismantle or install. When welding or grinding in the vicinity, protect against welding particles or accidental grinding deviations. The spring leaves should remain bare: do not apply any sprayed or painted coatings (protect, when spraying underbody with rust preventer). A leaf spring accidentally chipped or affected by welding particles should be replaced immediately to avoid breakage.



CAUTION!

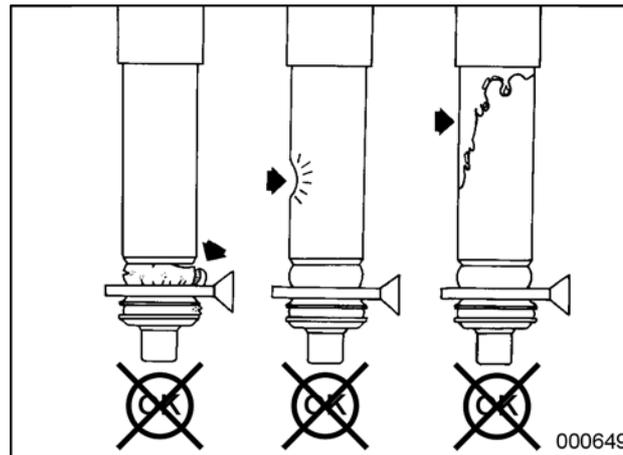
Do not spray lubricant on or between the spring leaves. Lubricants and grease damage the rubber of the spring carrier arms.

To check shock absorbers for damage and leakage

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: shock absorber failure



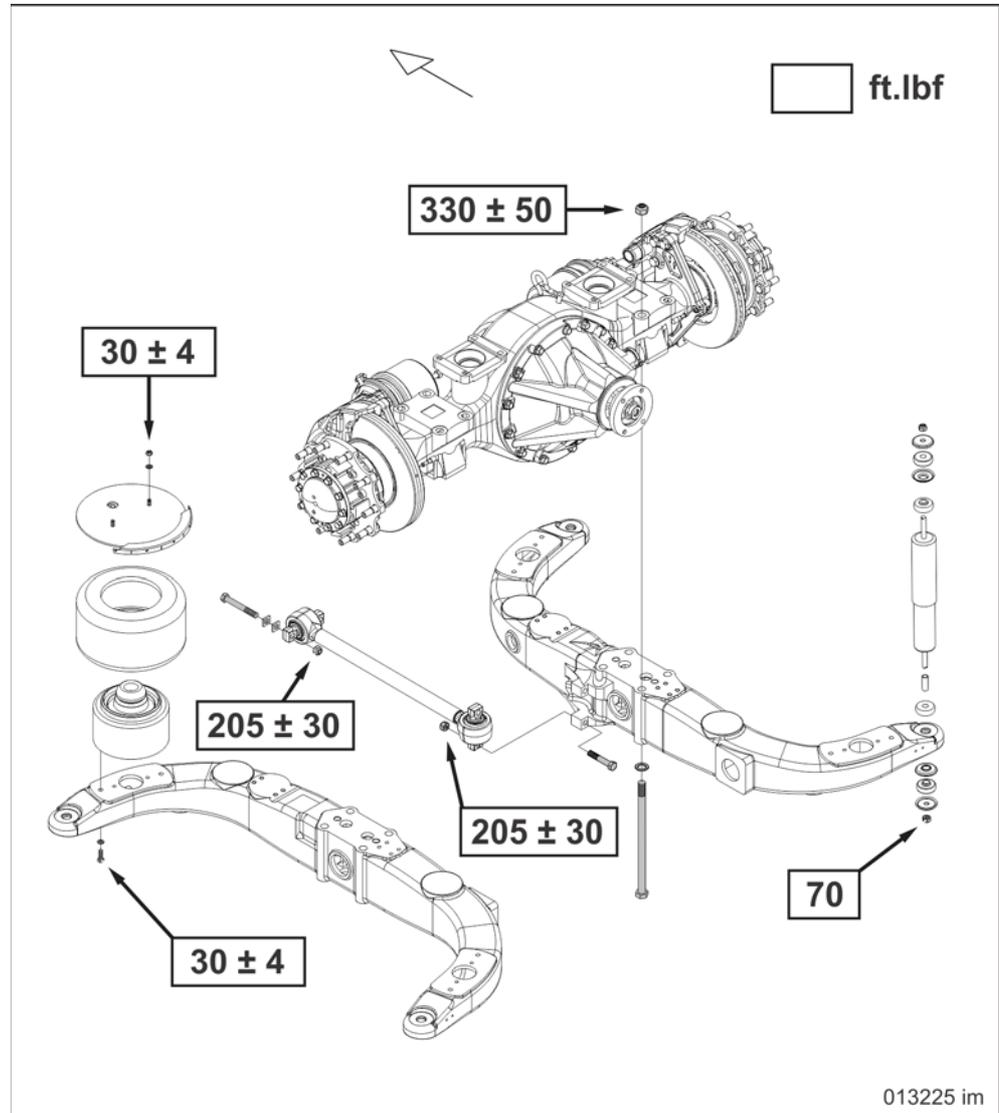
What to check?

Check the shock absorber for:

- fatigue cracks on rubbers;
- damage at housing;
- oil leaks.

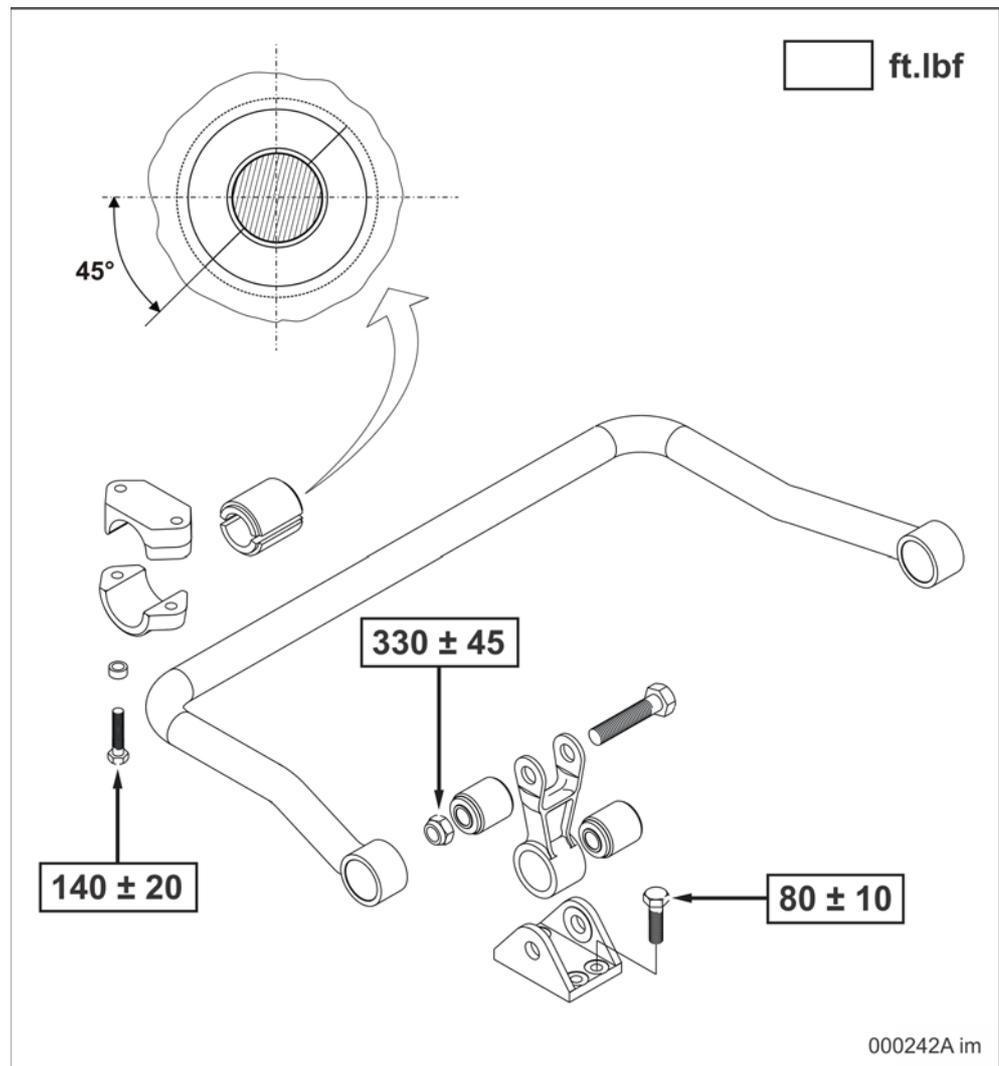
Technical data: drive axle suspension

Figure:
tightening
torques



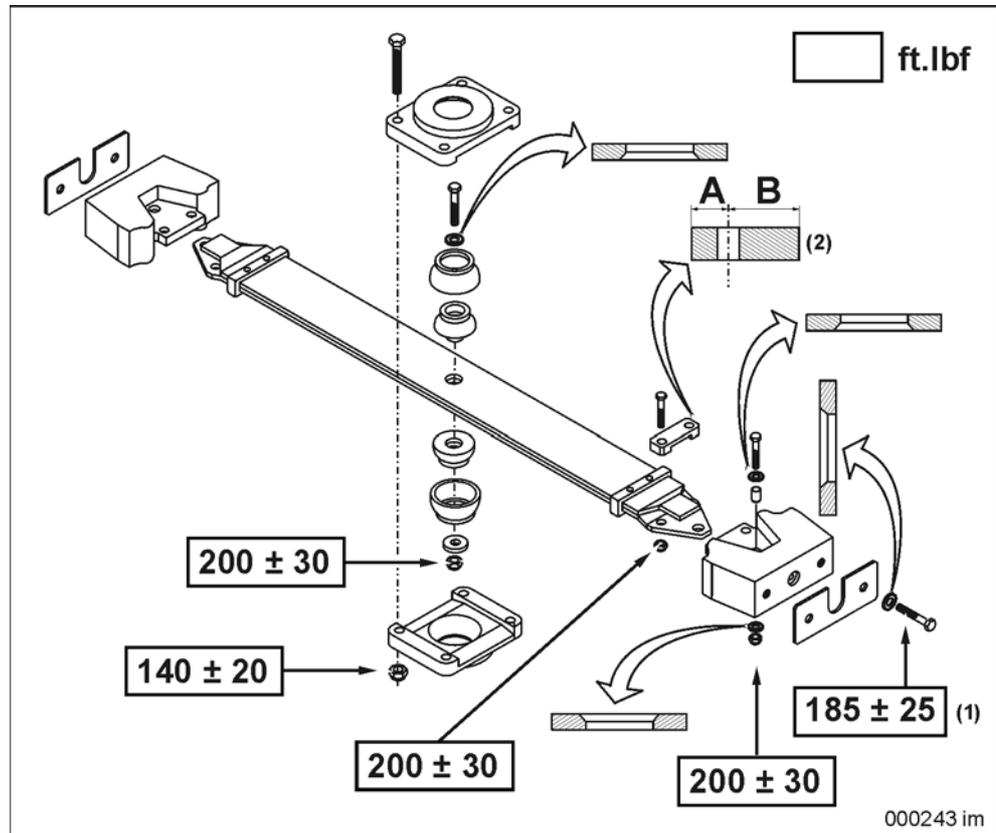
Security of beams.

Figure:
tightening
torques



Security of sway bar.

Figure:
tightening
torques



Security of leaf spring.

(1) Screws locked with Loctite 243 or equivalent

(2) "B" must be positioned at the spring carrier arm side



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Chapter 18: Trailing axle suspension

Overview

Introduction

This chapter deals with the trailing axle suspension.

Number of pages

4

Chapter publication date

14 October 2016

Contents

Topic	See page
To check security of suspension components	3.18-2
To check shock absorbers for damage and leakage	3.18-3
Technical data: trailing axle suspension	3.18-4

The following subjects have been *added/modified* since the former edition:

Topic	See page
Technical data: trailing axle suspension	3.18-4

To check security of suspension components

Tightening torques

Refer to "Technical data" at the end of this chapter.

Procedure

Visually check those bolts, screws and nuts that are locked by means of a cotter pin, a locking plate or locking adhesive (Loctite). The security of all others must be checked mechanically. Retighten, if necessary.



WARNING!

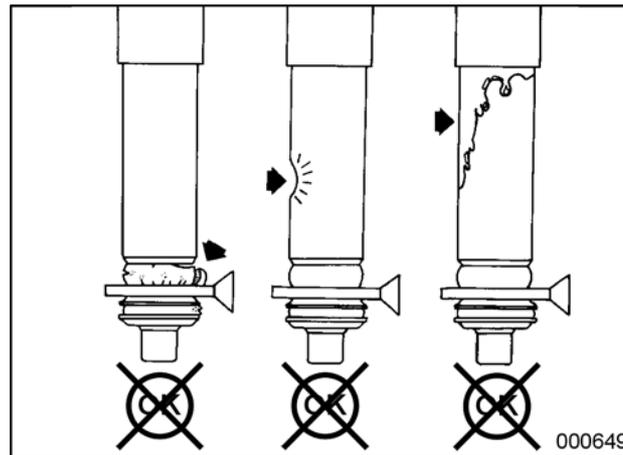
Never retighten bolts, screws or nuts that are fitted with locking adhesive, as this would destroy locking properties.

To check shock absorbers for damage and leakage

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: shock absorber failure



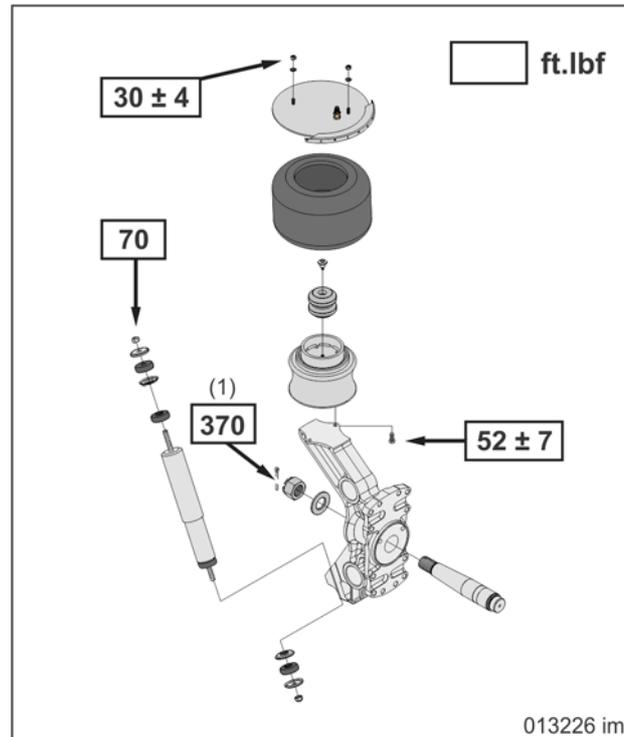
What to check?

Check the shock absorber for:

- fatigue cracks on rubbers;
- damage at housing;
- oil leaks.

Technical data: trailing axle suspension

Figure:
tightening
torques



Fixation of air bag piston and shock absorber

- (1) *If necessary, tighten the nut a little further until you can install the cotter pin.
Never turn back to install the cotter pin.*

Chapter 34: Wheels

Overview

Introduction This chapter deals with the wheels.

Number of pages 12

Chapter publication date 21 September 2016

Contents

Topic	See page
Wheel-mounting systems	3.34-2
To check wheels for damage	3.34-6
To change wheel	3.34-7
Technical data: wheels	3.34-10
Special tools: wheels	3.34-11

Wheel-mounting systems

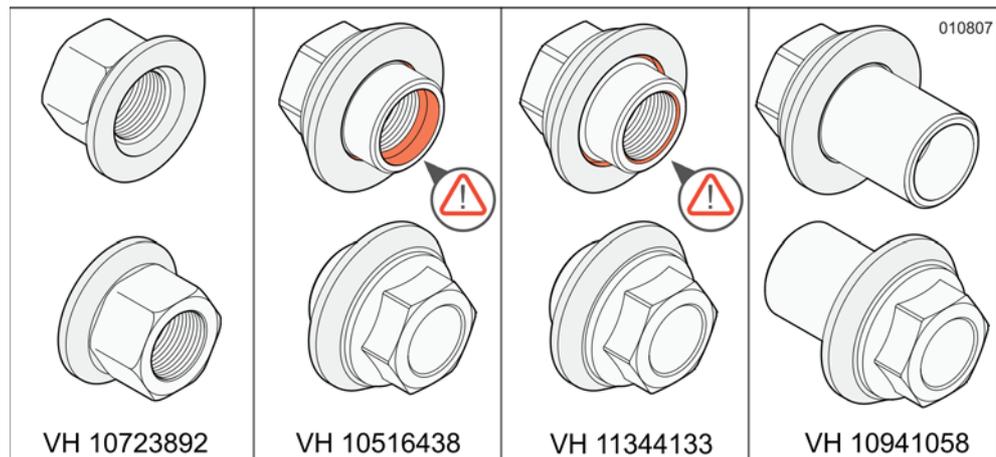
Types of wheel nuts



WARNING!

Using the wrong wheel nuts can cause wheels to loosen. Only use wheel nuts suitable for the applicable wheel version.

Most wheel nuts can be recognized immediately by their shape. This is not the case for wheel nuts VH10516438 and VH11344133. The incorrect use of these wheel nuts can lead to a "bottom out" of the wheel nut on the unthreaded part of the wheel bolt before the wheel has been clamped correctly.

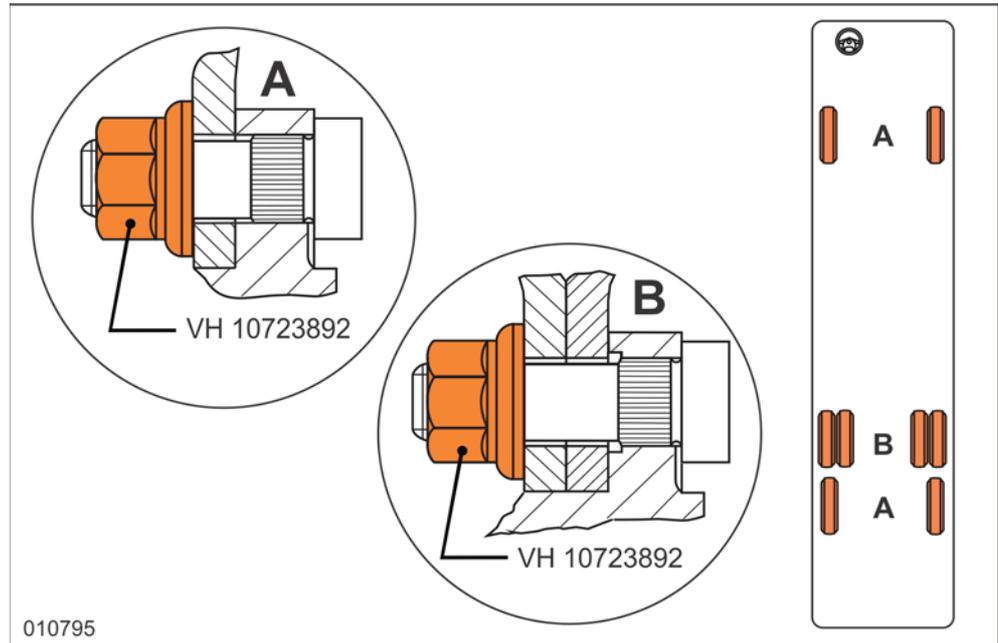


The table below shows which wheel nuts to use for which wheel version:

	Wheel	Tire	Wheel nut
Front axle	Steel 9" x 22.5"	315/80R22.5	10723892
	Light alloy 9" x 22.5"	315/80R22.5	10516438
	Light alloy 10.5" x 22.5"	365/70R22.5	11344133
Drive axle	Steel 9" x 22.5"	315/80R22.5	10723892
	Light alloy 9" x 22.5"	315/80R22.5	10941058
Trailing axle, single wheel mounting	Steel 9" x 22.5"	315/80R22.5	10723892
	Light alloy 9" x 22.5"	315/80R22.5	10516438
	Light alloy 10.5" x 22.5"	365/70R22.5	11344133
Trailing axle, twin wheel mounting	Steel 9" x 22.5"	315/80R22.5	10723892
	Light alloy 9" x 22.5"	315/80R22.5	10941058

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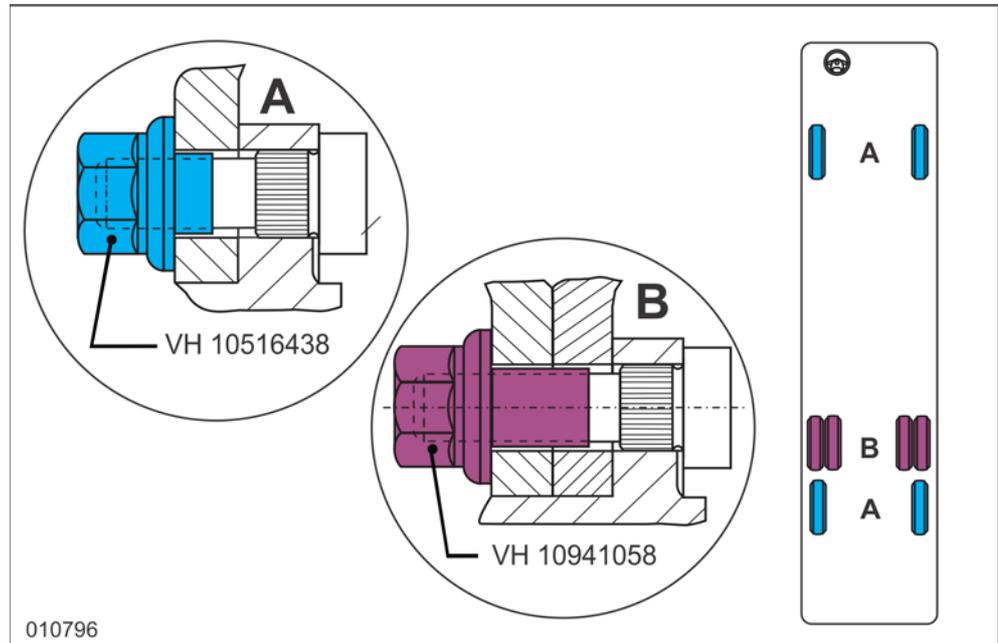
Figure: wheel mounting system



010795

Eight-wheel vehicle with all around 315/80R22.5 tires and 9" x 22.5" steel wheels

Figure: wheel mounting system

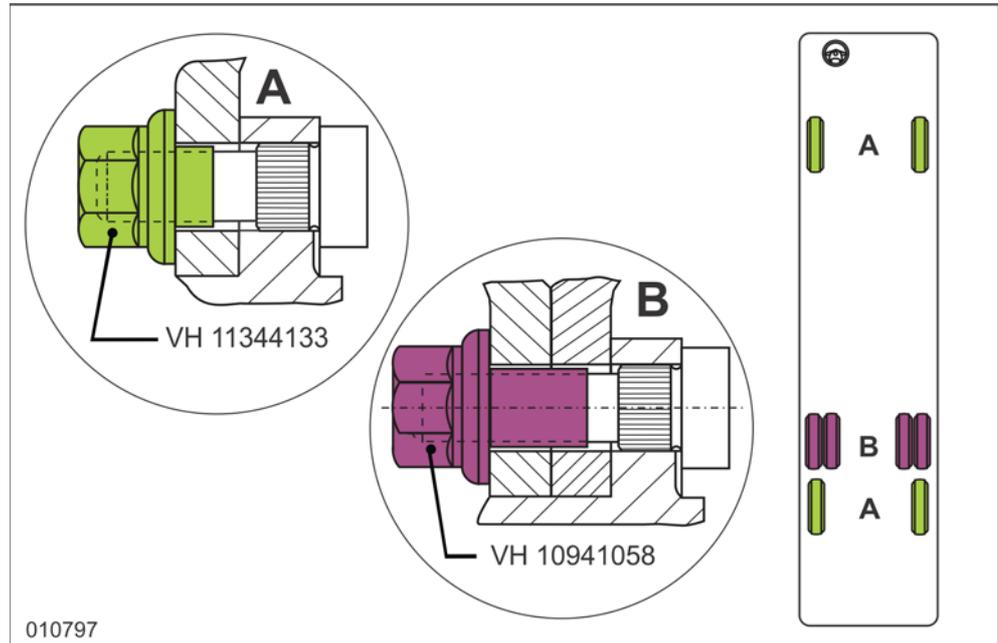


010796

Eight-wheel vehicle with all around 315/80R22.5 tires and 9" x 22.5" light-alloy wheels

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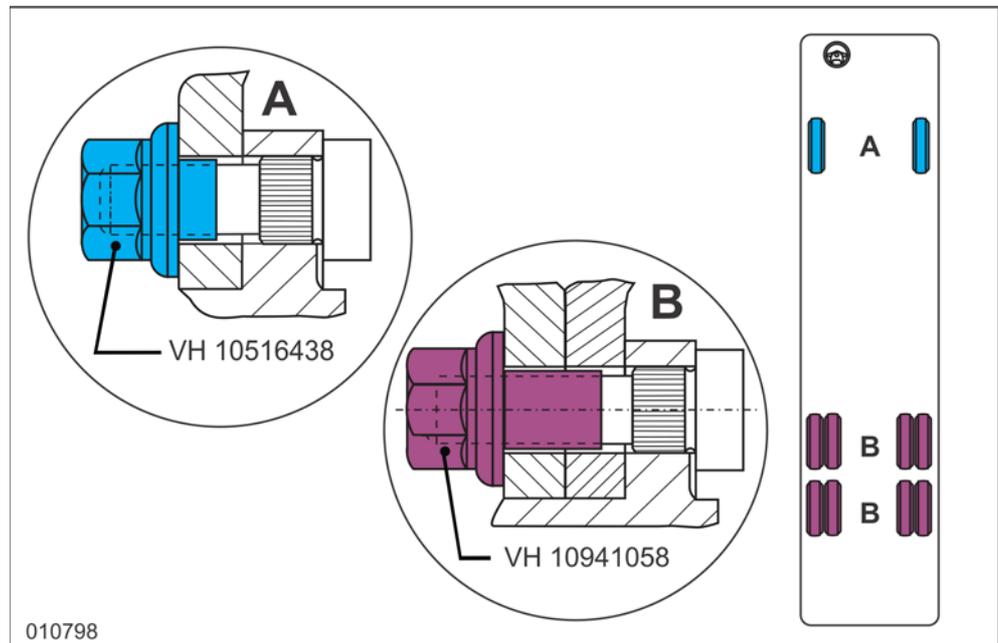
Figure: wheel mounting system



010797

Eight-wheel vehicle with 365/70R22.5 tires and 10.5" x 22.5" light-alloy wheels on the front axle and trailing axle; 315/80R22.5 tires and 9" x 22.5" light-alloy wheels on the drive axle.

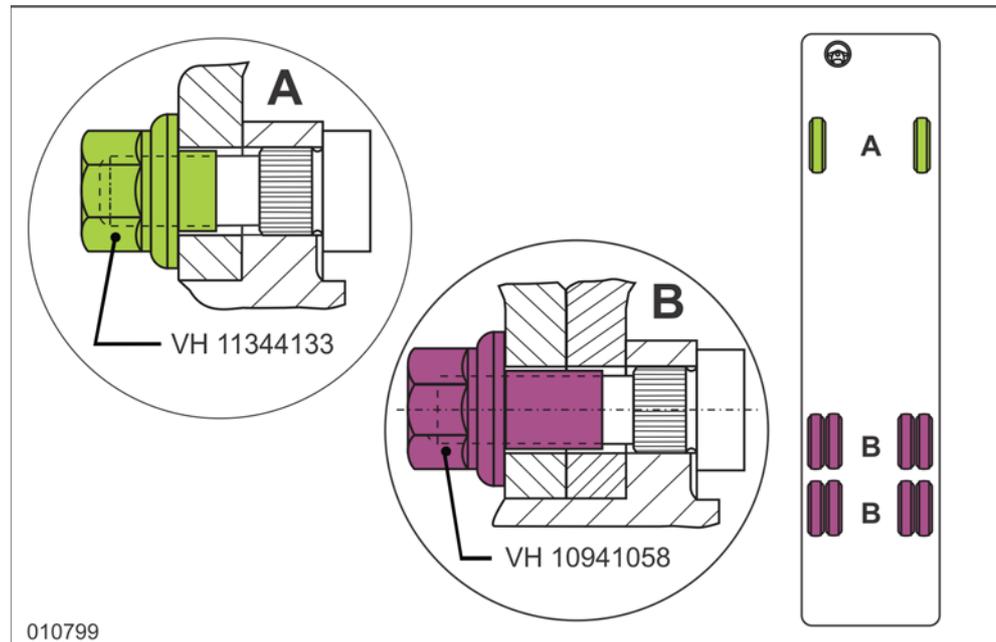
Figure: wheel mounting system



010798

Ten-wheel vehicle with all around 315/80R22.5 tires and 9" x 22.5" light-alloy wheels

Figure: wheel mounting system



010799

Ten-wheel vehicle with 365/70R22.5 tires and 10.5" x 22.5" light-alloy wheels on the front axle; 315/80R22.5 tires and 9" x 22.5" light-alloy wheels on the drive axle and trailing axle.

Hub piloting

Van Hool apply the so called "hub pilot system" on their vehicles: the wheel disc center hole fits a machined spigot (or a number of pads) on the hub precisely.

Hub-piloting characteristics:

- Wheels with cylindrical bolt holes;
- Wheel nuts with flat, rotary but non-removable washers.



WARNING!

Only use wheels and wheel nuts suitable for hub piloting.

To check wheels for damage

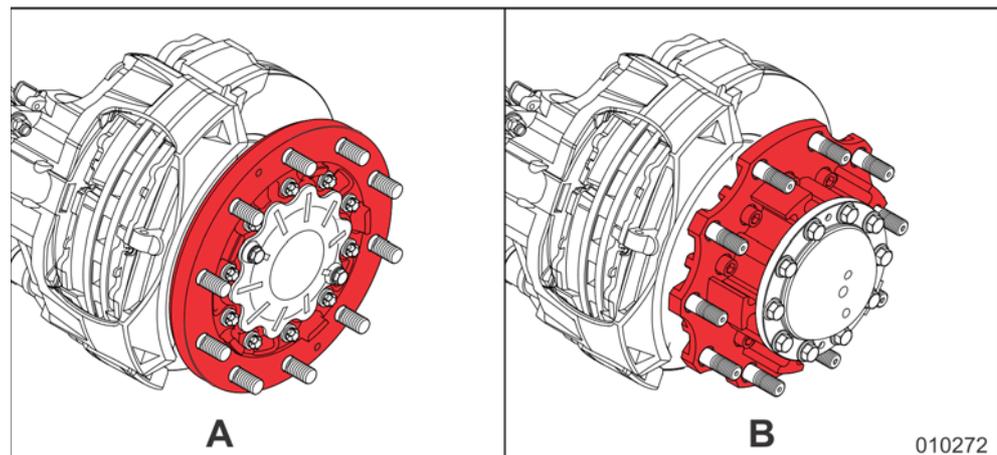
To check what?

Check the wheels regularly for the following points (in case of a dual wheel set, also check the inner wheel):

- deformation of rim edges and wheel disc;
- cracks in the wheel disc and wheel rim;
- deformation of or cracks at the wheel-bolt holes. On fixed intervals according to maintenance schedule (refer to chapter 1.1), also check the edges of the bolt holes for cracks. Practice has revealed that such cracks occur especially on wheels mounted on not completely round wheel hubs (see figure).

Immediately replace the wheel in case of one of the afore mentioned damages.

Figure: wheel-hub forms



A Example of a completely round wheel hub

B Example of a not completely round wheel hub

To change wheel

Wheel nut tightening torque

Refer to "Technical data" at the end of this chapter.

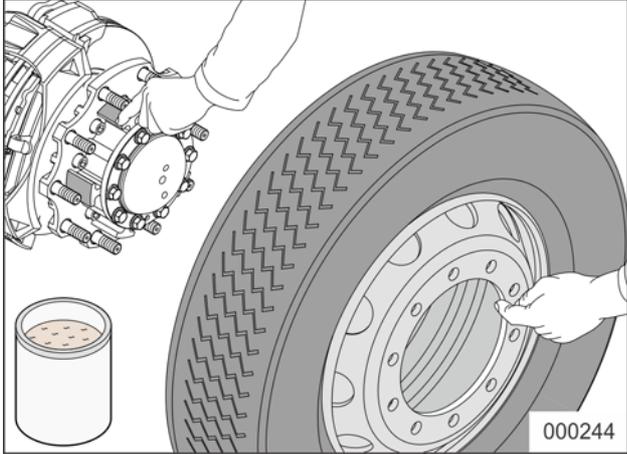
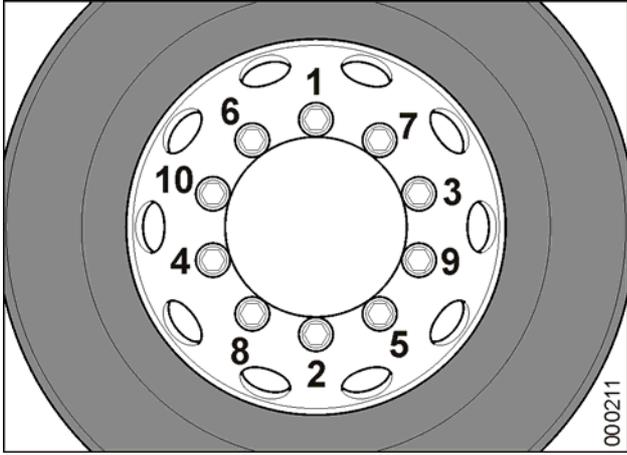
Precautions at wheel installation

- Before mounting a wheel, remove burrs, rust, dirt and paint runs from the contact surfaces. These are the areas of the wheel disc that touch the hub (or the other wheel in a dubble assembly), as well as the wheel nut contact areas.
- The contact areas (see above) may only be painted very thinly. Total coat thickness may not exceed 0.002 in. Only mount the wheel after the paint has hardened completely. Too thick a coat of paint or wheel mounting, when the paint is not fully hard yet, can cause wheel nut slackening.
- Before installing a wheel, always check wheel bolts for damage. Also check that bolts are well-secured in hub bolt-holes.
- After fitting a new tire, the wheel has to be balanced again.

Procedure

Step	Action
1	Using a socket wrench, remove the wheel nut caps, if present, by turning them counterclockwise until they are loose.
2	If necessary, clean wheel bolt ends with a stiff brush.
3	Slacken all wheel nuts by half a turn.
4	Jack up vehicle.
5	Remove wheel nuts and wheel.

continued on next page

Step	Action
6	<p>Clean hub pilot and wheel disc center hole. Smear pilot lightly with "Never-Seez".</p> 
7	<p>Clean wheel bolts with steel brush.</p>
8	<p>Locate wheel on hub. In case of a double mounting, make sure the valve of the inner wheel is accessible through hand holes.</p>
9	<p>Fit wheel nuts and tighten them according to sequence given in figure. Tighten wheel nuts evenly by alternately turning every nut progressively further each time, until specified torque is reached.</p> 
10	<p>If necessary, reinstall the wheel nut caps, as described under "To install wheel nut caps".</p>

To install wheel nut caps

Step	Action
1	<p>Install the wheel nut cap loosely on the wheel nut.</p>

continued on next page

Step	Action
2	 <p>CAUTION! Only use a socket wrench to tighten the wheel nut caps. Using a socket wrench, turn the wheel nut caps clockwise until you sense a slight clamping.</p>

To retighten wheel nuts

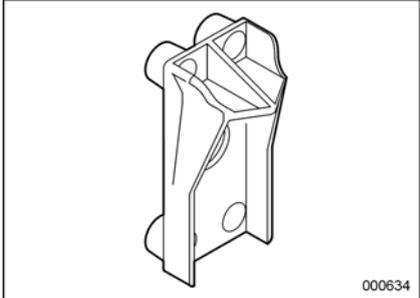
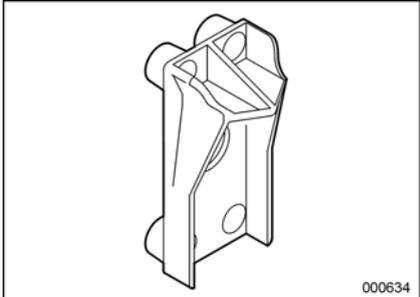
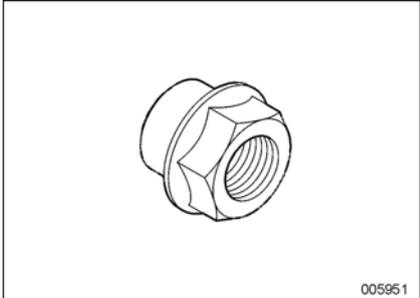
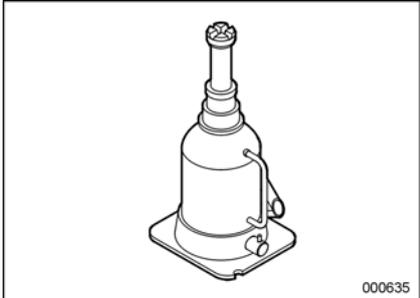
When a wheel has been changed, retighten wheel nuts with torque wrench after 30 miles and again after the next 60 miles. Subsequently check torque daily, until nuts are finally tight. Wheel nut slackening is explained by the fact that the fasteners set, so that part of the original torque is lost.

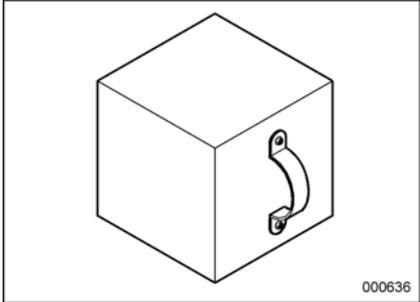
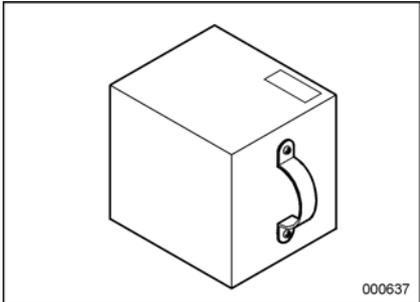
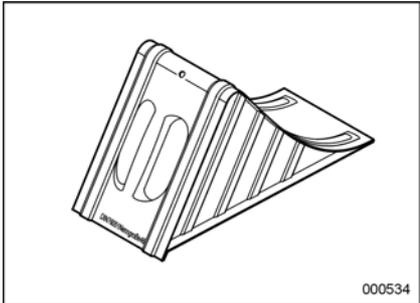
Technical data: wheels

Tightening torques

Wheel nuts	445 ± 15 ft.lbf
------------	-----------------

Special tools: wheels

Ordering number	Description	Figure
Van Hool 619900160	Lifting bracket (in case of a steel wheel)	 <p style="text-align: right; font-size: small;">000634</p>
Van Hool 10627455	Lifting bracket (in case of a light alloy wheel)	 <p style="text-align: right; font-size: small;">000634</p>
Van Hool 10627683	Nut to secure lifting bracket 10627455 to wheel (in case of a light alloy wheel)	 <p style="text-align: right; font-size: small;">005951</p>
Van Hool 10583382	Hydraulic jack	 <p style="text-align: right; font-size: small;">000635</p>

Ordering number	Description	Figure
Van Hool 10581561	Wooden supporting block for jack	
Van Hool 10581556	Wooden supporting block for steering knuckle carrier	
Van Hool 10545507	Wheel chock	

Chapter 38: Tires

Overview

Introduction This chapter deals with the tires.

Number of pages 8

Chapter publication date 21 September 2016

Contents

Topic	See page
Tire selection	3.38-2
To check tires for inflation pressure and damage	3.38-3
To inspect tires	3.38-4
What to check with dual tires?	3.38-6
To change tires	3.38-7
Technical data: tires	3.38-8

Tire selection



WARNING!

Do not fit tires of size or construction other than the original ones without prior consent by Van Hool. Never fit tires with lower load or speed ratings.

Dimensions

Refer to "Technical data" at the end of this chapter.

Load and speed ratings

Refer to "Technical data" at the end of this chapter.

To check tires for inflation pressure and damage

To be carried out when?

Before commencing daily service.

Tire inflation pressure

Refer to "Technical data" at the end of this chapter.



CAUTION!

If pressure is found to drop more than normal over a period of time, remove and inspect the tire to determine the cause.

Tire damage

Remove any stones or similar which have become embedded in the tread. They may cause damage in the long run.

Change the tire, if you encounter any of the following signs of damage:

- bumps, bulges or knots;
 - tread cuts, snags or side wall cracks deep enough to expose the casing cords;
 - any exposed casing material.
-

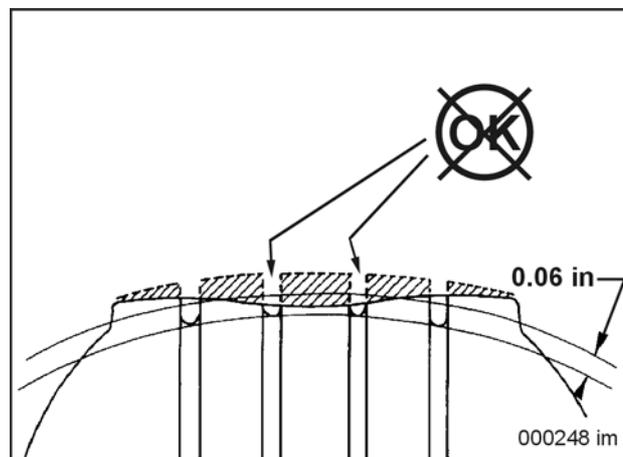
To inspect tires

To measure tread depth

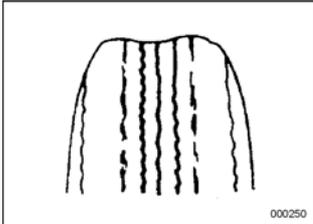
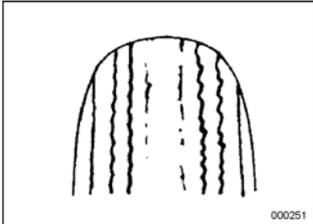
Measure the depth of the main tread grooves. Driving with a tread depth of less than 0.06 in is legally prohibited. One had better not wait, until the legal minimum has been reached, but replace the tire at a tread depth of 0.1 to 0.08 in already. The risk of skidding on wet and slippery roads increases, when tread is below this value.

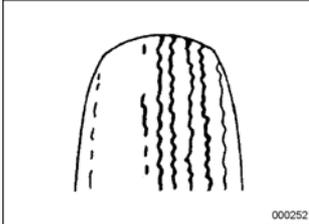
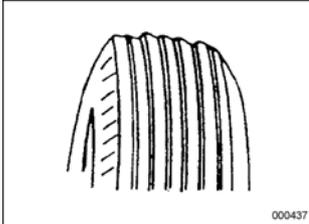
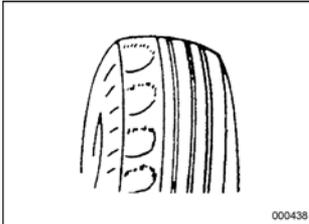
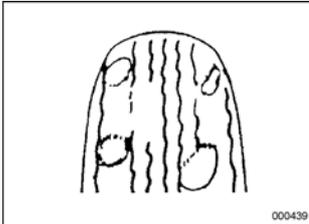
NOTE: Tires of recent date have wear indicators.

Figure: tread depth



Abnormal tread wear

Type of wear	Cause	Figure
Shoulder wear	Surface is "dished" due do underinflation.	 000250
Center wear	Surface is "domed" due to overinflation.	 000251

Type of wear	Cause	Figure
<p>Severe wear on one side of the tread</p>	<p>Excessive camber. Sometimes also misalignment.</p>	 <p style="text-align: right; font-size: small;">000252</p>
<p>Feather edging When you run your hand across the tread, you feel sharp edges in one direction (burrs).</p>	<p>Wheel alignment is incorrect.</p>	 <p style="text-align: right; font-size: small;">000437</p>
<p>Cupping</p>	<p>Usually poor shock absorbers. Sometimes unbalanced wheels. Occasionally also incorrect wheel alignment.</p>	 <p style="text-align: right; font-size: small;">000438</p>
<p>Bald spots</p>	<ul style="list-style-type: none"> • Unbalanced wheels. • Wheel run-out. • Excessive play in wheel bearings. • Incorrect wheel alignment in combination with loose steering joints. • Braking problems 	 <p style="text-align: right; font-size: small;">000439</p>

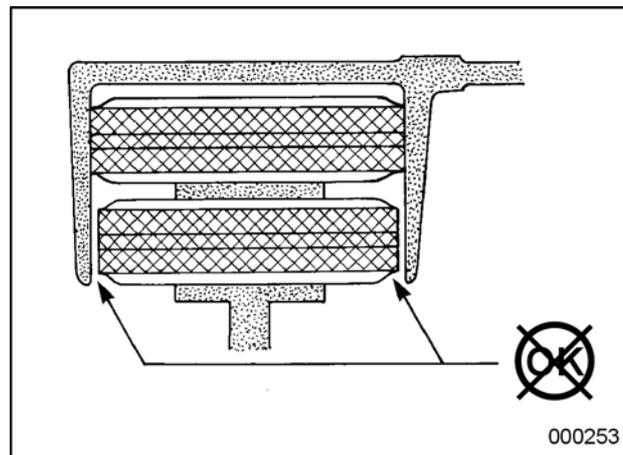
What to check with dual tires?

What to check?

To prevent overloading (and therefore damaging) one of dual tires, take care that:

- in mounted, inflated condition, the diameter difference (see figure) between both tires does not exceed 0.24 in;
- pressure in both tires is identical.

Figure: to check difference in diameter between tires



To change tires

To remove/ mount tires

To change a tire on this vehicle, follow the normal procedure for tubeless tires and drop-center rims.

NOTE: Always change the tires on each side of the axle at the same time.

Technical data: tires

Which tires should be on the vehicle?

Dimensions	Load and speed ratings
315/80 R22.5	156/150 L

Tire inflation pressure

The tire inflation pressure is mentioned on the vehicle identification plate in the step well of the passenger door.

The pressure values given in the table apply to cold tires, i.e. after at least 1 hour of standstill.

Under extreme operating conditions or, if tire wear gives cause to do so, tire inflation pressure should be adapted after consulting the tire manufacturer and Van Hool.

Part 4 - Driveline/Axle

Overview

Contents

Chapter	See page
Chapter 10: Propeller shaft	4.10-1

Chapter 10: Propeller shaft

Overview

Introduction This chapter deals with the propeller shaft.

Number of pages 14

Chapter publication date 21 September 2016

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Topic	See page
To carry out minor inspection of propeller shaft	4.10-2
To lubricate propeller shaft universal joints	4.10-7
To carry out major inspection of propeller shaft	4.10-8
To install propeller shaft	4.10-11
Technical data: propeller shaft	4.10-13

To carry out minor inspection of propeller shaft

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment condition

Vehicle over an inspection pit or on a lifting device



CAUTION!

Never clean the propeller shaft with a high-pressure or steam cleaner. If in doubt whether someone has done so lately, regrease propeller shaft universal joints, until new grease escapes from bearing seals.

Minor inspection

The minor inspection contains the following points:

- To check flange bolts/screws for security;
- To check for wear;
- To check balance weights;
- To check universal joint bearings;
- To check seals;
- To check synthetic resin-coating of sliding joint;
- To check shaft for damage.

If the propeller shaft is damaged, parts are missing or excessive wear is found, remove the shaft for repair in an authorized workshop.

To check security of flange bolts/screws

Check security of flange bolts/screws at transmission side with torque wrench. At drive axle side you can find one of following fixation types:

If mating flange has...	then ...
tapped holes to receive screws locked with Loctite,	you may not retorque screws, otherwise locking properties of adhesive will be destroyed. Visually check whether screw heads contact flange.

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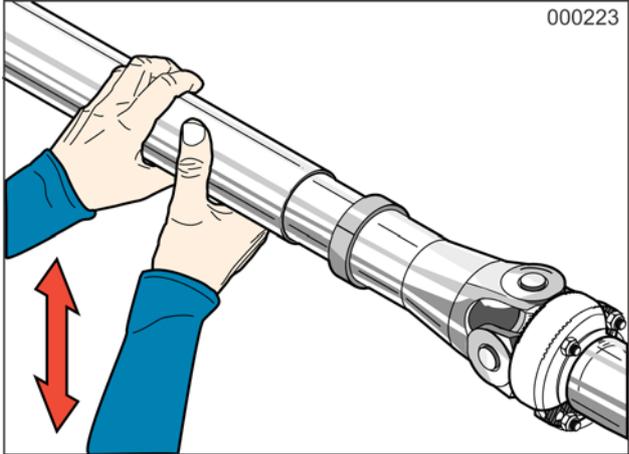
If mating flange has...	then ...
holes to receive bolts,	you have to check security with torque wrench.

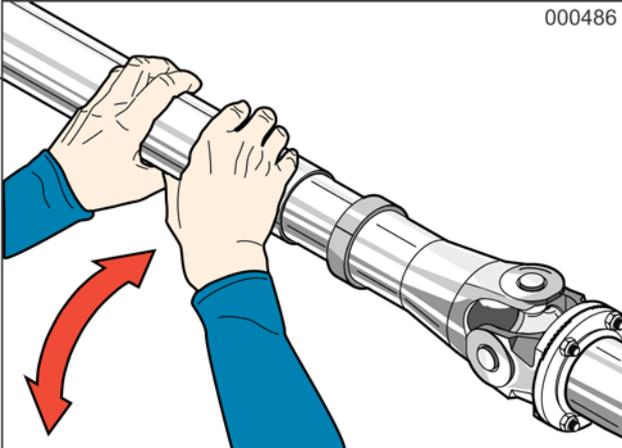


CAUTION!

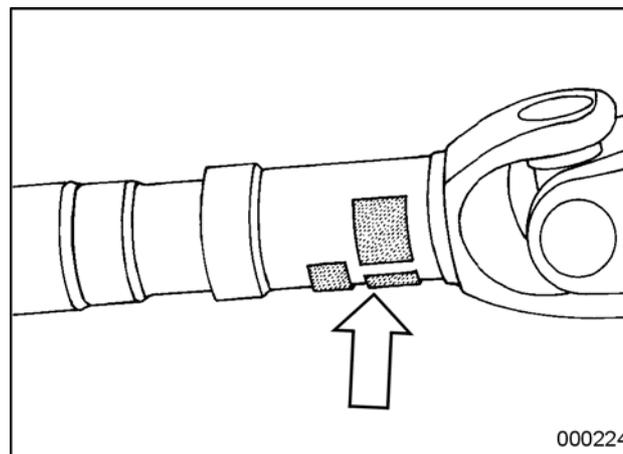
Do not attempt to turn the propeller shaft by means of a lever inserted through a universal joint. This may cause damage to seals and grease nipple.

To check for wear

Step	Action
1	<p>Try to move shaft up and down by hand: any movement indicates lash in sliding joint.</p> 

Step	Action
2	<p><i>NOTE: Check for looseness in universal joints, before re-lubricating them..</i></p> <p>Try to twist shaft by hand: any movement of shaft main section in relation to flange yoke indicates play in universal joint.</p> 

**Figure:
balance
weights**

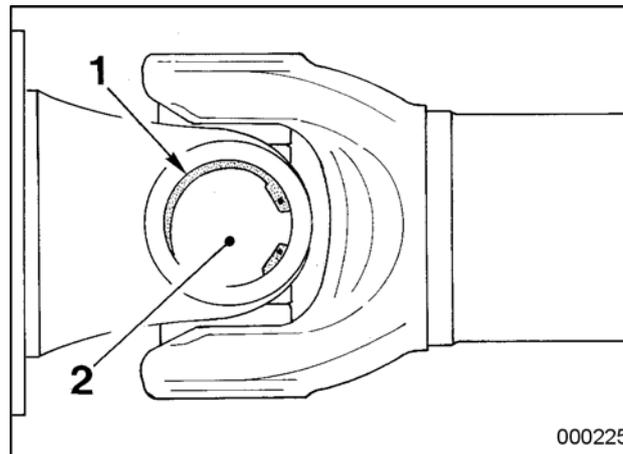


**To check
balance
weights**

Check whether all balance weights are secure. Look for traces of missing balance weights. Remove all build-up of foreign matter, which can cause an out-of-balance condition from shaft tube.

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Figure:
universal joint



- 1 Snap ring
- 2 Universal joint bearing

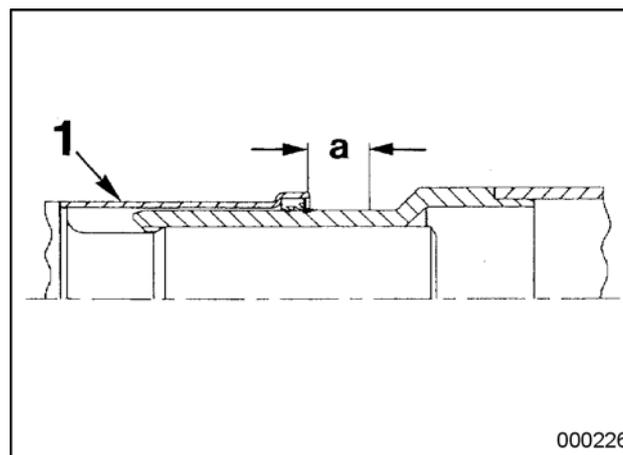
To check universal joint bearings

Check whether all bearings are secured with a snap ring (1). Check bearing cup (2) for signs of overheating (blue discoloration).

To check seals

Visually check condition of universal joint bearing seals and sliding joint seal. A damaged seal will result in excessive grease loss. This will soon lead to breakdown of the shaft.

Figure: detail of sliding joint



- 1 Protection sleeve
- a Synthetic resin-coated area

continued on next page

**To check
synthetic
resin-coating**

Check condition of synthetic resin-coating at outer diameter of slip stub shaft (where protective sleeve seal will slide). The coating may not show signs of any damage or abrasion.

**To check shaft
for damage**

Visually check shaft tube for flaked paint, cracks and dents. Also check protection sleeve (1) of sliding joint for eccentricity.

To lubricate propeller shaft universal joints

To be carried out when?

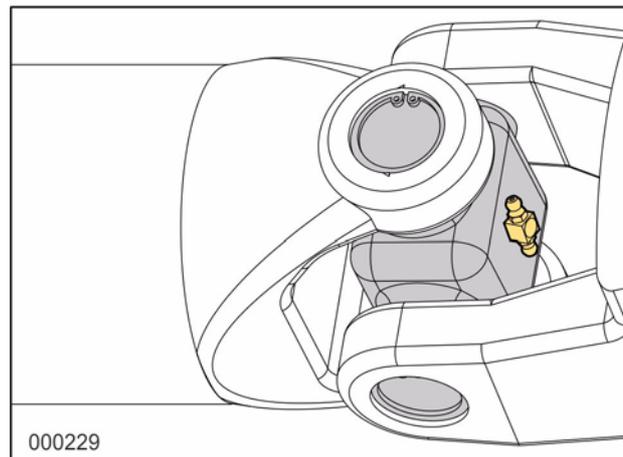
Refer to chapter 1.1, "Maintenance schedule".

Grease type

Refer to chapter 1.1, "Fluids and lubricants".

**CAUTION!**

Avoid pressure surges at lubrication. Maximum allowable grease gun pressure: 200 psi.

Figure: grease nipple on universal joint**Procedure**

Use a grease gun to apply lubricant through the T-nipple on each trunnion. Check that old grease escapes from all bearing seals.

Grease will not pass through?

If no grease escapes along the bearing seal during lubrication, the bearing can be considered damaged. If such a bearing is found, remove the drive shaft for repair in an authorized workshop. There they will change both shaft trunnions for safety reasons.

To carry out major inspection of propeller shaft

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

Propeller shaft removed



CAUTION!

Never clean the propeller shaft with a high-pressure or steam cleaner. If in doubt whether someone has done so lately, regrease propeller shaft universal joints, until new grease escapes from bearing seals.

Major inspection

The major inspection contains the following points:

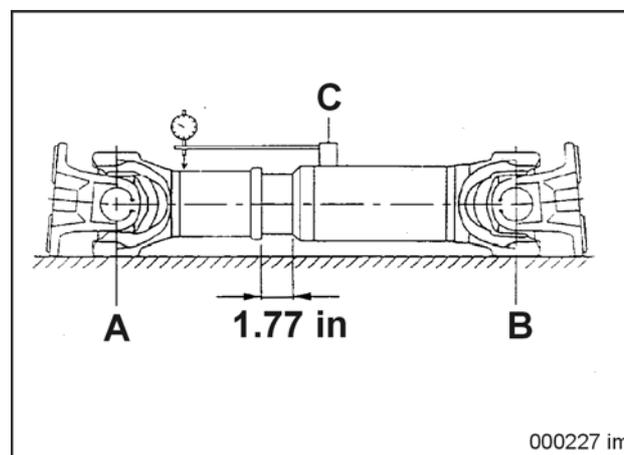
- To check universal joint bearings;
- To check lash in sliding joint;
- To check the dismantled sliding joint visually.

If the inspection reveals damage or excessive wear, bring the shaft to an authorized workshop for repair.

To check universal joint bearings

Manoeuvre universal joints by hand in all directions to check whether they are free of play or "tight spots" (e.g. hooking).

Figure: set-up for checking lash in sliding joint



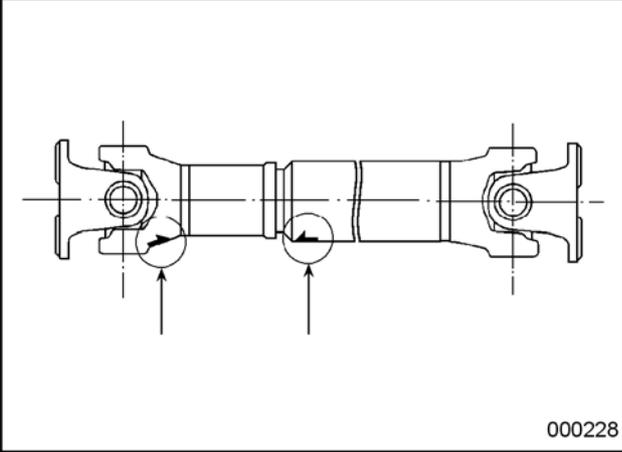
**To check lash
in sliding joint**

Step	Action
1	Lay complete shaft on flat surface, lugs of inner yokes resting on surface (points A and B). Extend sliding joint by approximately 1.77 in.
2	Mount dial indicator with magnetic base next to weld of sliding yoke (point C). Position stylus of dial indicator against protective sleeve, as close as possible to weld of latter.
3	Lift propeller shaft (approximately in its center of gravity), until inner yokes become free of flat surface.
4	Read variation shown by dial indicator. The maximum allowable value is 0.0067 in.

**To check
dismantled
sliding joint**

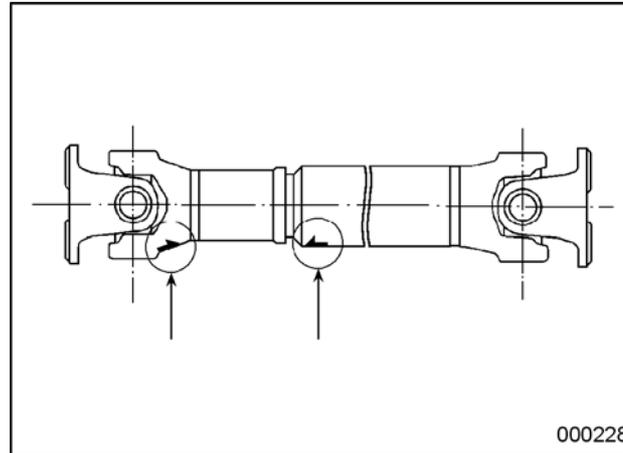
Step	Action
1	 <p>CAUTION! Do not damage synthetic coating of sliding joint. Do not use solvents; they can affect the synthetic coating.</p> <p>Withdraw slip stub shaft from sliding yoke.</p>
2	Examine sliding joint for damage on inside and outside of sliding yoke and at splines of slip stub shaft.
3	Check condition of protective sleeve seal.
4	If sliding joint is undamaged, regrease splines and seal. For grease type refer to chapter 1.1, "Fluids and lubricants".

continued on next page

Step	Action
5	<p data-bbox="582 309 1364 376">Push slip stub shaft into sliding yoke, making sure alignment marks (arrows) are in line.</p> <div data-bbox="694 421 1316 873"><p data-bbox="1236 840 1316 862">000228</p></div>

To install propeller shaft

**Figure:
alignment
marks on shaft
members**



**Installation
marks on shaft
members
aligned?**

Before mounting, check the relative position of the sliding joint members: the arrows (see figure) on the sliding yoke and the slip stub shaft should be aligned.

**Flanges clean
and
degreased?**

The mounting surfaces should be cleaned carefully on beforehand. Remove any traces of rust preventer, paint and lubricant with a suitable solvent.

NOTE: In the case of flanges with a toothed mounting surface you do not have to remove the rust preventer fitted on the toothing by the manufacturer.

**Before
installing
bolts/screws**

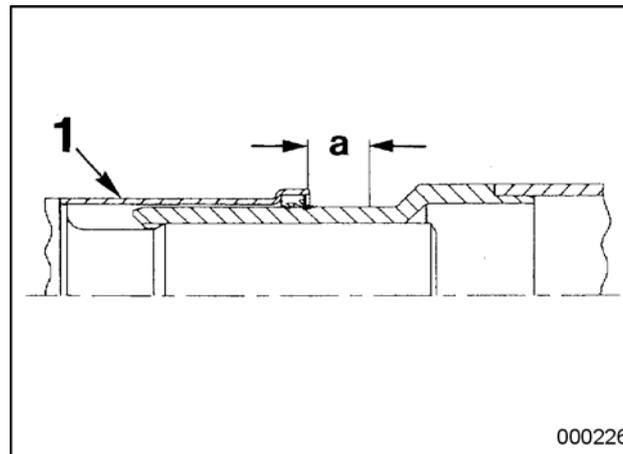
Screw or bolt	Treatment
Screw (without nut) to be used in tapped holes	Apply liquid adhesive Loctite 243 to screw threads.
Bolt (with nut) to be used in untapped holes	Slightly oil bolt threads. <i>NOTE: Do not use lubricants containing molybdenum disulphide (MoS₂).</i>

**To tighten
screws and
nuts**

Cross-tighten the screws and nuts of the flanges gradually, until the prescribed tightening torque is reached (refer to "Technical data" at the end of this chapter). Only use self-locking screws according to DIN 980, quality 10.

continued on next page

**Figure: detail
of sliding joint**



- 1 Protection sleeve*
a Synthetic resin-coated area

When painting

During painting operations the synthetic resin-coated plain section of the sliding yoke, where the protective sleeve seal will slide, has to be protected.

Technical data: propeller shaft

Tightening torques flange fasteners

The tightening torque depends on the fasteners type.

The following table gives you an overview of all propeller shaft fasteners used on Van Hool vehicles. With toothed propeller shaft flanges, these are fasteners available in regular retail trade; with smooth propeller shaft flanges, you have to use the special fasteners mentioned in the Van Hool spare parts manual.

Flange type	Fastener (quality 10.9)	Tightening torque
With a toothed flange	M12 x 1.75	74 ± 11 ft.lbf
	M12 x 1.5	77 ± 11 ft.lbf
	M14 x 2	118 ± 15 ft.lbf
	M14 x 1.5	133 ± 18 ft.lbf
With a smooth flange	M10	52 ± 4 ft.lbf
	M12	89 ± 6 ft.lbf
	M14	140 ± 10 ft.lbf
	M16	218 ± 15 ft.lbf

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Part 5 - Brakes

Overview

Contents

Chapter	See page
Chapter 2: Control systems	5.2-1
Chapter 10: Compressed-air brakes	5.10-1

Chapter 2: Control systems

Overview

Introduction This chapter deals with the control systems.

Number of pages 18

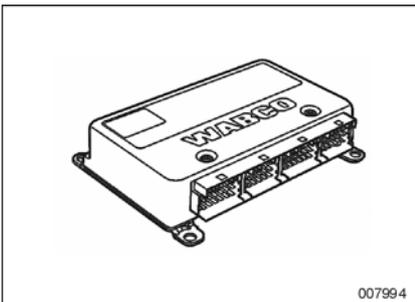
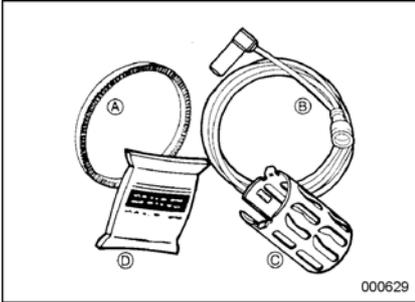
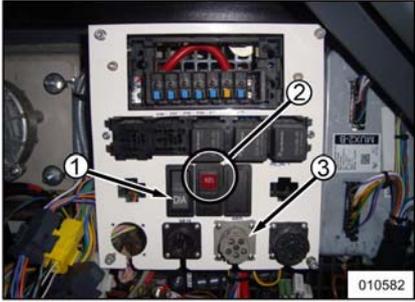
Chapter publication date 21 September 2016

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Topic	See page
ABS: visual identification of components	5.2-2
ABS: layout	5.2-3
ABS: fault reproduction	5.2-4
ABS: troubleshooting with diagnostic switch	5.2-6
To test ABS with "Pro-Link" or "Toolbox Software"	5.2-9
ABS: to check power supply	5.2-10
To check ABS valve	5.2-11
To check ABS wheel-speed sensor	5.2-14
ABS and EBS: to mount wheel-speed sensor	5.2-17

ABS: visual identification of components

Components

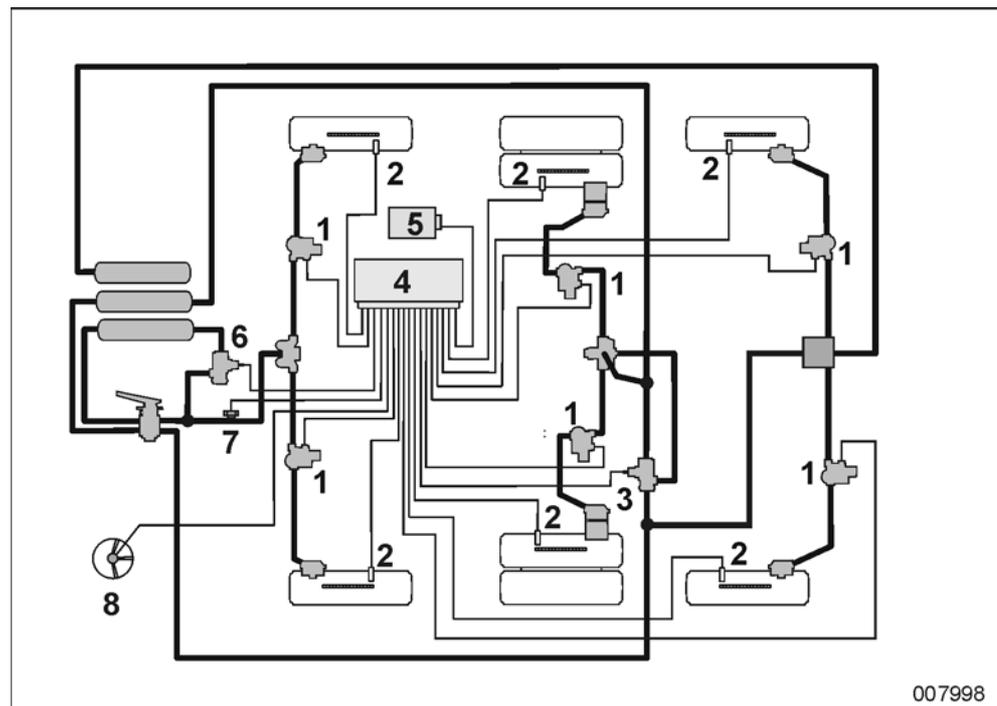
Denomination	Figure
Electronic control unit	 <p style="text-align: right;">007994</p>
ABS valve	 <p style="text-align: right;">000628</p>
Wheel-speed sensor kit + pulse ring <i>A Pulse ring</i> <i>B Wheel-speed sensor</i> <i>C Spring sleeve</i> <i>D Special grease</i>	 <p style="text-align: right;">000629</p>
Diagnostics panel in front junction box 1 Diagnostic switch 2 ABS diagnostics lamp 3 ABS diagnostic socket	 <p style="text-align: right;">010582</p>

ABS: layout

Common parts with other systems

The ATC system and, if mounted, the electronic stability control (ESC) have many components in common with the ABS system. Therefore you will find the ABS components as well as the ATC and ESC components in the schematic.

Figure: 6S/6M
ABS/ATC/ESC
schematic



007998

Components 5, 6, 7 and 8 are only present if an electronic stability control system (ESC) has been installed.

- 1 ABS valve
- 2 Wheel-speed sensor
- 3 ATC valve
- 4 Electronic control unit
- 5 ESC module
- 6 Front-axle active brake valve
- 7 Brake pressure sensor
- 8 Steering-angle sensor

ABS: fault reproduction

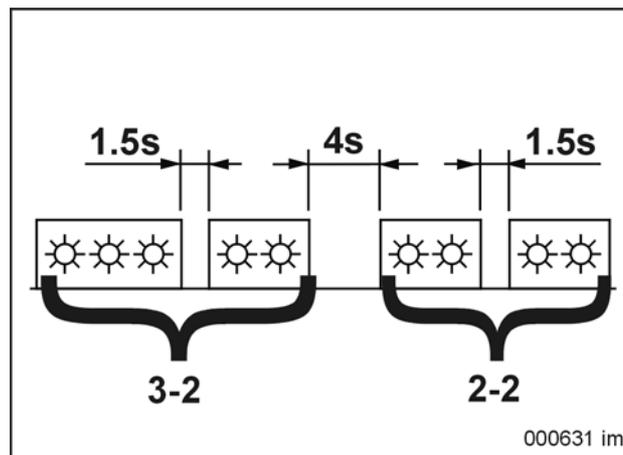
Introduction

The electronic control unit contains a self-diagnostic feature. The electronics constantly monitor the correct operation of the system and fault findings are stored in a memory. Upon request, the ABS lamp on the diagnostic panel in the front junction box shows fault memory contents in the form of a flash code.

What does a flash code look like?

The fault code consists of two sets of flashes with each set separated by a 1.5 seconds pause. If there are more fault findings in the memory, their flash codes are separated by a 4 seconds pause.

Figure:
example of
fault codes



Fault codes 3-2 and 2-2

Types of faults

Type of fault	What is it?
Active fault	<ul style="list-style-type: none"> Fault that exists during the reading of the diagnostic memory <p><i>NOTE: An active fault must be repaired, before you can display additional faults.</i></p>
Stored fault	<ul style="list-style-type: none"> A repaired fault that has not been cleared from the diagnostic memory, or... a fault that has disappeared spontaneously.

continued on next page

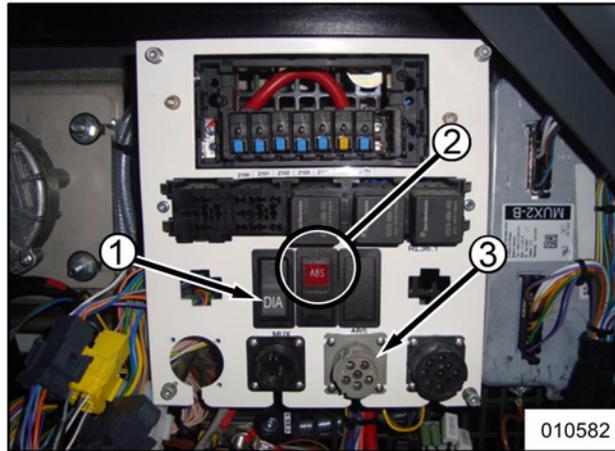
Fault reproduction according to fault type

The reproduction of the fault code is different for "active" and for "stored" faults.

In the case of...	the diagnostic lamp displays...	and...
an active fault	one fault code, even if there are more fault messages in the memory	repeats this code, as long as vehicle ignition is switched on.
a stored fault	successively the codes of all stored fault messages	does this one time only. <i>NOTE: If you want to look at the codes again, press the diagnostic push-button a second time.</i>

ABS: troubleshooting with diagnostic switch

Figure:
components
for ABS diag-
nostics



Diagnostics panel in junction box EKF

- 1 Diagnostic switch
- 2 ABS lamp
- 2 ABS diagnostic socket

Does diagnostic memory contain fault messages?

Switch on the ignition and look at what the ABS lamp is doing.

If the lamp...	then ...
illuminates momentarily,	there is no fault code in the memory. No action required.
does not illuminate,	there is probably a fault in the wiring to the lamp.
illuminates and stays on,	there are fault codes in the memory.

To read fault codes

Step	Action
1	Switch on the vehicle ignition.
2	Press and hold diagnostic switch for 1 second.
3	Release the switch. The ABS lamp starts to flash. Count and note number of flash series, refer to "ABS: fault reproduction".
4	Compare code with figures in table "Fault code explanation".
5	Repair fault.

continued on next page

Step	Action
6	<ul style="list-style-type: none"> In the case of an active fault: repeat steps 2 up to 5, until you receive code "1-1". This means the system is OK. In the case of stored faults: note fault codes. If these faults appear repeatedly, you have to repair the fault.
7	Clear fault codes from memory, refer to "To clear fault codes from diagnostic memory".

To clear fault codes from diagnostic memory

Even after the fault has disappeared spontaneously or has been repaired, the lamp in the ABS diagnostic switch will stay on and the fault code will remain in the memory, until you clear the memory manually.

Step	Action
1	Switch on the vehicle ignition.
2	<p>Press and hold the diagnostic switch for at least 3 seconds.</p> <p>The ABS lamp starts to flash.</p> <ul style="list-style-type: none"> Lamp flashes eight times, after 4 seconds followed by one or two flashes. This code will be repeated, until the ignition is switched off. This means all fault codes have been cleared successfully. Lamp flashes one or two time(s). This means there are still active faults. Repeat steps 1 up to 7 under "To read fault codes".

Fault code explanation

Number of flashes series 1	Number of flashes series 2	Explanation
1	1	No fault codes found
2	1	ABS valve of RH front wheel
2	2	ABS valve of LH front wheel
2	3	ABS valve of RH drive axle wheel
2	4	ABS valve of LH drive axle wheel
2	5	ABS valve of RH trailer/trailing axle wheel
2	6	ABS valve of LH trailer/trailing axle wheel
3, 4, 5	1	Wheel-speed sensor of RH front wheel
3, 4, 5	2	Wheel-speed sensor of LH front wheel
3, 4, 5	3	Wheel-speed sensor of RH drive axle wheel

continued on next page

Number of flashes series 1	Number of flashes series 2	Explanation
3, 4, 5	4	Wheel-speed sensor of LH drive axle wheel
3, 4, 5	5	Wheel speed sensor RH trailer/trailing axle wheel
3, 4, 5	6	Wheel speed sensor LH trailer/trailing axle wheel
6	1	Pulse ring of RH front wheel
6	2	Pulse ring of LH front wheel
6	3	Pulse ring of RH drive axle wheel
6	4	Pulse ring of LH drive axle wheel
6	5	Pulse ring of RH trailer/trailing axle wheel
6	6	Pulse ring of LH trailer/trailing axle wheel
7	1	Data link CAN, J1939 or ESC ^a
7	2	ATC valve
7	3	Retarder (auxiliary brake) relay
7	4	ABS lamp
7	5	ATC configuration
7	6	ESC trailer valve or front-axle valve
7	7	ESC brake pressure sensor
7	8	Tire inflation surveillance system
8	1, 2, 3, 4, 5	Electronic control unit
8	6	ESC module

a. ESC is short for "Electronic Stability Control".

More information?

Consult the Meritor Wabco maintenance manual MM-0112 via "www.meritor-wabco.com".

To test ABS with "Pro-Link" or "Toolbox Software"

**Cross-
reference**

Consult the Meritor Wabco maintenance manual MM-0112 via "www.meritor-wabco.com".

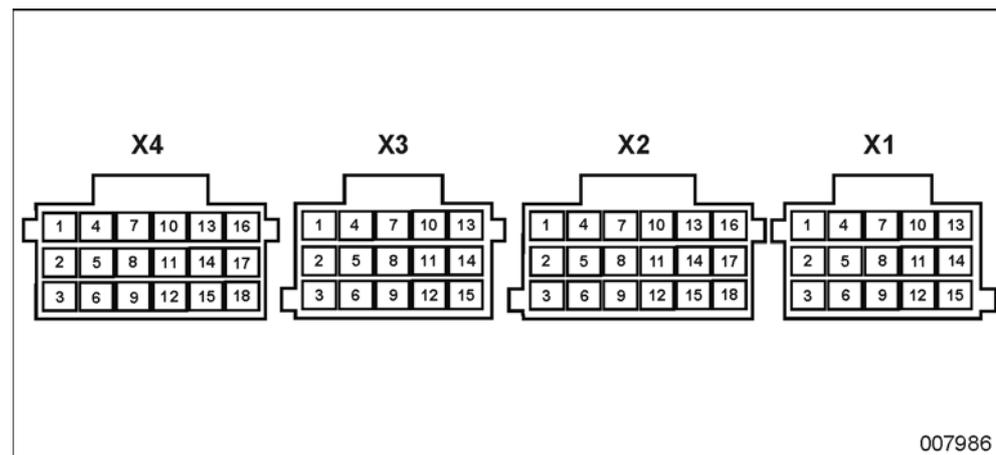
ABS: to check power supply

Correct value Power supply has to be between 18 and 30 Volts.

Procedure

Step	Action
1	Switch off master switch on dashboard.
2	Disconnect connector "X1" from the control unit.
3	Switch on master switch on dashboard and turn on ignition.
4	Measure the tension between pins 7 and 9, and 8 and 9 of connector "X1".

Figure: pin numbering of connectors on electronic control unit



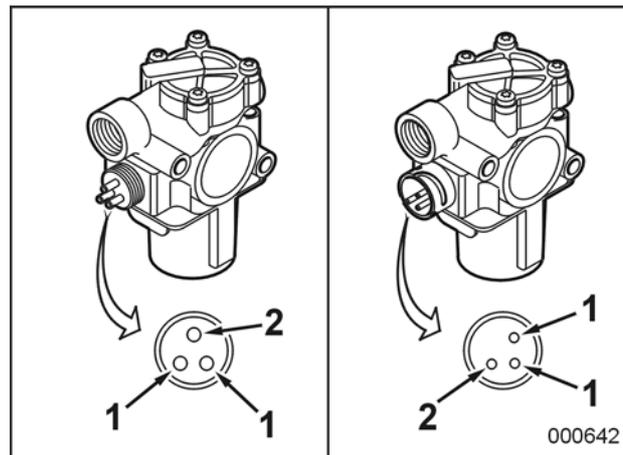
Connectors as seen from wire input side.

To check ABS valve

Location of ABS valves

Refer to "ABS: structure" in the present chapter.

Figure: ABS valve terminals



Left: ABS valve with screw connection; right: ABS valve with bayonet coupling

- 1 Solenoid coil terminals
- 2 Ground terminal

Correct resistance value

The resistance should be between 11,0 and 21,0 Ohms.

Equipment condition

Battery isolating switch off



CAUTION!

The pins of the connectors used in the ABS system are very fragile.

Procedure

Step	Action
1	On the ABS control unit, pull the connector of the cable that leads to the ABS valve that has to be checked.

continued on next page

Step	Action
2	At the connector (that you have pulled from the ABS control unit), measure the combined resistance of the ABS valve and its connecting cable. Refer to "Measuring points at connectors of electronic control unit" further in the text in order to know between which contacts you have to measure.
3	Is the measured resistance value within the prescribed tolerances? <ul style="list-style-type: none"> • If so, the valve and its connecting cable are OK. Reconnect the connector to the ABS control unit. No further action required. • If not, proceed with step 4.
4	Is the measured resistance value higher than 21,0 Ohms? <ul style="list-style-type: none"> • Yes, but not infinite. Continue with step 5. • Yes, the resistance is infinite (circuit rupture). Continue with step 6.
5	Detach the connector at the ABS valve, clean the electrical contacts and reconnect the connector. Check the ABS valve once again, beginning with step 2.
6	Detach the connector at the ABS valve and measure the resistance between the solenoid coil terminal (1) and the ground terminal (2) directly at the valve.
7	Is the resistance you now measure infinite? <ul style="list-style-type: none"> • If so, change the ABS valve. • If not, look for the interruption in the cabling between the control unit and the ABS valve.

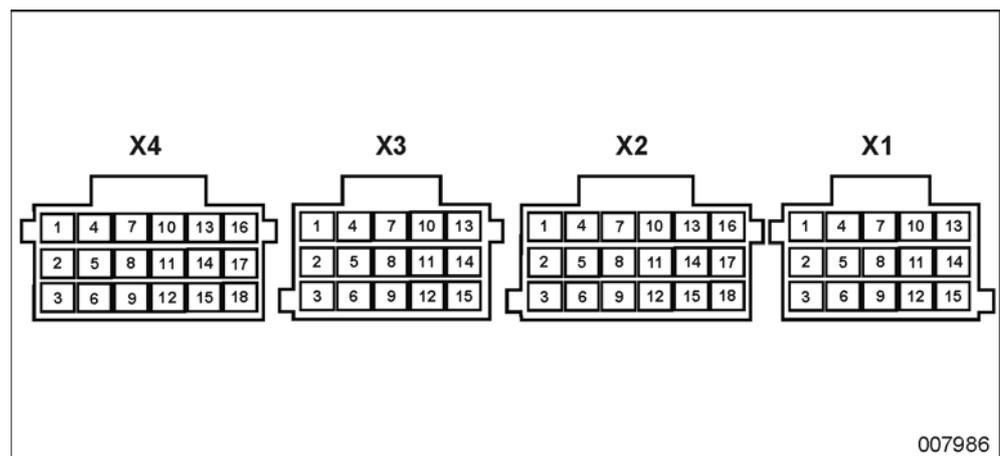
Measuring points at connectors of electronic control unit

ABS valve	Measure between
LH front wheel	<ul style="list-style-type: none"> • pin 3 of connector "X2" and pin 9 of connector "X1" • pin 6 of connector "X2" and pin 9 of connector "X1"
RH front wheel	<ul style="list-style-type: none"> • pin 1 of connector "X2" and pin 9 of connector "X1" • pin 4 of connector "X2" and pin 9 of connector "X1"
LH drive axle wheel	<ul style="list-style-type: none"> • pin 2 of connector "X2" and pin 9 of connector "X1" • pin 5 of connector "X2" and pin 9 of connector "X1"

continued on next page

ABS valve	Measure between
RH drive axle wheel	<ul style="list-style-type: none"> pin 8 of connector "X2" and pin 9 of connector "X1" pin 9 of connector "X2" and pin 9 of connector "X1"
LH trailer/trailing axle wheel	<ul style="list-style-type: none"> pin 3 of connector "X3" and pin 9 of connector "X1" pin 6 of connector "X3" and pin 9 of connector "X1"
RH trailer/trailing axle wheel	<ul style="list-style-type: none"> pin 12 of connector "X3" and pin 9 of connector "X1" pin 15 of connector "X3" and pin 9 of connector "X1"

Figure: pin numbering of connectors on electronic control unit



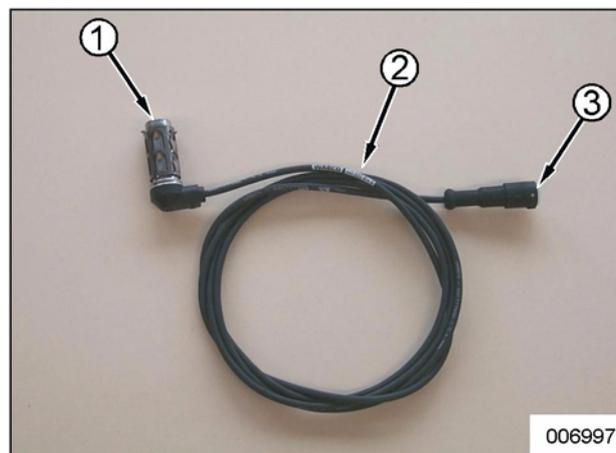
Connectors as seen from wire input side.

To check ABS wheel-speed sensor

Location of ABS wheel- speed sensors

Refer to "ABS: structure" in the present chapter.

Figure: ABS wheel-speed sensor (example)



The wheel-speed sensor, the connecting cable and the plug are an unit.

- 1 Wheel-speed sensor
- 2 Connecting cable
- 3 Connector

Correct resistance value

The resistance should be between 900 and 2 000 Ohms.

Minimum output voltage

At least 0,2 Volt AC at 30 rpm.

Equipment condition

Battery isolating switch off



CAUTION!

The pins of the connectors used in the ABS system are very fragile.

To measure sensor resistance

Step	Action
1	On the ABS control unit, pull the plug of the cable that leads to the ABS wheel-speed sensor that has to be checked.
2	At the plug (that you have detached from the ABS control unit), measure the combined resistance of the connecting cable to the control unit, the connecting cable (2) of the wheel-speed sensor (1), and the wheel-speed sensor itself. Refer to "Measuring points at connectors of electronic control unit" further in the text in order to know between which contacts you have to measure.
3	Is the measured resistance value within the prescribed tolerances? <ul style="list-style-type: none"> • If so, the wheel-speed sensor (1), the connecting cable (2) and the connecting cable to the control unit are OK. Reconnect the plug of the connecting cable to the control unit. No further action is required. • If not, proceed with step 4.
4	If resistance is infinite (circuit rupture), pull the connecting cable to the control unit out of plug (3).
5	At plug (3), measure the combined resistance of wheel-speed sensor (1) and cable (2).
6	Is the resistance you now measure infinite? <ul style="list-style-type: none"> • If so, change the wheel-speed sensor (1), completely with cable (2) and plug (3). • If not, look for interruption in the connecting cable to the control unit.

To measure output voltage of sensor

Step	Action
1	On the ABS control unit, pull the plug of the cable that leads to the ABS wheel-speed sensor that has to be checked.
2	Rotate wheel by hand with a speed of 30 rpm (one revolution every 2 seconds) and measure output voltage of wheel-speed sensor at connector (that you have detached from the ABS control unit). Refer to "Measuring points at connectors of electronic control unit" further in the text in order to know between which contacts you have to measure.
3	If the measured voltage value is lower than the prescribed minimum output voltage, push the wheel-speed sensor further inward with the hand (if necessary by means of a blunt rod) until it butts the pulse ring (crown gear) in the hub.

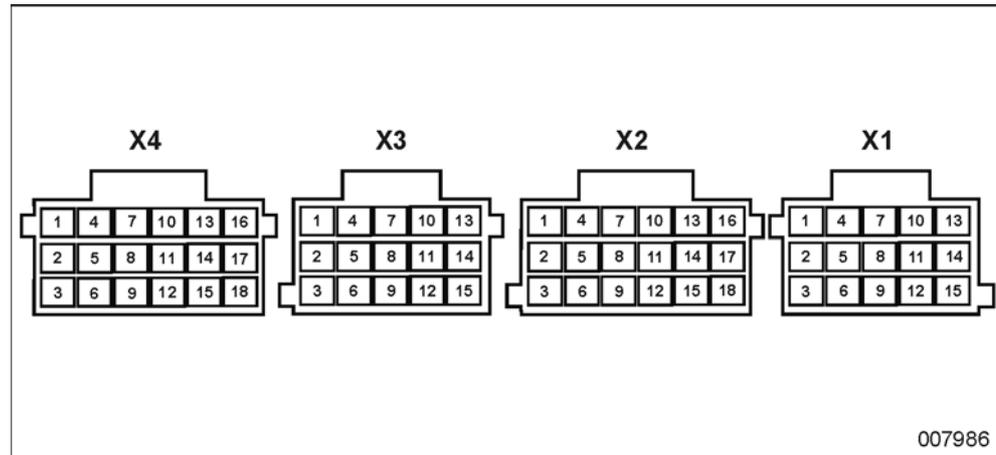
continued on next page

Step	Action
4	Repeat step 2. <i>NOTE: The necessary clearance between the wheel-speed sensor and the pulse ring originates during the first few revolutions of the wheel.</i>

Measuring points at connectors of electronic control unit

Wheel-speed sensor	Connector	Measure between pins
LH front wheel	X2 (18 pins)	12 and 15
RH front wheel	X2 (18 pins)	10 and 13
LH drive axle wheel	X2 (18 pins)	11 and 14
RH drive axle wheel	X2 (18 pins)	17 and 18
LH trailer/trailing axle wheel	X3 (15 pins)	2 and 5
RH trailer/trailing axle wheel	X3 (15 pins)	11 and 14

Figure: pin numbering of connectors on electronic control unit



Connectors as seen from wire input side.

ABS and EBS: to mount wheel-speed sensor

Consumables

Special high temperature grease	Van Hool No. 10610096
"Blue seal" vaseline	Van Hool No. 660852700

Procedure

Step	Action
1	Apply special high temperature grease to clamping bush and sensor.
2	Push clamping bush into place.
3	Push sensor into place by hand, until it contacts pulse ring. The necessary gap between the sensor and the pulse ring will develop automatically, when the vehicle starts moving, at the first revolutions of the wheel.
4	<i>NOTE: In order to prevent the ingress of water, fill wheel-speed sensor connector with "Blue seal" vaseline.</i> Connect wheel-speed sensor to chassis wiring.



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Chapter 10: Compressed-air brakes

Overview

Introduction This chapter contains the compressed-air brakes.

Number of pages 22

Chapter publication date 21 September 2016

Contents

Topic	See page
Safety precautions concerning compressed air	5.10-2
Air line color codes	5.10-3
To test service-brake circuits for air-tightness	5.10-4
To check and lubricate the operating mechanism of the foot brake valve	5.10-7
To inspect brake chambers on front axle	5.10-9
To inspect brake chambers on drive axle	5.10-10
To inspect brake chambers on trailing axle	5.10-12
To check quick release valve of front wheel brakes	5.10-14
To check quick release double check valve of drive axle parking brake	5.10-15
To check relay valve of drive axle service brake	5.10-16
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Safety precautions to be taken, when exposed to brake dust	5.10-18
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Safety precautions concerning compressed air

**Cross-
reference**

Refer to chapter 13.1, "Complete compressed-air system".

Air line color codes

**Cross-
reference**

Refer to chapter 13.25, "Air lines".

To test service-brake circuits for air-tightness

To be carried out when?

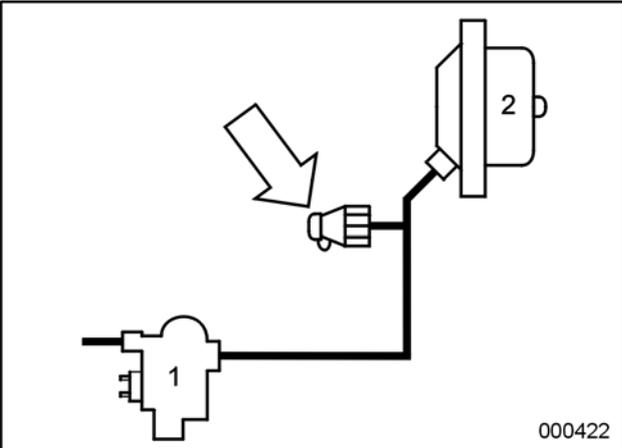
Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

A pressure of 115 to 130 psi in the air tanks

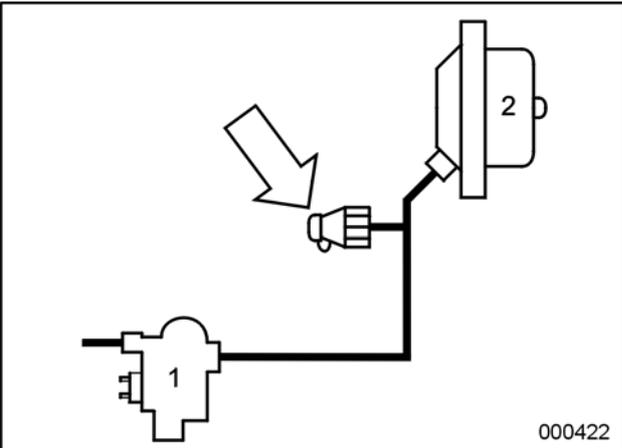
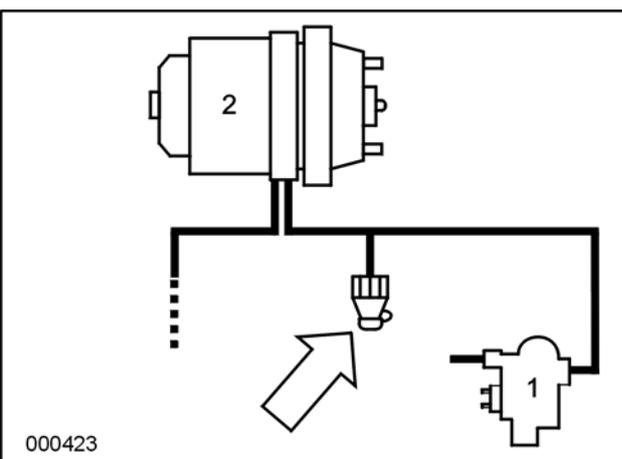
Procedure

Test the three service-brake circuits for air-tightness as follows:

Step	Action
1	<p>Connect a class 0.6 pressure gauge with a range of 145 psi to the test fitting in air line to right-hand front wheel brake chamber. The test fitting is located between ABS valve (1) and brake chamber (2).</p>  <p style="text-align: right;">000422</p>

Step	Action
<p>2</p>	<p>Watch the pressure gauge, as an assistant fully applies and holds brake pedal.</p> <p>The leakage rate with full brake application after 5 minutes must not exceed 4.34 psi.</p> <div data-bbox="694 504 1316 952" style="border: 1px solid black; padding: 5px;"> </div>
<p>3</p>	<p>Repeat the test, this time having connected the pressure gauge to the test fitting in the air line to the drive axle RH service brake chamber.</p> <p>The test fitting is located between ABS valve (1) and brake chamber (2).</p> <div data-bbox="694 1220 1316 1668" style="border: 1px solid black; padding: 5px;"> </div>

continued on next page

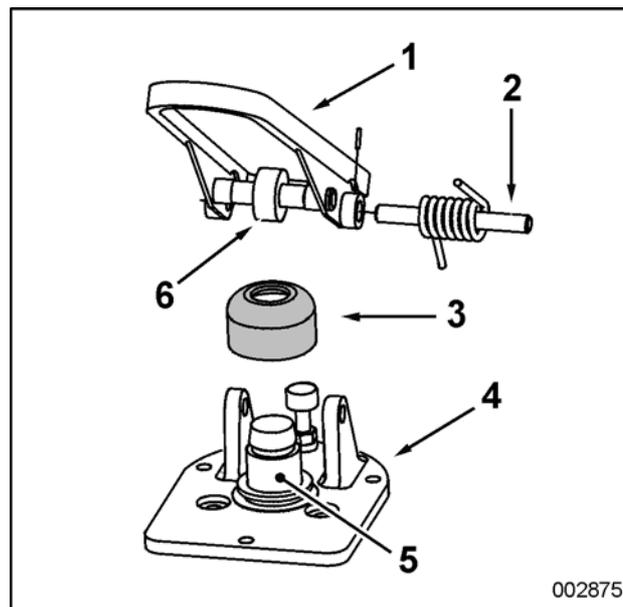
Step	Action
4	<p>On vehicles with only a service brake chamber on the trailing axle: repeat the test, this time having connected the pressure gauge to the test fitting in the air line to the trailing-axle RH brake chamber.</p> <p>The test fitting is located between ABS valve (1) and brake chamber (2).</p>  <p style="text-align: right;">000422</p>
5	<p>On vehicles with a parking brake chamber on the trailing axle: repeat the test, this time having connected the pressure gauge to the test fitting in the air line to the trailing axle RH service brake chamber.</p> <p>The test fitting is located between ABS valve (1) and brake chamber (2).</p>  <p style="text-align: right;">000423</p>
6	<p>If the pressure drop exceeds the permitted rate, locate the air leaks with an electronic detector or by coating the suspected spots in the circuit with a soap solution.</p>

To check and lubricate the operating mechanism of the foot brake valve

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: foot brake valve operating mechanism



- 1 Threadle
- 2 Hinge pin with return spring (return spring only on bus application)
- 3 Plunger dust boot
- 4 Mounting plate
- 5 Plunger
- 6 Threadle roller

Procedure

Step	Action
1	Remove the accumulated dirt, dust, gravel and grease from the heel of threadle (1), plunger (5), plunger dust boot (3) and mounting plate (4).
2	Check the plunger rubber dust boot (3) for damage. Change if necessary.
3	Check threadle (1) and mounting plate (4) for damage, wear and corrosion. Change if necessary.



Step	Action
4	Apply 2 to 4 drops of oil between plunger (5) and mounting plate (4). Do not use too much oil!
5	Lubricate threadle roller (6), threadle roller pin and hinge pin (2) with thin oil.

To inspect brake chambers on front axle

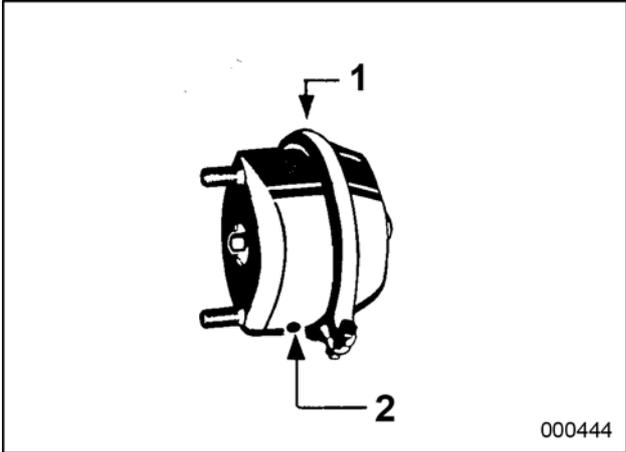
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

Maximum pressure (115 to 130 psi) in the air tanks

Procedure

Step	Action
1	Clean the outside of the brake chamber and look for visible damage.
2	Brush soapy water to vent hole (2) and clamping ring (1). <div data-bbox="692 927 1318 1379" data-label="Image">  </div>
3	Watch for bubbles while an assistant applies the brakes. No leakage whatsoever should be noticeable at the vent hole. On the clamping ring only a little foam should be formed.
4	If the chamber is damaged, or leaking, remove it for further inspection and repair.

To inspect brake chambers on drive axle

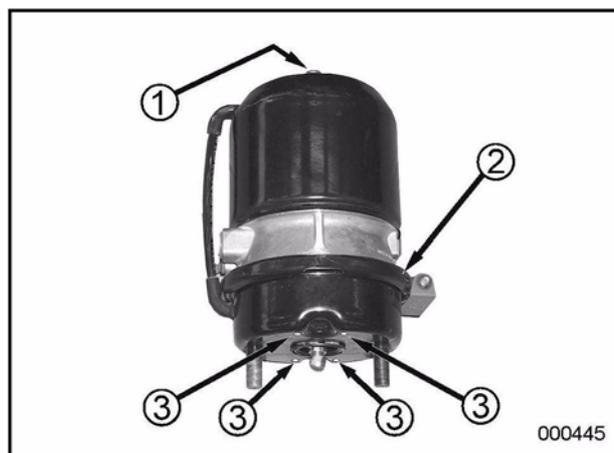
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

- Maximum pressure (115 to 130 psi) in the air tanks
- Wheels chocked

Figure: brake chambers on the drive axle



- 1 Emergency release bolt
2 Clamping ring
3 Vent holes

Procedure

Step	Action
1	Clean the outside of the brake chamber and look for visible damage.
2	Brush soapy water to vent holes (3) and clamping ring (2).
3	Watch for bubbles while an assistant applies the brakes. No leakage whatsoever should be noticeable at the vent holes. On the clamping ring only a little foam should be formed.
4	Release the parking brake.
5	Brush soapy water around the emergency release bolt (1) there where it sticks through the chamber wall. Look for soap bubbles. Only a little foam is allowed to show.
6	If the chamber is damaged, or leaking, remove it for further inspection and repair.

continued on next page

To inspect brake chambers on trailing axle

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

Maximum pressure (115 to 130 psi) in the air tanks

Procedure in case of a service brake chamber

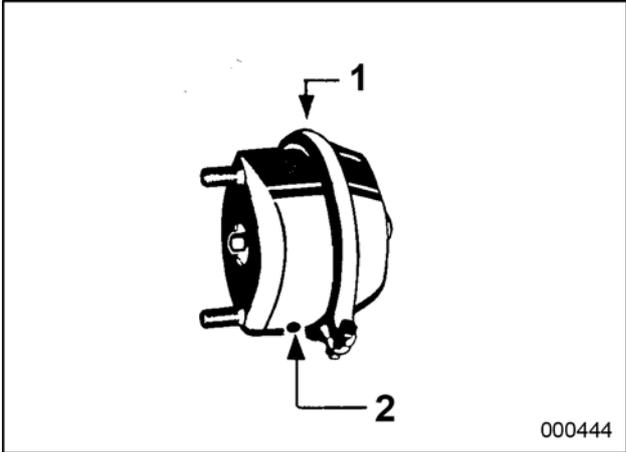
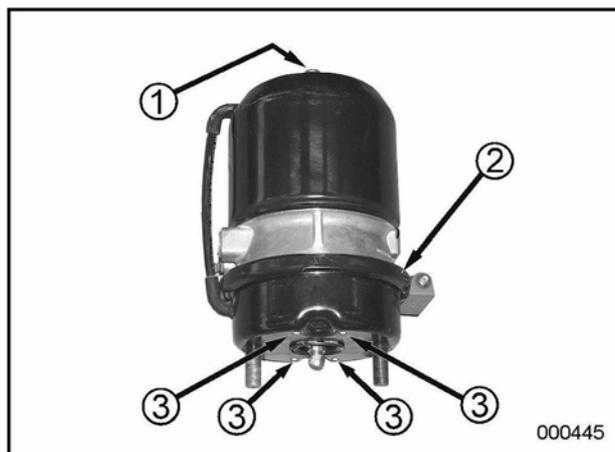
Step	Action
1	Clean the outside of the brake chamber and look for visible damage.
2	Apply soapy water to vent hole (2) and the clamping ring (1). <div style="text-align: center;">  <p>000444</p> </div>
3	Watch for bubbles while an assistant applies the brakes. No leakage whatsoever should be noticeable at the vent hole. On the clamping ring, only a little foam is allowed to show.
4	If the chamber is damaged, or leaking, remove it for further inspection and repair.

Figure:
parking brake
chamber



- 1 Emergency release bolt
- 2 Clamping ring
- 3 Vent holes

**Procedure in
case of a
parking brake
cilinder**

Step	Action
1	Clean the outside of the brake chamber and look for visible damage.
2	Brush soapy water to vent holes (3) and clamping ring (2).
3	Watch for bubbles while an assistant applies the brakes. No leakage whatsoever should be noticeable at the vent holes. On the clamping ring, only a little foam is allowed to show.
4	Put chocks in front of and behind the wheels.
5	Release the parking brake.
6	Brush soapy water around the emergency release bolt (1) there where it sticks through the chamber wall. Look for soap bubbles. Only a little foam is allowed to show.
7	If the chamber is damaged, or leaking, remove it for further inspection and repair.

To check quick release valve of front wheel brakes

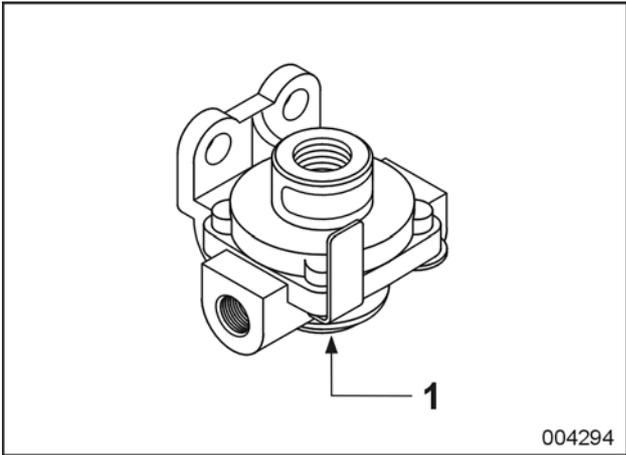
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

Maximum pressure (115 to 130 psi) in the air tanks

Procedure

Step	Action
1	Temporarily remove muffler of the valve, if present.
2	Clean the exhaust opening (1) and brush soapy water on it. Watch for bubbles while an assistant fully applies the brakes (leakage check). <div style="text-align: center; margin-top: 10px;">  </div>
3	Check whether the valve exhausts quickly and without hesitation when the pedal is released.
4	If the valve leaks or fails to exhaust properly, remove it for repair.

To check quick release double check valve of drive axle parking brake

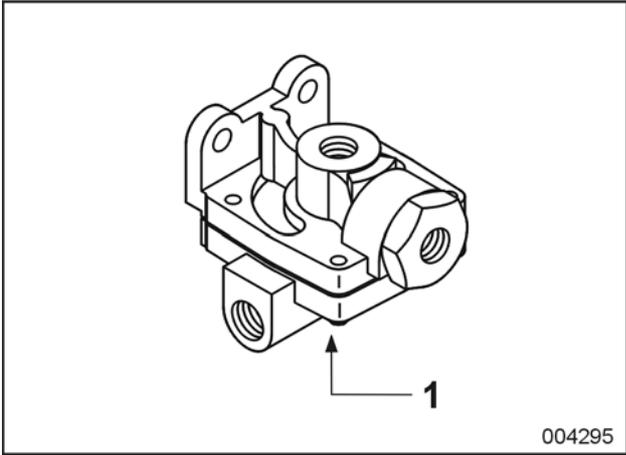
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

- Maximum pressure (115 to 130 psi) in the air tanks
- Wheels chocked

Procedure

Step	Action
1	Temporarily remove the muffler of the valve, if present.
2	Clean the exhaust opening (1) and brush soapy water on it. Check for bubbles while an assistant releases the parking brake (leakage check). <div style="text-align: center;">  </div>
3	Check whether the valve exhausts quickly and without hesitation when the parking brake is applied.
4	If the valve leaks or fails to exhaust properly, remove it for repair.

To check relay valve of drive axle service brake

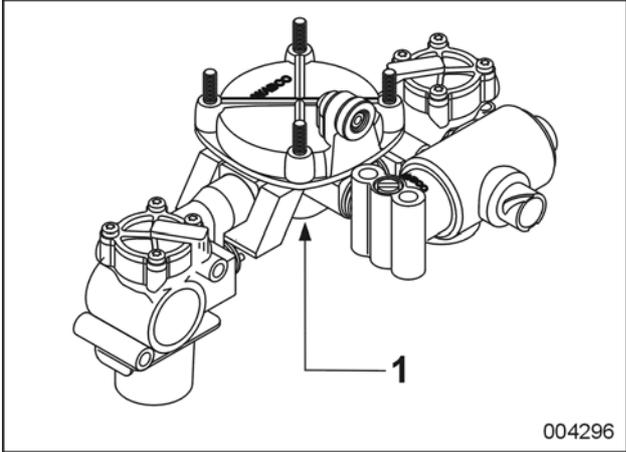
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

Maximum pressure (115 to 130 psi) in the air tanks

Procedure

Step	Action
1	Temporarily remove the muffler of the valve, if present.
2	Clean the exhaust opening (1) and brush soapy water on it. Watch for bubbles while an assistant fully applies the brakes (leakage check). <div style="text-align: center; margin-top: 10px;">  <p style="text-align: right; margin-right: 20px;">004296</p> </div>
3	Check whether the valve exhausts quickly and without hesitation when the pedal is released.
4	If the valve leaks or fails to exhaust properly, remove it for repair.

To check relay valve of trailing axle service brake

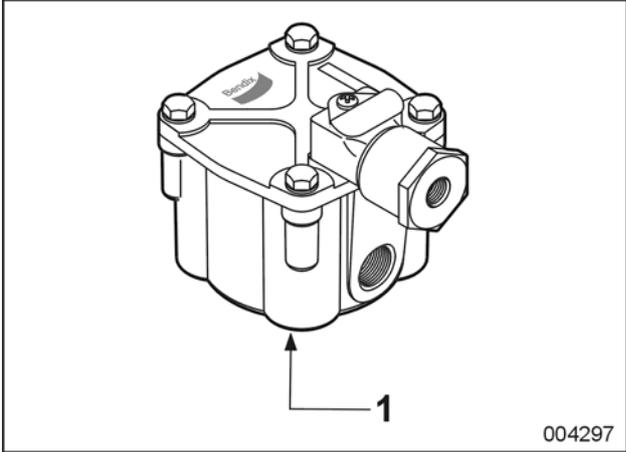
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

Maximum pressure (115 to 130 psi) in the air tanks

Procedure

Step	Action
1	Temporarily remove the muffler of the valve, if present.
2	Clean the exhaust opening (1) and brush soapy water on it. Watch for bubbles while an assistant fully applies the brakes (leakage check). <div style="text-align: center; margin-top: 10px;">  </div>
3	Check whether the valve exhausts quickly and without hesitation when the pedal is released.
4	If the valve leaks or fails to exhaust properly, remove it for repair.

Safety precautions to be taken, when exposed to brake dust

Introduction

Van Hool use on its vehicle brake pads with asbestos-free material.

Experts do not agree on the harmless nature of asbestos-free brake linings. It is therefore recommended to observe the safety instructions below even with asbestos-free brakes. They are meant to prevent the creation of airborne brake dust and inhalation.



WARNING!

To remove dust from brake parts or from the floor, use an industrial vacuum cleaner designed for this type of work. Do not ever use brushes or compressed air!



WARNING!

Before removing a road wheel, vacuum the wheel disc first. After removing the wheel, vacuum around the brake caliper. Wipe any remaining dust using a wet rag. Put used rags in plastic waste bags, before they get dry. Remove dust fallen on the floor with a vacuum cleaner; do not ever use a brush to sweep it up. If necessary, wet the dust thoroughly and scrape it up.

To dispose of brake pads

Dispose of used brake pads in accordance with the environment regulations of your country or region.

Knorr-Bremse SN7... disc brakes: maintenance

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Procedure

Follow the instructions mentioned in the manual "Service Manual Pneumatic Disc Brake SN7..." by Knorr-Bremse.

Knorr-Bremse SN7... disc brakes: to remove/install brake pads

Consumables

Set of brake pads (four brake pads + four brake pad springs)	Van Hool No. N508206030 (Jurid 539-20)
Wear indicator set (two wear indicators + wire clip) ^a	Van Hool No. N508226028

a. Not on vehicles with EBS (Electronic Braking System) except in case of a DAF rear axle.

Setting values

Refer to "Technical data" at the end of this chapter.

Tightening torques

Refer to "Technical data" at the end of this chapter.



CAUTION!

Do not use brake pads with lining material different from that specified in the technical data.



CAUTION!

Always change the brake pads on both axle ends at the same time.



CAUTION!

When changing brake pads, always fit new brake pad hold-down springs. On vehicles with ABS, new wear indicators have to be mounted as well.

Procedure

Follow the instructions mentioned in the manual "Service Manual Pneumatic Disc Brake SN7..." by Knorr-Bremse.

Technical data: compressed-air brakes

Brake assembly

Make	Knorr-Bremse
Type	SN7...
Brake clearance (brake pad-to-piston)	0.024 to 0.043 in

Brake disc

Maximum permissible run-out, when installed	0.002 in
Thickness, new	1.77 in
Maximum remachining thickness	1.57 in
Discard when worn to...	1.46 in

Brake pad

Lining thickness, new	0.83 in
Minimum permissible lining thickness	0.08 in
Lining material	(Jurid 539-20) (asbestos-free)

Tightening torques

Brake carrier fixing screws	300 ft.lbf
Front and trailing axles: screws securing brake disc and wheel flange to hub unit	300 ft.lbf



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Part 6 - Transmission

Overview

Contents

Chapter	See page
Chapter 10: Transmission	6.10-1

The following chapters have been *modified* since the former edition:

Chapter	See page
Chapter 10: Transmission	6.10-1

Chapter 10: Transmission

Overview

Introduction This chapter deals with the transmission.

Number of pages 16

Chapter publication date 14 October 2016

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Topic	See page
Allison WTB500(R) transmission: to check oil level with cold transmission	6.10-2
Allison WTB500(R) transmission: to check oil level with warm transmission	6.10-4
Allison WTB500(R) transmission: to call up oil level with transmission selector	6.10-6
Allison WTB500(R) transmission: to retrieve condition of oil, oil filters and clutches by means of range selector	6.10-8
Allison WTB500(R) transmission: to change oil	6.10-10
Allison WTB500(R) transmission: to change oil filters	6.10-12
Technical data: transmission	6.10-15

The following subjects have been *added/modified* since the former edition:

Topic	See page
Allison WTB500(R) transmission: to call up oil level with transmission selector	6.10-6
Allison WTB500(R) transmission: to retrieve condition of oil, oil filters and clutches by means of range selector	6.10-8
Allison WTB500(R) transmission: to change oil	6.10-10

Allison WTB500(R) transmission: to check oil level with cold transmission

Introduction

This check enables you to determine whether there is enough oil in the transmission so that it can safely operate until it's warmed up. Check the oil level again with a warm transmission.

Equipment condition

- Vehicle on level ground
- Parking brake applied

Location of dipstick and filler cap

Refer to chapter 1.1, "Access doors and controls at the outside".

Before starting the check

Step	Action
1	Check the oil level with the dipstick before you start the engine. The level should be close to the "HOT FULL" mark.
2	Top up with oil, if necessary.

Procedure

Step	Action
1	Start engine and let it idle for approximately 1 minute.
2	Engage briefly "D" and then "R" to bleed air from hydraulic circuits.
3	Put the transmission in neutral and let the engine idle.
4	Pull out dipstick.
5	Wipe the dipstick clean with a cloth and reinsert it.

continued on next page

Step	Action
<p>6</p>	<p>Pull out dipstick.</p> <p>The oil level should be between the "COLD ADD" and the "COLD FULL" marks on the dipstick.</p> <div data-bbox="694 470 1316 918" style="text-align: center;"> <p>004602</p> </div>
<p>7</p>	<p>If oil level is too low, top up with oil through filler tube. If the level is too high, drain some oil.</p>

After oil level check with cold transmission

Before taking the vehicle into operation, carry out a check with warm transmission after a check with cold transmission. Refer to "Allison WTB500(R) transmission: to check oil level with warm transmission".

Allison WTB500(R) transmission: to check oil level with warm transmission

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

- Transmission at operating temperature (minimum transmission-oil temperature 160 °F)
- Vehicle on level ground
- Parking brake applied
- Transmission selector in neutral position

Location of dipstick and filler cap

Refer to chapter 1.1, "Access doors and controls at the outside".

Procedure

Step	Action
1	Start engine and let it idle.
2	Pull out dipstick.
3	Wipe the dipstick clean with a cloth and reinsert it.
4	<p>Pull out dipstick.</p> <p>The oil level should be between the "HOT ADD" and the "HOT FULL" marks on the dipstick.</p> <p style="text-align: right;">004603</p>

Step	Action
5	If oil level is too low, top up with oil through filler tube. If oil level is too high, drain some oil.

Allison WTB500(R) transmission: to call up oil level with transmission selector

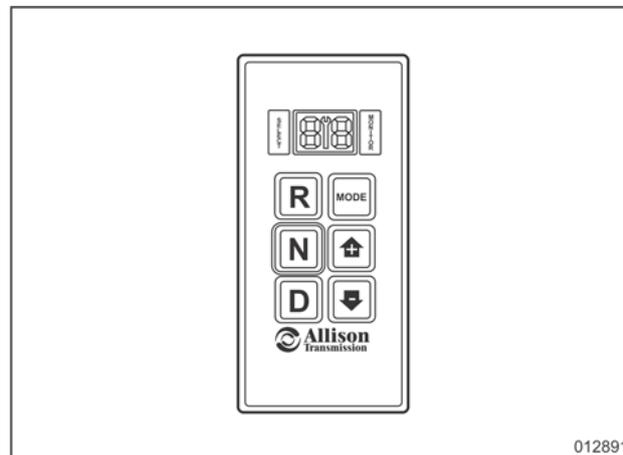
Introduction

The transmission is equipped with an oil level sensor, allowing the driver to call up the oil level by using the transmission range selector in the driver's cab.

Equipment conditions

- Vehicle on level ground
- Parking brakes applied

Figure: range selector



Delayed oil level information

The oil level will only be rendered if the following conditions are met:

- transmission at service temperature (oil temperature between 140°F and 220°F);
- transmission in neutral;
- vehicle at standstill (at least 2 minutes);
- idling engine.

The oil level information will be delayed if these conditions are not met. During this delay, various messages may appear on the display (refer to table below).

Rendition on display	Explanation
SETTLING	Vehicle standstill time not long enough
ENG RPM TOO LO	Engine speed too low
ENG RPM TOO HI	Engine speed too high

continued on next page

Rendition on display	Explanation
MUST BE IN NEUTRAL	Transmission not in neutral
OIL TEMP TOO LO	Oil temperature too low
OIL TEMP TOO HI	Oil temperature too high
VEH SPD TOO HI	Propeller shaft turning
SENSOR ERROR	Sensor failure

Procedure

Simultaneously press the "down" and the "up" arrow button of the transmission selector once.

On the display of the transmission range selector, various messages may appear (refer to table below).

Rendition on display	Explanation
TRANS OIL LEVEL OK	Oil level correct
TRANS OIL 1QT LO	1 U.S. Qts of oil short
TRANS OIL 2QT LO	2 U.S. Qts of oil short
TRANS OIL 1QT HI	1 U.S. Qts of oil too many
TRANS OIL 2QT HI	2 U.S. Qts of oil too many

To exit the oil level check mode

Press one of the "drive" keys on the transmission range selector.

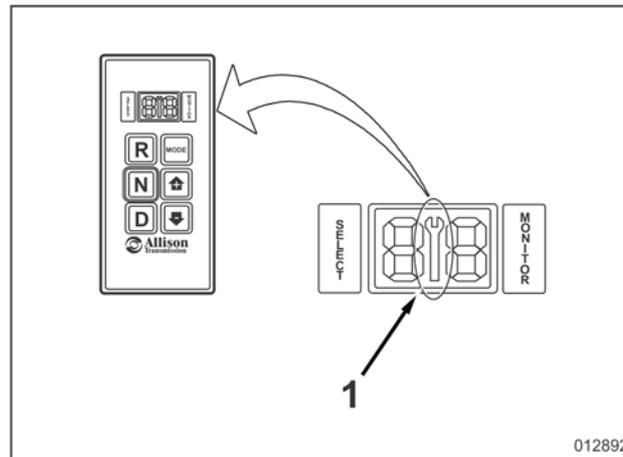
Allison WTB500(R) transmission: to retrieve condition of oil, oil filters and clutches by means of range selector

Introduction

The transmission has been fitted with a prognostic function. Through the range selector display, the prognostic function shows:

- the remaining life of the oil;
- the condition of the oil filters;
- the condition of the clutches.

Figure: range selector



1 Service indicator

To retrieve remaining oil life

Two consecutive times, simultaneously press the "down" and the "up" arrow button of the transmission range selector.

"OIL LIFE" appears on the range selector display, followed by the remaining life in percentage. Fresh oil is indicated as "100%".

When an oil change is necessary, the service indicator on the range selector display comes on. The service indicator comes on each time you switch on the ignition, and remains on for approximately 2 minutes after you have pressed the "D" button. If transmission maintenance is overdue, the message "CHECK TRANS" appears after a while on the multifunctional display of the dashboard.

After an oil change, you have to reset the prognostic function. To this end, retrieve the "OIL LIFE" information and press the range selector "MODE" button for 10 seconds.

continued on next page

To retrieve oil filters condition

Three consecutive times, simultaneously press the "down" and the "up" arrow button of the transmission selector.

"FILTERS OK" or "REPLACE FILTERS" appears on the range selector display. "FILTERS OK" means that the filters are still good, "REPLACE FILTERS" means that the filters have to be changed.

When the filters have to be changed, the service indicator on the range selector display starts to flash. The service indicator flashes each time you switch on the vehicle ignition, and will keep flashing for approximately 2 minutes after you have pressed the "D" button. If transmission maintenance is overdue, the message "CHECK TRANS" appears after a while on the multifunctional display of the dashboard.

After you have changed the filters, you have to reset the prognostic function. To this end, retrieve the "FILTERS" information and press the range selector "MODE" button for 10 seconds.

To retrieve condition of clutches

Four consecutive times, simultaneously press the "down" and the "up" arrow button of the transmission selector.

"TRANS HEALTH OK" or "TRANS HEALTH LO" appears on the range selector display. "TRANS HEALTH OK" means that the clutches are still good, "TRANS HEALTH LO" means that the clutch has to be replaced. It is not indicated which clutch has to be replaced.

If one or more clutches have to be replaced, the service indicator on the range selector display comes on, and remains on while the vehicle is in service. If replacement of the clutches is overdue, the message "CHECK TRANS" appears after a while on the multifunctional display of the dashboard.

After you have changed the clutches, you have to reset the prognostic function. This can only be done by means of Allison diagnostic software.

To exit prognostic function

Press one of the "drive" keys on the transmission range selector.

Allison WTB500(R) transmission: to change oil

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Oil type

Refer to chapter 1.1, "Fluids and lubricants".

Consumables

Refer to Van Hool spare parts manual.

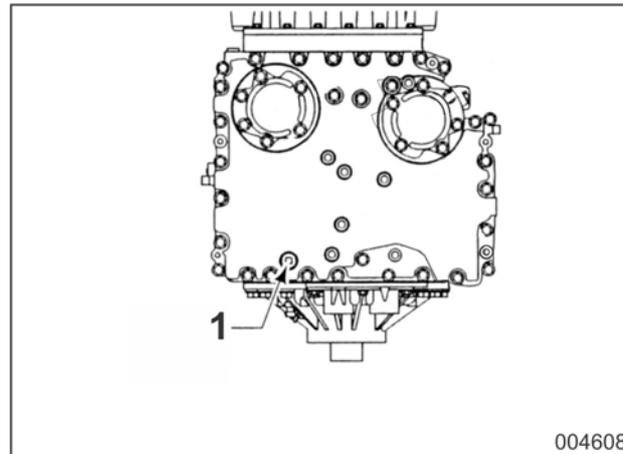
Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment conditions

- Transmission oil temperature at least 160 °F
- Engine stopped

Figure: bottom view of transmission



1 Oil pan drain plug



WARNING!

Hot oil flowing out of the oil pan can cause scalds. Avoid contact with skin.

Procedure

Step	Action
1	Unscrew drain plug (1) from the oil pan and allow oil to drain.
2	Re-install the plug, with a new O-ring, in its place, and tighten it to the prescribed torque.
3	Fill the transmission with oil through filler tube.
4	Check the oil level (refer to "Allison WTB500(R) transmission: to check oil level with cold transmission").
5	Check the transmission for leaks.
6	Check the oil level with warm transmission (refer to "Allison WTB500(R) transmission: to check oil level with warm transmission").

Allison WTB500(R) transmission: to change oil filters

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Consumables

"MAIN + LUBE" filter set (two "High Capacity" filter elements + two O-rings + two sealing rings + two gaskets)	Allison No. 29545776
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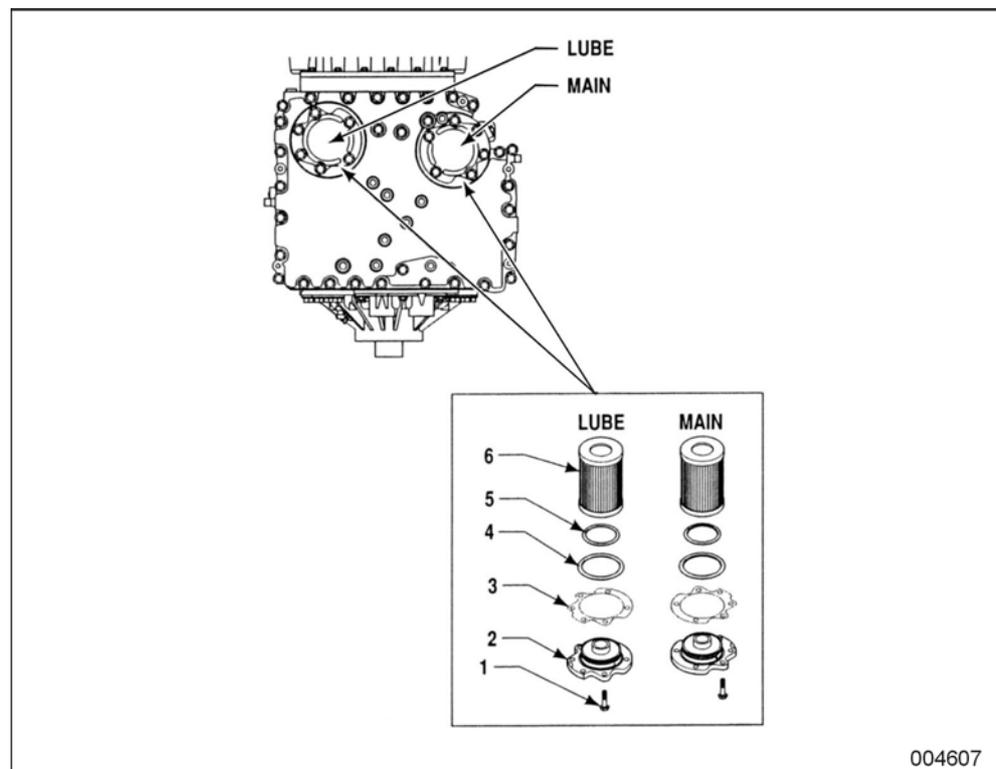
Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment condition

Oil drained, refer to "Allison WTB500(R) transmission: to change oil"

Figure: bottom view of transmission



- 1 Fixing screw
- 2 Filter cover
- 3 Gasket
- 4 Filter cover sealing-ring
- 5 O-ring
- 6 Filter

Procedure

NOTE: Procedures for replacing "MAIN" and "LUBE" filters are identical.

Step	Action
1	Remove the screws securing the filter cover to the transmission.
2	Remove the filter cover together with the filter element from the transmission.
3	Pull the filter element from the filter cover, and dispose of it in accordance with the environmental regulations.
4	Remove gasket (3) and sealing ring (4) from filter cover.
5	Lubricate O-ring (5) with oil, and place it on the filter element.
6	Place sealing ring (4) on the filter cover.
7	Install gasket (3).
8	Push the new filter element on the filter cover.

continued on next page

Step	Action
9	Place the filter cover together with the new filter element into the filter housing and tighten the screws to the prescribed torque.

Technical data: transmission

Tightening torques

Allison WTB500(R)	Oil drain plug	18 to 24 ft.lbf
	Filter cover fixing screws	38 to 45 ft.lbf

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Part 7 - Steering

Overview

Contents

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Chapter 6: Front axle steering system

Overview

Introduction This chapter deals with the front axle steering system.

Number of pages 64

Chapter publication date 21 September 2016

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To check power steering fluid level

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Fluid type

Refer to chapter 1.1, "Fluids and lubricants".

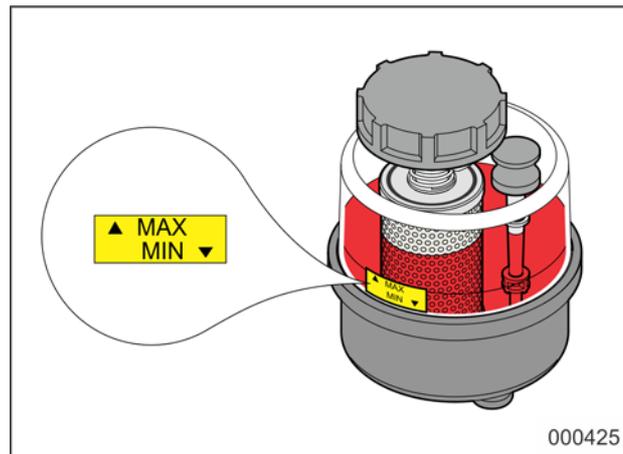
Equipment condition

- Engine idling
- Steering fluid at operating temperature

Location of steering fluid tank

Refer to chapter 1.1, "Access doors and controls at the outside".

Figure: level marks on steering fluid tank



CAUTION!

If fluid level is too low, malfunctioning and possibly even loss of power steering can be the results.

Correct level

The level is correct, if it reaches the "MAX" mark on the transparent tank.

To add fluid

Step	Action
1	Thoroughly clean tank top.
2	Unscrew filler cap from tank.
3	Add fluid.
4	Screw filler cap back on tank. <i>NOTE: If, after turning off the engine, the level rises more than 0.4 to 0.8 in above the "MAX" mark, this means there is too much air in the fluid system.</i>

To change fluid of power steering system

To be carried out when?

It is recommended to change the complete fluid content of the hydraulic circuit, when the steering gear or the steering pump are overhauled or when fitting a replacement. At the same time change the oil filter and clean out the fluid lines.

Fluid type

Refer to chapter 1.1, "Fluids and lubricants".

Content of fluid circuit

Refer to chapter 1.1, "Fluids and lubricants".

Equipment condition

- Vehicle over inspection pit
- Parking brake applied
- Chocks in front of and behind drive axle wheels
- Vehicle jacked up at the front



CAUTION!

Absolute cleanliness is necessary when servicing hydraulic systems. Solid particles entering the liquid may cause considerable damage within a short space of time. Take care that no dirt enters the tank, when you open it. Before undoing any pipe or hose connections, thoroughly clean the connections and their immediate surroundings.



CAUTION!

Do not re-use fluid which has been drained from the circuit.

To drain fluid

Step	Action
1	Place a container with sufficient capacity underneath steering gear.
2	Disconnect hydraulic pressure and return lines from steering gear.

continued on next page

Step	Action
3	 <p>CAUTION! While executing this step, do not operate engine for more than 10 seconds. Otherwise power steering pump can be damaged.</p> <p>Start engine and allow to idle briefly in order to discharge fluid from tank, lines and pump.</p>
4	<p>Turn steering wheel from stop to stop, until no more fluid comes out.</p> <p><i>NOTE: After this quite some fluid will remain in steering gear. If drained fluid is heavily contaminated (for example due to metal particles generated by a defective pump), steering gear has to be removed. It has to be opened and cleaned in a ZF-approved workshop.</i></p>
5	Reconnect pressure and return lines to steering gear.

**CAUTION!**

The engine must not be allowed to exceed idling speed during the filling procedure.

To fill circuit

Step	Action
1	Unscrew fluid tank cap and fill tank to edge with recommended fluid.
2	<p>Be ready to top up fluid, while assistant starts engine.</p> <p>With engine running, fluid level in tank will drop rapidly. Add new fluid at same rate to avoid tank from getting empty and air being drawn into system.</p>
3	Bleed circuit (see below).

To bleed air from circuit

Start bleeding procedure no sooner than fluid in tank remains at dipstick "MAX" mark, while engine is running.

NOTE: Do not rev up engine. Otherwise the fluid will foam, causing bleeding to take unnecessarily long.

continued on next page

Step	Action
1	<p>Let engine idle for 2 to 3 minutes, while assistant watches fluid level and tops up, if level drops.</p> <p>Thus most of the air is bled from steering gear.</p> <p><i>NOTE: To speed up bleeding procedure, turn steering wheel from stop to stop a few times (but do not apply effort in full lock positions!).</i></p>
2	<p>If necessary, add fluid, until level remains at "MAX" mark and no more air bubbles emerge in tank, when steering wheel is turned.</p>
3	<p>Stop engine.</p> <p>If system has been bled properly, fluid should not rise more than 0.4 to 0.8 in above "MAX" mark on dipstick in tank.</p>
4	<p>Lower wheels onto ground.</p>

To connect the "Servotest 570" tester

Introduction

ZF have developed a special tester, which allows for easy checking of the hydraulic power assistance system: the Servotest 570.

The tester comes with a manual, which explains how the tester is to be connected to the steering system and how the controls work.

Figure:
Servotest 570

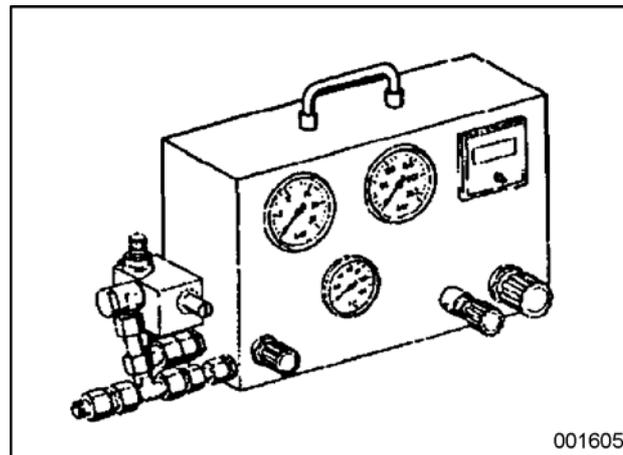
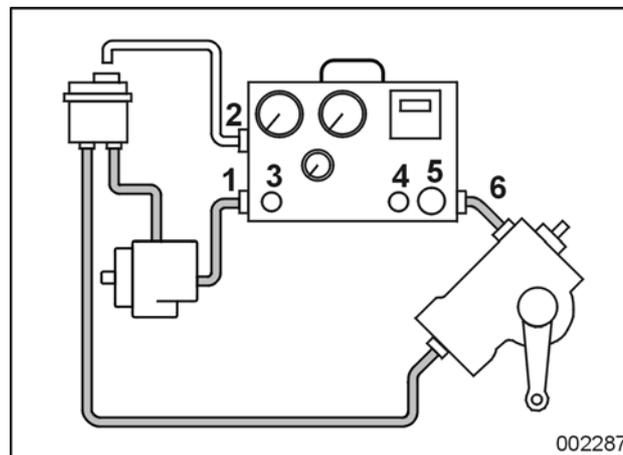


Figure:
connection diagram for Servotest 570



- 1 "EINGANG" (inlet)
- 2 "TANK" (tank)
- 3 "DROSSELVENTIL" (flow control valve)
- 4 "DRUCKBEGRENZUNGSVENTIL" (pressure relief valve)
- 5 "ABSPERRVENTIL" (shut-off valve)
- 6 "AUSGANG" (outlet)

Equipment condition

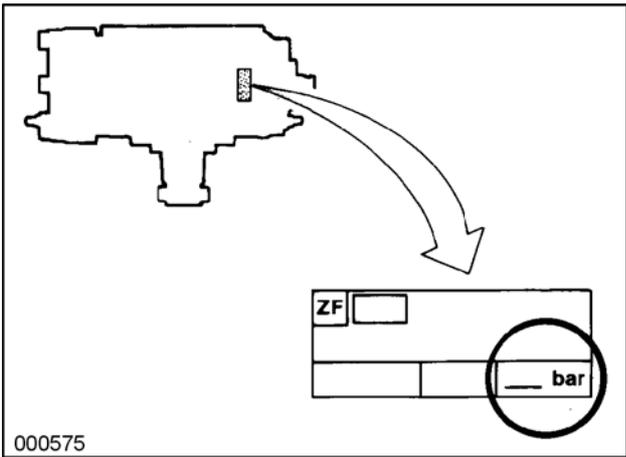
- Vehicle over inspection pit
- Parking brake applied
- Chocks in front of and behind drive axle wheels



CAUTION!

Absolute cleanliness is necessary when servicing hydraulic systems. Solid particles entering the liquid may cause considerable damage within a short space of time. Before undoing any pipe or hose connections, thoroughly clean the connections and their immediate surroundings.

To connect and set the tester

Step	Action
1	Connect the steering pump pressure line to the "EINGANG" port of the tester.
2	Connect the steering gear pressure line to the "AUSGANG" port of the tester.
3	Connect a hose to the "TANK" port. Hang the other end of the hose loosely in the steering fluid tank of the vehicle.
4	Turn the "DRUCKBEGRENZUNGSVENTIL" knob to maximum operating pressure, as indicated on the steering gear identification plate. 
5	Close the "DROSSELVENTIL" knob.
6	Open the "ABSPERRVENTIL" knob completely.

continued on next page

Before carrying out the checks with the tester

After you have connected and set the tester, proceed as follows before checking the steering system:

Step	Action
1	Bleed the installation, refer to "To change fluid of power steering system" in the present chapter
2	Heat the steering fluid to 50 °C (122 °F), refer to "To bring the steering fluid up to testing temperature" below.
3	Check the fluid level, refer to "To check power steering fluid level" in the present chapter.

To bring the steering fluid up to testing temperature

You can use the tester to bring the steering fluid up to testing temperature.

Step	Action
1	Let the engine idle.
2	Set the pressure to 50 bar (725 psi) with the "ABSPERRVENTIL" shut-off valve.
3	Wait until the built-in thermometer indicates the desired temperature, then turn the shut-off valve completely open.

Before putting the vehicle into service

Step	Action
1	Disconnect the tester.
2	Connect the pressure lines.
3	Bleed the installation, refer to "To change fluid of power steering system" in the present chapter
4	Check the fluid level, refer to "To check power steering fluid level" in the present chapter.

To check steering pump flow

To be carried out when?

At each major inspection of the steering system

Special tools

"Servotest 570" tester	ZF No. 7418798574
------------------------	-------------------

Checking values

Refer to separate manual of the "Servotest 570" tester.

Equipment condition

- Parking brake applied
- Chocks in front of and behind drive axle wheels
- "Servotest 570" tester connected (follow the instructions under "To connect Servotest 570 tester" in this chapter)
- Steering fluid temperature 50 °C (122 °F)

Procedure

Step	Action
1	Let the engine idle.
2	With the shut-off valve of the tester, set the checking pressure listed in the tester manual.
3	Read flow.
4	Compare the measured value to the value prescribed in the manual of the tester.

To check/set hydraulic steering limitation

Introduction

If a front wheel were to be turned against the steering stop with full power-assisted pressure, the steering pump and steering mechanism would be damaged due to overstraining. This is why the steering gear has two valves that automatically reduce pressure, just before a road wheel reaches its maximum steering turning angle. It is possible to set the point in time at which these valves open.

To be carried out when?

Refer to "Steering system: to perform major inspection" in chapter 1.1, "Maintenance schedule".

Special tools

Steering wheel puller	Van Hool No. 619900910
Torque meter socket with serrations	Van Hool No. 10575651
Hose to connect pressure checking gauge	Van Hool No. 639901590

Setting values

Refer to "Technical data" at the end of this chapter.

Equipment condition

- Parking brake applied
- Chocks in front of and behind drive axle wheels.
- Steering angle lock angles set correctly, refer to "To check/set steering lock angles" in chapter 12.6.
- Steering fluid temperature between 40 and 60 °C (104 and 140 °F), refer to "To bring steering fluid up to temperature" below.

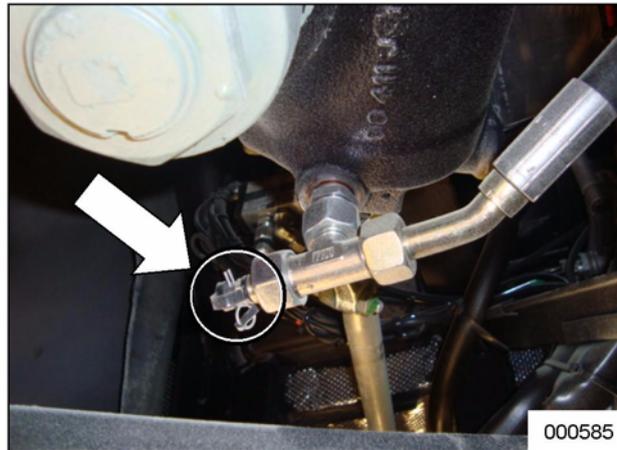
To bring steering fluid up to temperature

You can warm up the steering fluid by running the engine and turning the steering wheel from stop to stop a few times. Measure the temperature in the fluid tank.

NOTE: If you are using the special tester by ZF, you can warm up the fluid quickly by operating the shut-off valve of the tester (refer to "To connect Servotest 570 tester" earlier in this chapter).

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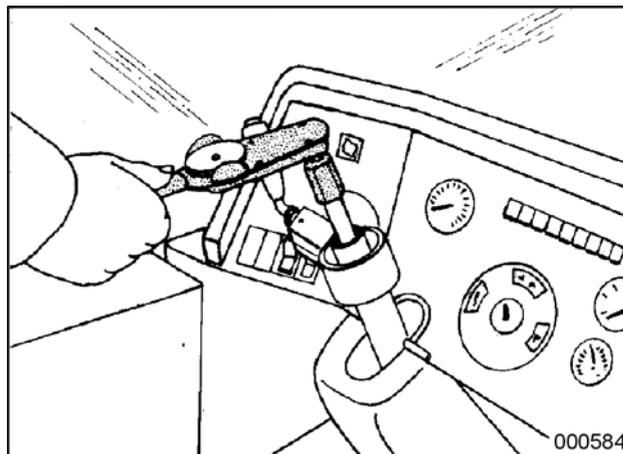
Figure: test fitting near steering gear

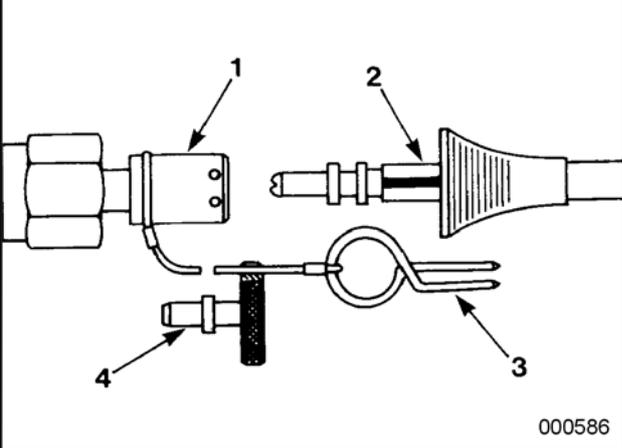


To check maximum limitation pressure values

NOTE: If you use the tester to measure limitation pressure values, take care that the tester shut-off valve is open completely.

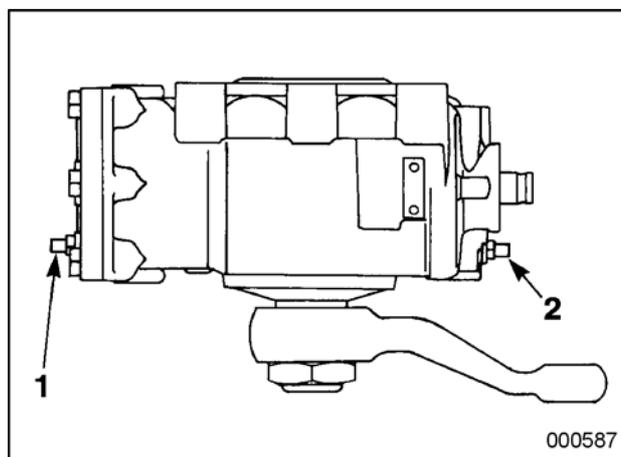
Step	Action
1	Jack up vehicle at front, until wheels clear ground.
2	Using a screwdriver pry cover from steering wheel hub. Remove the steering-wheel nut and pull the steering wheel off the steering column with a special puller.
3	Place a torque meter with the special socket on the serrated steering column end.



Step	Action
4	<p>There is a T-piece with test fitting underneath the vehicle near the steering gear. Pull spring cotter (3) of plug (4) from test fitting (1). Remove plug (4). Connect a pressure gauge of 250 bar (3 600 psi) to hose (2) (special tool). Connect hose (2) to test fitting.</p>  <p style="text-align: right;">000586</p>
5	Start the engine and let it idle during the remaining part of the test.
6	<p>Have an assistant hold a 0.12 in thick hard steel plate against adjusting screw (see figure) of LH steering knuckle carrier.</p>  <p style="text-align: right;">000198</p>
7	Use the torque meter to turn the steering column counter-clockwise until the strip is caught between the adjusting screw and the tie-rod arm.

Step	Action
8	 <p>CAUTION! Do not keep steering column end in end-of-travel position for longer than 5 seconds.</p> <p>Using a torque meter, pull steering column briefly against left end stop at 18 to 36 ft.lbf. and read pressure on pressure gauge.</p>
9	Repeat test for right wheel.
10	Compare measured values with values in technical data.

Figure:
adjusting
screws on
steering gear



- 1 Limiting end-pressure on left turns
2 Limiting end-pressure on right turns

**To set end
limitation
pressure
values**

Step	Action
1	Let go of steering column end, so that only no-load pressure is still in system.
2	Using a 14 mm wrench, loosen locknut of relevant adjusting screw on steering gear.
3	Turn adjusting screw with 5 mm socket wrench: <ul style="list-style-type: none"> • counterclockwise to increase pressure; • clockwise to reduce pressure.
4	Check whether pressure has changed as described under "To check maximum limitation pressure values".
5	Repeat steps 1 and 3, until prescribed maximum limitation pressure is reached.

continued on next page

Step	Action
6	Tighten locknut to prescribed torque without adjusting screw turning as well.
7	Lower front wheels onto ground.
8	Fix the steering wheel in straight-ahead position on the steering column.
9	Turn off engine. Remove pressure gauge and reinstall test fitting plug.
10	Check setting, refer to "To check setting".

To check setting

Slowly drive vehicle (with normal load) forward and turn steering wheel clockwise (and a second time counterclockwise as well), until point where power assistance falls out. Some clearance should still remain between the tie-rod arm and the adjusting screw on the steering knuckle carrier.

To check steering gear pressure

To be carried out when?

Refer to "Steering system: to perform major inspection" in chapter 1.1, "Maintenance schedule".

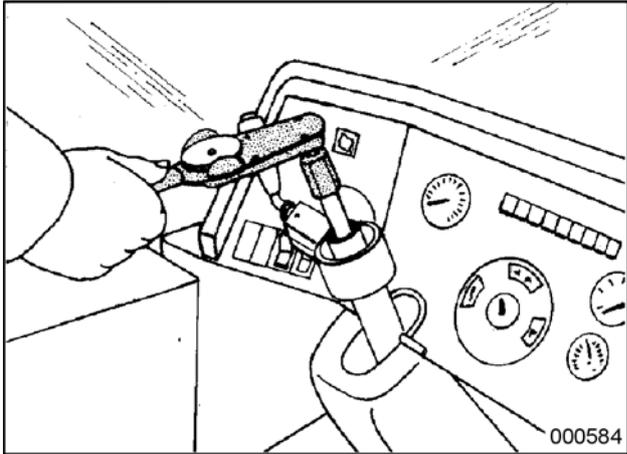
Special tools

"Servotest 570" tester	ZF No. 7418798574
Steering wheel puller	Van Hool No. 619900910
Torque meter socket with serrations	Van Hool No. 10575651

Equipment condition

- "Servotest 570" tester connected, refer to "To connect Servotest 570 tester" earlier in this chapter
- Shut-off valve of "Servotest 570" tester fully open
- Parking brake applied
- Chocks in front of and behind drive axle wheels

Procedure

Step	Action
1	Using a screwdriver pry cover from steering wheel hub. Remove the steering wheel nut and pull the steering wheel off the column with the special puller.
2	Place a torque meter with the special socket on the serrated steering column end. 
3	Start the engine and let it idle during the remaining part of the test.

Step	Action
4	<p>Have an assistant hold a 0.6 in thick hard steel strip against adjusting screw (see figure) on the left steering knuckle carrier.</p> 
5	<p>Use the torque meter to turn the steering column counter-clockwise until the strip is caught between the adjusting screw and the tie-rod arm.</p>
6	<p> WARNING!</p> <p>There is a danger that the test block will be squeezed out from between the stops; therefore do not look straight at the block. If the block has to be held by hand during the pressure test, first check whether sufficient space is available between the wheel and the chassis parts to do so safely. Danger of crushing your hands, if for example the block is squeezed out and the wheel springs back.</p> <p>Using the torque meter now pull the steering column end with 18 to 36 ft.lbf against the left stop – but no longer than 5 seconds.</p> <p>Make note of highest reading on pressure gauge.</p>
7	<p>Repeat same test for right wheel.</p>

To evaluate steering gear pressure measured

If the measured pressure values (or one of them) are (is) less than the maximum steering pump pressure measured in "To check steering pump pressure":

- either the pressure relief valve in the steering gear is faulty;
- or oil leakage in the steering gear is excessive (as a result of parts wear).

To check steering gear for internal leakage

To be carried out when?

Refer to "Steering system: to perform major inspection" in chapter 1.1, "Maintenance schedule".

Special tools

"Servotest 570" tester	ZF No. 7418798574
Steering wheel puller	Van Hool No. 619900910
Torque meter socket with serrations	Van Hool No. 10575651

Checking values

Refer to "Technical data" at the end of this chapter.

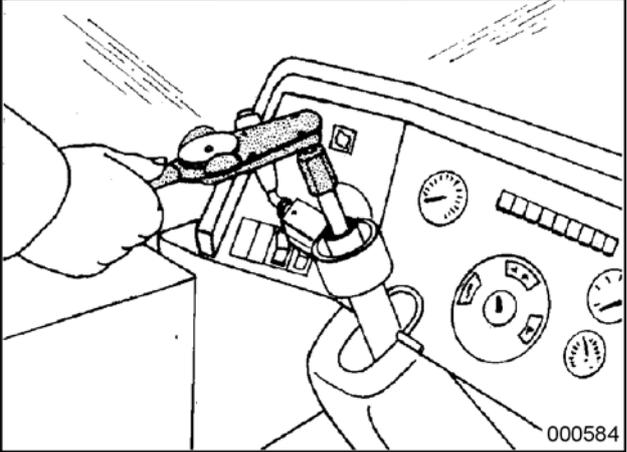
Equipment condition

- Vehicle over inspection pit
- "Servotest 570" tester connected, refer to "To connect Servotest 570 tester" earlier in this chapter
- Parking brake applied
- Chocks in front of and behind drive axle wheels

Procedure

Step	Action
1	Using a screwdriver pry cover from steering wheel hub. Remove the steering wheel nut and pull the steering wheel off the column with the special puller.

continued on next page

Step	Action
2	Place a torque meter with the special socket on the serrated steering column end. 
3	Start the engine and let it idle during the remaining part of the test.
4	Close shut-off valve on tester completely and close flow-control valve far enough to create a pressure which is 30 bar (435 psi) below the maximum pump pressure measured in "To check maximum steering pump pressure".
5	Re-open shut-off valve.
6	Have an assistant hold a 0.6 in thick hard steel strip against adjusting screw (see figure) on the left steering knuckle carrier. 
7	Use the torque meter to turn the steering column counter-clockwise until the strip is caught between the adjusting screw and the tie-rod arm.

Step	Action
8	 <p>WARNING!</p> <p>There is a danger that the test block will be squeezed out from between the stops; therefore do not look straight at the block. If the block has to be held by hand during the pressure test, first check whether sufficient space is available between the wheel and the chassis parts to do so safely. Danger of crushing your hands, if for example the block is squeezed out and the wheel springs back.</p> <p>Using the torque meter now pull the steering column end with 18 to 36 ft.lbf against the left stop – but no longer than 5 seconds. Read oil leakage and release torque meter from steering column end.</p>
9	Repeat same test for right wheel.
10	<p>Check whether high-pressure seals in steering gear leak more than is allowed with low pump flow as well. Set Servotest to 3 dm³/min (0.8 gal/min) flow. If necessary, repeat steps 4 through 8.</p> <p>The leak flow measured must not exceed the value found at normal operating flow.</p>
11	Secure the steering wheel in the straight-ahead position on the steering column.

Causes of excessive leak flow

Cause	What to do?
Defective pressure reducing valve in steering gear	Have a specialized professional change the pressure reducing valve.
Pressure reducing valve in steering gear opens up too soon	Set steering limiter valves as described in "To check/adjust hydraulic steering lock" earlier in this chapter.
Seals in steering gear show leaks	Remove the steering gear for repair in an authorized ZF workshop.

To check return time of power steering valve

To be carried out when?

At each major inspection of the steering system

Special tools

"Servotest 570" tester	ZF No. 7418798574
------------------------	-------------------

Checking values

Refer to "Technical data" at the end of this chapter.

Equipment condition

- Parking brake applied
- Chocks in front of and behind drive axle wheels
- "Servotest 570" tester connected (follow the instructions under "To connect Servotest 570 tester" in this chapter)
- Steering fluid temperature 50 °C (122 °F)

Procedure

Step	Action
1	Block pitman arm in mid-position.
2	Start the engine and let it idle during the remaining part of the test.
3	Turn steering wheel to close power steering valve in steering gear, i.e. until maximum pump pressure is being reached on pressure gauge.
4	Slowly release steering wheel, until pressure gauge pointer indicates no-load pressure.
5	Use shut-off valve of tester to set pressure that is 10 bar (145 psi) higher than no-load pressure.
6	Release steering wheel. Power steering valve must return to neutral position within 1 second. In other words, pressure must drop within that time to a value not excessive of 0.5 bar (7.25 psi) above no-load pressure.

To check steering wheel play

To be carried out when?

At each major inspection of the steering system

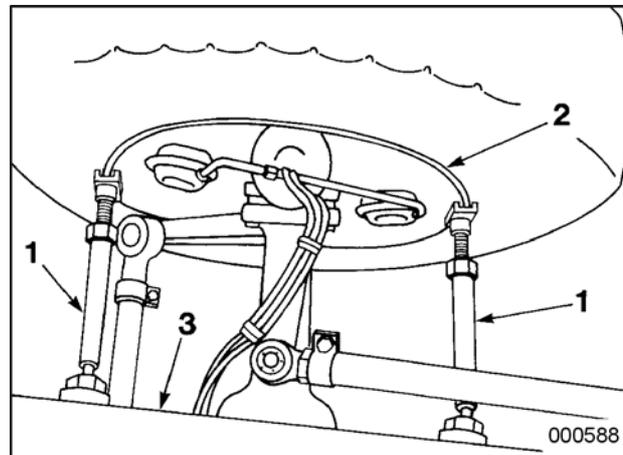
Special tools

"Servotest 570" tester	ZF No. 7418798574
Two adjustable struts	ZF No. 7418798653
Scale and pointer	Van Hool No. 10675798

Equipment condition

- Parking brake applied
- Chocks in front of and behind drive axle wheels
- "Servotest 570" tester connected (follow the instructions under "To connect Servotest 570 tester" in this chapter)
- Steering fluid temperature 50 °C (122 °F)
- Front wheels in straight-ahead position

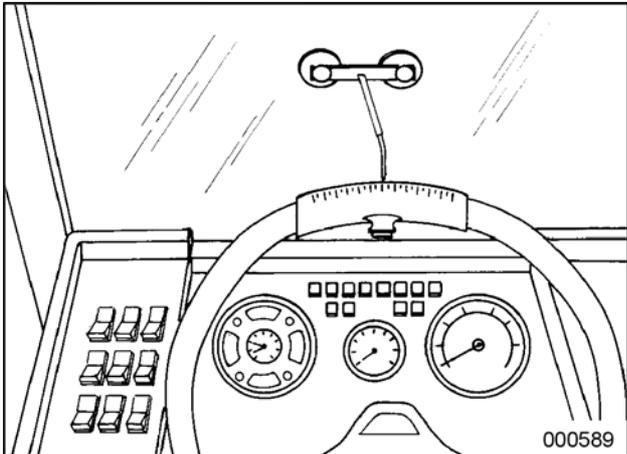
Figure: blocking arrangement



Example of set-up to block wheels in straight-ahead position

- 1 Adjustable strut
- 2 Wheel rim
- 3 Chassis beam

Procedure

Step	Action
1	<p>Block left front wheel (right front wheel on right-hand drive vehicles).</p> <p>This can be achieved, for instance, by installing adjustable struts between wheel rim edge and chassis frame in front of and behind center point of wheel.</p>
2	<p>Attach special scale to steering wheel and associated pointer on vehicle windshield or dashboard.</p> <p>The pointer has to be aligned with the zero in the middle of the scale.</p> 
3	<p>Start engine and let it run at approximately 1 000 rpm. Slowly turn steering wheel counterclockwise, until Servotest pressure gauge indicates a pressure value exceeding no-load pressure by 1 bar (14.5 psi).</p>
4	<p>Mark corresponding steering wheel travel on scale.</p>
5	<p>Perform same measurement turning steering wheel clockwise. Again mark steering wheel travel on scale.</p>
6	<p>The marks on the scale must not be further apart than 45 mm (1.77 in). Otherwise there is too much play in the steering gear.</p>
7	<p>If there is too much play, repeat entire test with pitman arm locked by one means or another (struts removed). Thus you can find out whether play is located before or after pitman arm (e.g. in rod joints).</p>
8	<p>If steering wheel travel still exceeds 45 mm (1.77 in), even when the pitman arm is blocked, then the excess play is in the steering gear.</p> <p>In that case remove steering gear and have it repaired in an authorized workshop.</p>

continued on next page

**Greater play
without power
assistance**

To avoid any misunderstandings it must be mentioned that steering wheel play is always far greater, when the wheel is turned without power assistance than when turned with power assistance. This becomes apparent, when the vehicle is being towed with the engine off.

To change filter in steering fluid tank

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Fluid type

Refer to chapter 1.1, "Fluids and lubricants".

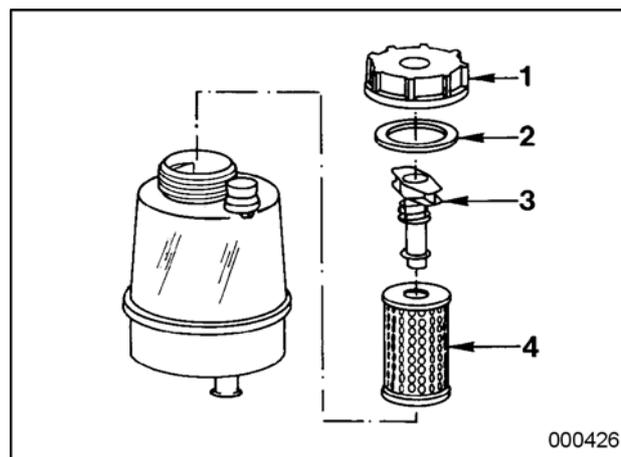
Consumables

Refer to Van Hool spare parts manual.

Tightening torques

Refer to "Technical data" at the end of this chapter.

Figure: filter in steering fluid tank



- 1 Filler cap
- 2 Gasket
- 3 T-shaped filter retainer
- 4 Filter element



CAUTION!

Take care that no dirt enters the tank, when you open it. Before removing the filler cap, thoroughly clean the tank and its immediate surroundings.

Procedure

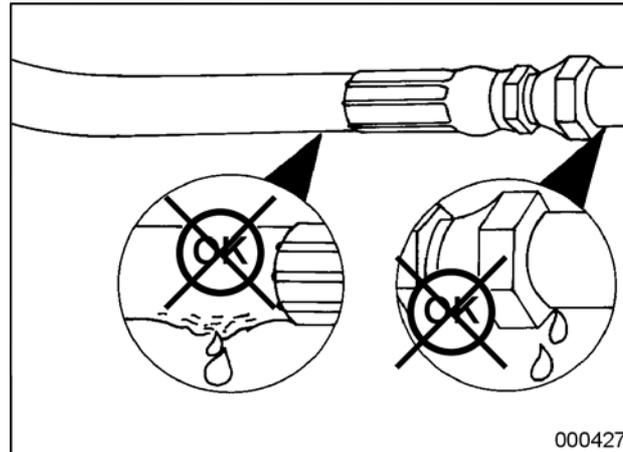
Step	Action
1	Thoroughly clean tank exterior.
2	Unscrew filler cap (1) off tank.
3	Twist T-shaped filter retainer (3) by a quarter of a turn to release filter (4).
4	Lift filter element from tank and pull retainer off filter element. Do not allow the filter element to drain inside the tank.
5	Fit retainer to new element and engage filter assembly on seat in tank.
6	Check gasket (2) and install filler cap.
7	Fill up tank with recommended fluid to prescribed level.

To check steering fluid lines for leaks

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure: checking steering fluid lines for leaks



Procedure

- Check the fluid lines for damages and leaks.
- Move hoses that are rubbing against parts of the chassis.
- Tighten leaky connections.
- Replace defective parts.

Hose clamps

**Cross-
reference**

Refer to chapter 1.1, "General mounting guidelines: hose clamps".

To check security of steering gear, rods and levers

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Tightening torques

Refer to "Technical data" at the end of this chapter.



WARNING!

Never retighten nuts or screws fitted with locking adhesive or "micro-encapsulated" nuts or screws, since this will destroy their locking properties. Once they have been removed, micro-encapsulated screws must not be reused.

How to check?

Visually check bolts, screws and nuts that are locked by means of a cotter pin, liquid adhesive (Loctite), staking or "micro-encapsulation". The security of all others must be checked mechanically. Retighten, if necessary.

To check steering gear mesh load

To be carried out when?

At each major inspection of the steering system.

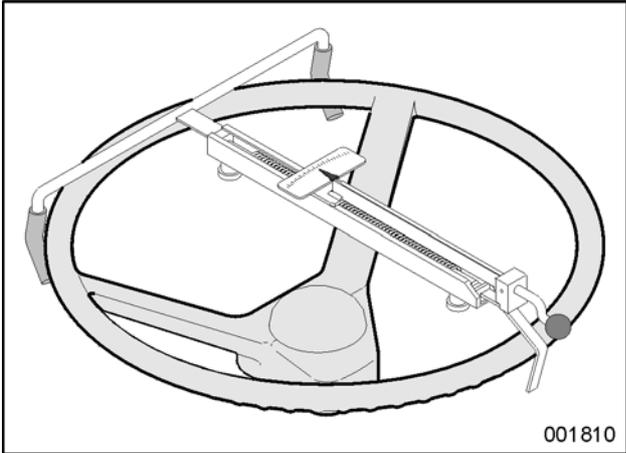
Special tools

Torque meter	ZF No. 7418798703
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Equipment condition

- Parking brake applied
- Chocks in front of and behind drive axle wheels

To check mesh load

Step	Action
1	Disconnect drag link at pitman arm.
2	Position torque meter (special tool) onto steering wheel. 
3	By means of torque meter turn steering wheel through its full travel and measure amount of frictional torque at approx. 1/2 turn from end positions. Note down torque reading.
4	With torque meter turn steering wheel to the right and to the left and this time measure frictional torque, when mid-position is being crossed (mesh load). Torque can exceed value found in step 3 by 20 to 160 Ncm (1.77 to 14.16 in.lbf). <i>NOTE: With a worn-in steering system frictional torque increase may also be less than 20 Ncm (1.77 in.lbf).</i>



**To adjust
mesh load**

Steering gear mesh load can be adjusted with steering gear removed only
(have steering gear removed in ZF workshop).

To dismantle steering gear



WARNING!

The steering gear should be dismantled or repaired at ZF authorized workshops only. They have original spare parts and appropriate tools at their disposal, as well as the necessary know-how.

To lubricate intermediate lever of steering system

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Grease type

Refer to chapter 1.1, "Fluids and lubricants".

Figure: grease nipple on intermediate lever**Procedure**

Push grease in the grease nipple until new grease escapes from the bottom of the bearing housing.

To check linkage joints

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

Exterior of joint that is to be checked must have been cleaned with a dry cloth or cotton waste

To check what?

- joint exterior for corrosion
- dust cover of steering linkage joint
- dust cover retaining rings
- joint for play

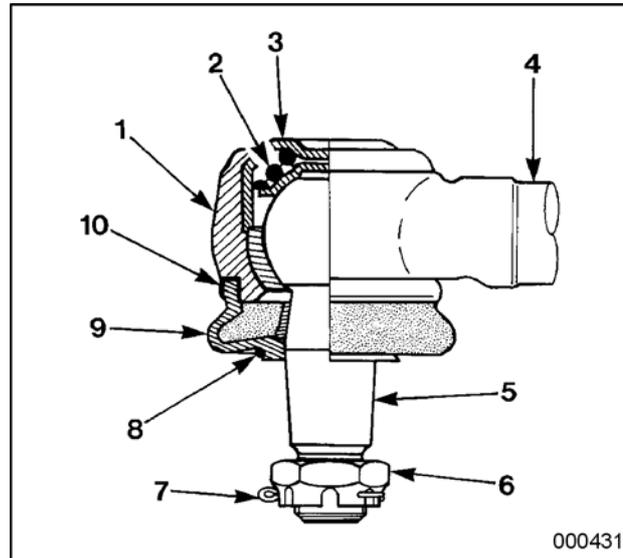
**CAUTION!**

Do not damage ball-joint dust cover. Do not use any detergents or solvents.

**CAUTION!**

Water entering the ball-joint through an untight dust cover will damage the joint in no time.

Figure: typical linkage joint



- 1 Casing
- 2 Compression spring
- 3 Cover
- 4 Shank
- 5 Ball-joint pillar
- 6 Castellated nut
- 7 Cotter pin
- 8 Dust cover retaining ring
- 9 Dust cover
- 10 Dust cover retaining ring

To check exterior for corrosion

There must not be any corrosion marks with a depth of more than 0.04 in. Especially check whether edge of casing (1) around cover (3) is free of corrosion.

If the joint is corroded to a greater extent than permitted, change it completely by a new one.

Change cotter pin (7), if any pitting marks are found.

To check dust cover

Check dust cover (9) for punctures, cracks or tears. Work the flexible cover between your fingers. No grease should escape through the dust cover walls (only through the opening in the middle).

If the dust cover is faulty, change the complete linkage joint by a new one.

To check dust cover retaining rings

First check whether rings (8) and (10) have been installed in the right way. Also, it has to be possible to rotate cover (9) by hand with respect to

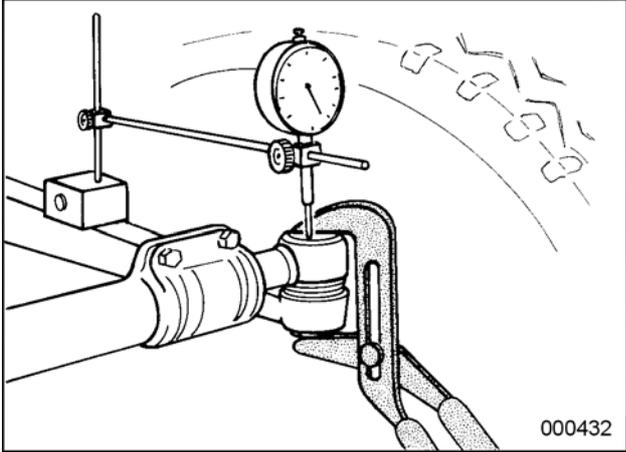
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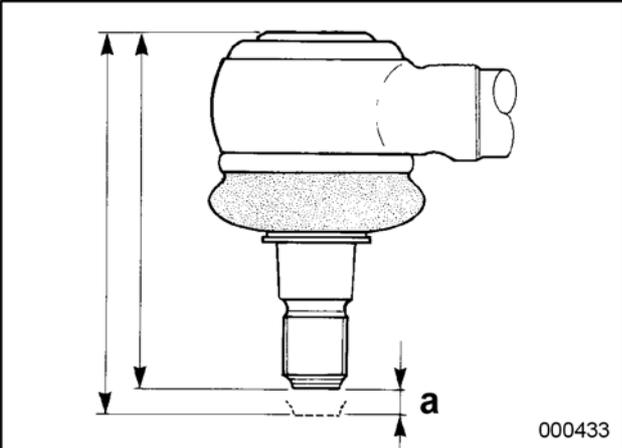
casing (1) (Grab cover with your fingers, near the largest ring, and try to turn it. Do not use any tools!).

If the rings are not up to standard, replace the entire linkage joint by a new one.

To check joint for play

Normal wear will not cause the ball-joint pillar to become any looser in its casing. After all, a spring pushes it against the joint liners. Play due to wear only shows, when you press the ball-joint pillar inwards against the spring pressure.

Step	Action
1	Set vehicle wheels in straight ahead position.
2	Mount a dial indicator with magnetic base on arm the joint is secured to. <div data-bbox="692 860 1318 1312" style="text-align: center;">  <p style="text-align: right; font-size: small;">000432</p> </div>
3	Position dial indicator stylus with slight pre-pressure against cover (3) of joint at a right angle.

Step	Action
4	<p data-bbox="574 309 1428 376">With adjustable-joint pliers compress joint and read travel of ball-joint pillar (5) on indicator.</p> <p data-bbox="574 392 1428 459">If play measurement result (a) exceeds 5/64 in, change complete joint by a new one.</p> <div data-bbox="694 504 1316 952"><p data-bbox="1228 918 1308 952">000433</p></div>

To check clamps of drag-link and tie-rod

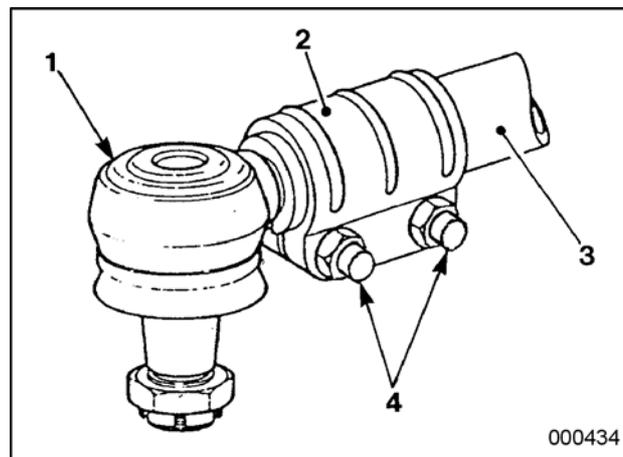
To be carried out when?

On fixed intervals according to maintenance schedule, refer to chapter 1.1.

Tightening torques

Refer to "Technical data" at the end of this chapter.

Figure: drag-link or tie-rod end



- 1 Rod end (joint)
- 2 Clamping collar
- 3 Tube
- 4 Clamping bolts

Equipment condition

Exterior of joint that is to be checked must have been cleaned with a dry cloth or cotton waste

To check rod-end parts for corrosion

- Clamping collar, clamping bolts and clamping nuts should be free of corrosion pitting marks with a depth of over 0.02 in. Otherwise: change affected parts.

To check rod-end threads for play

For the steering rod and the tie-rod, carry out the next steps with loaded axle (wheels on the ground):

Step	Action
1	 <p>CAUTION! Prevent the clamping bolt from turning along while retightening its nut.</p> <p>While retaining the bolt head, check tightness of the clamping-bolt nuts (4) with a torque wrench.</p>
2	Hold a finger on the edge of pipe (3) and simultaneously on rod end (1).
3	Have an assistant turn the steering wheel to and fro in a jerky manner.
4	Do you feel rod end (1) move within pipe (3)? <ul style="list-style-type: none"> • If not, there is no play, you do not need to carry out step 5. • If so, there is play (damaged thread). Go to step 5.
5	Replace the rod, completely with rod end, clamping collar, clamping bolt(s) and nut(s).

To check drag-link and tie-rod tubes

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".



WARNING!

It is not permitted to straighten a bent drag-link or tie rod.

Procedure

Visually check rod tube for deformation and damage.

Change the tube if you can see that it is not in proper condition.

To check maximum steering lock angles

To be carried out when?

At each major inspection of the steering system.

Procedure

Refer to chapter 12.6 "To check/adjust steering lock angles".

To check steering column bearings for play

To be carried out when?

At each major inspection of the steering system.

Procedure

Alternately push and pull steering wheel.

If too much play is felt, have steering column bearings renewed.

To check universal joints and flex couplings

To be carried out when?

At each major inspection of the steering system.

Procedure

Turn steering wheel alternately to the right and to the left, while assistant watches joints.

Joints that "clack" (indicating play) or bind have to be renewed.

To remove steering assembly

Equipment condition

- Vehicle over inspection pit
- Parking brake applied
- Steering fluid drained, refer to "To change fluid of power steering system"

To remove steering gear



WARNING!

The steering gear weighs approximately 90 lbs. Support it in a safe manner, before undoing its fixing screws.

To disconnect pitman arm



WARNING!

Do not under any circumstances hammer pitman arm to break it loose from its shaft, nor drive a wedge between pitman arm and steering gear. To do so can cause serious internal damage to the steering gear. Equally, do not attempt to free the pitman arm by heating it with a blow-torch. The heat affects the metal structure of the pitman arm, thus creating a risk of potential catastrophic failure.

The pitman arm has to be removed with a special puller.

To remove steering wheel center trim

To remove steering wheel center trim, simply pry it out with a screwdriver.

To install steering mechanism

Special tools

Tool set to press dust boot on lower steering column	
• Guide sleeve	Van Hool No. 11256435
• Pressure piece	Van Hool No. 11256486

Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment conditions

- Vehicle above an inspection pit
- Parking brakes applied
- Front wheels on turntables
- Steering gear splash-water protective cover inspected (refer to "To inspect the steering gear splash-water protective cover" in this chapter).



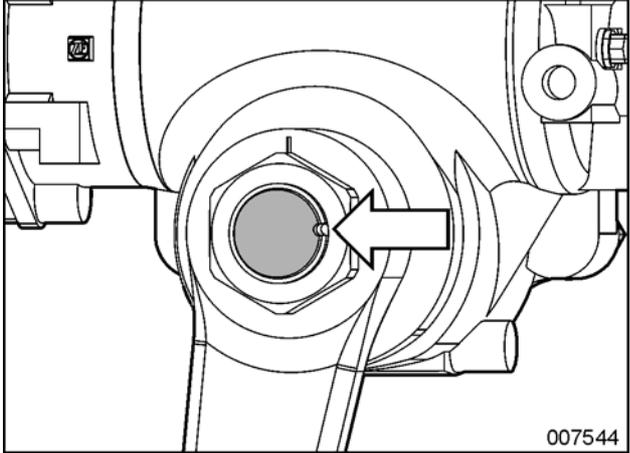
WARNING!

The steering gear weighs approximately 90 lbs. Keep this in mind during work.

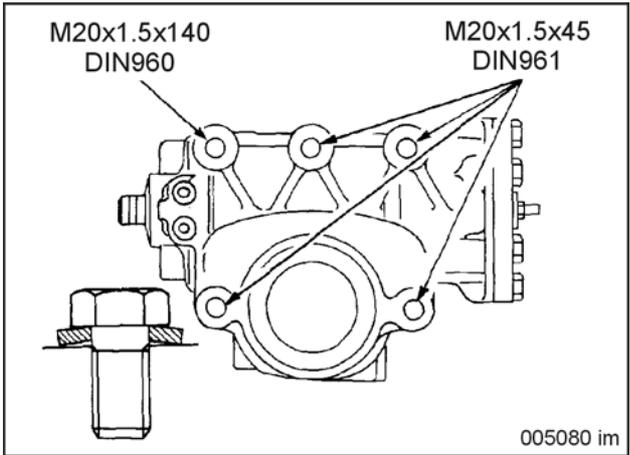
To install pitman arm

Step	Action
1	Install the pitman arm so that marks on the pitman shaft and the pitman arm are aligned.
2	<p><i>NOTE: A pitman shaft nut that has been removed must not be re-used because it is locked by staking.</i></p> <p>Install the pitman-shaft nut. Tighten the nut to the prescribed torque.</p>

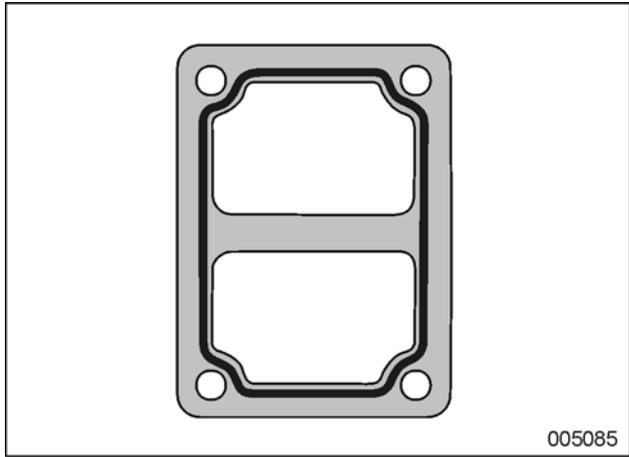
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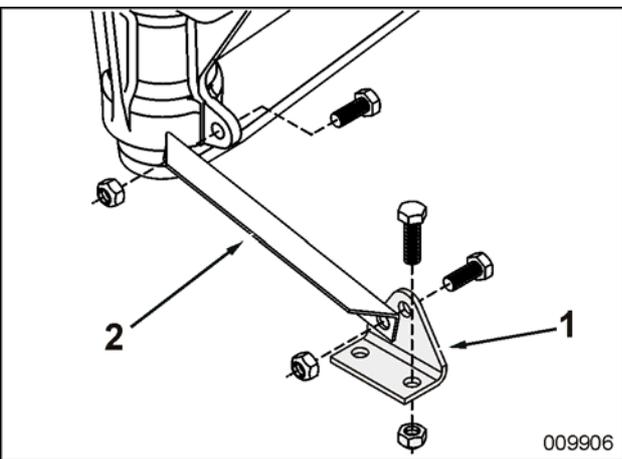
Step	Action
3	<p>Lock the pitman-shaft nut by staking its collar into the slot of the pitman shaft. The tool for staking should have a 0.24 in round point and the punch should be at least 0.06 in deep.</p> 

To install steering gear

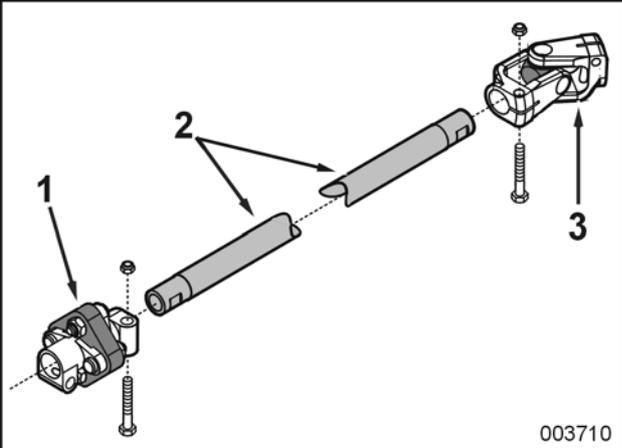
Step	Action
1	Remove all paint and dirt from the mating surfaces of the steering gear and the chassis frame.
2	<p>Secure the steering gear to the chassis frame with the screws and the special dished spring washers listed in the Van Hool spare parts manual. First install the fit-screw DIN 960. The "hollow" side of the dished spring washer has to face the steering gear. Tighten the screws to the prescribed torque.</p> 
3	Connect the fluid pressure and return lines to the steering gear.

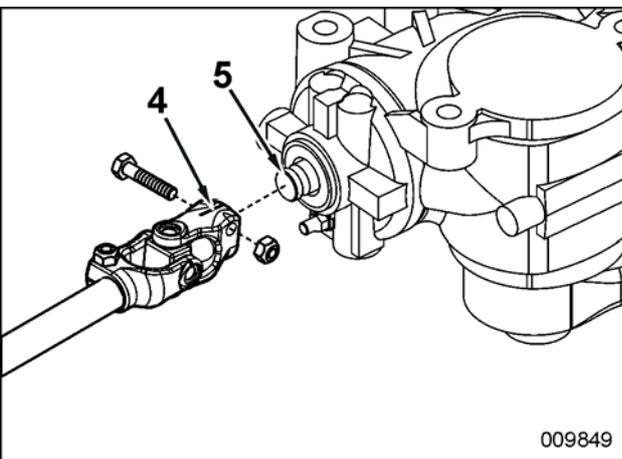
**To install inter-
mediate lever**

Step	Action
1	Remove all lacquer and dirt from the mating surfaces of the intermediate lever and the chassis.
2	Apply "Loctite 7063" cleaning agent to the mating surfaces. Wipe the mating surfaces clean with a cloth before the cleaning agent has evaporated.
3	Allow the cleaning agent to evaporate completely.
4	Apply "Loctite FAG-6" sealer to the chassis mating surface. Apply a closed bead as indicated in the figure. <div data-bbox="689 741 1318 1198" data-label="Image">  <p style="text-align: right;">005085</p> </div>
5	Secure the intermediate lever to the chassis. Tighten the fixing screws to the prescribed tightening torque.
6	Remove the sealer surplus.

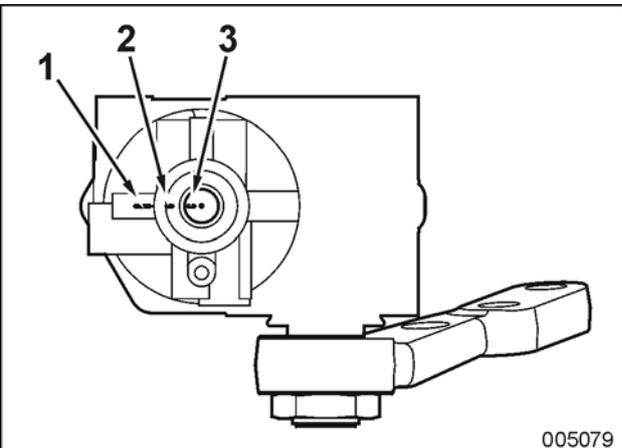
Step	Action
7	<p>Secure support (1) for intermediate lever to the chassis, but not completely tighten the nuts yet. Secure connecting profile (2). Tighten the fixing nuts of support (1) and profile (2) to the prescribed torque.</p>  <p style="text-align: right;">009906</p>

To install intermediate shaft

Step	Action
1	<p>Slide elastic joint (1) and universal joint (3) on intermediate shaft (2), so that the recess in the serrations of the shaft end leaves the passage for the joint clamping bolt clear. Mount the clamping bolts with new self-locking nuts. Do not tighten the nuts yet (tightening occurs when proceeding with "To install bevel gear" further on in this text).</p>  <p style="text-align: right;">003710</p>

Step	Action
2	<p>Secure the intermediate shaft with the universal joint to the steering gear input shaft. Make sure that clamping slot (4) of the joint coincides with mark (5) stamped on the steering gear input shaft. Install a new self-locking nut on the clamping bolt.</p>  <p style="text-align: right;">009849</p>

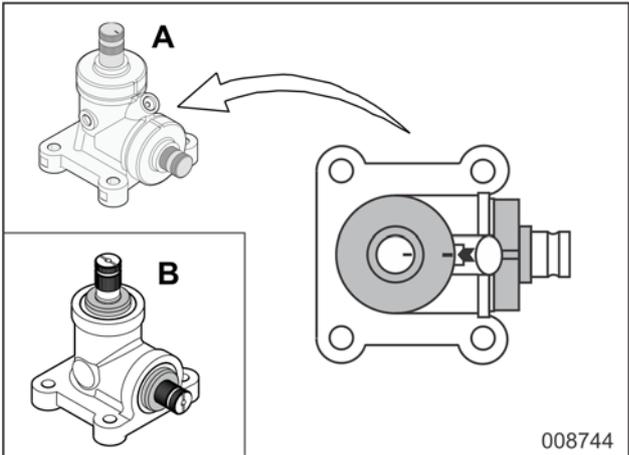
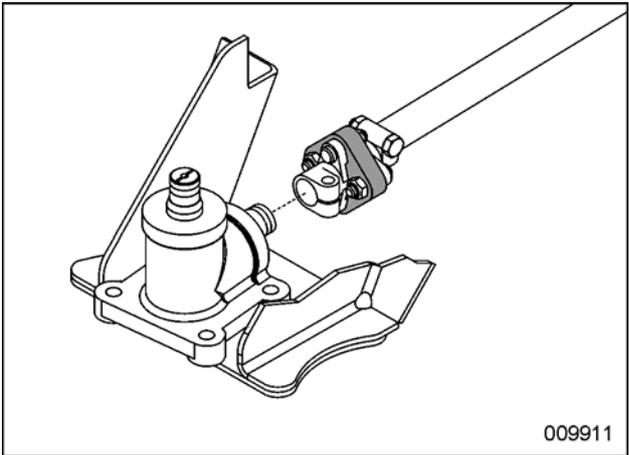
To set steering gear to straight-ahead position

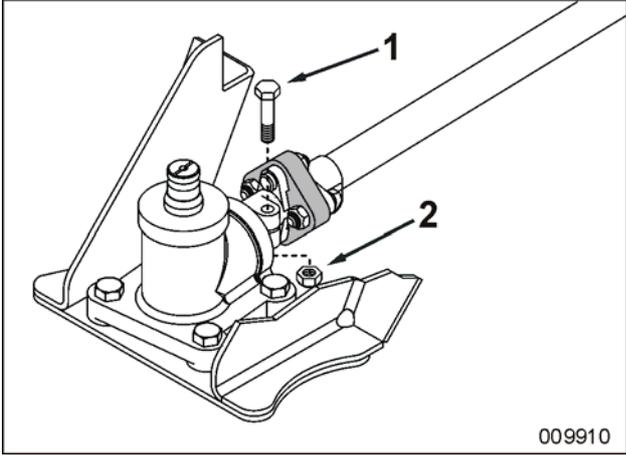
Step	Action
1	<p>Turn the steering-gear input shaft by means of the intermediate shaft from lock to lock and count the number of revolutions.</p>
2	<p>Turn back half the number of revolutions counted, until the rear clamping slot of the intermediate-shaft universal joint is precisely aligned with marks (1) and (2) at the steering-gear input side.</p> <p>As you have secured the joint to the steering gear with the clamp slot in line with mark (3), the marks (1), (2) and (3) are now aligned. The steering gear is now in the straight-ahead position.</p>  <p style="text-align: right;">005079</p>

To install tie rods

Step	Action
1	Secure the center tie rod between the pitman arm and the intermediate lever.
2	Set the front wheels in the straight-ahead position using a regular wheel alignment device.
3	Check and, if necessary, adjust the front-suspension air-spring height before installing the outer tie rods.
4	<p>Adjust the outer tie rods length (refer to "To adjust tie-rod length" in this chapter).</p> <p>The length of the rod is correct if the ball stud of the rod ends enters without effort into the hole of the pitman arm (for the right rod: into the eye of the intermediate lever) and in the eye of the tie rod arm without changing the set position of the steering box or the front wheel.</p>
5	Install the outer tie rods and fit the ball-joint pillar nuts. Tighten the nuts to the prescribed torque ensuring that the cotter pin hole is in line with a slot of the nut. Lock the nuts with a new cotter pin.
6	 <p>CAUTION!</p> <p>The slot in the outer clamp of the tie rod has to point downward. The slot in the inner clamp has to point upward.</p> <p>Install the clamping pieces of the outer tie rods with new self-locking nuts. Tighten them to the prescribed torque.</p>

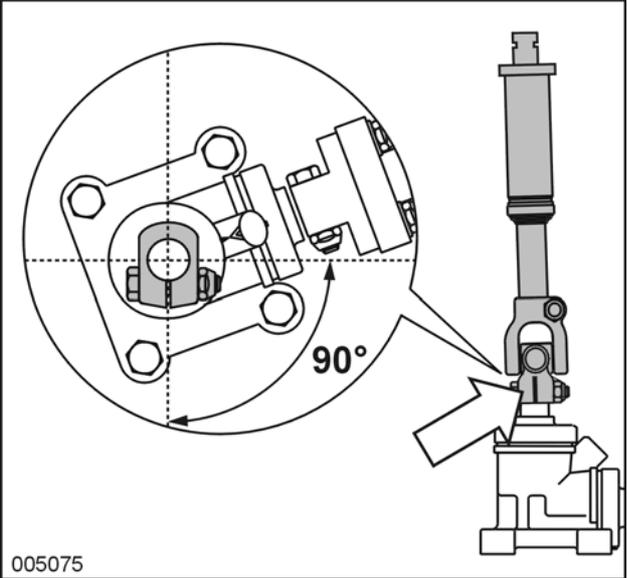
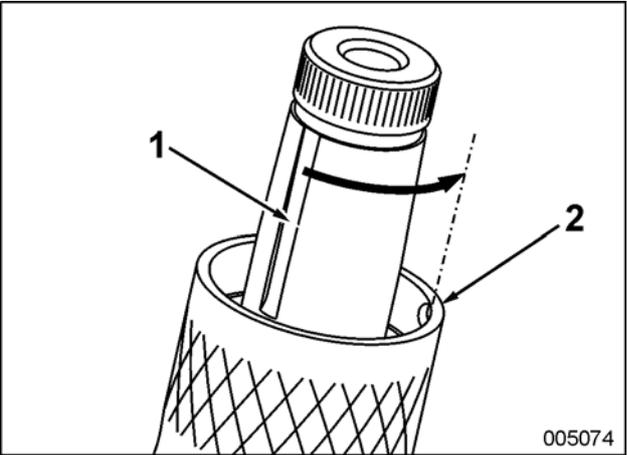
To install bevel gear

Step	Action
1	<p><i>NOTE: Carry out this step in case of a model "A" bevel gear only (refer to figure).</i></p> <p>Rotate input shaft of bevel gear to align mark on bevel gear dust cap and on input shaft itself with ridge on bevel gear housing. In this position (mid-position), the bevel gear is free of backlash.</p>  <p style="text-align: right;">008744</p>
2	<p>Put the bevel gear on its support on the chassis. If adjusting shims were present on your vehicle under the bevel gear, mount them again.</p>
3	<p><i>NOTE: Carry out this step with the steering gear in the straight-ahead position.</i></p> <p>Push the bevel gear against the direction of travel to slide its output shaft in the hole of the joint.</p>  <p style="text-align: right;">009911</p>

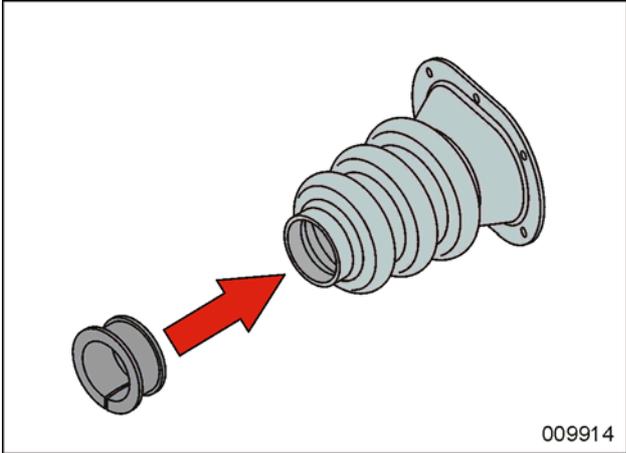
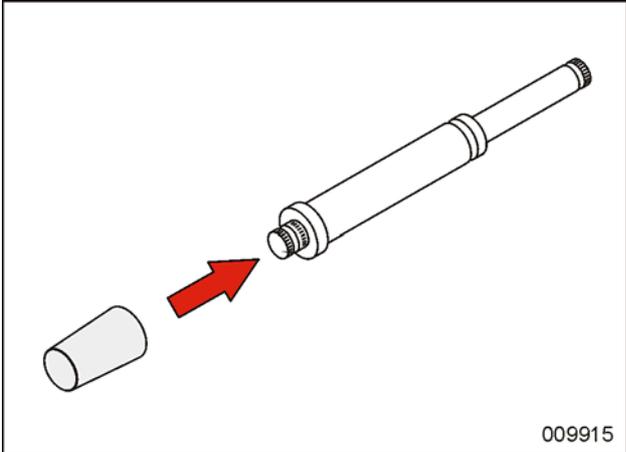
Step	Action
4	Secure the bevel gear to the chassis with four M12-bolts fitted with new self-locking nuts. Tighten the screws to the prescribed torque.
5	Install clamping bolt (1) with a new self-locking nut (2).
	
6	Tighten the clamping bolts of the elastic joint and the universal joint to the prescribed torque.

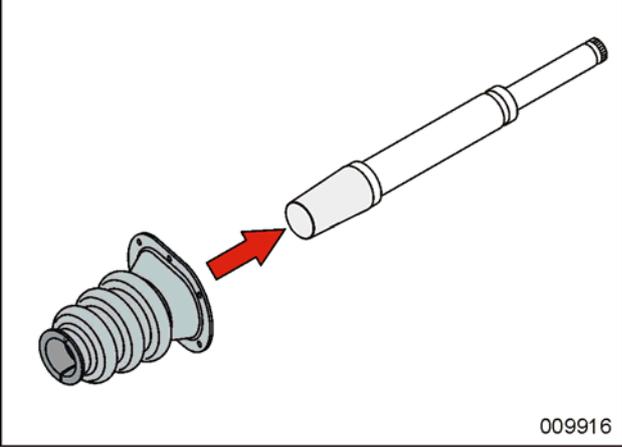
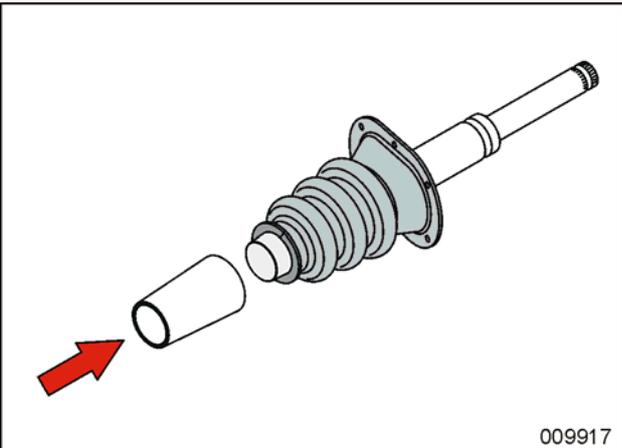
To install steering column

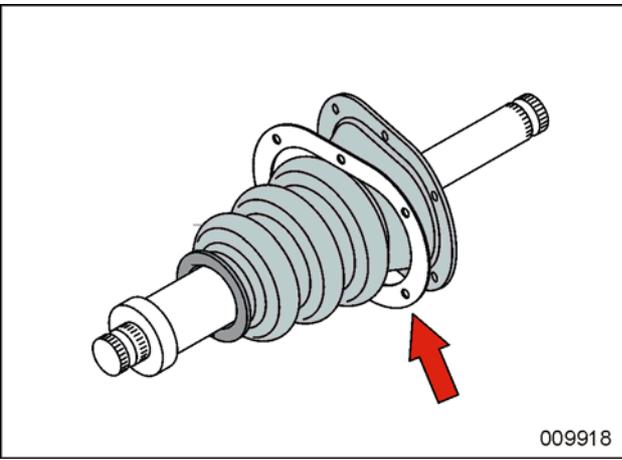
Step	Action
1	Slide the dust boot onto the lower steering column (propeller shaft). For procedure, refer to "To mount dust boot of lower steering column" further on in the text.

Step	Action
2	<p>Secure the universal joint to the propeller shaft. Install the propeller shaft as shown in the figure. Ensure that the clamping slot of the universal joint is square to the longitudinal vehicle axis.</p>  <p>005075</p>
3	<p>Turn the upper steering column until slot (1) is in line with hole (2). Install the upper steering column.</p>  <p>005074</p>
4	<p>Tighten the clamping bolts of the universal joints to the prescribed torque.</p>
5	<p>Fit the steering wheel in the straight-ahead position and tighten the steering-wheel screw to the prescribed torque. Fit steering wheel center trim.</p>

To mount dust boot of lower steering column

Step	Action
1	<p>Put the dust-boot ring in the dust boot. Make sure that the end with the largest diameter will be at the outside of the dust boot afterwards!</p>  <p style="text-align: right;">009914</p>
2	<p>Install the guide sleeve (special tool) over the serrations of the propeller shaft.</p>  <p style="text-align: right;">009915</p>

Step	Action
3	<p data-bbox="582 309 1117 347">Slide the dust boot onto the guide sleeve.</p>  <p data-bbox="1228 806 1308 840">009916</p>
4	<p data-bbox="582 869 1380 929">By using the pressure piece (special tool), push the dust boot over the guide sleeve.</p>  <p data-bbox="1228 1400 1308 1433">009917</p>

Step	Action
5	Install the metal ring over the dust boot. <div data-bbox="694 380 1316 840" style="text-align: center;">  <p>009918</p> </div>

Subsequent to installation

Step	Action
1	Set the toe (refer to chapter 12.06, under "To check/adjust toe").
2	Fill the power steering system with the recommended fluid and bleed the system (refer to "To change fluid of power steering system" in this chapter).
3	Set the steering limiter valves (refer to "To check/set hydraulic steering limitation" in this chapter).
4	Road-test the vehicle and check whether the steering wheel is actually in the straight-ahead position while driving straight ahead.

To inspect the steering gear splash-water protective cover

Grease type

Refer to chapter 1.1, "Fluids and lubricants".

Equipment condition

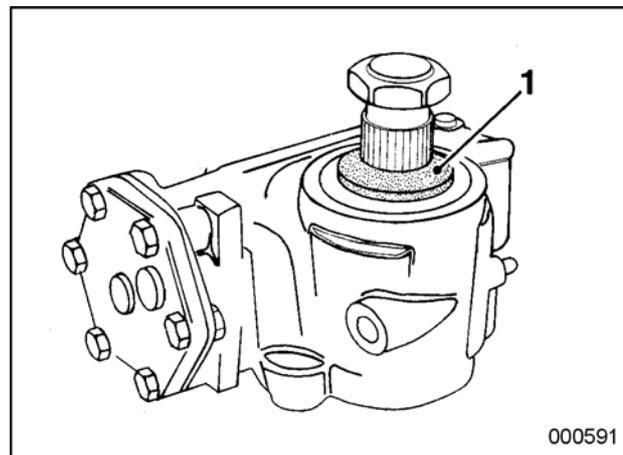
- Parking brake applied
- Chocks in front of and behind drive axle wheels

Location of protective cover

On the pitman shaft, between the pitman arm and the steering gear

Purpose of the protective cover

The plastic cover filled with grease is used for preventing pitman-shaft rusting. Rust at the pitman-shaft seal would damage the seal and cause the steering gear to leak.

**Figure:
steering gear
ZF 8089**

1 Splash-water protective cover

Procedure**WARNING!**

Do not under any circumstances hammer pitman arm to break it loose from its shaft, nor drive a wedge between pitman arm and steering gear. To do so can cause serious internal damage to the steering gear. Equally, do not attempt to free the pitman arm by heating it with a blowtorch. The heat affects the metal structure of the pitman arm, thus creating a risk of potential catastrophic failure.

Step	Action
1	Remove the pitman arm with a special puller.
2	Inspect the cover and replace it when damaged or worn. <i>NOTE: Fill the space inside the new cover completely with the specified grease.</i>

Technical data: front axle steering system

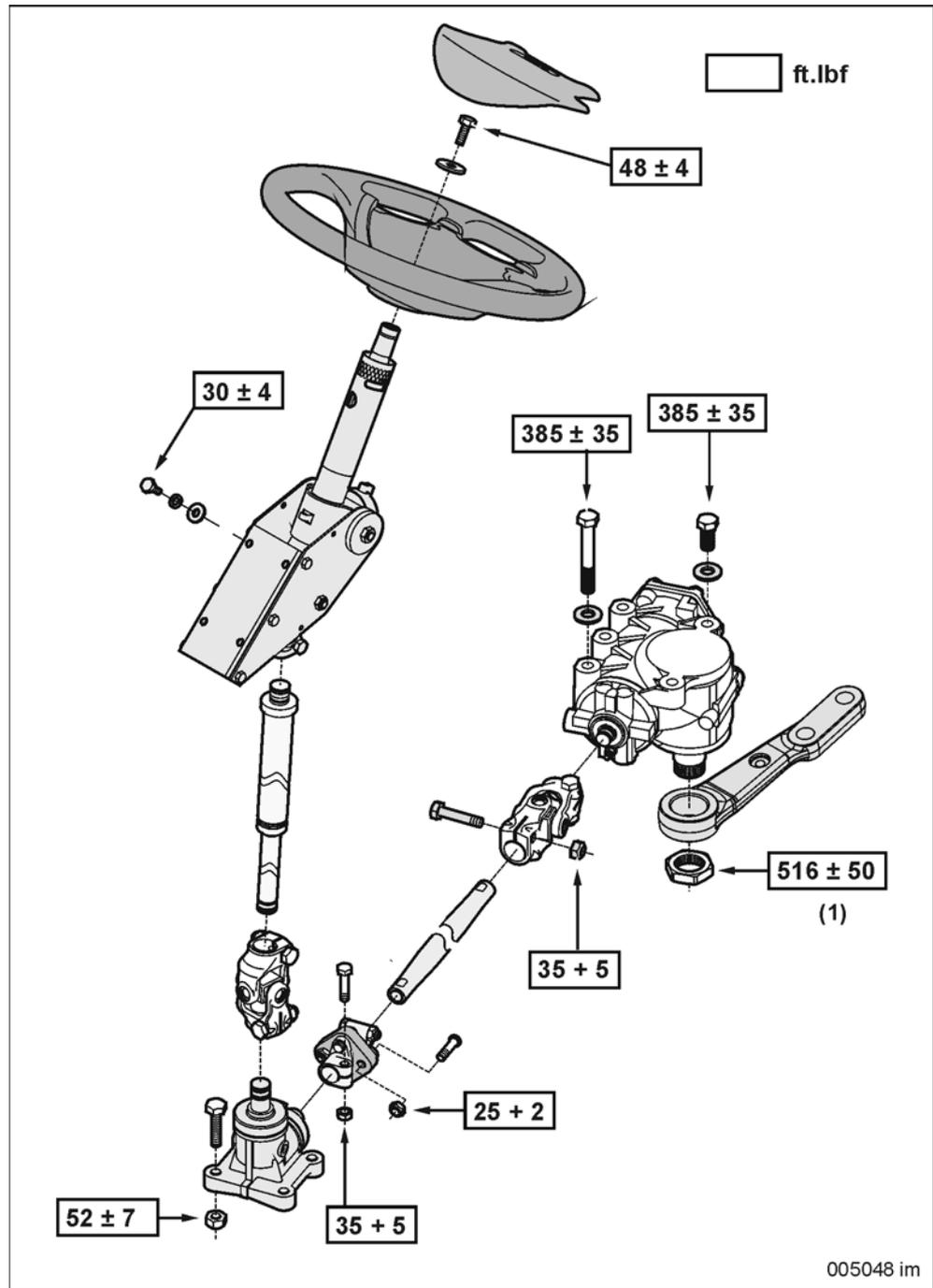
Hydraulic circuit

Maximum pressure	170 + 10 bar (2 466 + 145 psi)
No-load pressure	4 bar (58 psi)
Steering limiter valve relief pressure	50 to 60 bar (725 to 870 psi) at a fluid temperature of 50 ± 10 °C (122 ± 18 °F)
Steering gear internal leakage rate	Maximum 2.5 dm ³ /min (0.66 gal/min)

Tightening torques

Standard hose clamps, clamping range up to 0.9 in dia.	2.2 ± 0.4 ft.lbf
Standard hose clamps, clamping range up to 1.06 in dia.	3.3 + 0.4 ft.lbf
Constant torque hose clamps (manufacturer "Breeze"), with four conical spring washers	5.2 ± 0.4 ft.lbf
Constant torque hose clamps (manufacturer "Breeze"), with five conical spring washers	6.6 + 0.7 ft.lbf
Limiter valve adjuster locknuts	15 + 7 ft.lbf

Figure:
tightening
torques

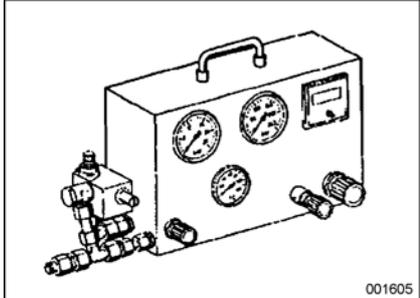
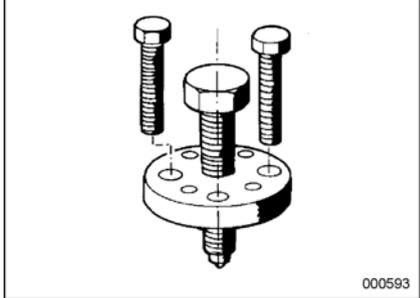
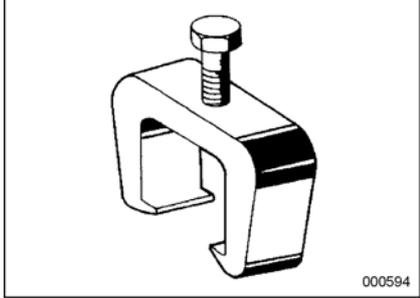
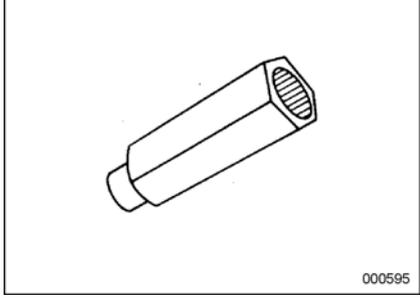


Security of steering column and steering gear

(1) Locked by staking

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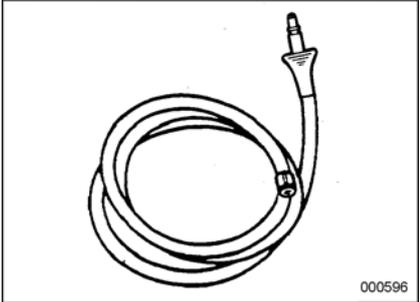
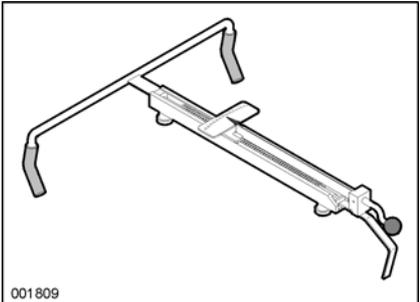
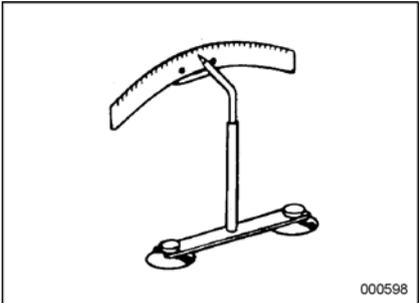
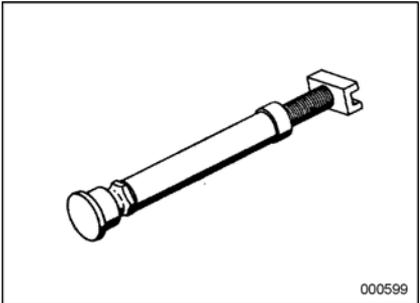
Special tools: front axle steering system

Ordering number	Description	Figure
ZF 7418798574	"Servotest 570" tester with a 2 dm ³ /min flow control valve	 <p>001605</p>
Van Hool 619900910	Steering wheel puller	 <p>000593</p>
Van Hool 619900920	Pitman arm puller	 <p>000594</p>
Van Hool 10575651	Torque meter socket with serrations, fitting the steering column end	 <p>000595</p>

7.6

Steering Front axle steering system



Ordering number	Description	Figure
Van Hool 639901590	Hose for pressure checking gauge with a M16 union nut	 000596
ZF 7418798703	Torque meter	 001809
Van Hool 10675798	Scale and pointer for measuring play at steering wheel	 000598
ZF 7418798653	Two struts to lock front wheels in straight-ahead position	 000599

Part 8 - Climate control

Overview

Contents

Chapter	See page
Chapter 2: Control systems	8.2-1
Chapter 6: Airside systems	8.6-1
Chapter 10: Water circuit	8.10-1
Chapter 14: Refrigerant circuit	8.14-1

The following chapters have been *modified* since the former edition:

Chapter	See page
Chapter 14: Refrigerant circuit	8.14-1

Chapter 2: Control systems

Overview

Introduction This chapter deals with the control system.

Number of pages 34

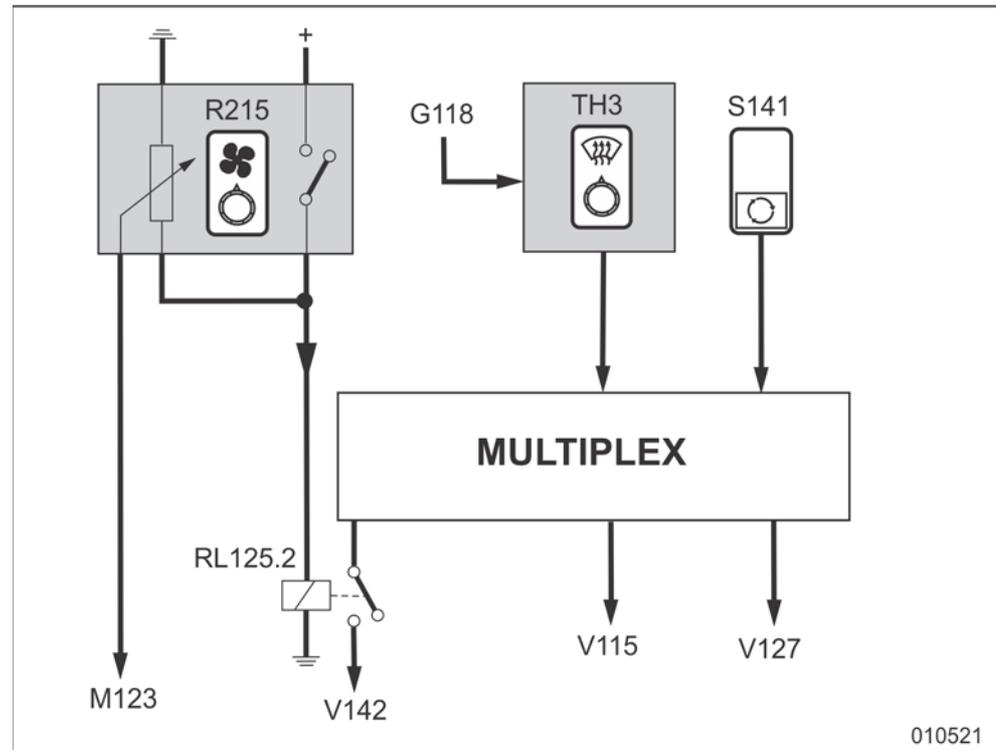
Chapter publication date 21 September 2016

Contents

Topic	See page
Driver's cab control system: layout	8.2-2
Driver's cab control system: visual identification of components	8.2-3
Driver's cab control system: component location	8.2-5
Passenger compartment control system: layout	8.2-6
Passenger compartment control system: visual identification of components	8.2-8
Passenger compartment control system: operation	8.2-11
Passenger compartment control system: component location	8.2-18
Passenger compartment control system: to troubleshoot using the dashboard display	8.2-21
Passenger compartment control system: climate-control compressor diagnostics menu	8.2-26
Passenger compartment control system: to call up temperatures	8.2-29
Passenger compartment control system: to check temperature sensors	8.2-31
Technical data: control system	8.2-33

Driver's cab control system: layout

Figure: block diagram of driver's cab control system

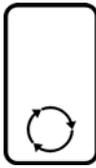


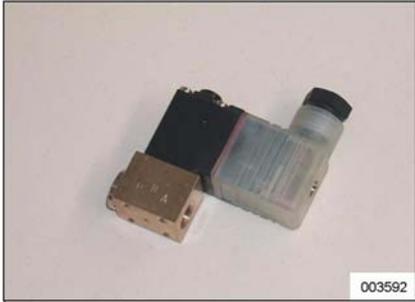
References in figure

Reference in figure	Explanation
G118	Temperature sensor, outlet air
M123	Fan motor
R215	Potentiometer for fan speed control
S141	Inside/outside air flap switch
TH3	Temperature control unit
V115	Pilot valve of hot-water supply metering valve
V127	Pilot valve of inside/outside air flap
V142	Shut-off valve in refrigerant line to evaporator of driver's cab climate-control unit

Driver's cab control system: visual identification of components

Components

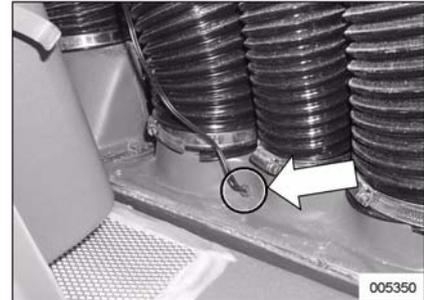
Element	Figure
Potentiometer for fan speed control (R215)	
Temperature control unit (TH3)	
Outlet-air temperature sensor (G118)	
Inside/outside air flap switch (S141)	

Element	Figure
Pilot valve of hot-water supply metering valve(V115)	 <p>003592</p>
Pilot valve of inside/outside air flap (V127)	 <p>001662</p>

Driver's cab control system: component location

Temperature sensor (G118)

In the outlet manifold of the climate-control unit

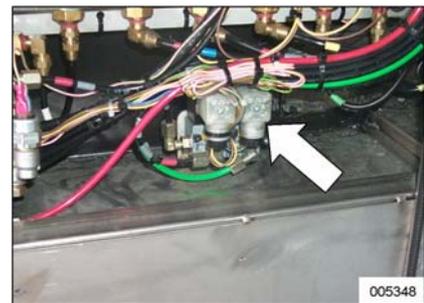


Pilot valves

On the interior-heating valve block: pilot valve of metering valve in hot-water supply to driver's cab climate-control unit (V115)

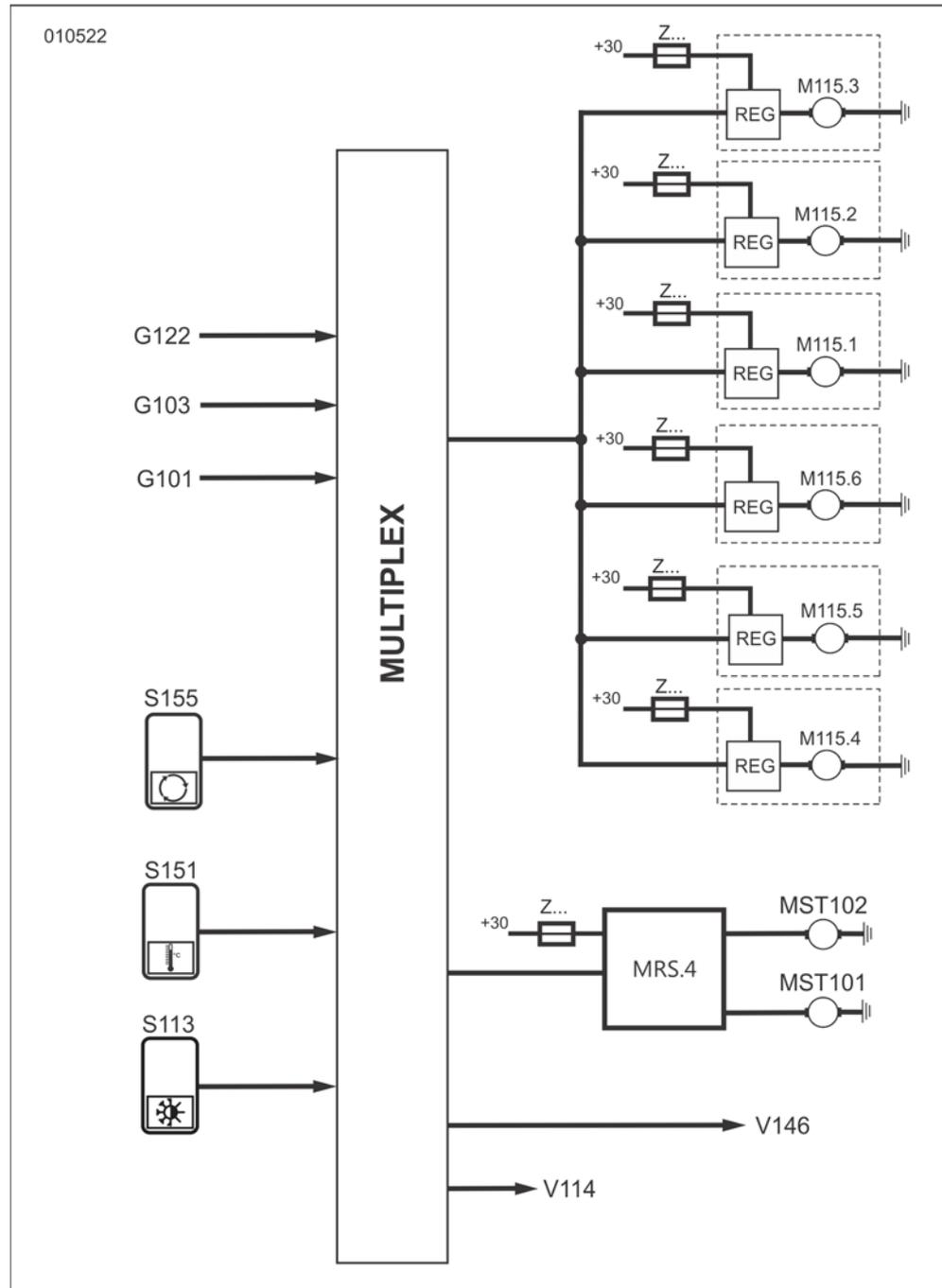


In the rear wall of the luggage compartment: pilot valve of inside/outside air flap (V127)



Passenger compartment control system: layout

Figure: block diagram of passenger compartment control system



continued on next page

References in figure

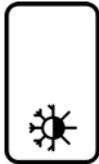
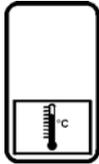
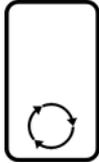
Reference in figure	Explanation
+30	Voltage after battery switch
G101	Interior-air temperature sensor
G103	Outside-air temperature sensor
G122	Duct-air temperature sensor
M115	Evaporator fans motors
MST	Outside air flap adjusting motor
MRS.4	“MRS” motor reversing switch
REG	Electronic speed controller (chopper)
S113	Switch to cut the system on/off
S151	Temperature setting switch
S155	Switch for 100% inside air
V114	Pilot valve of metering valve in hot-water supply to roof heating
V146	Pilot valve of metering valve in hot-water supply to floor heating
Z...	Fuse

Principle of operation

The climate-control system program has been stored in the computer module of the multiplex system. The computer module assesses the input signals (from temperature sensors, switches,...), and controls the output components (pilot valves, motors,...).

Passenger compartment control system: visual identification of components

Dashboard controls

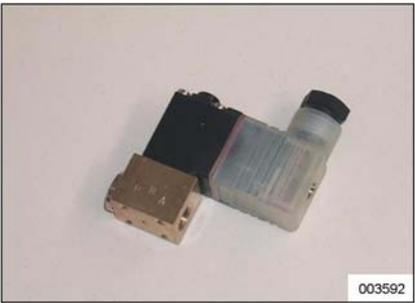
Element	Figure
Switch to cut off the system (S113)	 001351
Temperature setting switch (S151)	 003368
Switch for 100% inside air (S155)	 000087

Temperature sensors

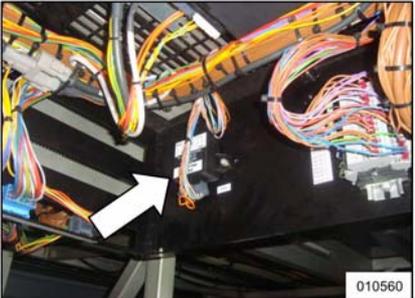
Element	Figure
Interior-air temperature sensor (G101)	 001647

Element	Figure
Duct-air temperature sensor (G122)	 <p>001646</p>
Outside-air temperature sensor (G103)	 <p>001645</p>

Pilot valves

Element	Figure
<ul style="list-style-type: none"> • Pilot valve (V114) of metering valve in hot-water supply to roof heating • Pilot valve (V146) of metering valve in hot-water supply to floor heating 	 <p>003592</p>

Other component

Element	Figure
Electronic speed controller (REG)	
"MRS" motor reversing switch (MRS.4)	

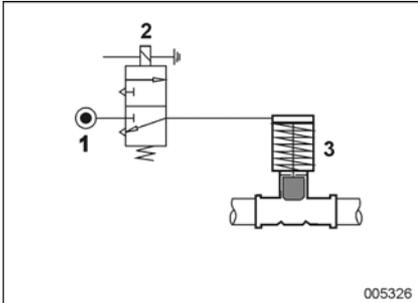
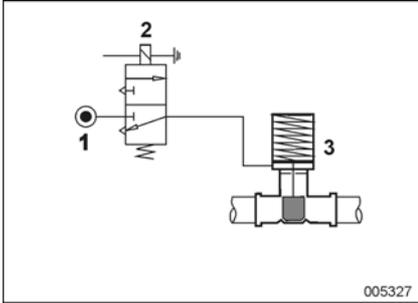
Passenger compartment control system: operation

Controller

The controller, programmed in the computer module of the multiplex system, compares the actual interior temperature to the set temperature and uses that information to calculate the duct temperature. Then, it compares this duct temperature to the actual duct temperature and calculates the control signal for pilot valve V114.

Pilot valve/hot-water valve combinations

The pilot valve/hot-water valve combinations on the vehicle are:

Combination	Figure
<p>"Normally closed" pilot valve (2) with "normally open" hot-water valve (3)</p>	 <p>(1) Compressed-air supply</p>
<p>"Normally closed" pilot valve (2) with "normally closed" hot-water valve (3)</p>	 <p>(1) Compressed-air supply</p>

PWM

PWM is short for "Pulse width modulation".

Pilot valve V114 of roof-heating metering valve

The "normally closed" pilot valve V115 is energized by a PWM signal with a period of approximately 20 seconds. The pulse width depends on the required amount of heating. If V114 is energized, the "normally open" metering valve in the hot-water supply closes.

continued on next page

Pilot valve V146 of floor-heating metering valve

The "normally closed" pilot valve V146 is controlled by a PWM signal with a period of approximately 20 seconds. The signal runs synchronous with the PWM signal of pilot valve V114 until the duct temperature drops below the set temperature value.

NOTE: The floor heating is switched off if the exterior temperature exceeds 55°F.

Adjusting motor MST of outside air flaps

Under normal circumstances, the installation operates with 80% inside air and 20% outside air. When necessary, you can have the installation operate with 100% inside air. If you press dashboard switch S155, a CAN message is sent from the computer module of the multiplex system to motor reversing switch MRS.4. The outside-air flaps close and the installation operates with 100% inside air. A symbol appears on the dashboard display to indicate that the installation operates with 100% inside air.

NOTE: To switch to the normal condition again, press S155 a second time.

Evaporator fans

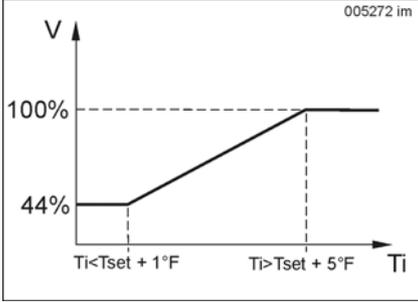
NOTE: The computer module knows the bus engine coolant temperature through the CAN bus of the drive line.

The speed of the evaporator fans (M113/M115) is controlled by an electronic speed controller (chopper) mounted on the fan housing. The amplitude of the pilot signal (constant direct voltage) at the speed controller determines the fan speed (44 to 100%). 44% corresponds to a pilot signal of 16V, 100% to 0V. Consequently, fan speed is inversely proportional to the amplitude of the pilot signal.

The evaporator fans turn at what speed?

Mode	Fan speed	
Heating	Bus-engine coolant temperature below 113°F	44%
	Bus-engine coolant temperature above 113°F and...	
	<ul style="list-style-type: none"> • interior temperature more than 7°F lower than the set temperature • interior temperature less than 7°F lower than the set temperature 	66%
		44%

continued on next page

Mode	Fan speed
"REHEAT", cooling	<p>Stepless between 44 and 100%</p>  <p><i>V: Fan speed, Ti: interior temperature, Tset: set temperature</i></p>

Climate-control compressor clutch

Refer to "Climate-control compressor: electromagnetic clutch" in chapter 8.14.

Shut-off valves in refrigerant circuit

Refer to "Solenoid shut-off valves" in chapter 8.14.

Refrigerant circuit pressure switches

Refer to "Pressure switches" in chapter 8.14.

Condenser fans

Refer to "Condenser" in chapter 8.14.

Coolant heater

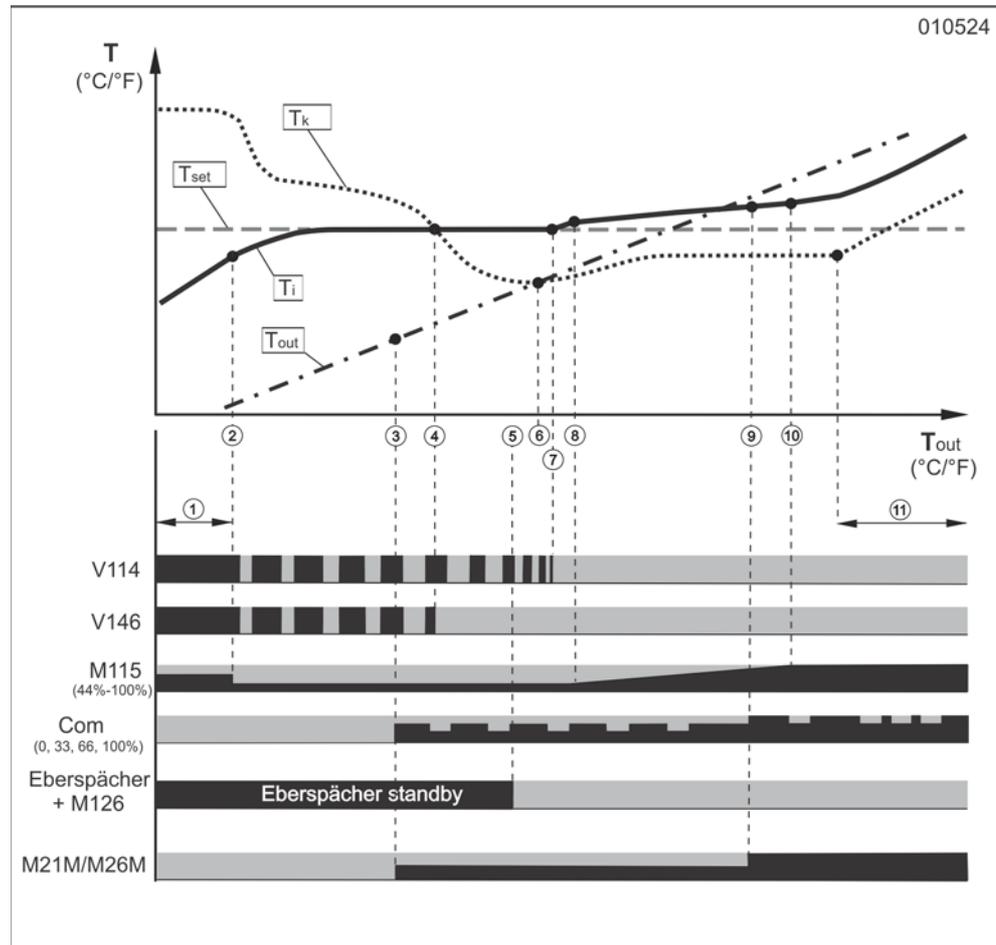
To switch on the coolant heater by means of the dashboard switch or the programmable control, refer to operating manual.

Circulating pump M126

The circulating pump runs when the coolant heater is in standby mode.

continued on next page

Switching points with warm engine



- T_i* Interior temperature
- T_{out}* Exterior temperature
- T_{set}* Set temperature
- T_k* Calculated duct temperature
- Com* Climate-control compressor

Explanation of switching points with warm engine

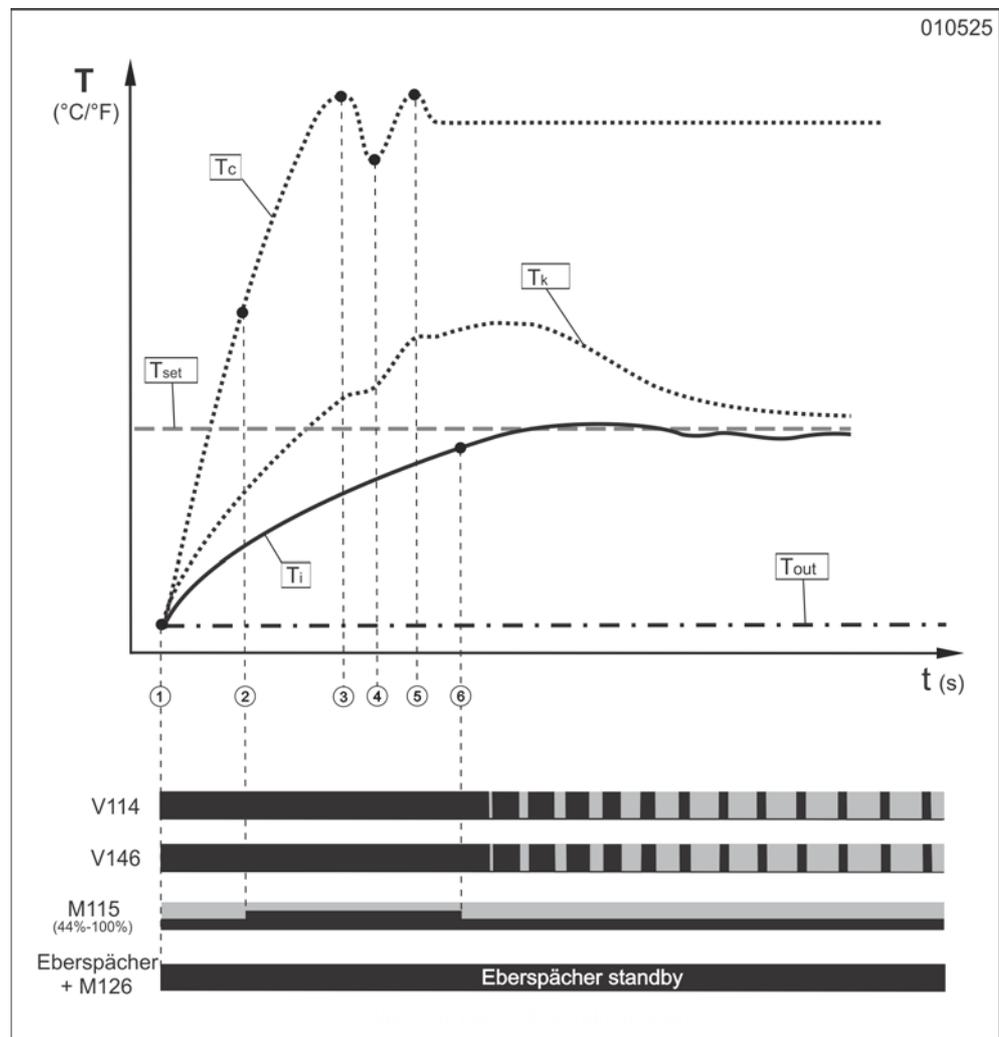
Switching point	Explanation
1	Interior temperature below control range (maximum heating capacity)
2	Interior temperature 7°F below set temperature
3	Exterior temperature 25°F
4	Calculated duct temperature equal to set temperature
5	Roof-heating metering valve open for more than 40% of the time

continued on next page

Switching point	Explanation
6	Calculated duct temperature equal to exterior temperature
7	Heating balanced on set point (heating off, climate-control compressor on)
8	Interior temperature 1°F above set temperature
9	Interior temperature 4°F above set temperature
10	Interior temperature 5°F above set temperature
11	Interior temperature above control range (maximum cooling capacity)

continued on next page

Switching points at cold start



Cold start at low exterior temperature

- T_i Interior temperature
- T_{out} Exterior temperature
- T_{set} Set temperature
- T_k Calculated duct temperature
- T_c Bus-engine coolant temperature

Explanation of switching points at cold start

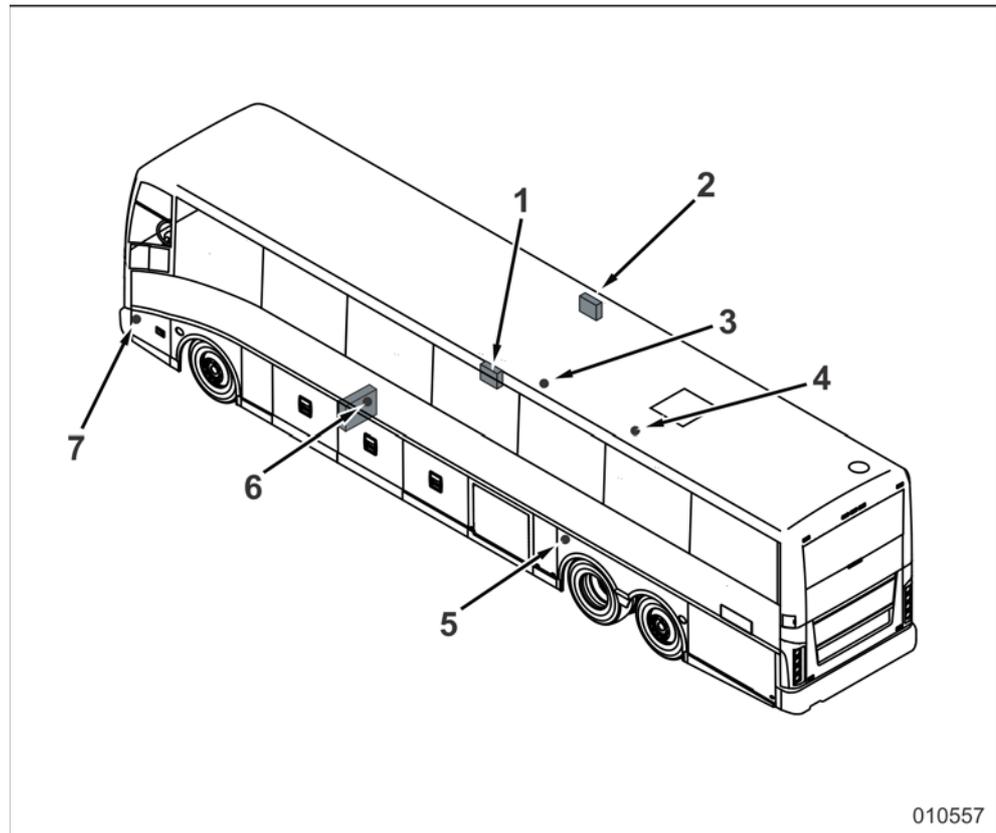
Switching point	Explanation
1	Bus-engine started
2	Coolant temperature 113°F
3	Coolant heater cut-off temperature (185°F)

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Switching point	Explanation
4	Coolant heater cut-in temperature (160°F)
5	Interior temperature 7°F lower than set temperature

Passenger compartment control system: component location

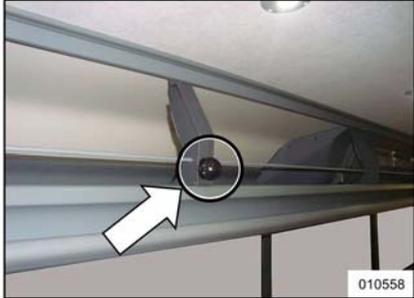
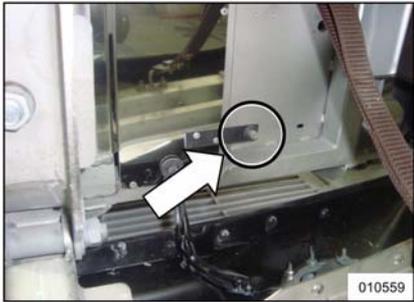
Figure:
location in
vehicle



- 1 Printed circuit with relay and fuses of LH evaporator fans (PR102)
- 2 Printed circuit with relay and fuses of RH evaporator fans (PR101)
- 3 Duct-air temperature sensor (G122)
- 4 Interior-air temperature sensor (G101)
- 5 Pilot valve (V114) of metering valve in hot-water supply to roof heating, pilot valve (V146) of metering valve in hot-water supply to floor heating
- 6 "MRS" motor reversing switch of outside air flaps (MST)
- 7 Outside-air temperature sensor (G103)

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Temperature sensors

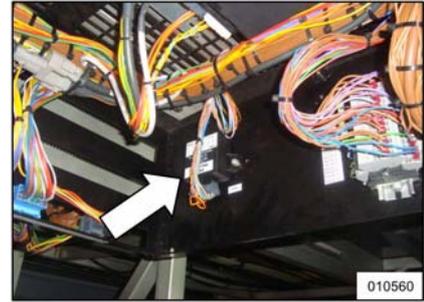
<p>On a post of the left-hand luggage rack: interior-air temperature sensor G101</p>	 <p>010558</p>
<p>At the left, behind front bumper: outside-air temperature sensor G103</p>	 <p>010559</p>
<p>Below the protective cap of the climate-control unit (accessible through the roof): duct-air temperature sensor G122</p>	 <p>010610</p>

Pilot valves

<p>On the interior-heating valve block:</p> <ol style="list-style-type: none"> 1 Pilot valve V114 of metering valve in hot-water supply to roof heating 2 Pilot valve V146 of metering valve in hot-water supply to floor heating 	 <p>010603</p>
---	--

Motor reversing switch (MRS.4)

In junction box EKV



Passenger compartment control system: to troubleshoot using the dashboard display

Climate-control system test program

To simplify the troubleshooting process, the multiplex system of the vehicle has been provided with a climate control test program. You can use the test program to activate equipment yourself to determine how it responds to control signals. Moreover, the commands "HEAT CH" and "GAS CH" of this program allow you to activate the whole heating or cooling system of the passenger compartment.



CAUTION!

Do not operate the climate control system fans for more than a short period when the engine is stopped. This will avoid putting a load on the batteries and draining them.



CAUTION!

If you activate the electromagnetic clutch of the climate-control compressor with the engine off, do so only for a short time while an assistant checks that the clutch responds. If it remains activated for too long, the electromagnet will overheat.

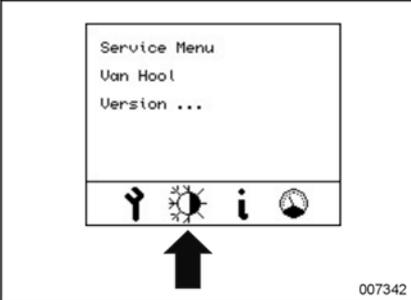
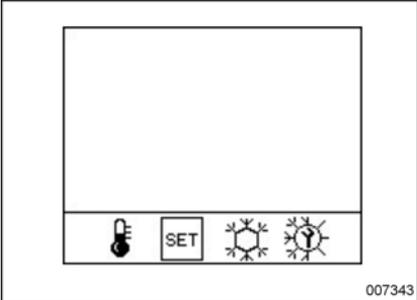
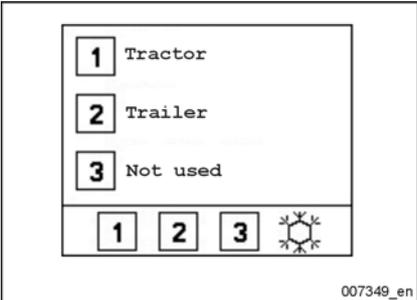
Dashboard display control

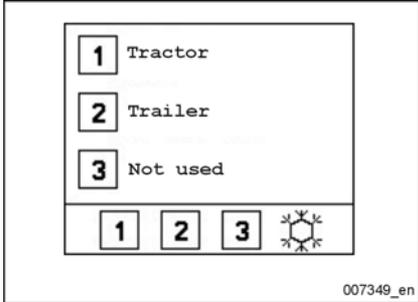
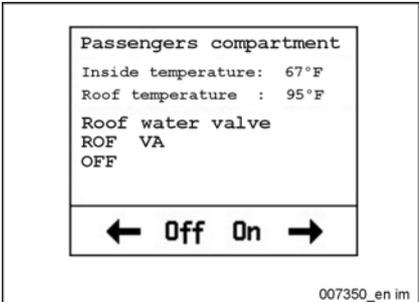
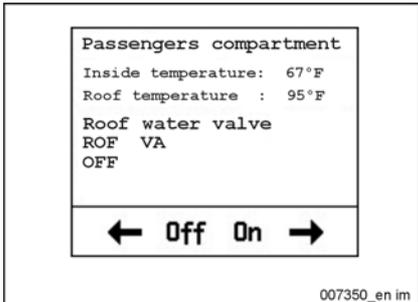
For more information on how to scroll through menus and to select functions in the service menu of the dashboard display, see chapter 11.1, under "To operate the dashboard display".

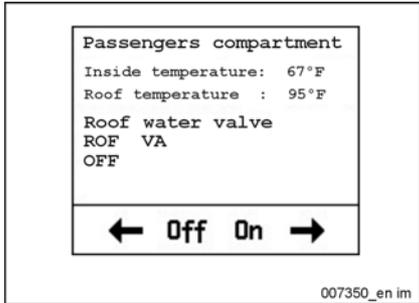
Equipment condition

Battery isolation switch on

To check equipment operation

Step	Action	Result
<p>1</p>	<p>Press the dashboard-display menu button longer than 5 seconds.</p>  <p>007687</p>	<p>The service menu appears on the display.</p>  <p>007312</p>
<p>2</p>	<p>Press the button under the climate control symbol.</p>  <p>007342</p>	<p>The climate control menu appears on the display.</p>  <p>007343</p>
<p>3</p>	<p>Press the button under the wrench symbol.</p>	<p>The menu below (example) appears on the display.</p>  <p>007349_en</p>

Step	Action	Result
<p>4</p>	<p>Press the button under the “1”, “2”, or “3” figure to select the control you wish to check.</p>  <p>007349_en</p>	<p>You are now in the climate control system test program. The following will appear on the display:</p> <ul style="list-style-type: none"> • selected control; • interior temperature; • duct temperature; • equipment description; • equipment code; • equipment condition.  <p>007350_en im</p>
<p>5</p>	<p>Change the equipment status by pressing the button under "Off" or "On".</p>  <p>007350_en im</p>	<p>Check if the activated equipment responds to the status change.</p> <p><i>NOTE: The equipment will remain in the modified state until you leave the climate control menu.</i></p>

Step	Action	Result
6	<p>Press the button under the left or right arrow to navigate to the next or previous item of equipment.</p>  <p>007350_en im</p>	See step 4.
7	<p>Repeat steps 5 and 6 until all equipment has been checked.</p> <p><i>NOTE: See further on for the equipment sequence.</i></p>	

Equipment sequence on the display

Code	Component
ROF VA	Pilot valve of metering valve of hot-water supply to roof heating system and floor heaters/convectors (if present)
CNV VA	Pilot valve of metering of hot-water supply to floor heaters/convectors (vehicles with separate heating circuit for floor heaters/convectors)
EVAP 1	Fans for air supply through the roof ("low" speed)
EVAP 2	Fans for air supply through the roof ("moderate" speed)
EVAP 3	Fans for air supply through the roof ("high" speed)
RF FSH	Inside/outside air selection flap
CNV 1	Floor heater fans ("low" speed)
CNV 2	Floor heater fans ("high" speed)
LQD VA	Solenoid shut-off valve(s) in refrigerant circuit (vehicles with interior cooling)
BYPASS	Pilot valve of hot-water circuit bypass valve
COND	Condenser fans
CLU	Climate-control compressor electromagnetic clutch (vehicles with interior cooling)
CAP VA1	Unloader valve 1 of climate-control compressor capacity control (vehicles with interior cooling)

continued on next page

Code	Component
CAP VA2	Unloader valve 2 of climate-control compressor capacity control (vehicles with interior cooling)
CIRC	Water circulating pump
GAS CH	CLU, COND, LQD VA, and EVAP 3 (vehicles with interior cooling)
HEAT CH	CIRC, CNV VA, ROF VA, BYPASS, CNV 2 and EVAP 1

To exit test program

Momentarily press the menu button of the dashboard display as many times as necessary to return to the service menu.

Passenger compartment control system: climate-control compressor diagnostics menu

What can be retrieved by means of the climate-control compressor diagnostics menu?

The climate-control compressor diagnostics menu shows the position of the:

- climate-control compressor electromagnetic clutch;
- pressure switches of the refrigerant-circuit protection system;
- unloader valve of the climate-control compressor capacity control

Refrigerant circuit protection system

The protection system ensures that the pressure in the refrigerant circuit is limited. If the pressure falls outside the permissible range, the climate-control compressor is cut out via the electromagnetic clutch. The protection system consists of a high-pressure and a low-pressure switch.

Climate-control compressor capacity control

As its operation requires a lot of energy and it is not always necessary to have it operating at full capacity, the climate-control compressor has been equipped with a capacity control. The main components of the control system are a pressure switch and an unloader valve. Some climate-control compressors have been equipped with a second unloader valve.

Dashboard display control

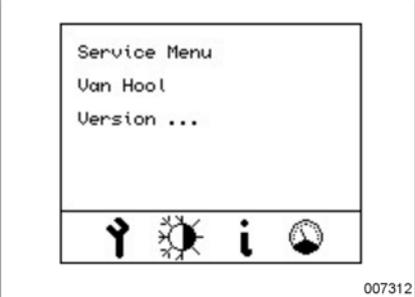
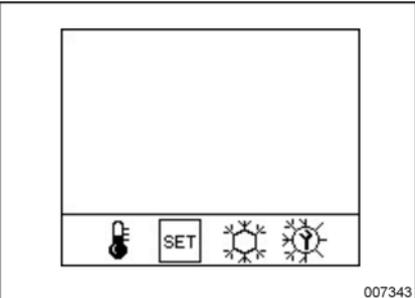
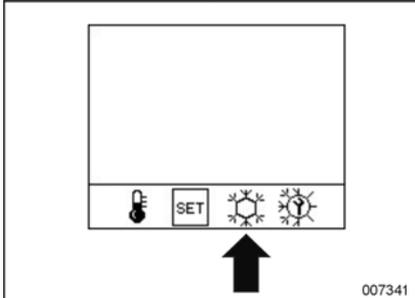
For more information on how to scroll through menus and to select functions in the service menu of the dashboard display, see chapter 11.1, under "To operate the dashboard display".

Equipment condition

Battery isolation switch on

continued on next page

To retrieve the climate-control compressor diagnostics menu

Step	Action	Result
1	Press the dashboard-display menu button longer than 5 seconds.	The service menu appears on the display.  007312
2	Press the button under the climate control symbol.	The climate control menu appears on the display.  007343
3	Press the button under the symbol for the climate-control compressor diagnostics menu.	The climate-control compressor diagnostics menu appears on the display.  007341

**Explanation of
climate-
control
compressor
diagnostics
menu**

Component	Explanation
Upper switch	<ul style="list-style-type: none"> • Contacts closed: climate-control compressor electromagnetic clutch activated by control system • Contacts open: climate-control compressor electromagnetic clutch not activated by control system
CAP VA1	Unloader valve 1 of capacity control
CAP VA2	Unloader valve 2 of capacity control
CLU	Climate-control compressor electromagnetic clutch
HP CLU	High-pressure switch of protection system (positions: open, closed or unknown ^a)
LP CAP	Low-pressure switch of capacity control (positions: open or closed)
LP CLU	Low-pressure switch of protection system (positions: open or closed)
TH	Thermal switch of capacity control (positions: open or closed)

a. Position cannot be determined because the climate-control compressor clutch is not activated.

**To exit
climate-
control
compressor
diagnostics
menu**

Momentarily press the menu button of the dashboard display as many times as necessary to return to the service menu.

Passenger compartment control system: to call up temperatures

Which temperatures are accessible?

- Coolant temperature
- Outside air temperature
- Outlet-air temperature of the driver's cab heater/climate-control unit
- Interior air temperature or temperatures (depending on the vehicle type)
- Duct-air temperature or temperatures (depending on the vehicle type)

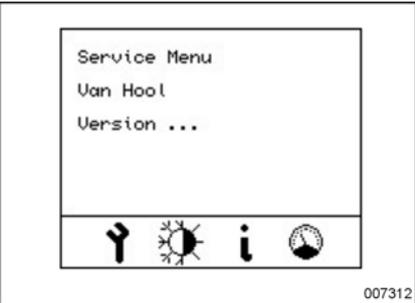
Dashboard display control

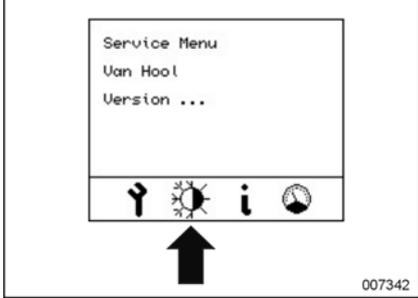
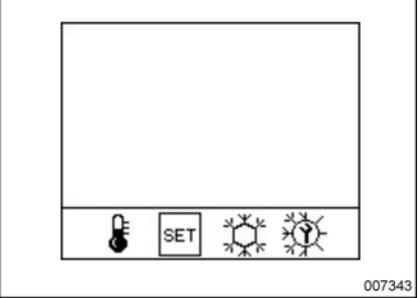
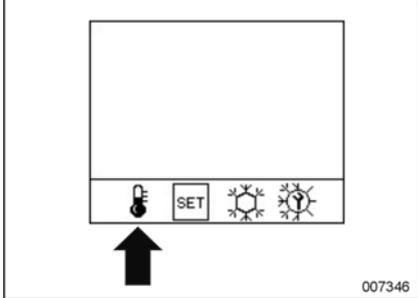
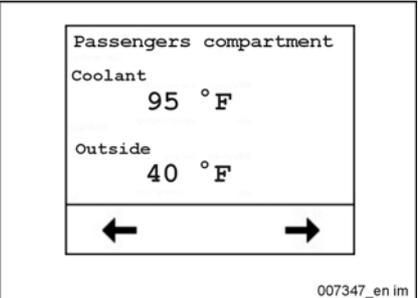
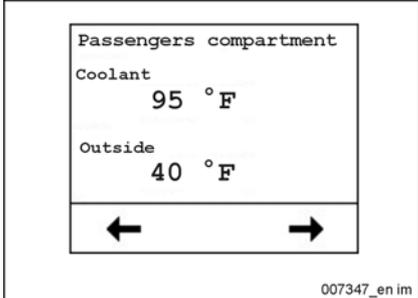
For more information on how to scroll through menus and to select functions in the service menu of the dashboard display, see chapter 11.1, under "To operate the dashboard display".

Equipment condition

Battery isolation switch on

Procedure

Step	Action	Result
1	<p>Press the dashboard-display menu button longer than 5 seconds.</p>  <p>007687</p>	<p>The service menu appears on the display.</p>  <p>007312</p>

Step	Action	Result
2	<p>Press the button under the climate control symbol.</p>  <p>007342</p>	<p>The climate control menu appears on the display.</p>  <p>007343</p>
3	<p>Press the button under the thermometer symbol.</p>  <p>007346</p>	<p>The outside-air and water temperatures are shown on the display.</p>  <p>007347_en im</p>
4	<p>Press the button under the right arrow to retrieve other temperatures.</p>  <p>007347_en im</p>	

To close the temperature adjustment menu

Momentarily press the menu button of the dashboard display as many times as necessary to return to the service menu.

Passenger compartment control system: to check temperature sensors

Introduction

The control system contains three temperature sensors: one for interior temperature, one for duct temperature and one for outside temperature.

Sensor type

The temperature sensors are of the NTC type (negative temperature coefficient) with a resistance of 4 700 ohms at 77°F. NTC means that resistance decreases, as temperature increases.

To check sensor

When in doubt whether sensor is okay, you can check it with the resistances given in the table.

Temperature (°F)	Resistance (ohms)
-40	191541
-31	134029
-22	95172
-13	68520
-4	49975
5	36898
14	27559
23	20809
32	15874
41	12228
50	9507
59	7456
68	5896
77	4700
86	3774
95	3052
104	2485
113	2037
122	1679
131	1393
140	1162
149	974
158	821

continued on next page

8.2



Temperature (°F)	Resistance (ohms)
167	696

Technical data: control system

Driver's cab climate- control system

Outlet-air temperature sensor G118	NTC resistance with a value of 4700 ohm at 77°F.
------------------------------------	--

Passenger- compartment climate- control system

Outside-air temperature sensor G103	NTC resistance with a value of 4700 ohm at 77°F.
Interior-air temperature sensor G101	NTC resistance with a value of 4700 ohm at 77°F.
Duct-air temperature sensor G122	NTC resistance with a value of 4700 ohm at 77°F.



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Chapter 6: Airside systems

Overview

Introduction This chapter deals with the airside systems.

Number of pages 8

Chapter publication date 21 September 2016

Contents

Topic	See page
To check/clean filter cloth of climate-control units	8.6-2
To remove filter cloth of driver's cab climate-control unit	8.6-4
To remove filters of passenger compartment climate-control units	8.6-5

To check/clean filter cloth of climate-control units

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

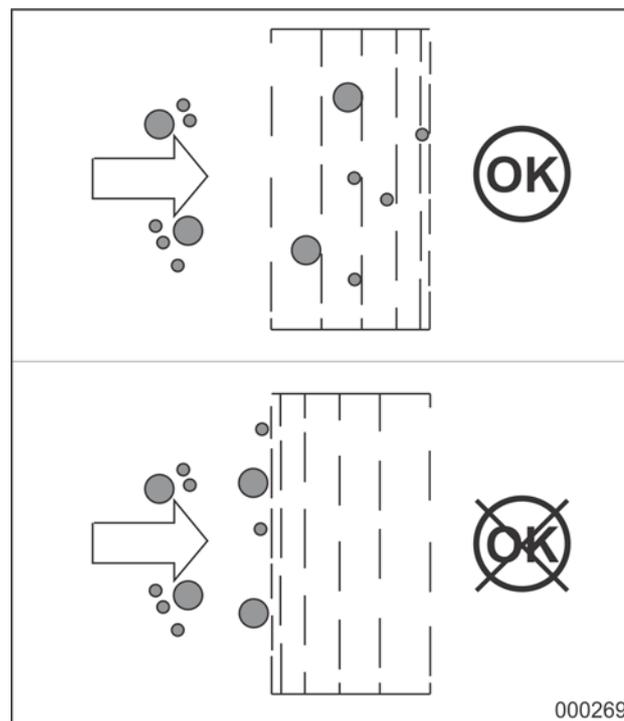
General

- The filter cloth has to be in front of the air-inlet opening of the heat exchangers at all times, otherwise dirt will collect between the strips of the heat exchanger and on the fans.
- If the cloth gets too dirty, system problems due to inadequate air flow will arise.

Installation direction of filter cloth

Some filter cloths have a coarsely woven side and a tightly woven side. With this kind of filter cloths the coarsely woven side has to face the air-inlet side at all times. If reversed, the filter will not work in terms of depth: in that case dirt will remain on the tightly woven surface and soon block the air passage (see figure).

Figure: schematic cross-section of filter material



Proper and improper direction of air flow

To clean filter cloth

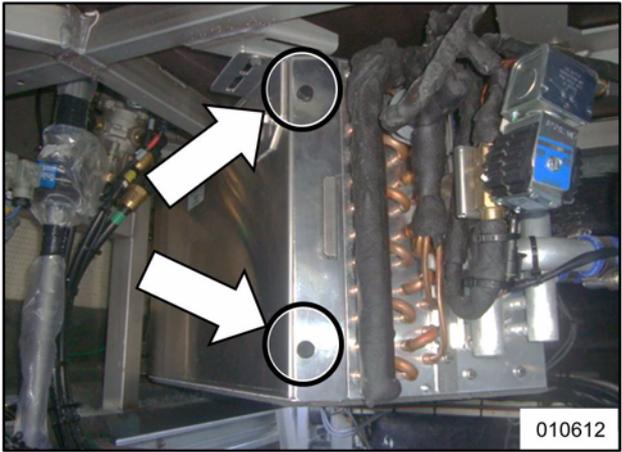
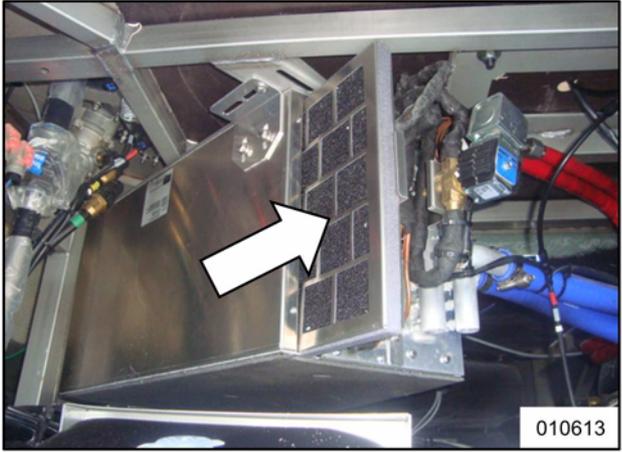
Step	Action
1	Remove filter cloth from climate-control unit.
2	Shake out cloth.
3	Wash cloth in lukewarm water. If heavily soiled, add mild detergent to water.
4	Rinse cloth thoroughly.
5	Allow cloth to dry completely before using. Do not wring it out; do not blow dry with compressed air.

To install filter cloth

Re-install cloth (procedure for removing filter cloth in reverse order).
Take care that new or cleaned filter cloth covers entire air flow opening.
Never install a cloth that is too small or damaged.

To remove filter cloth of driver's cab climate-control unit

Procedure

Step	Action
1	Open exterior door on left-hand side at the very front.
2	Remove the two fixing screws (refer to figure) and remove the plate.  010612
3	Pull filter frame out of climate-control unit.  010613
4	Remove the filter cloth from the frame.

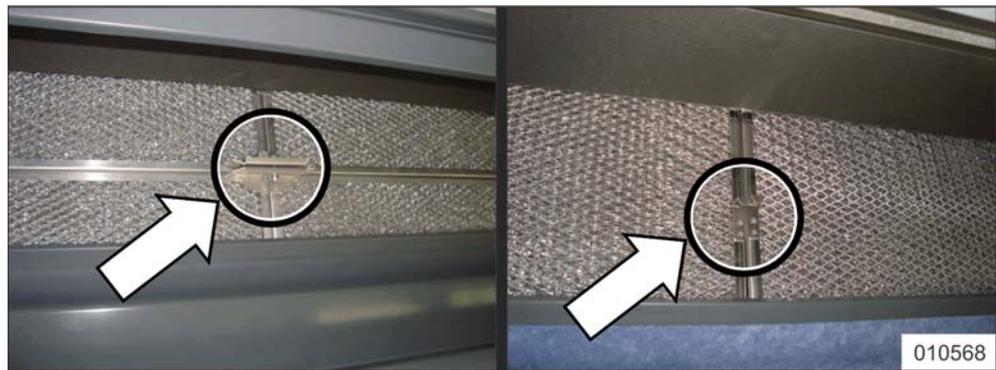
To remove filters of passenger compartment climate-control units

Introduction

The filters can be fixed at two ways:

- with locking piece (four filters);
- without locking piece (two filters).

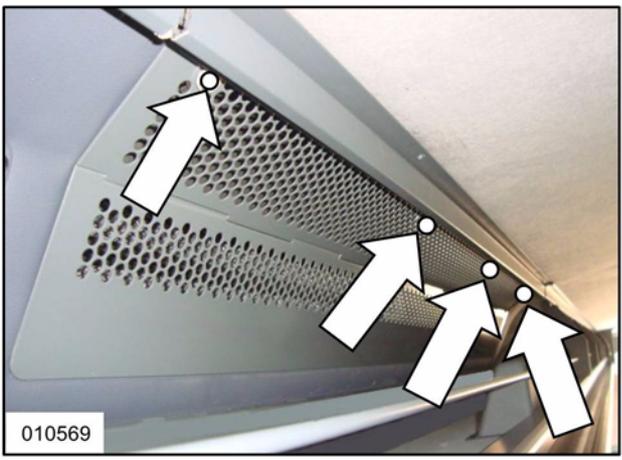
Figure: fixation of filters of passenger compartment climate- control unit



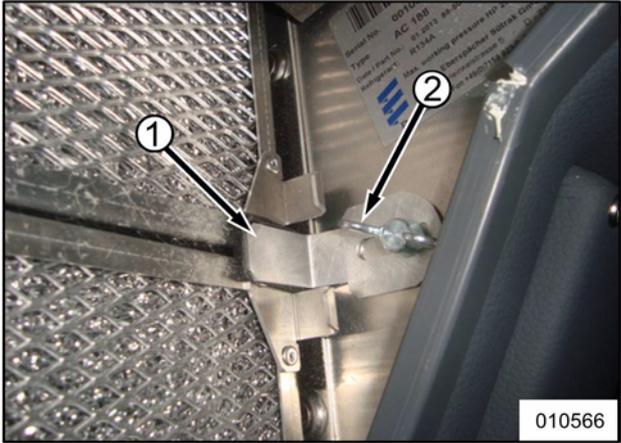
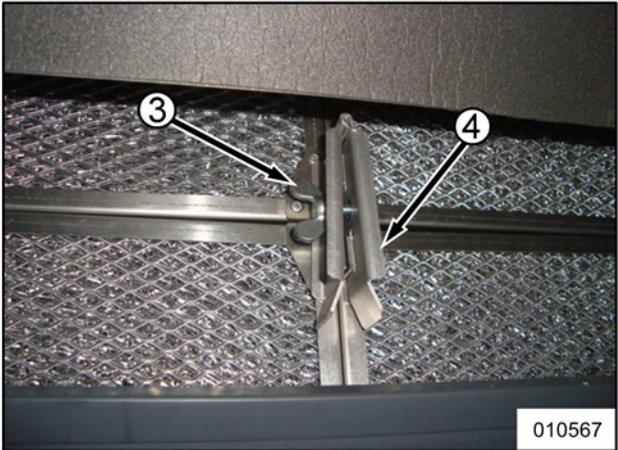
Left: design with locking piece; right: design without locking piece

Procedure

Carry out the operations for the climate-control unit in the left- and right-hand roof duct.

Step	Action
1	<p>Using a flat blade screwdriver, turn the fixation screws of the access panel (refer to figure) a quarter of a turn counterclockwise and take away the panel.</p> 

continued on next page

Step	Action
2	<p>Only for design with locking piece: remove wing nut (2) and take away retaining plate (1). Do this for both sides.</p> 
3	<p>Only for design with locking piece: loosen wing nut (3) and take away locking piece (4).</p> 
4	Remove the filters.

continued on next page

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Chapter 10: Water circuit

Overview

Introduction This chapter deals with the water circuit.

Number of pages 14

Chapter publication date 21 September 2016

Contents

Topic	See page
Safety instructions with respect to the water circuit	8.10-2
Protection against frost, deposits and corrosion	8.10-4
To drain engine cooling and interior heating circuit	8.10-5
To fill and bleed engine cooling and interior heating circuit	8.10-7
Interior heating circuit isolating valves	8.10-10
To check water hoses	8.10-11
Hose clamps	8.10-12
Technical data of water system	8.10-13

Safety instructions with respect to the water circuit



WARNING!

Antifreeze and coolant with antifreeze contain the toxic chemical ethylene glycol. Hazardous for ingestion or inhalation of fumes. Causes irritation upon contact with the eyes. In the event of ingestion, have a first-aider cause the victim to vomit (if conscious); in the event of inhalation, move the victim into the open air. Seek medical assistance in both cases. In the event of contact with the eyes, rinse the eyes with ample water. If eye irritation develops, consult an eye doctor.



WARNING!

Fleetguard DCA4 contains alkaline. Take care that it does not get into your eyes. In the event of contact with the eyes, rinse the eyes with ample water for at least 15 minutes. Seek medical assistance. Avoid prolonged or repeated contact with the skin. In the event of contact, wash the skin with soap and water immediately. Keep out of children's reach.



WARNING!

Never open the coolant expansion tank filler cap or pressure relief cap if the coolant temperature gauge indicates more than 122 °F. The pressure could cause hot water to squirt outward and cause scalds.



WARNING!

If the expansion tank filler cap or pressure relief cap has to be opened, first turn it carefully counterclockwise to the first stop and let the pressure escape. Then turn to the second stop and remove the cap.

**CAUTION!**

Never add cold coolant, when the engine is hot. The sudden cooling could cause parts of the engine block to crack.

Protection against frost, deposits and corrosion

**Cross-
reference**

Refer to chapter 2.34, "Cooling system".

To drain engine cooling and interior heating circuit

Introduction

The procedure below describes draining both the engine cooling circuit and the interior heating circuit.

If only the engine cooling circuit is to be drained, follow the instructions under "To drain engine cooling circuit" in chapter 2.34.

Special tools

Hose coupling for drain nipple	Van Hool No. 10772040
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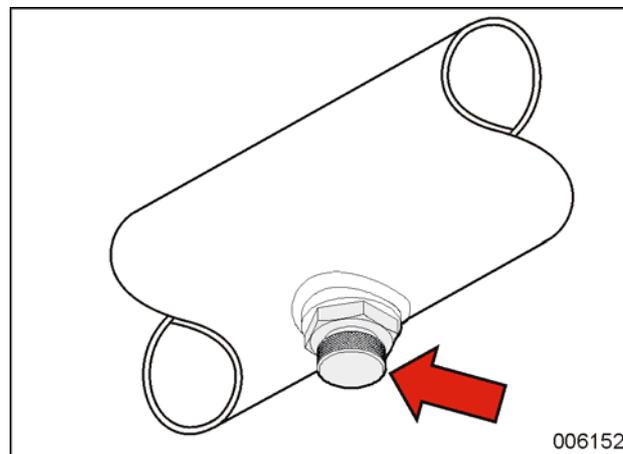
Equipment condition

- Cold engine
- Isolating valves of interior heating circuit open (refer to "To operate interior heating circuit isolating valves" in chapter 8.10).

Drain nipple

To simplify draining, a water pipe near the radiator has been provided with a drain nipple that can be connected with a hose.

Figure: drain nipple in cooling circuit water pipe



Drain hose

You can make the drain hose mentioned in the procedure yourself. It consists of a special coupling (refer to "Special tools") and a hose with an inner diameter of 3/4 inch (19 mm).

Procedure

NOTE: Depending on the way in which the water pipes have been installed, it may be necessary to undo some of the water hoses in order to completely drain the heating circuit. Collect the coolant.

continued on next page

Step	Action
1	Unscrew the expansion tank filler cap and remove it.
2	Hang the end of the drain hose in a container.
3	Remove the protective cap from the drain nipple. Screw the drain hose onto the nipple. Coolant now runs out of the drain hose.
4	If present, remove the drain plugs in the engine cooling circuit water pipes and collect the coolant.
5	Drain the roof heaters. To this end, loosen the screw of the upper hose clamp at each roof heater and prize the hose until you hear that air is being aspired. Tighten the hose clamp again to the prescribed torque if no more coolant runs out of the drain hose.
6	Drain the convectors. To this end, open the bleed screws of the convectors until no more coolant runs out of the drain hose.
7	Drain the driver's cab climate control unit. To this end, open the bleed screw of the driver's cab climate control unit until no more coolant runs out of the drain hose.

To fill and bleed engine cooling and interior heating circuit

Introduction

The procedure below describes filling and bleeding both the engine cooling circuit and the interior heating circuit. If only filling and bleeding of the engine cooling circuit is required, follow the instructions under "To fill and bleed engine cooling circuit" in chapter 2.34.

To operate climate-control devices

While carrying out the procedure, use the climate control test program (refer to chapter 8.2, under "Passenger compartment control system: to troubleshoot using the multifunctional display") to:

- switch the interior heating system circulation pump on or off;
- open or close the metering valve in the hot-water supply to the roof heating;
- open or close the metering valve in the hot-water supply to the floor heating;
- make the roof-heater fans turn.



WARNING!

Asphyxiation hazard. When carrying out works in a confined space, connect engine and coolant heater exhaust to an appropriate exhaust fumes evacuating system.

Procedure

Step	Action
1	Remove the drain hose (refer to "To drain engine cooling circuit"). Screw the protective cap on the drain nipple.
2	If present, install all the cooling circuit drain plugs.
3	Slowly pour coolant in the expansion tank until just above the yellow band of the gauge glass.
4	Observe the coolant level and top up until (after approximately a quarter of an hour) you notice that the level is not dropping anymore.
5	Switch the vehicle ignition on and use the climate control test program to open the hot-water supply metering valves to the passenger compartment.

continued on next page

Step	Action
6	From the dashboard, set the temperature of the driver's cab heating to maximum. The driver's cab heating metering valve is now open.
7	Through the climate control test program, switch on the heating system circulating pump. Top up with coolant as the level in the expansion tank drops. Proceed with the next step when the circulation pump has run steadily for approximately 5 minutes, without gargling or hissing.
8	Through the climate control test program, close the hot-water supply metering valves to the passenger compartment and switch off the heating system circulating pump.
9	From the dashboard, set the temperature of the driver's cab heating to minimum. The driver's cab heating metering valve is now closed.
10	Start engine and let it run approximately 5 minutes at high idle (do not exceed 1 000 rpm). Top up with coolant as the level in the expansion tank drops.
11	Through the climate control test program, switch on the heating system circulating pump.
12	Bleed each heating circuit separately, see further on in the text.
13	Make sure all the metering valves in the hot-water supply to the heating circuits are open.
14	Check the coolant level in the expansion tank and screw the filler cap on the expansion tank.
15	Drive the vehicle to make the engine reach its working temperature.
16	Check heat delivery of all heating devices. In case of a heater, make the fan(s) turn to this end.
17	If a device delivers less heat than normal, repeat step 12, but now only for the relevant heating circuit.
18	Leave the climate control test program and close the service menu.
19	Stop the engine and check the coolant level as soon as the system has cooled down completely. If necessary, top up with coolant.

continued on next page

To bleed the heating circuits separately

The table below gives a detailed description of step 12 of "Procedure", see above.

Step	Action
1	<p>Open the metering valve in the hot-water supply to the floor heating. Top up with coolant as the level in the expansion tank drops.</p> <p>The circuit is completely bled when the circulation pump has run steadily for approximately 5 minutes, without gargling or hissing.</p>
2	<p>Close the metering valve in the hot-water supply to the floor heating.</p>
3	<p>From the dashboard, set the temperature of the driver's cab heating to maximum. The metering valve in the hot-water supply to the driver's cab heating then opens. Top up with coolant as the level in the expansion tank drops.</p> <p>The circuit is completely bled when the circulation pump has run steadily for approximately 5 minutes, without gargling or hissing.</p>
4	<p>From the dashboard, set the temperature of the driver's cab heating to minimum. The metering valve in the hot-water supply to the driver's cab heating then closes.</p>
5	<p>Open the metering valve in the hot-water supply to the roof heating. Top up with coolant as the level in the expansion tank drops.</p> <p>The circuit is completely bled when the circulation pump has run steadily for approximately 5 minutes, without gargling or hissing.</p>

Interior heating circuit isolating valves

Purpose of isolating valves

Two manual shut-off valves in water pipes allow engine cooling system to be completely isolated from heating system if required.

Location of isolating valves

For location of isolating valves, refer to “Access doors and controls at the outside”.



CAUTION!

There is no objection against the vehicle being driven with isolating valves closed, but on no account must heating system be switched on in this condition.

To close isolating valves

Step	Action
1	Turn handle of isolating valve in supply line of interior heating system clockwise until handle is square to pipe.
2	Turn handle of isolating valve in return line of interior heating system clockwise until handle is square to pipe.

To open isolating valves

Step	Action
1	Turn handle of isolating valve in supply line of interior heating system counterclockwise until handle is in line with pipe.
2	Turn handle of isolating valve in return line of interior heating system counterclockwise until handle is in line with pipe.

To check water hoses

**Cross-
reference**

Refer to chapter 2.34, under "To check coolant hoses".

Hose clamps

Cross- reference

Refer to chapter 1.1, "General mounting guidelines: hose clamps".

Technical data of water system

Tightening torques

Standard hose clamps, clamping range up to 0.9 in dia.	2.2 ± 0.4 ft.lbf
Standard hose clamps, clamping range up to 1.06 in dia.	3.3 + 0.4 ft.lbf
Constant torque hose clamps (manufacturer "Breeze"), with four conical spring washers	5.2 ± 0.4 ft.lbf
Constant torque hose clamps (manufacturer "Breeze"), with five conical spring washers	6.6 + 0.7 ft.lbf

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Chapter 14: Refrigerant circuit

Overview

Introduction This chapter deals with the refrigerant circuit.

Number of pages 38

Chapter publication date 14 October 2016

Contents

Topic	See page
Safety instructions when working on refrigerant circuit	8.14-3
Operation	8.14-4
To connect pressure gauge set	8.14-6
To disconnect pressure gauge set	8.14-9
To check refrigerant charge	8.14-12
To add refrigerant	8.14-14
To flush refrigerant circuit	8.14-15
Climate-control compressor: general	8.14-16
Climate-control compressor: capacity control	8.14-17
Climate-control compressor: oil level check	8.14-18
Climate-control compressor: to add oil	8.14-19
To replace the climate-control compressor	8.14-21
Climate-control compressor: electromagnetic clutch	8.14-22
Evaporators	8.14-23
Condenser	8.14-24
To change filter/dryer	8.14-26
Thermostatic expansion valve: general	8.14-28
Service valves: general	8.14-31
Solenoid shut-off valves	8.14-33
Pressure switches	8.14-34
Technical data of refrigerant circuit	8.14-37

continued on next page

The following subjects have been *added/modified* since the former edition:

Topic	See page
Climate-control compressor: capacity control	8.14-17
Climate-control compressor: electromagnetic clutch	8.14-22

Safety instructions when working on refrigerant circuit

**WARNING!**

Maintenance and repair works should only be carried out by a refrigeration technician.

**WARNING!**

The refrigerant circuit is pressurised.

**WARNING!**

Never work with refrigerant in a confined space or near an open fire.

**WARNING!**

Make sure that your eyes and skin do not come in contact with the refrigerant. In the event of contact with the eyes, rinse the eyes with ample water. In the event of contact with skin, apply pure vaseline to the affected spot. Always consult a physician.

Operation

General

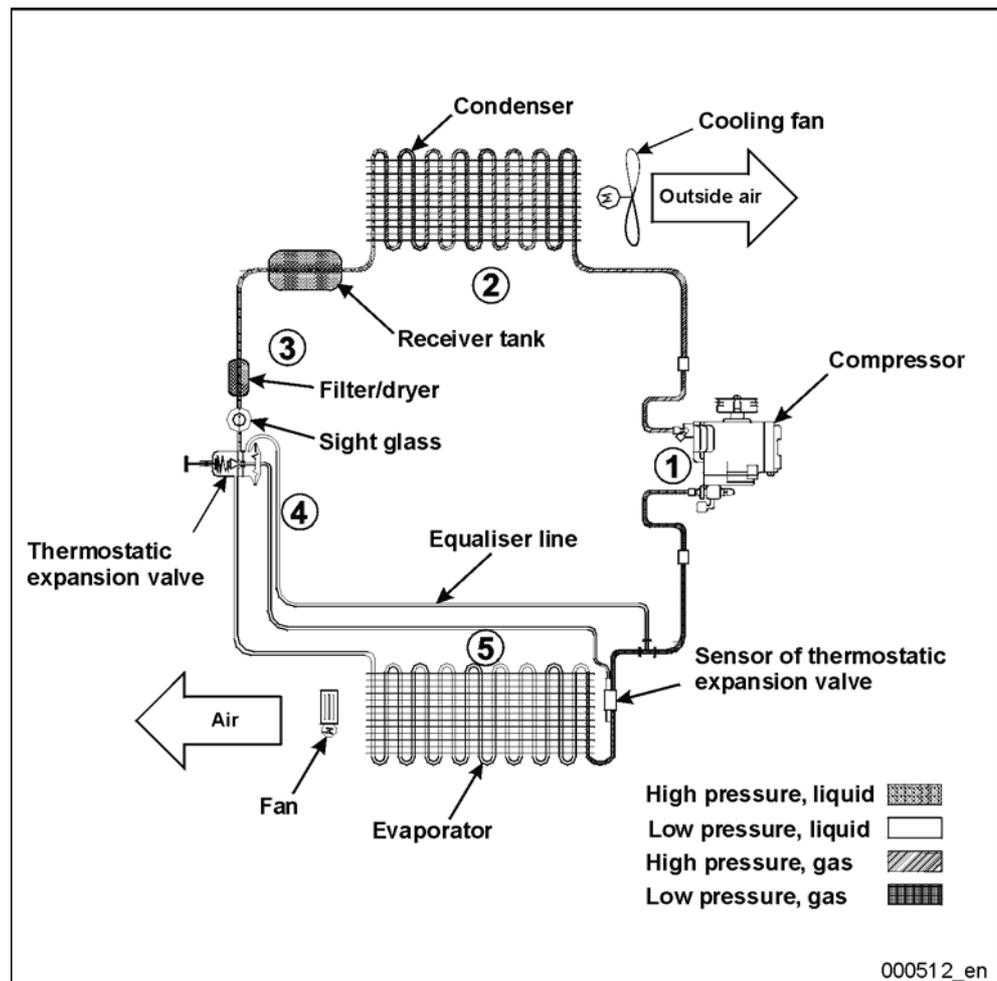
In the event of outside temperatures higher than the desired inside temperatures, these can only be achieved by refrigerating the air. The climate control system must therefore contain a refrigerant system, which reduces the temperature of the air supply.

Refrigerants

The refrigerant acts as a means of conveyance that takes away heat on one place in the system by evaporating it and gives off this heat by condensing it on another place. No chemical changes occur during this process.

The refrigerant used in your vehicle is R-134a (tetrafluoroethane, which does not damage the ozone layer).

Figure:
cooling cycle



Cooling cycle

Phase	Name	Description
1	Compression	The gaseous refrigerant is compressed into the compressor. This causes both the pressure and the temperature of the gas to rise.
2	Cooling	In the condenser, the gas gives off heat to the surrounding air and condenses into a liquid. <i>NOTE: Cooling can be speeded with fans</i>
3	Storage	The fluid tank stores the refrigerant (in liquid and in gaseous state) coming from the condenser. It remains in this tank, until the evaporator requires refrigerant.
4	Filtration/drying	Humidity and dirt from the refrigerant circuit are caught in the filter/dryer.
5	Flow control	The thermostatic expansion valve permits just enough liquid refrigerant to flow to the evaporator. Here the temperature and pressure of the liquid refrigerant decline, and a part of the refrigerant takes on a gaseous form.
6	Evaporation	The partially liquid and partially gaseous refrigerant, which has a lower pressure and temperature, flows to the evaporator. The refrigerant continues to evaporate by extracting heat from the air flow, which passes through the evaporator coil. All the liquid refrigerant is converted into a gaseous form in the evaporator, and only the warmed gaseous refrigerant flows to the compressor.

To connect pressure gauge set

Introduction

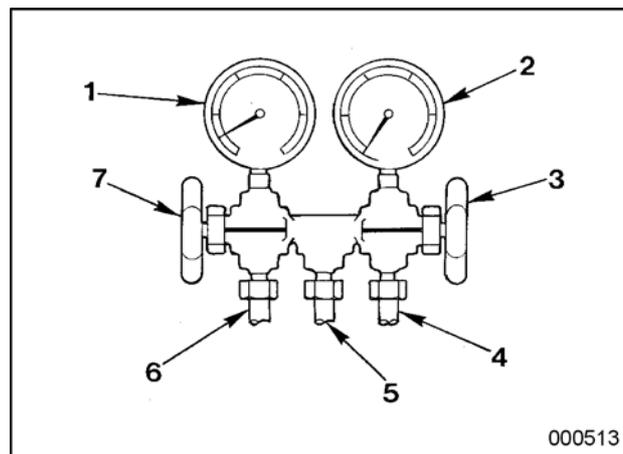
The pressure gauge set is used for measuring the suction and discharge pressure of the refrigerant system. In combination with other tools, maintenance tasks can also be carried out with it.



CAUTION!

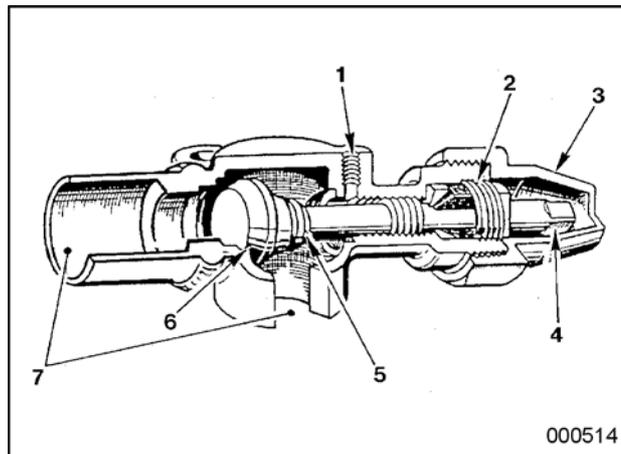
The hoses of the pressure gauge set must be vacuumed, after they have been connected to the installation. Otherwise the installation will be contaminated by the air and the humidity in the hoses.

Figure:
pressure
gauge set



- 1 Low-pressure gauge
- 2 High-pressure gauge
- 3 High-pressure cock
- 4 High-pressure hose
- 5 Center hose
- 6 Low-pressure hose
- 7 Low-pressure cock

Figure: service valve



- 1 Service connection
- 2 Gland
- 3 Protective cap
- 4 Stem
- 5 Rear valve seat
- 6 Front valve seat
- 7 Inlet or outlet (depending on application)

Location of climate-control compressor service valves

Refer to "Climate-control compressor: general"

Preliminary operations

Step	Action
1	Clean the area surrounding the two service valves on the climate-control compressor.
2	Close the cocks of the pressure gauge set (clockwise, as far as it will go).
3	Remove protective cap (3) from the service valve and turn stem (4) counterclockwise until the stop is reached. Connection (1) is now isolated from the refrigerant circuit.
4	Repeat step 3 with the other service valve.
5	Remove the protective cap from service connection (1) on both service valves.

continued on next page

What happens with the center hose?

If...	then ...
you only have to check the suction and the discharge pressure of the refrigerant system.	you leave the cocks of the pressure gauge set closed and do not connect the center hose to the set.
you carry out other tasks	you connect the center hose to the equipment, which is required for carrying out your tasks.

To connect pressure gauge set

Step	Action	Result
1	Connect the high-pressure hose of the pressure gauge set to service connection (1) at the "discharge side" service valve.	
2	Connect the low-pressure hose of the pressure gauge set to service connection (1) at the "suction side" service valve.	
3	Turn the stem of both service valves half a turn in a clockwise direction, so that the service connections are connected to the refrigerant circuit.	The gauges of the set should now indicate pressure.
4	Connect a receiving cylinder to the center hose of the pressure gauge set.	
5	Open the high-pressure cock of the pressure gauge set.	The air in the high-pressure hose flows to the receiving cylinder, together with a small quantity of refrigerant.
6	Close the high-pressure cock of the pressure gauge set.	The high-pressure hose is now deaerated.
7	Open the low-pressure cock of the pressure gauge set.	The air in the low-pressure hose flows to the receiving cylinder, together with a small quantity of refrigerant.
8	Close the low-pressure cock of the pressure gauge set.	The low-pressure hose is now deaerated.

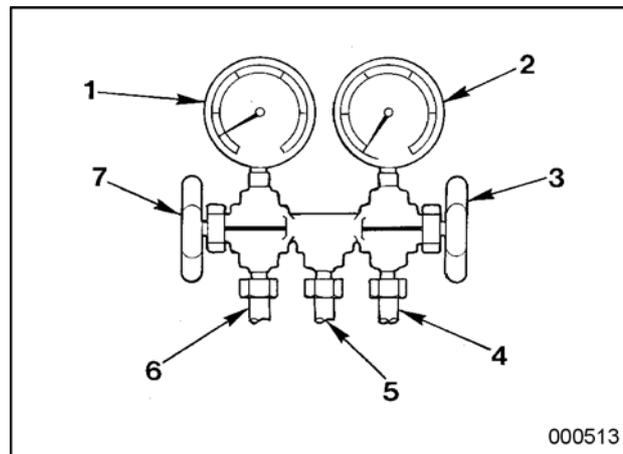
To disconnect pressure gauge set



CAUTION!

The hoses of the pressure gauge set must be emptied before they are disconnected, to prevent that refrigerant escapes.

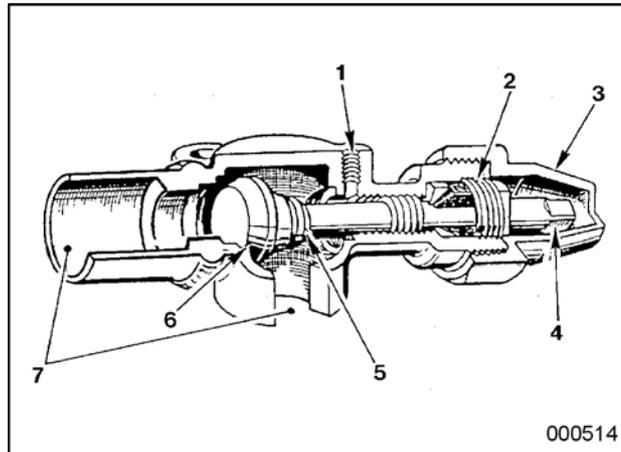
Figure:
pressure
gauge set



- 1 Low-pressure gauge
- 2 High-pressure gauge
- 3 High-pressure cock
- 4 High-pressure hose
- 5 Center hose
- 6 Low-pressure hose
- 7 Low-pressure cock

000513

Figure: service valve



- 1 Service connection
- 2 Gland
- 3 Protective cap
- 4 Stem
- 5 Rear valve seat
- 6 Front valve seat
- 7 Inlet or outlet (depending on application)

To disconnect pressure gauge set

Phase	Action	Result
1	Turn stem (4) of the service valve counterclockwise as far as it will go. Do this for both the service valves.	Service connection (1) is now isolated from the refrigerant circuit.
2	Close the cocks of the pressure gauge set by turning them clockwise as far as they will go.	
3	Connect a vacuum pump with a receiving cylinder to the center hose of the pressure gauge set.	
4	Open the high-pressure cock of the pressure gauge set.	The vacuum pump sucks the refrigerant out of the high-pressure hose into the receiving cylinder.
5	Close the high-pressure cock of the pressure gauge set.	The high-pressure hose is now empty.

continued on next page

Phase	Action	Result
6	Open the low-pressure cock of the pressure gauge set.	The vacuum pump sucks the refrigerant out of the low-pressure hose into the receiving cylinder.
7	Close the low-pressure cock of the pressure gauge set.	The low-pressure hose is now empty.
8	Disconnect the low- and high-pressure hoses of the pressure gauge set from the climate-control compressor service valves.	
9	Disconnect the center hose of the pressure gauge set from the vacuum pump.	
10	Mount the protective caps on the service valves.	

To check refrigerant charge

To be carried out when?

Refer to chapter 1.1, "Climate-control system maintenance schedule".

Equipment conditions

- Pressure gauge set connected, refer to "To connect pressure gauge set".
- Outside temperature higher than 50°F.

Preparation of check

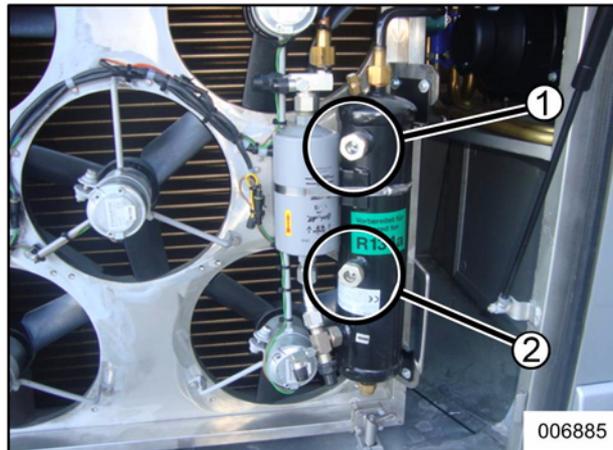
Step	Action
1	Disconnect the connectors of the capacity control valves. This prevents the capacity control from coming in operation during one of the following steps. For the location of the control valves of the capacity control, refer to "Climate-control compressor: capacity control".
2	Check the contamination of the filter cloths. If necessary, clean or replace filter cloths. Reinstall the access plates to the filters.
3	Start engine and let it run at approximately 1 200 to 1 300 rpm.
4	Set a temperature of 78°F in the passenger compartment (procedure: refer to operating manual).
5	Set the outlet-air temperature of the driver's cab climate unit to minimum (procedure: refer to operating manual).
6	Set the fan speed of the driver's cab climate unit to maximum.
7	Have the climate control (that of the driver's cab as well as that of the passenger compartment) operate with 100% inside air.
8	Wait until the temperature in the vehicle is 74 to 78°F.
9	Read the high-pressure gauge on the pressure gauge set. The gauge should indicate a pressure of 174 to 203 psi.
10	If necessary, increase the pressure by disconnecting one or more on the condenser fans (disconnect the connector). If various fans have to be switched off, do this in a way that the condenser is cooled evenly from top to bottom. To ensure that the liquid subcooler at the top of the condenser is sufficiently cooled, leave at least one of the two upper condenser fans connected. <i>NOTE: An excessive discharge pressure can be caused by too much refrigerant, or by air in the installation.</i>

Waiting time

Make sure that the test conditions in steps 3, 9 and 10, which are described under "Preparation of check", are maintained for 20 minutes.

continued on next page

Figure: sight-glasses



In climate-control condensor compartment

Check

Carry out the check 20 minutes after "Preparation of check".

Step	Action
1	<p>Inspect the sight-glasses of the coolant circuit.</p> <ul style="list-style-type: none"> • Too little coolant: the ball of the lower sight-glass is not at the top. • Sufficient coolant: the ball of the lower sight-glass is at the top and the ball of the upper sight-glass is not floating. • Too much coolant: the ball of the lower sight-glass is at the top and the ball of the upper sight-glass is floating.
2	If necessary, add refrigerant (refer to "To add refrigerant").
3	Reconnect the disconnected condenser fans and the pilot valves of the capacity control.
4	Disconnect the pressure gauge set; refer to "To disconnect the pressure gauge set".

To add refrigerant

Equipment condition

Steps mentioned under "To check refrigerant charge" carried out.

Procedure

Step	Action
1	Connect the center hose of the pressure gauge set to a charging cylinder.
2	Open the cock of the charging cylinder.
3	Loosen the union nut of the center hose just below the gauge set to purge the hose. Tighten the union nut after purging.
4	Open the low-pressure cock of the pressure gauge set a little. Refrigerant flows from the charging cylinder to the system.
5	Close the low pressure cock of the pressure gauge set if the circuit is properly charged; refer to "To check refrigerant charge".

To flush refrigerant circuit

Introduction

"Flushing" means the removal of air and other contaminations from the installation. This is performed by blowing nitrogen through the system.

Climate-control compressor: general

Drive

The vehicle engine drives the refrigerant compressor by means of two belts and a disconnectable clutch.

Refer to chapter 2.46 "Accessory drive system" for more information about the belt drive.

Compressor oil

The compressor circulates an amount of compressor oil together with the refrigerant.

It has hardly any disadvantageous influence on the system if the amount of oil which is brought in the refrigerant circuit by the compressor is very small. It is even good because the compressor valves will be lubricated.

On the other hand, the following problems can occur if a too large amount of oil circulates in the system:

- Because oil is withdrawn from the compressor sump, lubrication of the compressor can be insufficient. The compressor can seize.
 - The amount of oil which circulates with the refrigerant is not constant. The oil can accumulate in the evaporator, which can cause a sudden release of a large amount of oil to the compressor. Oil that is accumulated in the evaporator reduces the heat transfer whereby the cooling capacity reduces.
-

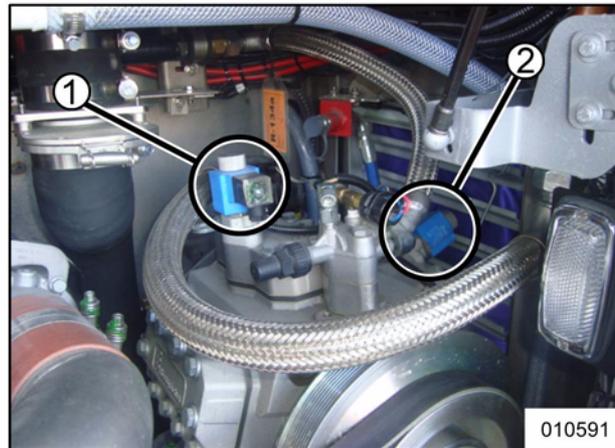
Climate-control compressor: capacity control

Introduction

As its operation requires a lot of energy and it is not always necessary to have it operating at full capacity, the climate-control compressor has been equipped with a capacity control. The main components of this control are two pressure switches (DK102.1 and DK103) and two electromagnetic pilot valves (V139 and V140) on the climate-control compressor.

NOTE: As from 2016, the designation of pressure switch DK102.1 has changed to DK104.

Figure: pilot valves of capacity control



1 Pilot valve V139 of capacity control
2 Pilot valve V140 of capacity control

Pilot valve V140 of capacity control

V140 is energized by pressure switch DK102.1 or DK103.

When pilot valve V140 is energized, two of the six cylinders of the climate-control compressor are switched off.

NOTE: As from 2016, the designation of pressure switch DK102.1 has changed to DK104.

Pilot valve V139 of capacity control

V139 is energized if the interior temperature is lower than the set temperature + 4°F ($T_i < T_{set} + 4^\circ\text{F}$).

When pilot valve V139 is energized, two of the six cylinders of the climate-control compressor are switched off.

Pressure switches

Refer to "Pressure switches" in chapter 8.14.

Climate-control compressor: oil level check

To be carried out when?

Refer to chapter 1.1, "Climate-control system maintenance schedule".

Correct oil level

The oil level must be between the center and the top of the sight-glass.

Figure: oil level sight-glass



There is a sight-glass at the left-hand and right-hand side.

Procedure

Step	Action
1	Start the engine.
2	Put the climate control in the "GAS CH" state. Follow the instructions included in "Passenger compartment control system: to troubleshoot using the dashboard display".
3	Switch off "GAS CH" after 20 minutes.
4	Shut off the engine.
5	Check the oil level within 30 seconds.

Climate-control compressor: to add oil

Oil type

Refer to chapter 1.1, "Fluids and lubricants".

Oil loss?

The climate-control compressor does not consume oil. Nevertheless, if it is necessary to add oil, this usually means that there is a leak in the refrigerant circuit. Check the refrigerant circuit for leaks first.

Equipment condition

Pressure gauge set connected, refer to "To connect pressure gauge set" in the present chapter.

To add oil

Step	Action
1	Turn the stem of the "suction side" service valve counterclockwise as far as it will go. The "suction side" service valve is now closed.
2	Turn the cocks of the pressure gauge set fully clockwise. The cocks are now closed.
3	Fill the low-pressure hose and the center hose of the pressure gauge set with oil.
4	Secure the low-pressure hose of the pressure gauge set to the service connection of the "suction side" service valve.
5	Immerse the loose end of the center hose in a can of climate-control compressor oil.
6	Turn the stem of the "suction side" service valve clockwise as far as it will go. The service connection is now connected to the refrigerant circuit.
7	Start the engine.
8	Let the compressor run until the low-pressure switch cuts out the climate-control compressor clutch.
9	Shut off the engine.
10	Open the low-pressure cock of the pressure gauge set a little. The oil is sucked into the climate-control compressor.
11	Close the low pressure cock, when the correct oil level is reached.
12	Turn the stem of the "suction side" service valve counterclockwise as far as it will go. The service connection is now isolated from the refrigerant circuit.

continued on next page



To replace the climate-control compressor



WARNING!

The refrigerant circuit is pressurised. First relieve the pressure, before you carry out any works on the compressor. Also see to it that no one can start the engine.

Dirt and humidity

The main enemies of a refrigerant system are dirt and humidity. During the installation of a new compressor, the protective gas must remain in the compressor as long as possible. Then take the necessary measures for protecting the compressor against dirt and humidity.

How much oil in the new compressor?

When changing the compressor, the new compressor must be taken into operation with the same quantity of oil as the quantity present in the removed compressor. New compressors are usually supplied with a standard quantity of oil; you will therefore probably have to remove a certain quantity of oil from the compressor.

Climate-control compressor: electromagnetic clutch

Compressor clutch V141

An electromagnetic clutch is used to switch in and out the connection between the engine and the compressor.

The main components are the stator, the rotor with pulley and the pressure plate. The stator is fixed to the compressor housing and the pressure plate is mounted on the compressor shaft.

The pulley always rotates when the engine is running because it is connected to the engine crankshaft by means of drive belts. But the compressor only begins to operate, when the electromagnetic clutch is energized. Whenever cooling is required, the control system sends an electric current to the magnetic coil. The electromagnet pulls the pressure plate against the friction plates of the pulley. Due to the friction between the plates, the clutch components will rotate as a unit and drive the compressor.

When does the clutch cut in?

NOTE: The clutch only cuts in when the on-board voltage is higher than 21.6V and the compressed-air system is pressurized.

The clutch cuts in if:

- outside temperature exceeds 25°F and...
- the roof-heating metering valve is closed for more than 40% of the time.

When does the clutch cut out?

Pressure switches DK101 and DK102.2 switch the clutch off if the pressure in the refrigerant circuit becomes too high or too low.

NOTE: As from 2016, the designation of pressure switch DK102.2 has changed to DK102.

Evaporators

Introduction

The refrigerant evaporates in the evaporator unit by absorbing heat from the surroundings.

The passenger compartment is cooled by two evaporators in the roof ducts. The cab is cooled by an evaporator in the climate-control unit of the cab.

Condenser

Introduction

The hot refrigerant gas, which has been compressed by the compressor, is cooled in the condenser until it becomes a fluid.
Fans speed up the heat exchange in the condenser.

To clean the condenser externally



WARNING!

Wear a dust mask, when cleaning with compressed air.

Check the condenser regularly for contamination (leaves, dust, ...). If necessary, blow the condenser through with compressed air (approx. 116 psi pressure).

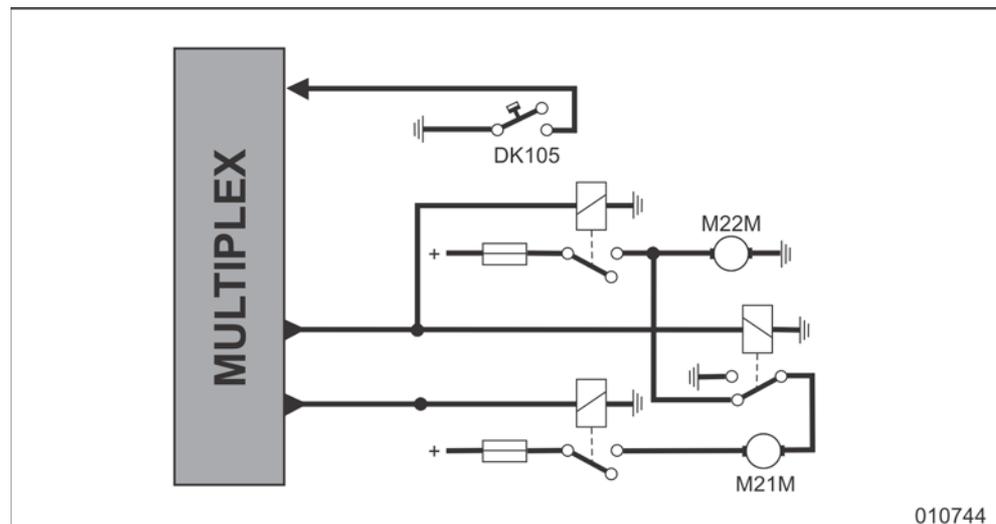
Condenser suspension maintenance

The suspension system makes it possible to fold out the condenser for maintenance.

To prevent some of the suspension elements from seizing after a while, perform the following maintenance works regularly.

Step	Action
1	Apply a drop of oil to the latches that keep the condenser in its place.
2	Only for hinges with a grease nipple: press grease into the grease nipple of the two condenser suspension hinges.

Figure: block diagram of condenser fans speed control



010744

continued on next page

References in figure

Reference in figure	Explanation
DK105	High-pressure switch of condenser fans
M21M/M22M	Condenser fans motors

Condenser fans speed control

The condenser fans will turn at low speed when the climate-control compressor clutch is switched on. They switch to high speed if pressure switch DK105 closes.

Speed is controlled by connecting the fans in "series/parallel".

NOTE: The condenser fans will keep running when the climate-control compressor clutch is switched off by high-pressure switch DK102.

To change filter/dryer

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

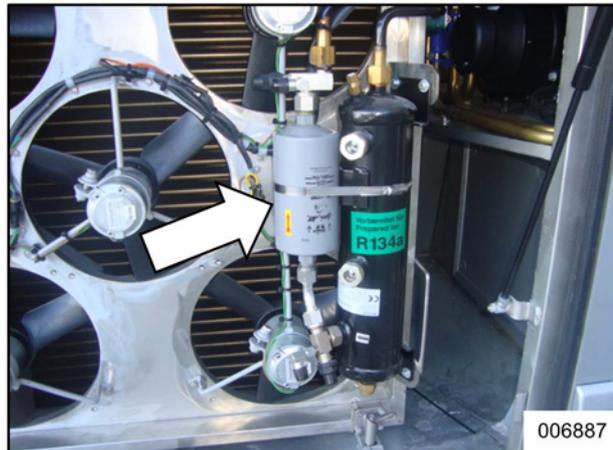
Function of the filter/dryer

The filter/dryer catches humidity and dirt in the refrigerant circuit.

Location of the filter/dryer

The filter/dryer is mounted in the climate-control condenser compartment.

Figure: filter/dryer



To remove the filter/dryer

Step	Action
1	Turn the stem of the two service valves, which are located above and under the filter/dryer, clockwise up to the stop.
2	Connect a recovery station to the service connection of one of the service valves, and remove the refrigerant from the filter/dryer.
3	Loosen the line connectors at the filter/dryer ends. Remove the filter/dryer.

To install filter/dryer

Step	Action
1	Install a new filter/dryer.
2	Connect the lines to the filter/dryer ends.

continued on next page

Step	Action
3	Vacuum down the filter/dryer.
4	Turn the stem of the two service valves, which are located above and under the filter/dryer, counterclockwise up to the stop.
5	Check for leaks

Thermostatic expansion valve: general

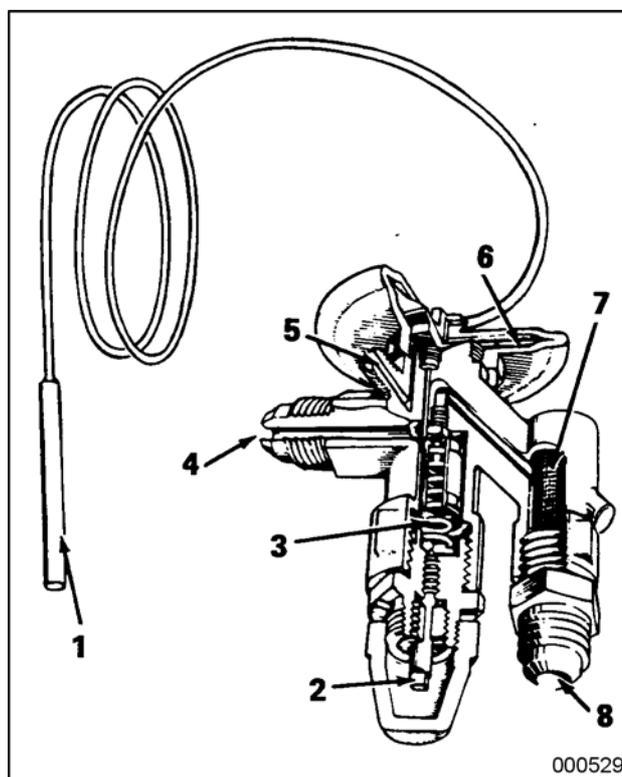
Introduction

The system has three thermostatic expansion valves: one for each evaporator in the climate-control unit on the roof, and one for the evaporator in the climate-control unit of the cab.

Function

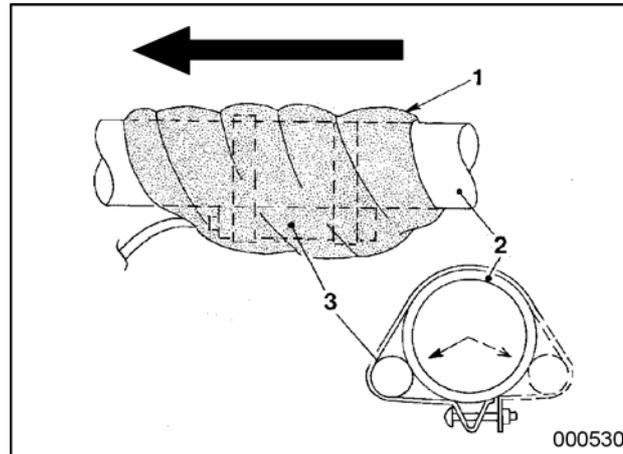
The thermostatic expansion valve admits only so much refrigerant to the evaporator as can be evaporated. The sensors of the thermostatic expansion valves are mounted on the line leaving the evaporator; they detect and react to any overheating.

Figure: thermostatic expansion valve



- 1 Sensor (heat-sensitive tube)
- 2 Adjusting screw
- 3 Needle and seat
- 4 Outlet
- 5 External equalizer
- 6 Membrane
- 7 Screen
- 8 Inlet

Figure: sensor installation



The arrow indicates the refrigerant flow direction.

- 1 Insulating tape
- 2 Copper tube
- 3 Sensor

Contact between the sensor and the refrigerant pipe

The system will only function properly if the sensor has a good contact with the copper pipe.

To position the sensor

With respect to the longitudinal axis of the copper pipe, the sensor should be in the 4 or 8 o'clock position (see figure).

Capillary line

This is the thin line between the thermostatic expansion valve and the sensor.



CAUTION!

Be careful not to bend the capillary line. Otherwise the thermostatic expansion valve does not operate.

To install the sensor

Step	Action
1	Clean the copper pipe and the sensor with fine abrasive paper. Do not use acids or copper polish!

continued on next page

Step	Action
2	To prevent oxidation, coat sensor and copper pipe with a thin layer of a heat conducting paste.
3	Secure the new sensor to a horizontal part of the pipe, with the help of a few hose clamps. Refer to "To position the sensor".
4	Wrap insulating tape around the sensor and the pipe.

Service valves: general

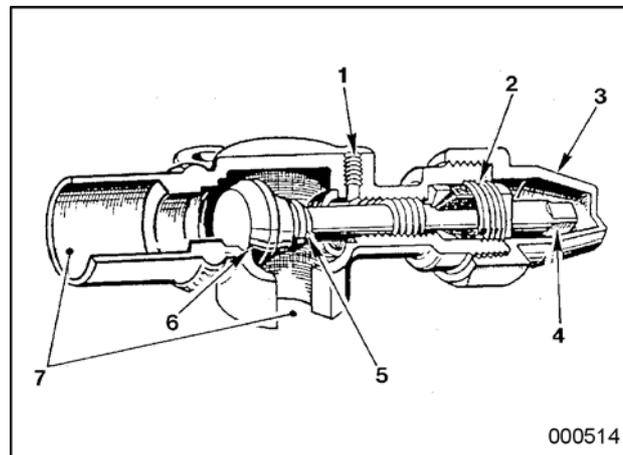
Introduction

The refrigerant circuit is fitted with four service valves: two on the compressor and two near the filter/dryer.

Function

- By closing the two service valves of a circuit component, you isolate that component from the rest of the circuit.
- Maintenance works can be carried out via the service connection on the valves, such as: evacuate, flush (with nitrogen), high-pressure test, charging with refrigerant.

Figure: service valve



- 1 Service connection
- 2 Gland
- 3 Protection cap
- 4 Stem
- 5 Rear valve seating
- 6 Front valve seating
- 7 Inlet or outlet (depending on application)

Service valve positions

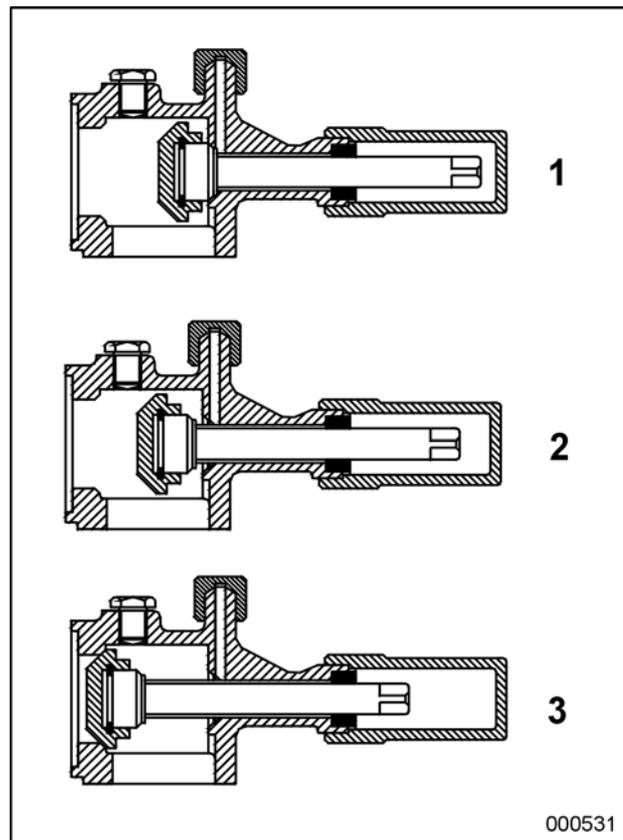
Each service valve has three positions (see figure).

Number in figure	Position	Result
1	Valve stem rotated counter-clockwise as far as it will go. This is the normal running position.	The valve is open, but the service connection is isolated from the refrigerant circuit.

continued on next page

Number in figure	Position	Result
2	Valve stem in the mid-position. This is the test position.	The valve is open, and the service connection to the refrigerant circuit is open.
3	Valve stem rotated clockwise as far as it will go.	The valve is closed.

Figure: service valve positions



Solenoid shut-off valves

Introduction

The refrigerant circuit has been equipped with three solenoid shut-off valves.

- Shut-off valve V142 in the line to the driver's cab climate-control unit evaporator.
- Shut-off valve V144.1 in the line to the evaporator in the LH roof duct of the passenger compartment.
- Shut-off valve V144.2 in the line to the evaporator in the RH roof duct of the passenger compartment.

When do the shut-off valves open?

The "normally closed" solenoid shut-off valves V142, V144.1 and V144.2 will open when the climate-control compressor clutch is switched on.

NOTE: The shut-off valves remain energized when the climate-control compressor clutch is switched off by pressure switch DK101.

NOTE: The program prevents shut-off valve V142 from being opened when the fan motor in the driver's cab climate-control unit is not running.

Pressure switches

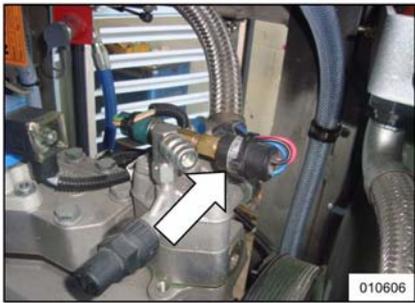
Introduction

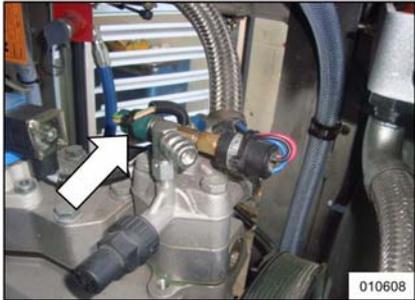
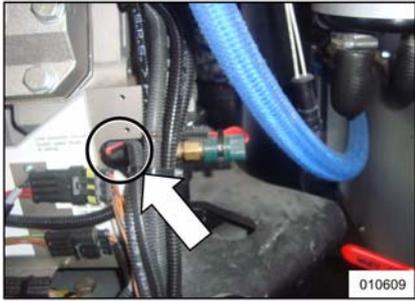
In order to monitor and to limit the pressure in the refrigerant circuit, four switches have been installed:

- DK101 and DK102.2 protect the installation against abnormal operating pressures,
- DK102.1 and DK103 switch on the capacity control.
- DK105 switches the condensor fans to high speed.

NOTE: As from 2016, the designation of pressure switch DK102.2 has changed to DK102, and the denomination of pressure switch DK102.1 to DK104.

Location of pressure switches

Element	Figure
<p>On the climate-control compressor: high-pressure switch DK102.2 of protection system</p> <p><i>NOTE: As from 2016, the designation of pressure switch DK102.2 has changed to DK102.</i></p>	 <p>010606</p>
<p>On the climate-control compressor: low-pressure switch DK101 of protection system</p>	 <p>010607</p>

Element	Figure
<p>On the climate-control compressor: high-pressure switch DK102.1 of capacity control</p> <p><i>NOTE: As from 2016, the designation of pressure switch DK102.1 has changed to DK104.</i></p>	
<p>On the climate-control compressor: low-pressure switch DK103 of capacity control</p>	
<p>In climate-control condenser compartment: high-pressure switch DK105</p>	

Low-pressure switch DK101

Pressure switch DK101 protects the installation against low operating pressure.

The contacts of the low-pressure switch open if the suction-side pressure drops to the value mentioned in the technical data. The electrical circuit of the compressor clutch is then interrupted, whereby the compressor is switched off. The pressure will continue to rise, because the compressor has been switched off. The contacts of the low-pressure switch close if the pressure has again reached the value mentioned in the technical data. The compressor is then switched in again.

High-pressure switch DK102.2

Pressure switch DK102.2 protects the installation against high operating pressure.

The contacts of the high-pressure switch open if the discharge-side pressure reaches the value mentioned in the technical data. The electrical circuit of the

continued on next page

compressor clutch is then interrupted, whereby the compressor is switched off. Because the condenser fans continue to run, the pressure will decrease slowly. The contacts of the high-pressure switch close if the pressure has once again dropped to the value mentioned in the technical data. The compressor is then switched in again.

NOTE: As from 2016, the designation of pressure switch DK102.2 has changed to DK102.

High-pressure switch DK102.1

Pressure switch DK102.1 activates the capacity control.

The contacts of the pressure switch close if the discharge-side pressure reaches the value mentioned in the technical data. The electrical circuit of pilot valve V140 on the climate-control compressor is then closed and two of the six cylinders of the climate-control compressor are disconnected.

NOTE: As from 2016, the designation of pressure switch DK102.1 has changed to DK104.

Low-pressure switch DK103

Pressure switch DK103 activates the capacity control.

The contacts of the pressure switch close if the suction-side pressure drops under the value mentioned in the technical data. The electrical circuit of pilot valve V140 on the climate-control compressor is then closed and two of the six cylinders of the climate-control compressor are disconnected.

High-pressure switch DK105

Pressure switch DK105 switches the condenser fans to high speed if the pressure at the discharge side reaches the value mentioned in the technical data.

Technical data of refrigerant circuit

Pressure switches

Low-pressure switch DK101	<ul style="list-style-type: none"> • Contact closes at 26 to 35 psi • Contact opens at 3 to 7 psi.
High-pressure switch DK102.1 <i>NOTE: As from 2016, the designation of pressure switch DK102.1 has changed to DK104.</i>	<ul style="list-style-type: none"> • Contact closes at 295 to 315 psi • Contact opens at 230 to 250 psi.
High-pressure switch DK102.2 <i>NOTE: As from 2016, the designation of pressure switch DK102.2 has changed to DK102.</i>	<ul style="list-style-type: none"> • Contact closes at 230 to 255 psi • Contact opens at 330 to 360 psi.
Low-pressure switch DK103	<ul style="list-style-type: none"> • Contact closes at 18 to 21 psi • Contact opens at 25 to 28 psi.
High-pressure switch DK105	<ul style="list-style-type: none"> • Contact closes at 250 to 270 psi • Contact opens at 195 to 200 psi.



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Part 9 - Occupant protection systems

Overview

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Chapter 6: Safety belts

Overview

Introduction This chapter deals with the safety belts.

Number of pages 4

Chapter publication date 21 September 2016

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To check/clean safety belts	9.6-2
Technical data: safety belts	9.6-3

To check/clean safety belts



WARNING!

**Never strain the belt, while it is wet. This may impair fabric strength.
Never bleach or dye belt fabric for the same reason.**

Replace belts when?

Replace belt, if mechanism no longer works properly or if fabric is torn or frayed.

To wash belts

If necessary, hand-wash belts in warm water with neutral soap. Keep buckles dry! Rinse thoroughly and allow to dry (not in the sun, however).

Technical data: safety belts

Tightening torques

Safety belt fixing screw	45 ft.lbf
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Part 10 - Body and body accessories

Overview

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Chapter 1: General

Overview

Introduction This chapter deals with general information about body and body accessories.

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Chapter publication date 21 September 2016

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To repair fiberglass damage	10.1-3
Vehicle exterior: lacquer care	10.1-5
Vehicle exterior: underbody care	10.1-7
Vehicle exterior: to clean chrome or anodized aluminum	10.1-8
Vehicle interior: to clean moquette seat upholstery	10.1-9
Vehicle interior: to wash crepe head-rest covers	10.1-10
Vehicle interior: to remove stains from fabric upholstery	10.1-11
Vehicle interior: to clean leatherette	10.1-12
Vehicle interior: to clean ABS plastic parts	10.1-13
Vehicle interior: to clean Plexiglas panels	10.1-14

Vehicle exterior: anti-corrosive measures

What to do?

-
- Always make sure the vehicle is stored in the best conditions.
 - Follow the instructions for maintenance of the vehicle underbody closely, refer to "Vehicle exterior: underbody care".
 - After each washing, check the lacquer for scratches and damage from small stones. Cover areas where layer of lacquer is lacking as quickly as possible with paint, so rust cannot work its way underneath the lacquer.
 - Accident damage must be repaired as quickly as possible to prevent rust.
 - When corrosion starts, take timely measures to prevent it from worsening. Repairs must never be delayed for longer than 3 months, otherwise the damaged area cannot be saved.
 - Every 2 years, the hollow sections that are located completely or partially under the floor level must be sprayed with a good rust preventive liquid for hollow spaces, such as Teroson Terotex HV 300 (Van Hool order number 660843407). The body posts are open at the bottom; there are holes drilled into the horizontal sections to be treated.
-

To repair fiberglass damage

Introduction

No matter how strong, impact-resistant and flexible fiberglass is, it can be damaged in a collision. In most cases, you can easily repair minor damage yourself.

Consumables

- Liquid, pre-accelerated polyester resin
- Hardener (catalyst)
- Glass fiber mats



WARNING!

Avoid getting hardener into your eyes. Should this happen anyway, rinse your eyes with abundant water and get medical assistance. Never use ointment!

Preparatory work

Step	Action
1	Trim back the damaged area to a round hole with a neat edge, free from cracks.
2	Grind the edges of the hole to a chamfer.
3	Clean the surface around the hole.
4	If possible, cover the hole on the inside with a piece of sheet material or cardboard in order to facilitate laying up the glass fiber mats.
5	Cut some pieces of glass fiber mat to a diameter allowing at least 2 in overlap all around the hole.
6	While stirring, mix 1 to 3% hardener with no more polyester resin than you think you can apply in 20 minutes.

To fill the hole

Step	Action
1	Lay the glass fiber mats on a scrap piece of cardboard and, using a paint brush, impregnate them with the activated polyester resin.
2	Place mat by mat over the opening until the hole is sufficiently filled up.

continued on next page

Step	Action
3	Dab the mats down with the brush. This should remove the air inclusions from the material.

To clean the tools

Clean the tools immediately after use, using acetone or cellulose thinners.

To finish off

Step	Action
1	Leave the polyester resin to set for about an hour.
2	Sand the hardened fiberglass level using a power grinder or coarse sandpaper.
3	Apply putty to the sanded fiberglass.
4	Paint the repair work.

Vehicle exterior: lacquer care



CAUTION!

When using commercial cleaning agents, preservative products and paint, always strictly follow the manufacturer's instructions.

General washing instructions

- Wash the body with ample, preferably softened, water.
- Use non-aggressive, non-abrasive cleaning agents only, always in liquid form and in the amount indicated by the manufacturer.
- Always wash the vehicle with clean water first. During this preliminary washing sand is soaked off and removed so that it cannot scratch the lacquer during the actual washing process. Use a soft brush to which no pressure is being applied.
- For hand-washing use a sponge or a car wash brush with soft bristles set in a holder made of rubber or soft synthetic material.
- Before removing dried-on insects, first soak them off with a special retail product.
- After washing, rinse the body thoroughly with soft water. Soap residues can damage the lacquer.
- After rinsing, you can dry the body with a soft chamois cloth.

To wash with brush machines



CAUTION!

In case of vehicles with high-voltage components on the roof, the use of roof brushes is not allowed.

- When washing vehicles with exterior mirrors that have been attached by means of dovetail connectors, remove the mirrors before washing.
- Many automatic car wash systems use sensors to open doors automatically or to activate machines. The parts of these sensors that touch the body have to be made of soft rubber or soft synthetic material.
- Take care that the vehicle goes through the car wash system positioned right in the center.
- The washing brushes must be adjusted correctly, so that they can reach everywhere without causing any wear. They must not touch the vehicle underside.
- The brushes should never work on one location of the body for too long; the vehicle has to move along the brushes without stopping, or vice versa.

continued on next page

- The sprinklers of the car wash system have to spray with their normal flow rate. Therefore, not too many sprinkler holes should be clogged.

To wash with high-pressure cleaners

- High-pressure cleaners do remove dirt, but not the greasy film on the body. A brush or sponge is still needed to remove this film.
- Do not set the machine too hot; 160 °F is the maximum.
- Pressure on the jet pipe must not exceed 580 psi.
- Keep the jet pipe head at least 12 in away from the lacquer and not on the same spot for too long. Otherwise, if the water is hot, you run the risk that the dirt is driven into the lacquer.

To remove road tar from lacquer

- Remove tar spots with a special product or with denaturated alcohol. Apply the cleaning agent with a soft cloth and carefully rub the cloth over the spot. Do not press too hard. Otherwise the sand grains that are stuck in the tar will scratch the lacquer.
- After the tar has been removed, wash and rinse the treated area.

Minor repairs to finish

- Repairs can be made with any type of good quality lacquer, without risking harm to the existing lacquer.
- First thoroughly clean the area that is to be treated (remove dirt and grease).
- Carefully sand the area that is to be repaired, so that the new lacquer can adhere well to the existing layer.
- Use a rust-preventive primer.
- Closely follow the paint manufacturer's instructions.

To wax finish

- After winter, it is a good idea to wax the vehicle with a liquid, non-abrasive polish. The body has to be absolutely clean and dry, before doing so.
- To give weathered or spotted lacquer its original shine a slightly grinding polish can be used. To prevent the lacquer from getting too thin, rub evenly and not on the same spot for too long. After cleaner treatment, apply a preservative layer of wax immediately.

To clean plastic lamp glasses and reflectors

To clean the plastic lamp glasses and reflectors, use only warm water, soap and a soft sponge (refer to chapter 10.2).

Vehicle exterior: underbody care

To be carried out when?

Once a year, after winter, the vehicle underbody has to be cleaned and inspected.

In tropical service conditions, carry out every 6 months.

Procedure

Step	Action
1	 <p>CAUTION!</p> <p>Do not spray the following items with a high-pressure cleaner: greasing points, bearings, shaft seals, universal joints, protective covers of steering system. Penetrating water may cause damage due to corrosion.</p> <p>Spray vehicle underbody with cold water to remove all mud and salt.</p> <p><i>NOTE: The water must not contain any detergents or petroleum derivatives, because they can damage the rust-preventive layer. Pressure on jet pipe must not exceed 725 psi.</i></p>
2	<p>Check rust-preventive layer for discontinuities.</p> <ul style="list-style-type: none"> • No discontinuities: underbody is all right. • Discontinuities: go to step 3.
3	<p>Allow underbody to fully dry.</p>
4	 <p>CAUTION!</p> <p>If you have to spray rust-preventing liquid near compressed-air devices, first cover openings or mufflers of said devices.</p> <p>Spray the areas that show discontinuities with a reliable anti-rust product for vehicle underbodies, such as Diffutherm UBC WAX 70 Metallic (Van Hool order number 660827810).</p>

Vehicle exterior: to clean chrome or anodized aluminum

Chrome

- Wash the chrome with soapy water, followed by a thorough rinsing.
- You can polish slightly neglected chrome with chrome polish.
- Protect chrome parts in the winter months by waxing them with special protective wax available from retail sale.

Anodized aluminum

- Clean anodized aluminum parts with neutral, non-abrasive synthetic products (definitely not chrome polish or agents containing soda, ammonium, chlorine or phosphoric acid).
 - Stubborn spots should not be treated with steel wool, or else the extremely thin protective layer will be worn away and the aluminum will start oxidizing. If necessary, use a dish washing scrub pad made of polyamide wool, such as Scotch Brite (from 3M).
 - Thoroughly rinse aluminum afterwards to remove any residue of the cleaning product.
-

Vehicle interior: to clean moquette seat upholstery

To vacuum Clean upholstery weekly with a vacuum cleaner.

To wash Moquette upholstery can be washed without any risk using a solution of neutral soap in cold water.

Step	Action
1	Apply soapy water in small amounts using a sponge or soft brush. Rub in the same direction as the fibers of the fabric go.
2	Remove soap with a soft, clean cloth or sponge.
3	Repeatedly rub the treated area with a dry cloth.
4	Rub moquette that is still damp with a fairly hard brush.
5	Once the seat upholstery is dry, brush it once again, brushing in the same direction as the fibers.

To rejuvenate The moquette can be "rejuvenated" by steaming it. Lay a wet cloth over the seat upholstery and run a hot iron over it. The steam goes into the fibers and perks them up.

Vehicle interior: to wash crepe head-rest covers

Guidelines

-
- The cloths have to be washed without softener. Otherwise the crepe becomes unattractive.
 - Use detergent "for fine washables", in water of about 86 °F. Rinse well in clean water and air-dry (do not wring out). Do not use any bleach.
-

Vehicle interior: to remove stains from fabric upholstery

Guidelines

- Clean stains as quickly as possible, before they dry or oxidate; afterwards, it is much more difficult to remove them.
 - Use a retail stain remover suited to the nature of the stain and that is harmless to the fabric to be cleaned (read the packaging). Simple household cleaners can also do a good job. Consult a stain-removal guide to see which cleaner is the best suited to which kind of stain.
 - If the nature of the stain is unknown, first treat it with a solution of water and detergent. If the stain does not go away, use a dry-cleaning chemical once you have allowed the fabric to dry completely.
 - Only use white cloths or kitchen paper to apply stain-removal agents.
 - Fresh coffee or chocolate stains are not difficult to remove with detergent in lukewarm water. But once they have dried, there is not much you can do about these stains.
 - Felt tip marker can only be removed with alcohol, felt pen marks with trichlorethylene, and nail polish with acetone.
 - The best way to remove chewing gum is to first freeze it with a spray product and then smash it and scrape it off.
 - Always try chemical stain removers out on an area that is not or hardly visible first, to make sure it does not cause any discoloration or damage.
 - When using chemical stain removers, ventilate the vehicle interior as well as possible.
-

Vehicle interior: to clean leatherette

Guidelines

-
- Occasionally wipe the leatherette with lukewarm, soapy water and rinse with water to which has been added a little vinegar.
 - Problematic stains can be removed with denaturated alcohol. Still, before treating large spots, it is advisable to do a test on a piece that is not so visible, so as to make sure no discoloration occurs.
 - Keep the leatherette supple by treating it occasionally with a mixture of 0.8 gallons of water, 0.08 gallons of milk and a handful of kitchen salt. Use a sponge to apply the mixture. Do not rinse, dry with a chamois cloth only. Rinse and wring out the chamois cloth as you go.
-

Vehicle interior: to clean ABS plastic parts

**WARNING!**

Do not use polish on steering wheel and ABS seats, or they will become too slippery.

**CAUTION!**

Solvents such as white spirit, paint thinner, trichlorethylene or cleaning spirit damage ABS plastic.

Guidelines

- Sponge the ABS plastic clean with warm, soapy water. A soft brush may be used with light pressure to remove stubborn spots.
 - To renew the original shine of ABS parts, use a special retail product.
-

Vehicle interior: to clean Plexiglas panels



CAUTION!

Solvents such as white spirit, thinner, trichlorethylene or cleaning spirit damage Plexiglas.

Guidelines

- Never shine Plexiglas, when it is dry.
 - Wash the panel thoroughly and dry it with an absolutely clean chamois cloth. After washing, apply anti-static polish.
 - You can polish out small scratches with a fine polish sold retail for the purpose.
-

Chapter 2: External lighting and signalling devices

Overview

Introduction This chapter deals with the exterior lighting and signalling devices.

Number of pages 10

Chapter publication date 21 September 2016

Contents

Topic	See page
To adjust headlamps	10.2-2
To replace headlamp bulb	10.2-3
To replace bulb of rear lamp cluster	10.2-7
To clean plastic lamp glasses and reflectors	10.2-10

To adjust headlamps

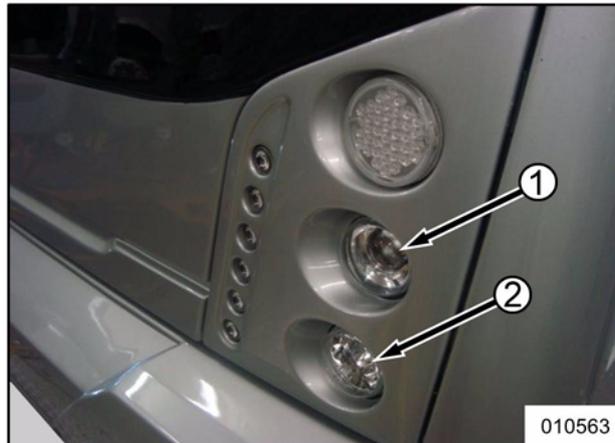
Access to headlamps adjusting screws

Step	Action
1	Remove the protective cap screw. 
2	Swing open the protective cap. Adjusting screws of headlamps are now accessible.

To replace headlamp bulb

Consumables Refer to Van Hool spare parts manual.

Figure: left headlamps



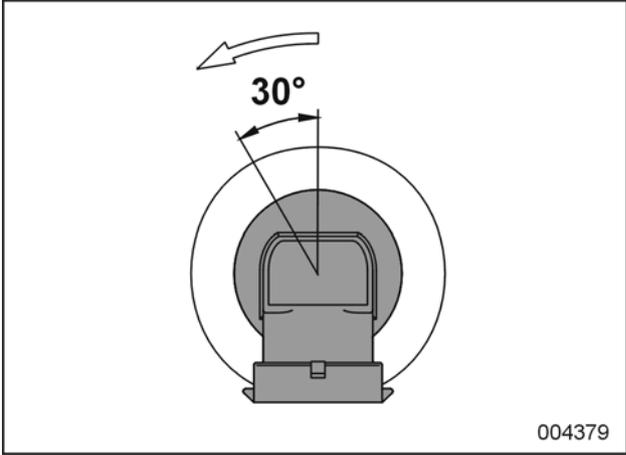
- 1 Low beam headlamp
- 2 High beam headlamp

Preliminary operations

Step	Action
1	Remove the protective cap screw. 
2	Swing open the protective cap. The back of headlamps is now accessible.

To remove
bulb**WARNING!**

Before removing a headlamp bulb that has just been burning, wait a few minutes for it to cool off sufficiently. You could seriously burn yourself on the hot bulb glass.

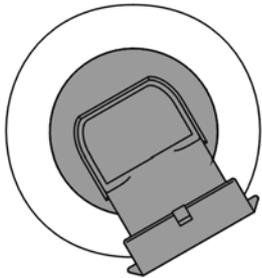
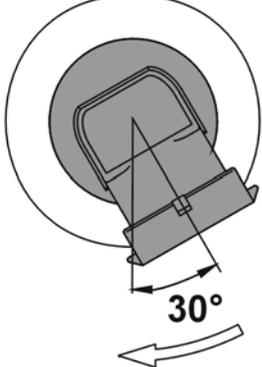
Step	Action
1	Disconnect the connector from the lamp socket.
2	Turn the lamp socket 30° counterclockwise and remove the bulb.  004379

To install bulb



CAUTION!

Seize new bulb by its base only. The slightest finger print or grease trace on the glass bulb will cause the bulb to burn out in a very short time. When in doubt over the cleanliness of the glass, clean it with alcohol.

Step	Action
1	Install the new bulb in the reflector opening. <div data-bbox="692 730 1318 1187" style="text-align: center;">  <p style="text-align: right; margin-right: 20px;">004380</p> </div>
2	Turn the lamp base 30° clockwise. <div data-bbox="692 1290 1318 1747" style="text-align: center;">  <p style="text-align: right; margin-right: 20px;">004378</p> </div>
3	Connect the connector to the lamp socket.

After changing a bulb

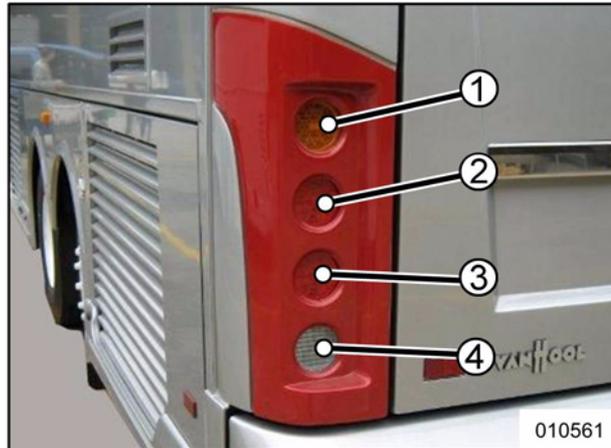
After changing a bulb, you have to check headlamp setting and, if necessary, correct it.

continued on next page



To replace bulb of rear lamp cluster

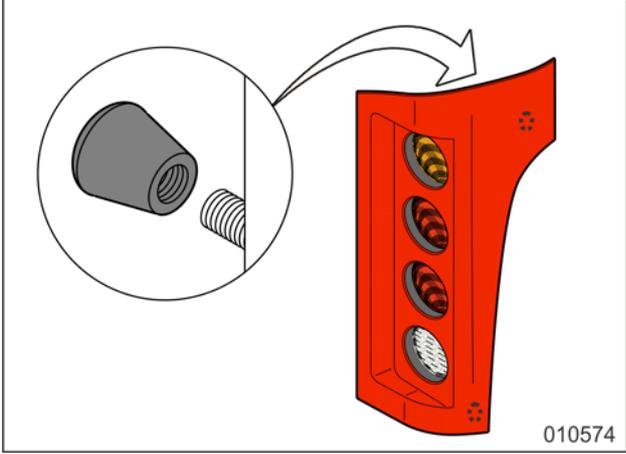
Figure: left-hand rear lamp cluster

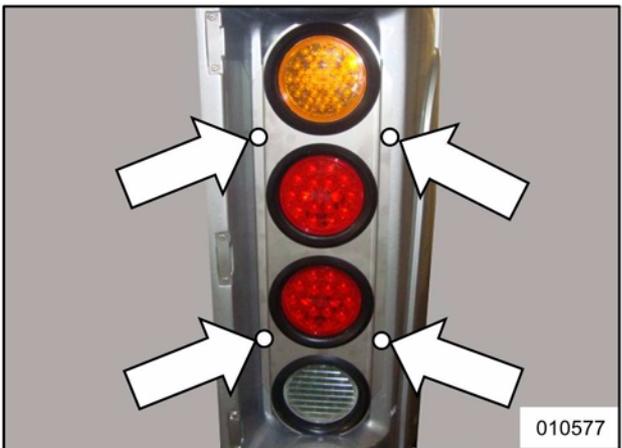


- 1 Turn signal
- 2 Stop lamp
- 3 Rear position lamp
- 4 Reversing lamp

Preliminary operations

Step	Action
1	Open engine compartment door.
2	Open starting interlock switch in engine compartment to prevent anyone from starting engine.
3	Put warning on steering wheel saying "DO NOT START: MAINTENANCE".

Step	Action
<p>4</p>	<p>Remove the protective cap nuts. The nuts are accessible through the engine compartment.</p>  <p>010574</p>
<p>5</p>	<p>Pull loose the upper part of the protective cap.</p>  <p>010575</p>

Step	Action
<p>6</p>	<p>Pull loose the lower part of the protective cap and take away the cap.</p> 
<p>7</p>	<p>Remove the 4 fixing screw of the lamp holder. The lamps are now accessible.</p> 

To change lamps

All lamps are sealed units with LED's and they are replaced as an unit.

To clean plastic lamp glasses and reflectors

Which products are not allowed?



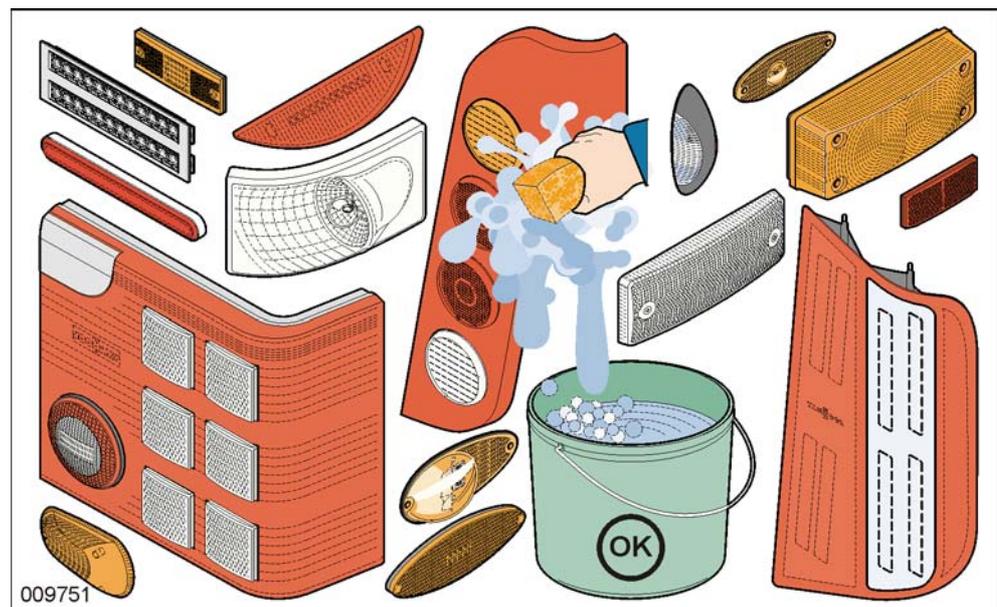
CAUTION!

Any damage related to the use of not allowable products is not covered by the warranty of the vehicle manufacturer.

- Alcoholic cleaning products;
- solvents such as acetone, ethanol, diethyl ether and benzene;
- thinners, kerosene, turpentine, gasoline;
- alkali (pH above 7) on the base of bleaching chlorine and ammonia;
- products made from caustic soda (solupan)

How to clean?

Use only warm water, soap and a soft sponge to clean the plastic lamp glasses and reflectors.



Chapter 46: Paint, graphics and lettering

Overview

Introduction This chapter deals with paint, graphics and lettering.

Number of pages 2

Chapter publication date 21 September 2016

Contents

Topic	See page
To remove adhesive design and advertising foils	10.46-2

To remove adhesive design and advertising foils

Introduction

You can remove adhesive vinyl design and advertising foils without damaging the underlying lacquer by following the instructions below.

Equipment condition

The temperature of the body has to be at least 60 °F.

Foil removal procedure



CAUTION!

Use only your hands to remove the foil. Tools can damage the body lacquer.

The foil has to be locally heated during 5 to 10 seconds with a hair dryer or hot-air gun. The temperature of the air has to be approximately 120 °F. Heat the foil at an edge or corner and then release it carefully with a finger nail. Continue to heat the foil evenly and slowly pull it from the vehicle, keeping the angle as flat as possible.

NOTE: If you detach the foil at too low a temperature, remnants of glue can stay behind on the lacquer.

To remove remnants of glue

To remove glue that has stayed behind on the lacquer, use a commercial neutral degreaser. Follow the manufacturer's instructions. After removing the glue, wash the treated areas as described in chapter 10.1, under "Vehicle exterior: lacquer care".

Warranty

Removing or applying films represents an adaptation of the vehicle surface. Any damage related to this type of intervention is not covered by the warranty of the vehicle manufacturer.

Chapter 62: Entrance and exit doors

Overview

Introduction This chapter deals with the entrance and exit doors.

Number of pages 16

Chapter publication date 21 September 2016

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Topic	See page
Safety precautions for passenger doors	10.62-2
Passenger door: schematic diagram	10.62-3
Passenger door: to check safety devices and emergency release valves	10.62-5
Passenger door: to grease locking wedges and locking cams	10.62-7
Passenger door: to lubricate door spindle	10.62-8
Passenger door: to check opening/closing time	10.62-9
Passenger door: to adjust opening/closing time	10.62-10
Passenger door: to set reversing-system switches	10.62-12
To preserve rubber door seals	10.62-15

Safety precautions for passenger doors



WARNING!

After working on a passenger door, check the closing power of that door before putting the vehicle back into service.

Equipment condition

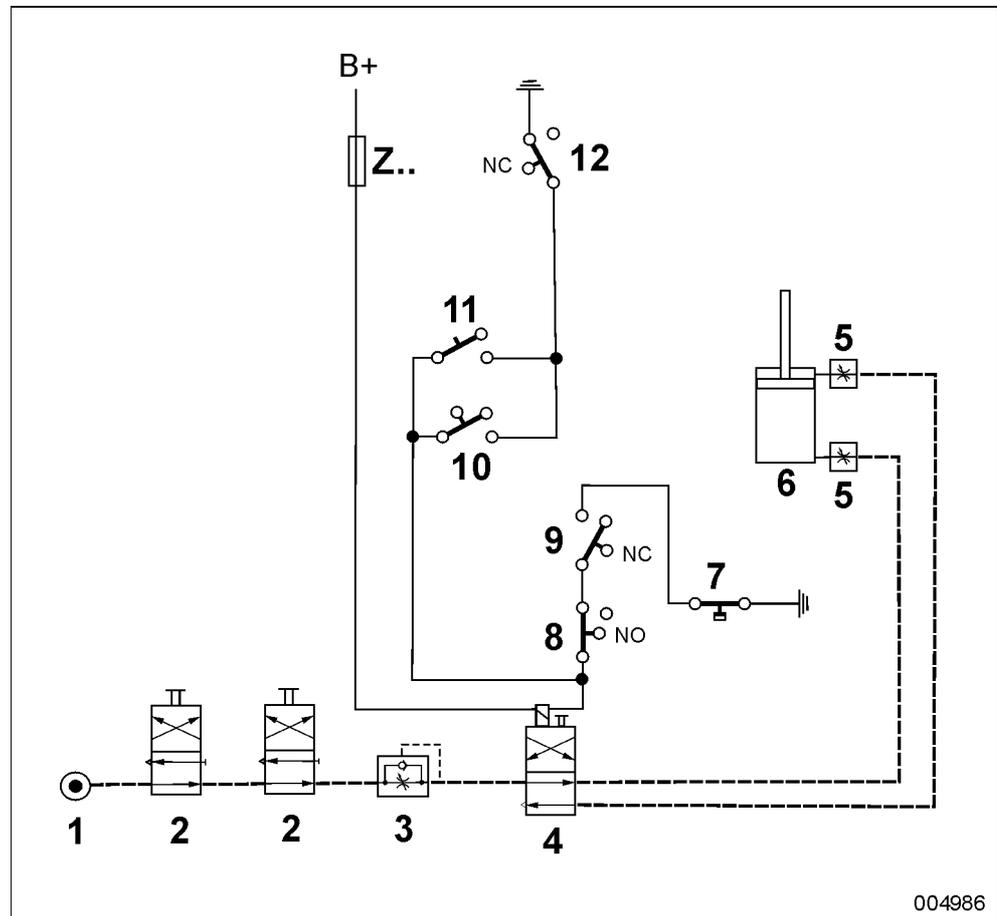
Air system charged to maximum operating pressure

Procedure

Step	Action
1	Close the door from the dashboard.
2	From the interior, push firmly in the middle of the door. The door should not open.

Passenger door: schematic diagram

Figure:
passenger
door
schematic
diagram



004986

Figure shows a closed, unlocked passenger door

- 1 Compressed-air supply
- 2 4/2-way valve, manually operated
- 3 Flow control valve
- 4 4/2-way valve, electrically operated (V011)
- 5 Flow control valve
- 6 Door actuating cylinder
- 7 Pressure switch (DK055)
- 8 Reversing switch (MS028)
- 9 Limit switch (MS033.2)
- 10 Switch (MS059) to open/close the door from the exterior
- 11 Dashswitch (S091) to open/close the door from the interior
- 12 Locking switch (MS057)
- B+ Voltage after batteries
- Z Circuit breaker or fuse

continued on next page

Function and location of switches

Switch	Function	Location
MS028	Reverse door movement if the door panel runs into something or somebody	on door cylinder
MS033.2	Cuts off the reversing system just before the door is fully closed.	on door cylinder
MS057	Ensures that the door can only be opened/closed if it is not locked.	door control panel on the outside
MS059	To open/close from outside	door control panel on the outside
S091	To open/close from inside	on dashboard
DK055	Ensures that the reversing system only works while closing the door.	screwed into port "21" of 4/2-way valve (4)

Passenger door: to check safety devices and emergency release valves

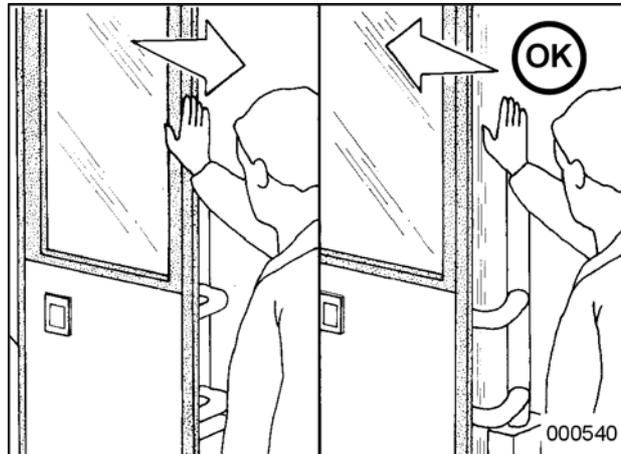
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Re-opening system

The reversing system is a safety device that protects against entrapment.

Figure: To check re-opening system



To check re-opening system

Step	Action
1	Try to stop closing door leaf by hand, when it is approximately half closed (this requires some force).
2	Does passenger door re-open automatically within 2 seconds? <ul style="list-style-type: none"> • Yes: re-opening system is ok. • No: go to step 3.
3	Have safety switches of door drive gear checked.

**Figure:
emergency
handle**



**To check the
emergency
release valves**

The emergency handle actuates an air valve, which depressurizes the door cylinder.

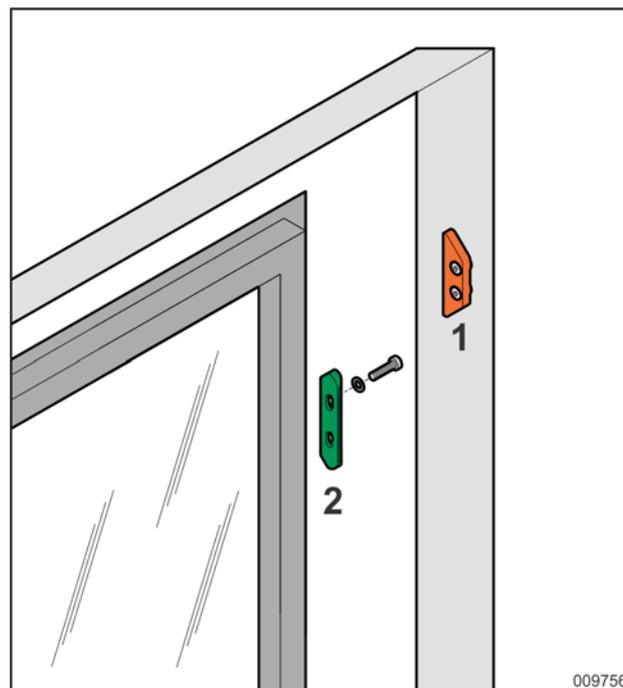
Turn the door emergency handle counterclockwise by a quarter of a turn. The door leaf should lower immediately, causing it to come loose of the locking wedges, so that it can be pulled open by hand. Repeat this check for each of the emergency handles (inside and outside).

Passenger door: to grease locking wedges and locking cams

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

**Figure:
locking
wedges and
locking cams**



- 1 Locking wedge on door post
- 2 Locking cam on door leaf

Procedure

Apply a small amount of vaseline on the sliding surfaces of the locking wedges and the locking cams.

Passenger door: to lubricate door spindle

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Grease type

Refer to chapter 1.1, "Fluids and lubricants".

Special tools

Tube to be used with grease pump	Van Hool No. 639901610
----------------------------------	------------------------

Figure: grease nipple on door spindle



CAUTION!

Use only the specified grease.

Procedure

Step	Action
1	Screw the adaptor tube fitting the flat grease nipple on the door spindle onto a hand-force grease pump.
2	Pump 3 to 5 strokes of grease into the nipple.

Passenger door: to check opening/closing time

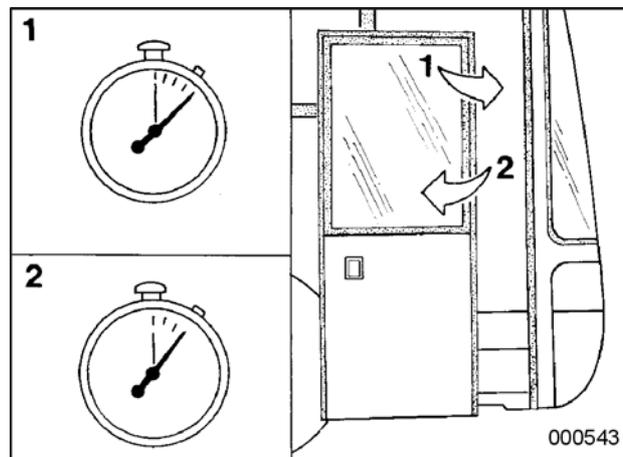
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

A pressure of 115 to 130 psi in the air tanks

**Figure:
opening/
closing time**



Procedure

With a stop watch, check the duration of the door wing movement.
Door opening/closing time should be 4 to 5 seconds.

Passenger door: to adjust opening/closing time

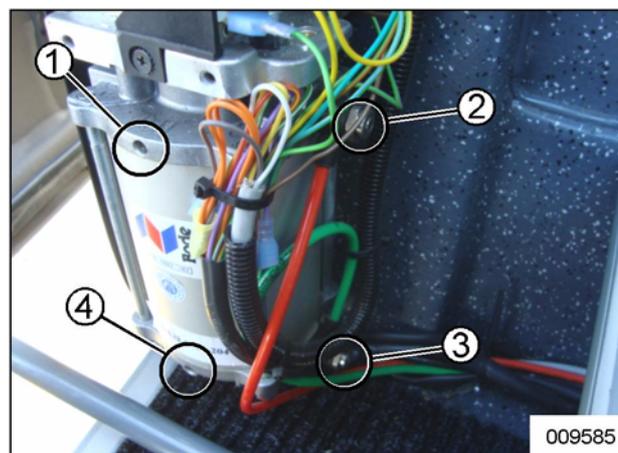
Introduction

The air cylinder, which opens and closes the passenger door leaf, has been fitted with four adjusting screws: one pair for adjusting door movement speed, the other pair for adjusting end damping (slowing down the door leaf towards the end of the movement to avoid door slamming).

Equipment conditions

- A pressure of 115 to 130 psi in the air tanks
- Air cylinder plastic protection cap removed

Figure: adjusting screws on air cylinder



Cylinder protective cap has been removed

- 1 Damping at closing
- 2 Closing speed
- 3 Opening speed
- 4 Damping at opening

To adjust movement speed

First, rotate counterclockwise both end-damping adjustment screws by an eighth to a quarter turn at the most and adjust door movement speed.

If door leaf...	rotate speed screw...
moves too slowly,	counterclockwise by a quarter turn at a time, until speed is correct.
moves too fast,	clockwise by a quarter turn at a time, until speed is correct.

continued on next page

**To adjust
damping**

To...	turn adjusting screw...
increase damping	clockwise.
decrease damping	counterclockwise.

Passenger door: to set reversing-system switches

Equipment conditions

Door cylinder depressurized

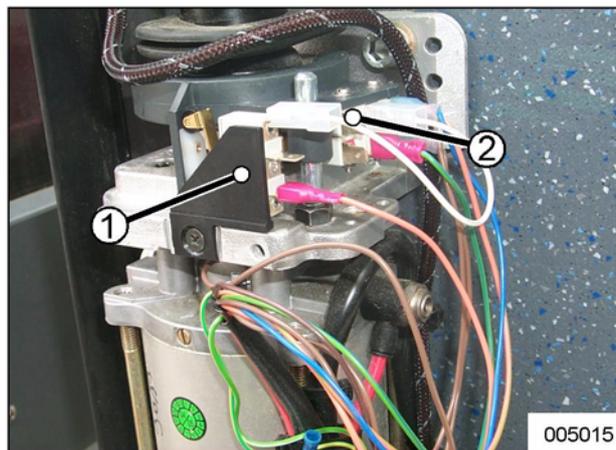
Reversing system

The reversing system is a safety device that protects against entrapment. If a door leaf runs into something or somebody while closing, the door movement will reverse immediately.

Location of switches

In the entrance, behind the protective cap of the door cylinder.

Figure: reversing- system switches

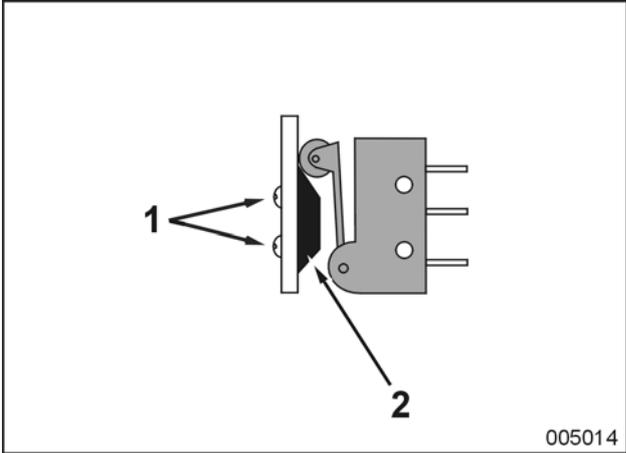


1 Reversing switch (MS028)

2 Limit switch (MS033.2)

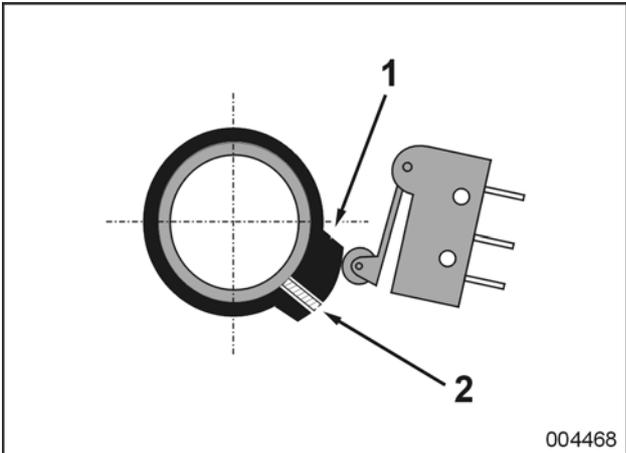
To set reversing switch

The reversing switch activates the door control valve so that door-leaf movement is reversed.

Step	Action
1	Untighten fastening screws (1) of actuating cam (2).
	 <p style="text-align: right;">005014</p>
2	Slide the actuating cam upward, until the switch contacts close.
3	Slide the actuating cam approximately 0.2 in (maximum 0.25 in) downward.
4	Secure the actuating cam in this position.

To adjust limit switch

The limit switch cuts off the reversing system just before the door is fully closed.

Step	Action
1	Untighten fastening screw (2) of actuating cam (1).
	 <p style="text-align: right;">004468</p>

continued on next page

Step	Action
2	Close the door by pushing it by hand.
3	Turn the actuating cam, until the switch contacts open.
4	Secure the actuating cam in this position.

To preserve rubber door seals

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Procedure

Rubber edge trims on door(s) harden less quickly if you treat them with silicone spray. Make sure you do not forget the inside of the rubber seals on the door leaf: the inside has to be able to slide smoothly along the posts, when the door leaf rises.

**CAUTION!**

Do not use vaseline as it freezes in winter, and will tear the rubbers.



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Part 11 - Control systems

Overview

Contents

Chapter	See page
Chapter 1: Multiplex system	11.1-1
Chapter 2: ATC	11.2-1
Chapter 3: ESC	11.3-1

Chapter 1: Multiplex system

Overview

Introduction This chapter deals with the multiplex system.

Number of pages 86

Chapter publication date 21 September 2016

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Multiplex safety instructions



WARNING!

Before operating the dashboard display to perform simulations or functional tests via the multiplex system, warn people working on the vehicle or about to do so that climate-control system fans and other devices may suddenly engage without engine running.



WARNING!

Never operate the dashboard display while driving.



CAUTION!

Before electric welding on the vehicle, switch off the electric battery switch first and wait for the delayed cut-off of the (24V electrical system) batteries. Take into account a waiting time of 90 seconds to be sure that on-board voltage is no more present. Then open the mechanical battery switch(es) and pull the plugs of all the electronic control units.



CAUTION!

Only use a multimeter as a test device, not a test lamp.



CAUTION!

Do not lengthen or shorten the CAN bus. Do not remove termination resistors.

**CAUTION!**

The electronics are very sensitive. Incorrect connection leads to damage. Avoid reversing polarity connections.

**CAUTION!**

Repairs to the wiring must always be carried out in accordance with the principles of good workmanship. Take appropriate care when soldering and crimping.

Introduction

What is multiplex?

Multiplex is a collective term for the technology used to transmit multiple signals (data/commands) through two conductors between two or more components in an electrical network.

Why multiplex?

The advantages of a multiplex system in relation to classic electrical equipment:

- a considerable reduction of the number of wires;
- thinner main cable looms in the vehicle.

The fact that all kinds of switching conditions can be built into a circuit easily means that the entire arrangement of electrical circuits is simplified. This leads to:

- a reduction of the number of relays;
- simplification of the junction boxes;
- a reduction of the vehicle mass (= reduced fuel consumption).

The fact that one or more diagnosis possibilities are available in the program makes it easier to test the vehicle or trace faults. Testing can be done through on-board diagnosis or by connecting an external PC. On-board diagnosis means the possibilities provided without the use of special equipment.

The multiplex system also reduces the number of separate electronic circuits (for example: turn signal box, windshield wiper interval, time switches,...).

The multiplex system can also read messages that are available on the CAN bus of the driveline (SAE J 1939). This also leads to a reduction of the number of wires and components in the periphery of the drive line.

What system is used by Van Hool?

Van Hool use the KIBES multiplex system. KIBES is the abbreviation of "Kienzle Bord Elektronik System".

Figure:
schematic of
classic wiring

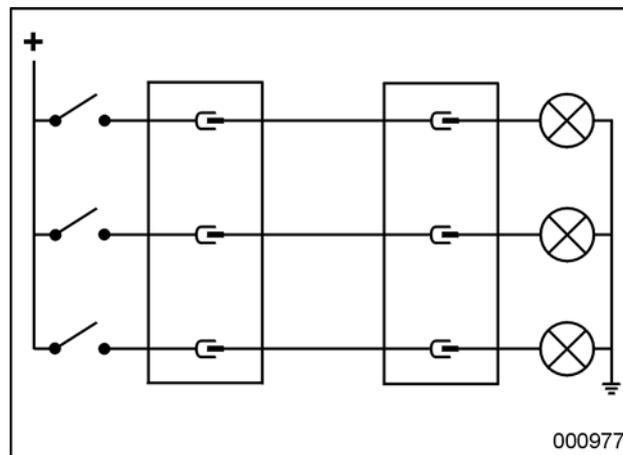
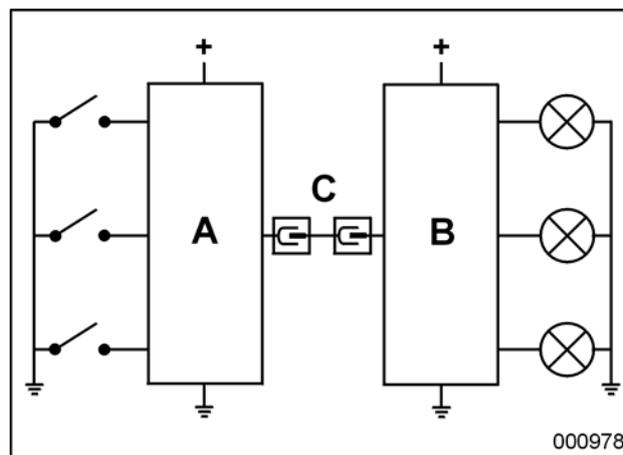


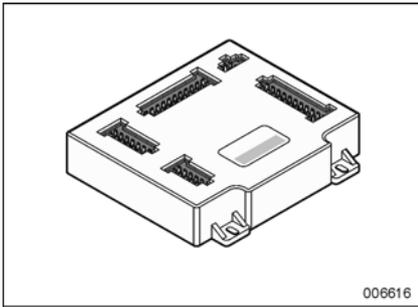
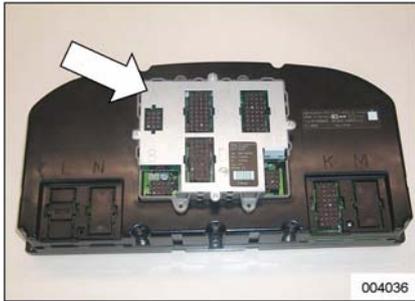
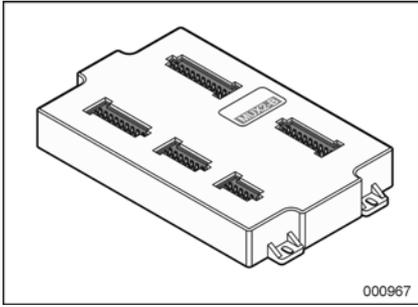
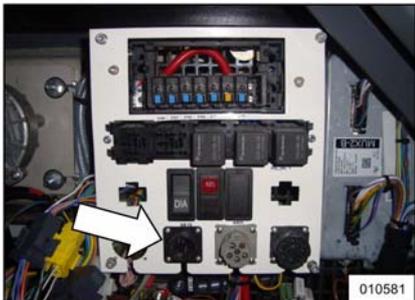
Figure:
schematic of
multiplex
wiring



- A Electronics box
- B Electronics box
- C Signal line

Visual identification of components

Hardware components

Element	Figure
Computer module (ZR32-A)	 <p style="text-align: right;">006616</p>
Dashboard node (DMUX)	 <p style="text-align: right;">004036</p>
Node (NODE)	 <p style="text-align: right;">000967</p>
Diagnostic socket (on diagnostic panel in junction box EKF)	 <p style="text-align: right;">010581</p>

Layout

Introduction

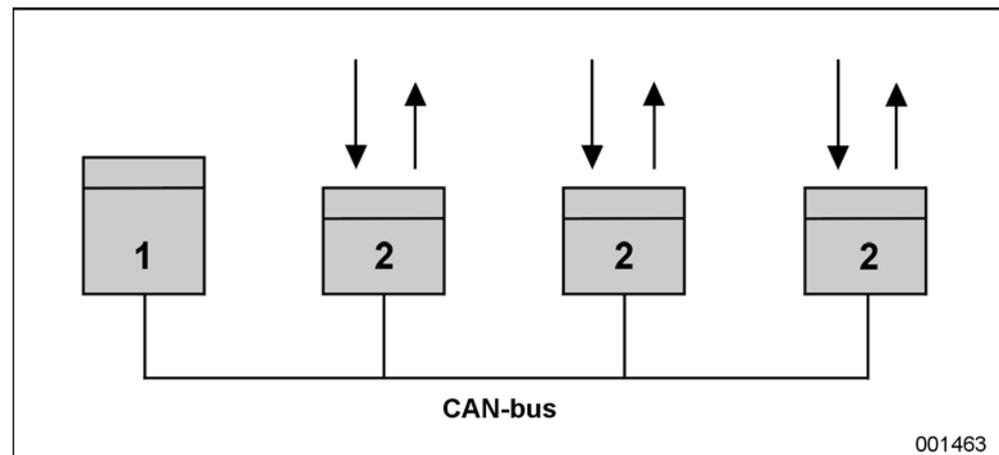
The system is constructed with "hardware" components (= all equipment in the system). This "hardware" is controlled by the "software" (= program which enables the "hardware" to function as required).

Hardware components

The Kibes system consists of the following "hardware" components:

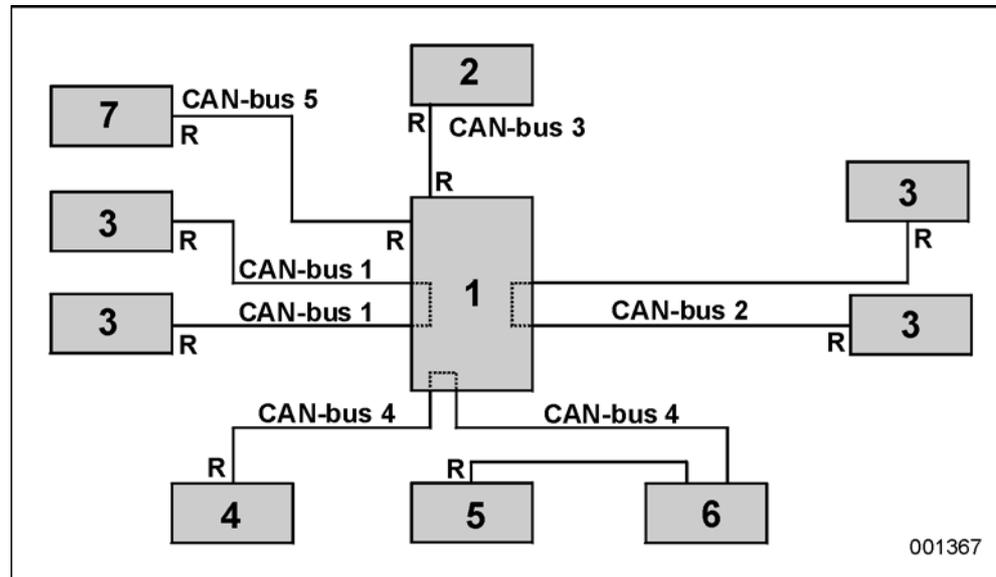
- a computer module (master) that contains the driver, in other words the programmable intelligence;
- a dashboard node (slave) that contains programmable information;
- a number of nodes (slaves) without programmable intelligence, just inputs and outputs;
- CAN-bus (interconnection between the elements of the multiplex system).

Figure: layout



1 Master
2 Slave

Figure: a KIBES multiplex network in practice

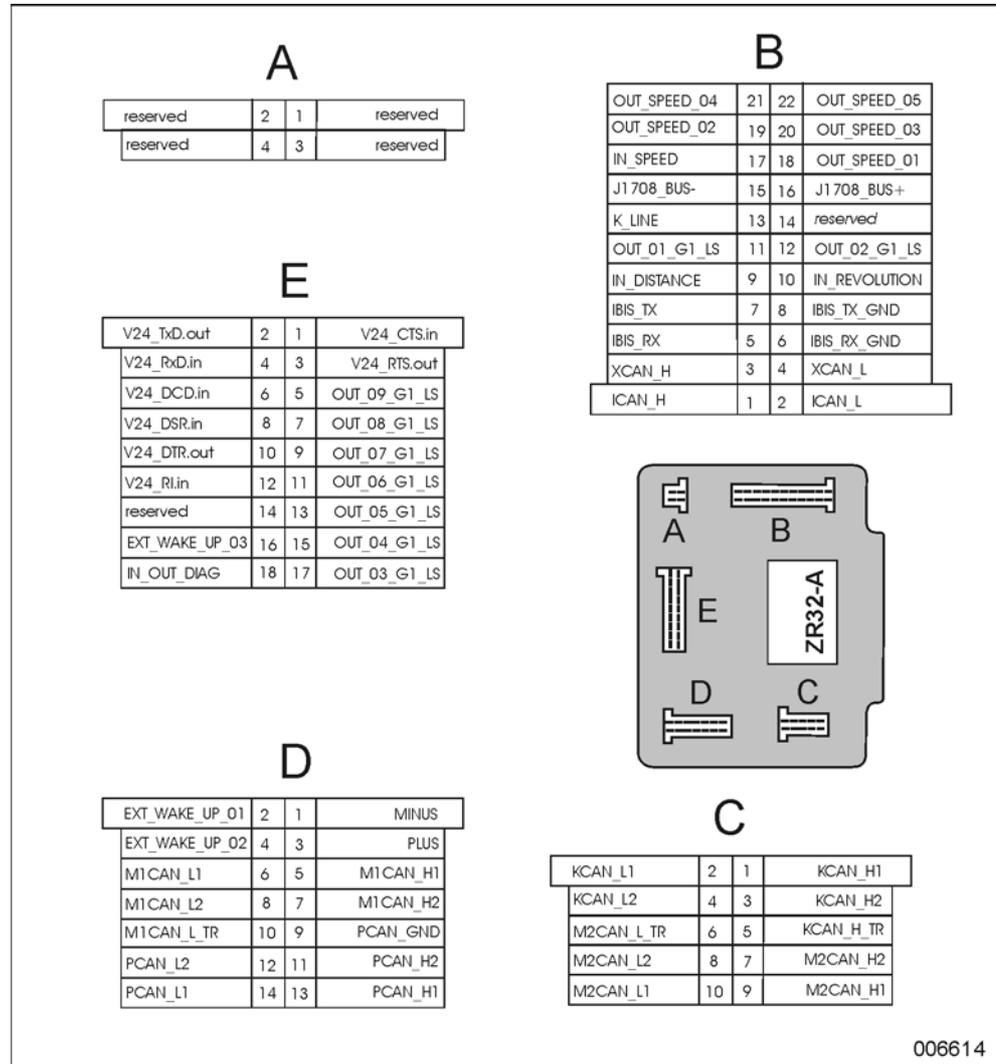


001367

- 1 Computer module
- 2 Dashboard node
- 3 Node
- 4 Vehicle engine control unit
- 5 Transmission control unit
- 6 ABS/ASR control unit
- 7 Door controls
- R Termination resistor

Kibes ZR32-A computer module

Figure: pin numbering of connectors at computer module



Connectors as seen from wire input side.

What does the computer module contain?

The computer module contains the executive program (the "software") that controls the system.

Refer to "Function diagram (FUP)" for the logic of this program.

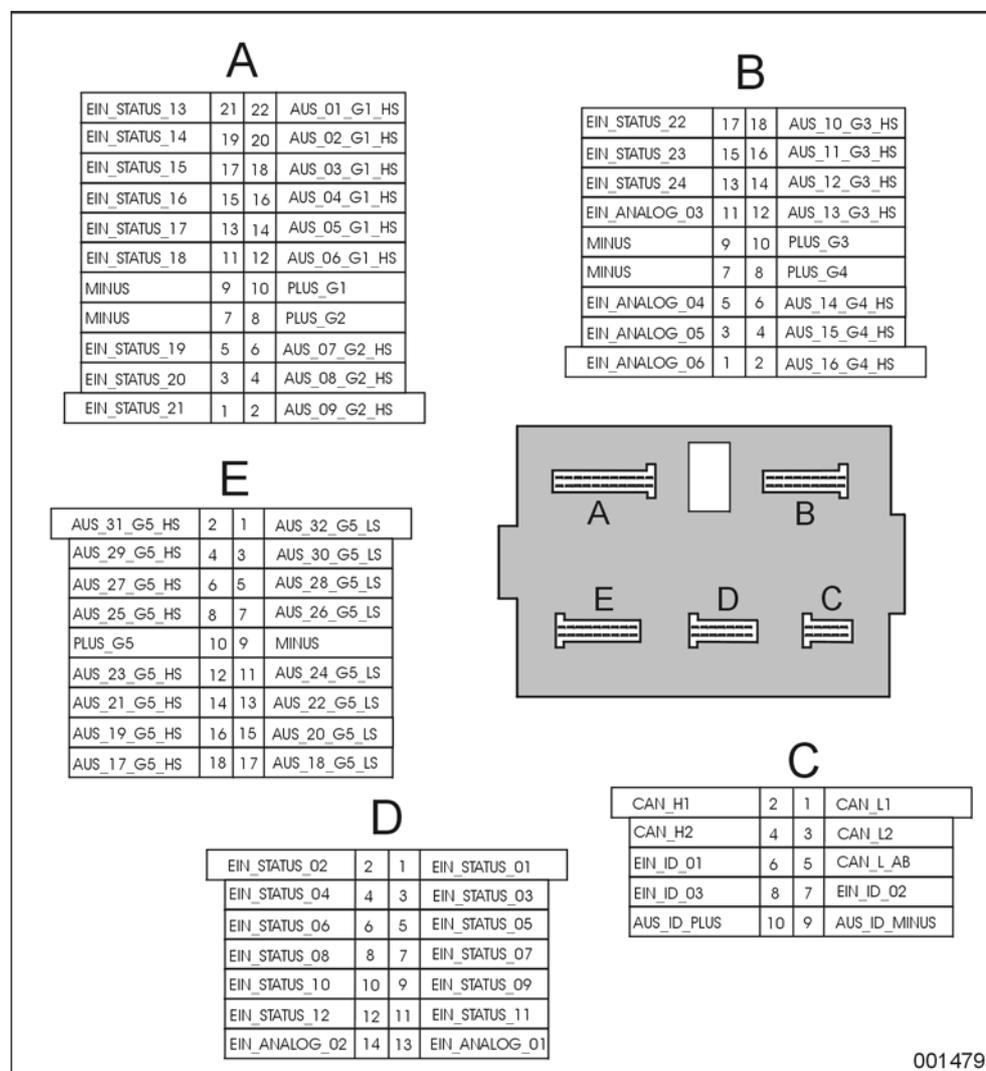
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**What in case
of defective
computer
module?**

The computer module does not contain repairable parts. If there is a defect, it is to be replaced as a whole by a unit with identical Van Hool order number. This number also contains the code of the program in the computer module.

Nodes

Figure: pin numbering of connectors at node



Connectors as seen from wire input side.

What is a node?

A node is an electronic "switchbox" with inputs and outputs controlled by the computer module to operate (via the outputs) or monitor (via the inputs) the electrical functions of the vehicle.

Inputs

There are two types of input: static and analog.

A(n) ... input	is indicated by ...
static	Ein_Status_

continued on next page

A(n) ... input	is indicated by ...
analog	Ein_Analog_

Outputs

An output is indicated by "Aus_".

The outputs are protected against overloads and short-circuits. They are NOT protected against an applied external voltage to the output.

Power supply

Each node is powered via five separate circuits, each fitted with a 15 A fuse. Each fuse protects a "group" of node outputs.

The internal electronics are fed via the fuse of "group 1" and/or "group 2".

Node locations

The nodes are located throughout the vehicle, close to the components to which they relate, thereby greatly reducing the amount of main cabling.

Are nodes interchangeable?

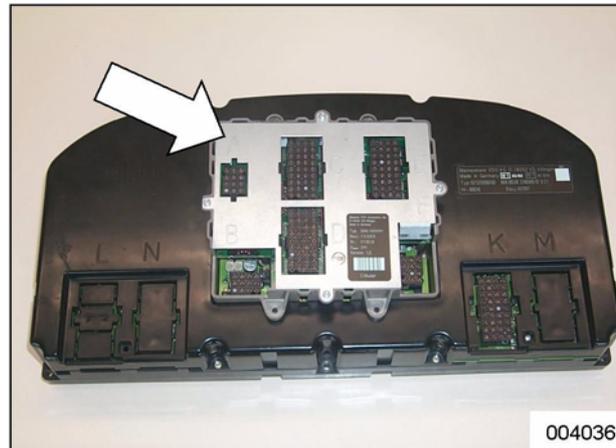
All nodes are interchangeable, with the exception of the dashboard node. This is because the nodes do not contain any software on the one hand and the "addressing" takes place by means of an external wire combination in a connector on the other hand. Addressing ensures that the node recognizes the messages that are intended for it.

What in case of a defective node?

The nodes do not contain any user-repairable parts. A faulty unit must be replaced as a whole.

Dashboard node

Figure:
dashboard
node



What does the dashboard node do?

- The dashboard node receives information relating to the position of the switches on the dashboard and sends this information to the computer module.
- The computer module controls the multifunctional display and the warning and indicator lights on the dashboard via the dashboard node.

Differences from other nodes

- Lower output current rating
- Integrated into the instrument panel
- Contains a program

What in case of a defective dashboard node?

The dashboard node does not contain any components that can be repaired by the user. If there is a fault, you have to replace it together with the instrument panel by a unit of the same Van Hool ordering number as the original. This ordering number relates not only to the dashboard "hardware", but also to the dashboard node program.

CAN bus

What is a communications bus?

A communications bus is an electric conductor that transfers digital signals in both directions between the components in a multiplex system. This conductor runs throughout the entire vehicle.

What is a CAN bus?

There are different types of bus designs. The CAN bus design has been specified in both ISO and SAE standards. "CAN" is the abbreviation for "Controller Area Network".

A twisted pair of wires (30 twists per meter) or a twin-core twisted and shielded cable are used as signal carriers in a CAN bus system.

Application	Function	Twisted wire pair	Twin-core twisted and shielded cable
Nodes (CAN-bus 1)	CAN H(igh)	green	-
	CAN L(ow)	yellow	-
Nodes (CAN-bus 2)	CAN H(igh)	blue	-
	CAN L(ow)	orange	-
Dashboard node (CAN-bus 3)	CAN H(igh)	blue	-
	CAN L(ow)	brown	-
Drive line J1939 (CAN-bus 4)	CAN H(igh)	blue	blue
	CAN L(ow)	brown	brown
Door control (CAN-bus 5)	CAN H(igh)	orange	-
	CAN L(ow)	brown	-
Voith transmission (CAN-bus Voith)	CAN H(igh)	orange	-
	CAN L(ow)	brown	-

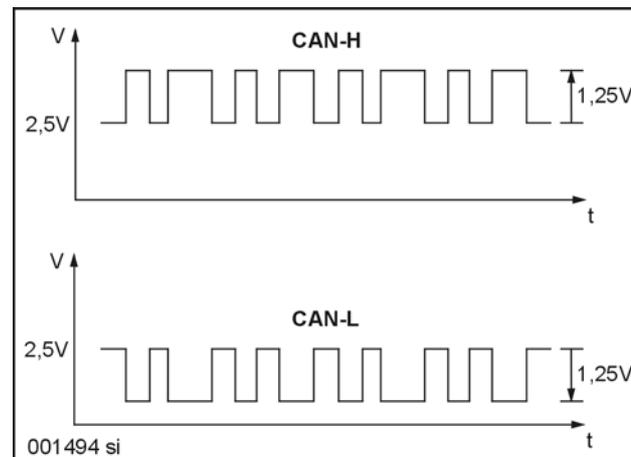
Voltages on CAN bus

- CAN H(igh): basic voltage of 2.5V with a positive signal voltage of 1.25V.
- CAN L(ow): basic voltage of 2.5V with a negative signal voltage of 1.25V.

The signal on CAN-L is called the "mirror" signal of CAN-H. This double signal allows for fault detection on data exchange and provides a high degree of protection against interference.

continued on next page

**Figure:
voltages on
CAN bus**



Communi- cation speed

The communication speed of a CAN bus depends on the protocol used. The computer module can communicate using different speeds and protocols via separate CAN bus lines:

- For the driveline (SAE J1939): speed of 250 kbit/s (example: communication between control units of the engine, transmission, retarder, ABS,...)
- For bodywork applications (ISO): different speeds are possible (example: communication between Kibes computer module and the nodes is effected at a speed of 125 kbit/s).

Termination resistors

Each CAN bus terminates at both ends with a 120 Ohm resistor. The resistors are necessary to guarantee the integrity of the data transfer as well as network stability.

The nodes in the Kibes system are fitted with an internal termination resistor. If necessary, you can switch in the termination resistor simply by placing a wire bridge between pin "3" and "5" of the "C" connector.

Devices with permanent built-in resistor must be fitted at the start or end of the CAN bus.

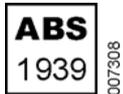
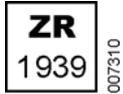
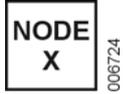
CAN bus faults

In case of a CAN bus fault, a symbol appears on the dashboard display indicating the location of the fault.

The symbols below may appear:

Symbol	Location
	CAN bus line between computer module and vehicle engine control unit

continued on next page

Symbol	Location
	CAN bus line between computer module and transmission control unit
	CAN bus line between computer module and ABS/ASR system control unit
	CAN bus line between computer module and retarder control unit
	SAE J1939 connection of computer module
	CAN bus line between computer module and node
	CAN bus line between computer module and dashboard node

To test the CAN bus

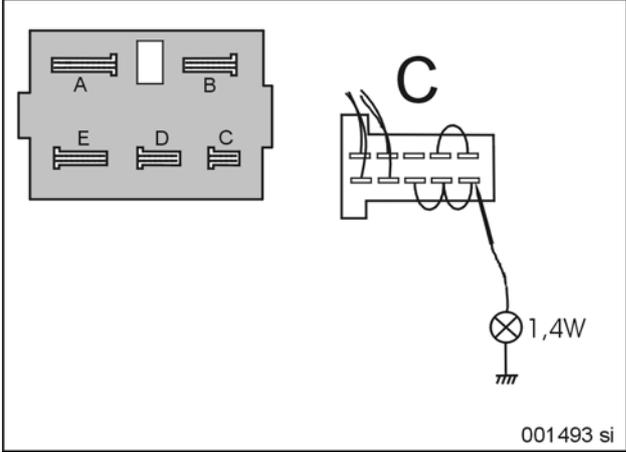
The CAN bus can be tested with a multimeter:

- Vehicle ignition on: You should measure a voltage of more than 2.6V on CAN-H and of less than 2.4V on CAN-L. You can detect an interrupted, inverted or shorted CAN bus by measuring the voltage.
- Vehicle ignition off: there should be a resistance of 60 Ohms between the two wires on the CAN bus.

You can also test the CAN bus at the node.

continued on next page

The CAN bus may also exceptionally be tested with a test lamp (this differs from the "Safety instructions for the multiplex system" at the beginning of this chapter):

Step	Action
1	<p data-bbox="579 450 1431 517">Connect a test lamp of maximum 1.4 W between pin C10 of node and ground.</p> <div data-bbox="692 562 1318 1014"><p data-bbox="1209 987 1310 1010">001493 si</p></div>

Step	Action
2	<p>Switch on the vehicle ignition.</p> <p>The test lamp starts to flash according to a particular pattern.</p> <ul style="list-style-type: none"> • Top pattern: CAN-bus OK • Middle pattern: CAN bus interrupted • Bottom pattern: only appears during the CAN bus start-up <div style="text-align: center;"> </div> <p>If the lamp goes out or stays out, then:</p> <ul style="list-style-type: none"> • the CAN bus has been interrupted or inverted or ... • the node has no power supply, or... • the node is defective. <p>If the lamp remains on, the node is defective.</p>

Working on CAN bus



CAUTION!

Do not interrupt the CAN bus with the ignition on. Otherwise, you will get fault messages.

After working on the CAN bus



CAUTION!

The multiplex system should be reset after working on the CAN bus.

Follow the procedure below to reset the multiplex system:

Step	Action
1	Switch off the vehicle ignition.

continued on next page

Step	Action
2	Switch off the electric battery switch and wait 90 seconds. Now you can be sure that there is no more on-board voltage present.
3	Momentarily withdraw plug D from the computer module. The multiplex system is reset.

Technology of node inputs and outputs

Node inputs

There are two types of input: static and analog.

A(n) ... input	changes the voltage level to ...
static	"0" or "1" (e.g. switch off or on). This digital data is then sent via the CAN bus to the computer module for processing. <i>NOTE: The current flow required to operate a static input is only 7mA.</i>
analog	a digital value that corresponds to the magnitude of the input signal (e.g. fuel gauge float).

Static inputs

The static inputs can be powered in different ways: positive (S3), ground (S2) or by a combination of both (S1).

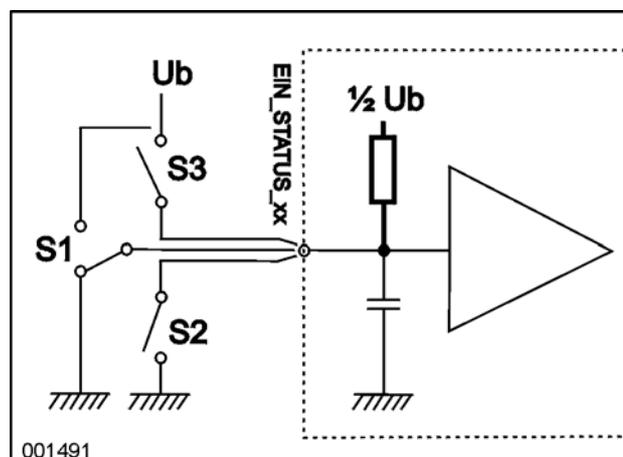
NOTE: You measure a voltage of about half the on-board voltage at the input if the switch is open.

	Switch setting	Voltage at node input	Digital signal
S1 ^a	ground switched	lower than 5V	0
	positive switched	higher than 19 V	1
S2	closed (to ground)	lower than 5 V	1
	open	higher than 7 V	0
S3	open	lower than 16 V	0
	closed (to positive)	higher than 19 V	1

a. This way of switching allows you to determine with a voltmeter whether the switch itself is faulty or whether there is an interruption in the wiring to the node. This switching method is sometimes used with the dashboard node.

continued on next page

Figure:
switching possibilities at static node input



Ub: on-board voltage

S1 Change-over switch

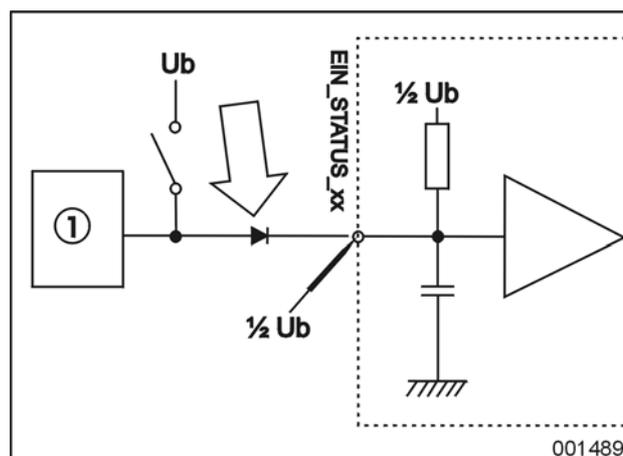
S2 Ground switched

S3 Positive switched

Electronic circuit at static node input

As mentioned above under "Static inputs", there is a voltage equal to approximately half the on-board voltage at the node input, if the switch is open. If you connect an electronic circuit to the node input, in parallel with the switch, then the node input voltage can affect the input of that electronic circuit. To avoid this, a diode (see figure for the correct direction) is placed in the wiring to the electronic circuit.

Figure:
electronic circuit at static node input



Ub: on-board voltage

1 Electronic circuit

continued on next page

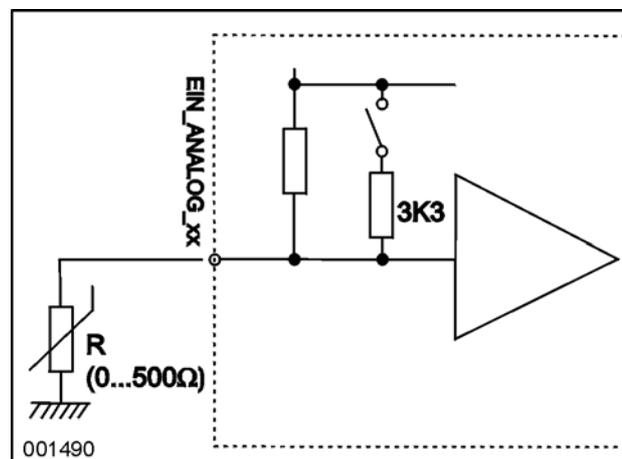
Analog inputs

A number of inputs on each node are specific analog inputs. You can connect a variable resistance of between 0 and 500 ohms to these inputs for further analog processing.

The analog inputs can also be used as static inputs (see table).

Voltage at node input	Digital signal
lower than 5 V	0
higher than 19 V	1

Figure:
variable
resistance at
analog input



Outputs on nodes

The outputs are divided into the following types:

High or low switching	Each node has outputs that are positive (high switching) and outputs that are ground (low switching) switched. The "positive" outputs are indicated with "HS", the "ground" outputs with "LS".
Maximum current	All node outputs are protected against short-circuits and overloads. Nevertheless, each output has a maximum output current rating. There are outputs of 1A, 3A, 5A and 10A.
Group	The outputs are divided into five groups. The total load on all outputs in a group must not exceed 15A. The groups are indicated with the letter "G", followed by a group number. For example "G3"

continued on next page

**Voltage at
node HS
output**

Output status		Voltage at output
Not active	Not loaded or load circuit interrupted	Few volts
	Loaded	About 0V
Active	Not shorted	On-board voltage
	Shorted	0V

**Voltage at
node LS
output**

Output status		Voltage at output
Not active	Not loaded or load circuit interrupted	About 0V
	Loaded	On-board voltage
Active	Not shorted	0V
	Shorted	0V

**How do the
electronics
detect a short
circuit at the
output?**

A short-circuit at a node output is detected via internal feedback.

**How do the
electronics
detect an
overload at the
output?**

An overload at a node output is detected by the thermal cut-outs of the final stages.

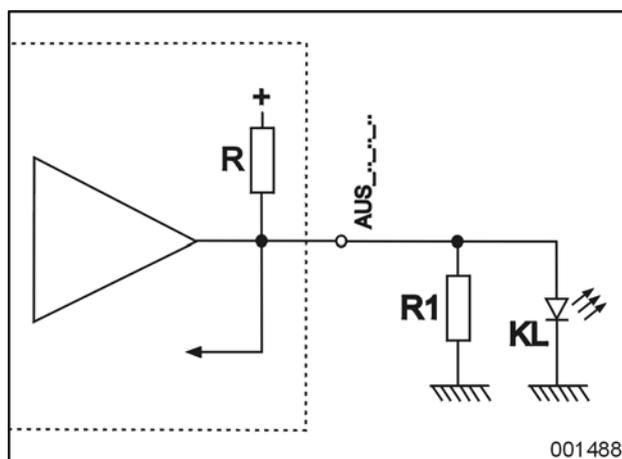
**Load with
extremely high
impedance at
node output**

An output connected to a load with very high impedance (example: LED) behaves like a non-loaded or interrupted output. Thus, the voltage at the node output can amount to several volts.

On the one hand, this means that very high impedance loads cannot be checked for interruption. On the other hand, the residual voltage can cause side-effects that can only be avoided by installing a resistor (R1) in parallel with the load. This resistor introduces an extra load, making the voltage at the output drop.

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Figure: very high impedance load at node output



R: Internal resistance
R1: "Pull-down" resistor
KL: Very high impedance load (for example: LED)

Numbering of inputs and outputs

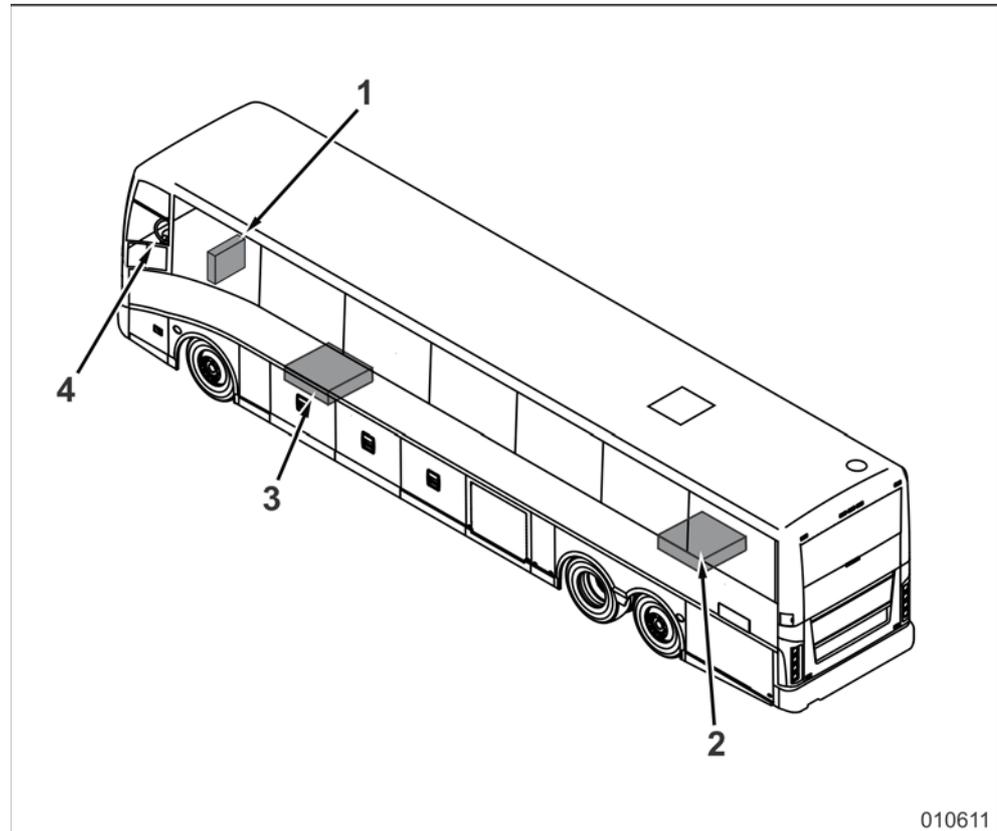
The numbering of inputs and outputs is coded. You will also find this numbering on the schematic circuit diagrams and in the fault code during diagnosis.

Example: N5E12

- N: Node
- 5: Node number
- E: Connector name
- 12: Pin number on connector.

Component location

Figure:
component
location



010611

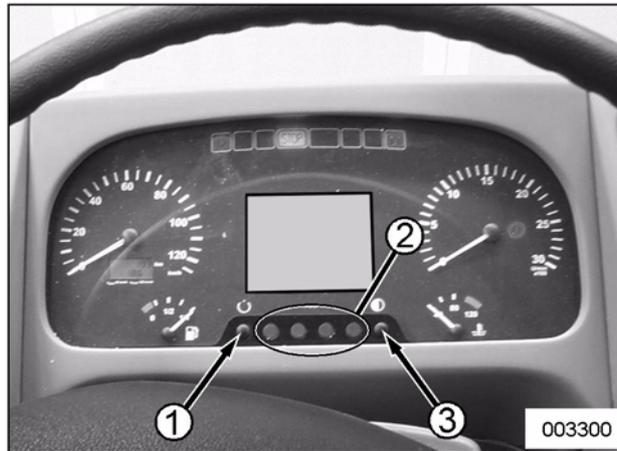
- 1 Node 1, diagnostic socket (in junction box EKF)
- 2 Node 4, node 5, node 6 (in junction box EKA)
- 3 Computer module, node 2, node 3 (in junction box EKV)
- 4 Dashboard node

To operate the dashboard display

Introduction

The aids for testing and the diagnostic systems are activated with the buttons located under the dashboard display.

Figure: control buttons of dashboard display



- 1 Menu button
- 2 Selection buttons
- 3 Adjusting button for dashboard instruments brightness

Function of control buttons

Button	Function
Menu button	<ul style="list-style-type: none"> • To open/close service menu • To return to previous menu.
Selection buttons	<p>To select the symbols in the lower part of the display to:</p> <ul style="list-style-type: none"> • open the submenu; • select functions in the submenu.



WARNING!

Before operating the dashboard display to perform simulations or functional tests via the multiplex system, warn people working on the vehicle or about to do so that climate-control system fans and other devices may suddenly engage without engine running.

continued on next page

**WARNING!**

Never operate the dashboard display while driving.

**How to open/
close service
menu?**

To ... the service menu	press ...
open	and hold the menu button for longer than 5 seconds.
close	the menu button again

**How to open
submenu?**

Momentarily press the selection button below the symbol of the submenu you wish to open.

**How to select a
function from
submenu?**

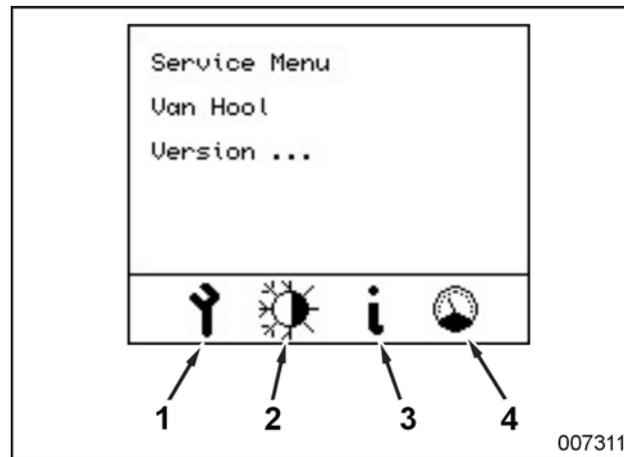
Momentarily press the selection button below the symbol of the function you wish to activate.

**How to close
submenu?**

Momentarily press the menu button.

Service menu layout

Figure: service menu



- 1 *Diagnostics menu*
- 2 *Climate-control menu*
- 3 *Miscellaneous menu*
- 4 *Garage feature menu*

Major faults

If a priority fault occurs, the corresponding message will appear on the display, deleting the called-up information screen.

Service menu layout

For more about ...	refer to ...
diagnostics menu (1)	<ul style="list-style-type: none"> • "On-board diagnostics system: functional check" • "On-board diagnostics system: self-diagnosis". • "On-board diagnostics system: "DM1/DM4" diagnosis"
climate-control menu (2)	Chapter 8.02: "Climate control: Control systems"
miscellaneous menu (3)	<ul style="list-style-type: none"> • "Aids for testing: "running engine" simulation" • "Aids for testing: "driving vehicle" simulation" • "Identification of the programs" • "To change language of dash-board display"

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For more about ...	refer to ...
garage feature menu (4)	"Aids for testing: garage feature"

On-board diagnostics system: functional check

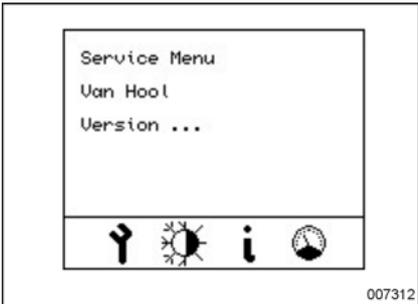
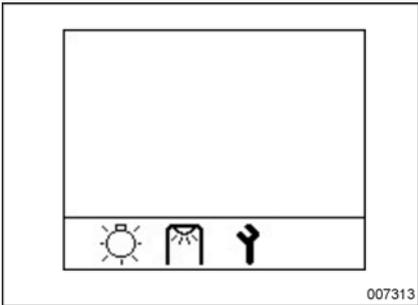
Introduction

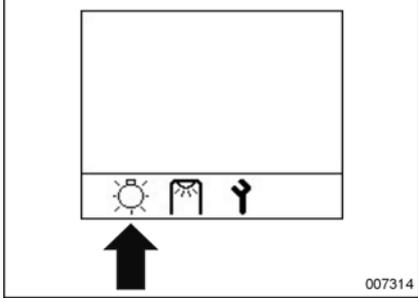
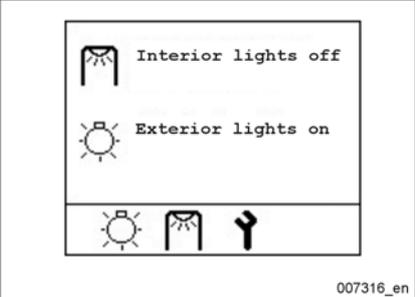
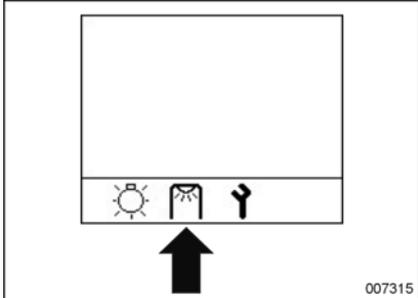
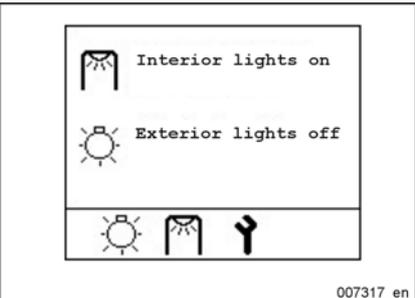
The program in the computer module also contains a "functional check". The purpose of it is to check the outputs to which the interior and exterior lights are connected.

Equipment condition

Battery switch on

To carry out functional check

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p>  <p>007312</p>
2	Press the button under the wrench symbol.	<p>The on-board diagnosis menu appears on the display.</p>  <p>007313</p>

Step	Action	Result
3	Press the button under the exterior lights symbol. 	The exterior lights will come on. 
4	Press the exterior lights symbol once more to switch off the function.	
5	Press the button under the interior lights symbol. 	The interior lights will come on. 
6	Press the interior lights symbol once more to switch off the function.	

To exit functional check

Momentarily press the far left button of the dashboard display as many times as necessary to return to the service menu.

On-board diagnostics system: self-diagnosis

Introduction

As soon as multiplex system is under tension, the computer module checks a number of node inputs and outputs for interruptions and/or short-circuits.

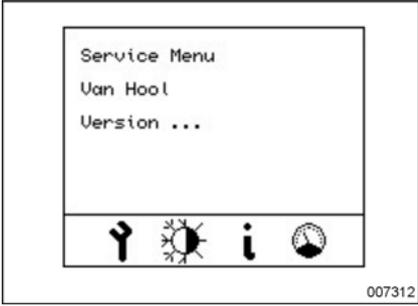
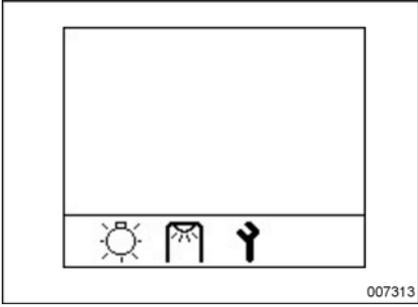
Equipment condition

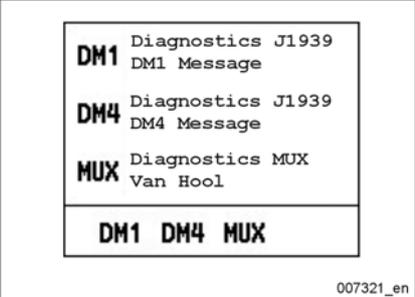
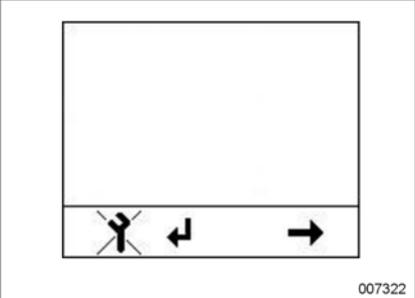
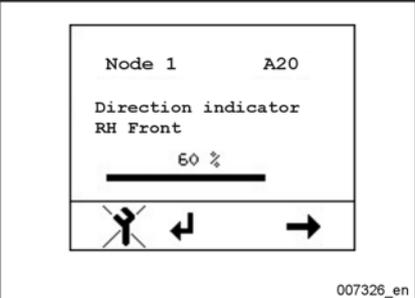
- Battery switch on
- Vehicle ignition on

How are you notified?

When the electronics detect an error, the wrench symbol appears on the dashboard display. At the same time the fault is stored as a code in the computer module memory.

To retrieve a fault code

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p>  <p>007312</p>
2	Press the button under the wrench symbol.	<p>The on-board diagnosis menu appears on the display.</p>  <p>007313</p>

Step	Action	Result
3	Press the button under the wrench symbol.	<p>A menu appears on the display.</p>  <p style="text-align: right; font-size: small;">007321_en</p>
4	Press the button under "MUX".	<p>The menu below appears on the display.</p>  <p style="text-align: right; font-size: small;">007322</p>
5	Press the button under the bent arrow to start the diagnosis.	<p>The node number, connector pin and a discription of the fault appear on the display when a fault is detected.</p> <p><i>NOTE: The bar and the percentage indicate the part of the memory you have already run through.</i></p>  <p style="text-align: right; font-size: small;">007326_en</p>
6	Press the button under the straight arrow to retrieve the next fault.	

continued on next page

Step	Action	Result
7	Repeat step 6 until you have gone through all of the faults.	

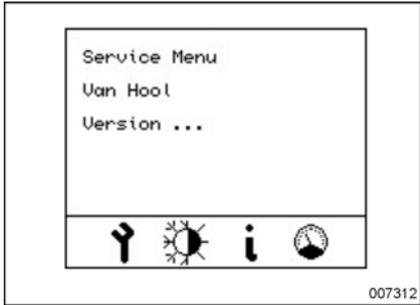
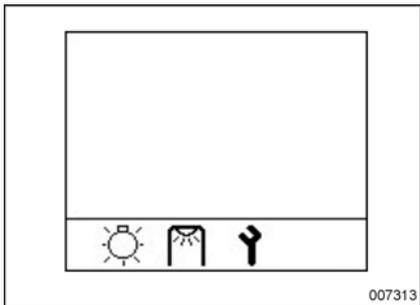
Trouble-shooting

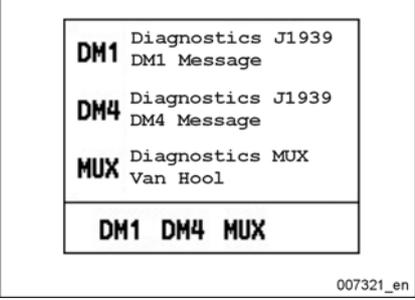
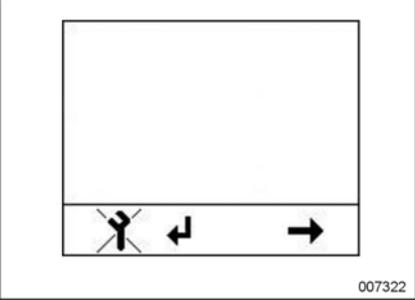
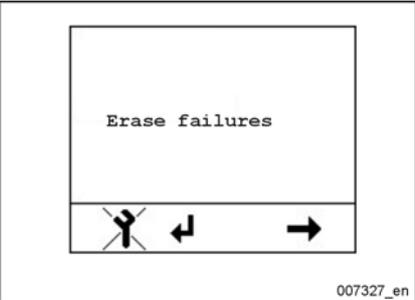
A multimeter and the electric diagram of the vehicle are required to find the exact location of the fault on your vehicle.

To exit self-diagnosis

Momentarily press the far left button of the dashboard display as many times as necessary to return to the service menu.

To erase fault memory

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p>  <p>007312</p>
2	Press the button under the wrench symbol.	<p>The on-board diagnosis menu appears on the display.</p>  <p>007313</p>

Step	Action	Result
3	Press the button under the wrench symbol.	The menu below appears on the display.  007321_en
4	Press the button under "MUX".	The menu below appears on the display.  007322
5	Press the button under the crossed out wrench symbol.	The fault memory is erased.  007327_en

When will the wrench symbol disappear?

Even after the fault has been repaired or disappeared spontaneously, the wrench symbol will remain on the display and the fault code(s) will remain in the memory, until you erase the memory manually.

If at the moment you give the erase command ...	then ...
there are no more faults active	the wrench symbol disappears from the display.

continued on next page

If at the moment you give the erase command ...	then ...
there are still faults active	the wrench symbol will remain on the display. Only the non-active faults have been erased. In that case repeat the procedure "To call up fault code". Repair the fault and repeat "To erase fault memory" procedure, until the key symbol disappears.

Aids for testing: "running engine" simulation

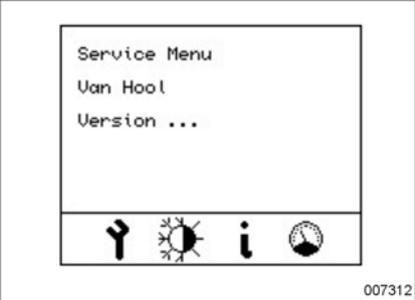
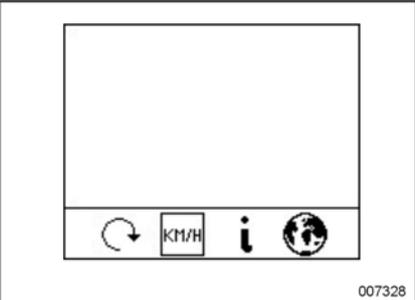
Introduction

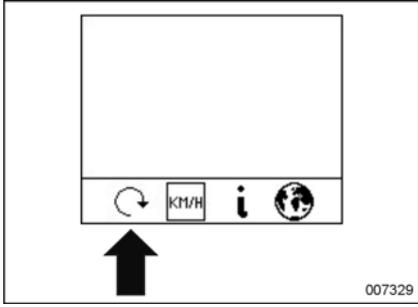
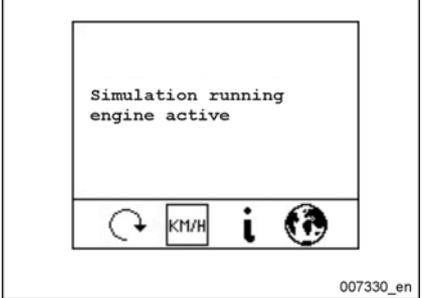
A number of electrical circuits are only powered when the vehicle engine is running. It may occasionally be necessary to simulate the "engine running" signal (D+) in order to test these electrical circuits without the engine actually being in operation.

Equipment condition

- Vehicle at standstill
- Battery switch on

To start simulation

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p>  <p>007312</p>
2	Press the button under the "i" symbol.	<p>The miscellaneous menu appears on the display.</p>  <p>007328</p>

Step	Action	Result
3	<p>Press the button under the symbol for "running engine" simulation.</p> 	<p>The simulation is now activated and an indicator light comes on next to the pointer in the dashboard revolution counter.</p> 

To end the simulation

Press the button under the symbol for the "running engine" simulation again. The simulation is deactivated and the indicator light does not illuminate any more.

To exit miscellaneous menu

Momentarily press the far left button under the dashboard display as many times as necessary to return to the service menu.

Aids for testing: "moving vehicle" simulation

Introduction

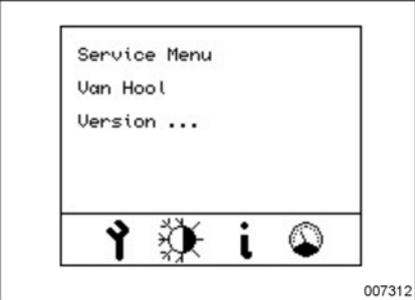
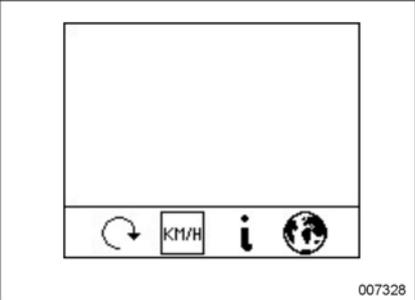
A number of electrical circuits are only powered when the vehicle is in motion. It may occasionally be necessary to simulate the electrical signal of a "moving vehicle" to enable these circuits to be tested without the vehicle actually moving.

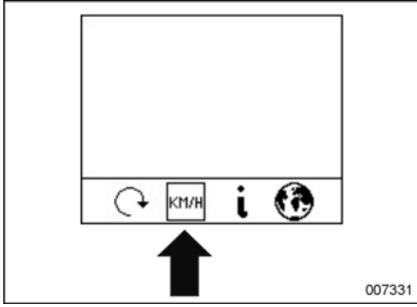
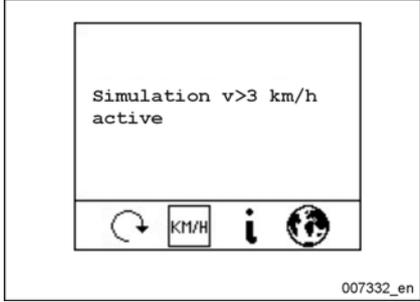
NOTE: When you start this function, the "running engine" simulation will also start. This is in order to approximate a realistic situation as closely as possible.

Equipment condition

- Engine off
- Battery switch on

To start simulation

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	The service menu appears on the display.  007312
2	Press the button under the "i" symbol.	The miscellaneous menu appears on the display.  007328

Step	Action	Result
3	<p>Press the button under the symbol for "moving vehicle" simulation.</p> 	<p>The simulation is activated.</p> 

To end the simulation

Press the button under the symbol for the "moving vehicle" simulation again. The simulation is deactivated.

To exit miscellaneous menu

Momentarily press the far left button under the dashboard display as many times as necessary to return to the service menu.

Identification of the programs

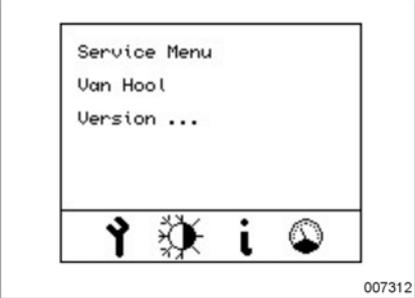
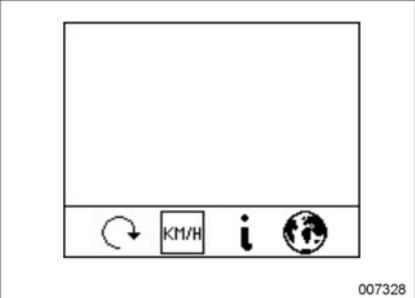
Introduction

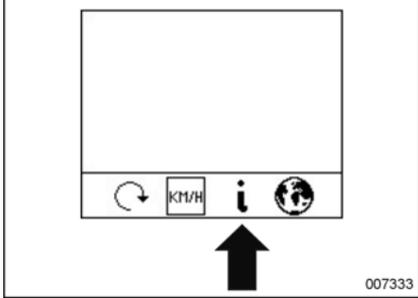
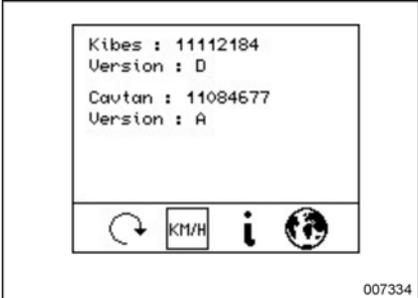
The program for the computer module and that for the dashboard node have unique identification numbers. Both numbers can be called up via the display.

Equipment condition

- Vehicle at standstill
- Battery switch on

Procedure

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p> 
2	Press the button under the "i" symbol.	<p>The miscellaneous menu appears on the display.</p> 

Step	Action	Result
3	Press the button under the "i" symbol. 	The identification data of the programs appear on the display. 

Recognizing the identification data

After ...	the display shows ...
"Kibes:"	the program identification number in the computer module.
"Version:" (under "Kibes:")	the change code (letter) of the computer module program.
"Cavtan:"	the program identification number in the dashboard node.
"Version:" (under "Cavtan:")	the change code (letter) of the program in the dashboard node.

To exit miscellaneous menu

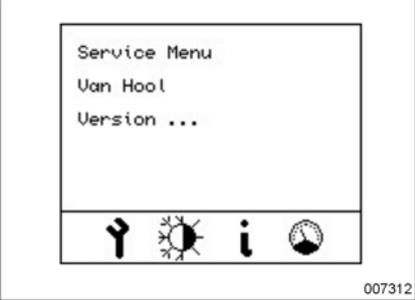
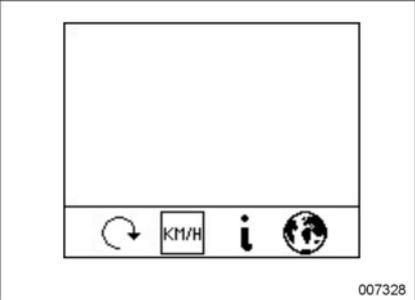
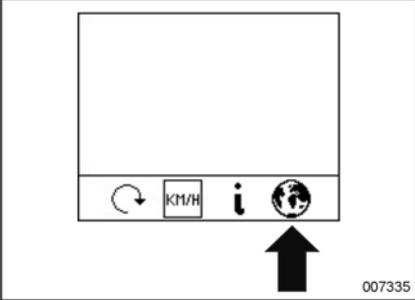
Momentarily press the far left button under the dashboard display as many times as necessary to return to the service menu.

To change language of dashboard display

Equipment condition

- Vehicle at standstill
- Battery switch on

Procedure

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	The service menu appears on the display.  007312
2	Press the button under the "i" symbol.	The miscellaneous menu appears on the display.  007328
3	Press the button under the symbol for language choice.  007335	The set language appears on the display.  007336

Step	Action	Result
4	Repeat step 3 until the desired language appears on the display.	See step 3.
5	Wait for 2 seconds.	The chosen language is loaded into the memory.

To exit miscellaneous menu

Momentarily press the far left button under the dashboard display as many times as necessary to return to the service menu.

Aids for testing: garage feature

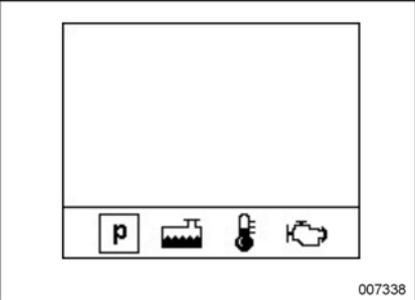
Introduction

During work it may be necessary to have an information screen permanently visible on the dashboard display. This can be done with the "garage feature".

Equipment condition

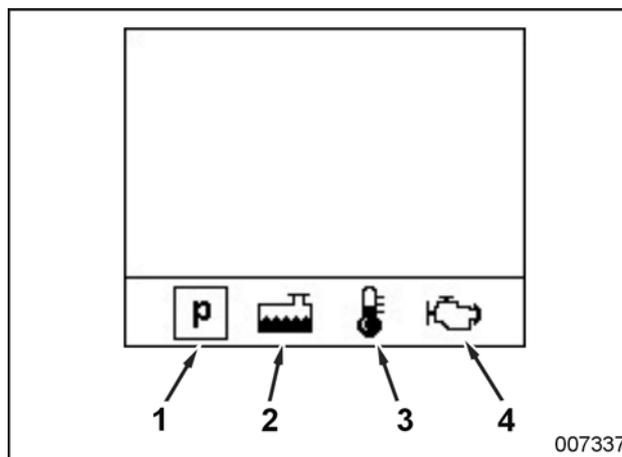
Vehicle ignition on

To start garage feature

Step	Action	Result
1	Press and hold the far left button under the display for longer than 5 seconds.	<p>The service menu appears on the display.</p>  <p style="text-align: right;">007312</p>
2	Press the button under the dial symbol.	<p>The garage feature menu appears on the display.</p>  <p style="text-align: right;">007338</p>

continued on next page

Figure: garage feature menu



- 1 To retrieve pressures
- 2 To retrieve fluid levels
- 3 To retrieve temperatures
- 4 To retrieve engine electronics info

To retrieve pressures

Step	Action
1	Press the pressures retrieval button. The first screen appears on the display.
2	Browse through the screens with the buttons under the arrows.

To retrieve fluid levels

Step	Action
1	Press the fluid levels retrieval button. The first screen appears on the display.
2	Browse through the screens with the buttons under the arrows.

To retrieve temperatures

Step	Action
1	Press the temperatures retrieval button. The first screen appears on the display.
2	Browse through the screens with the buttons under the arrows.

continued on next page

To retrieve engine electronics info

Step	Action
1	Press the engine electronics information retrieval button. The first screen appears on the display.
2	Browse through the screens with the buttons under the arrows.

To exit garage feature

Momentarily press the far left button under the dashboard display as many times as necessary to return to the service menu.

PC-aided diagnosis

Introduction

If on-board diagnostics do not yield a solution, you can carry out a complete test (Online-Test) of the program present in the Kibes computer module using a PC (or laptop).

Special tools

Cd-rom with Kibes KS32 Runtime-software (logiCAD5) + "USB hardware" key	Van Hool No. 11154536
---	-----------------------

Equipment condition

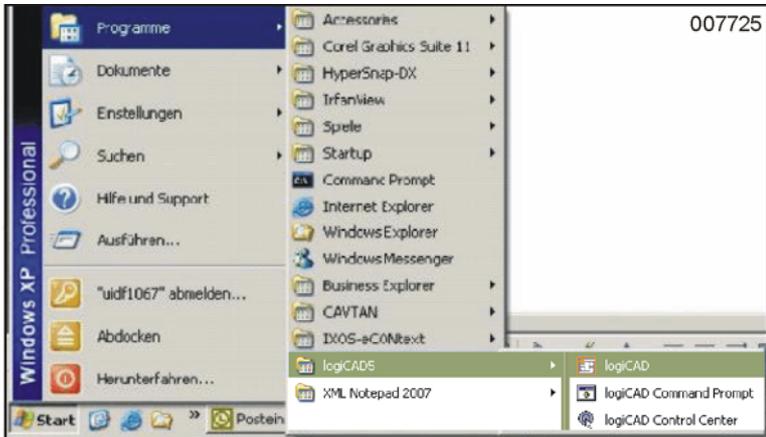
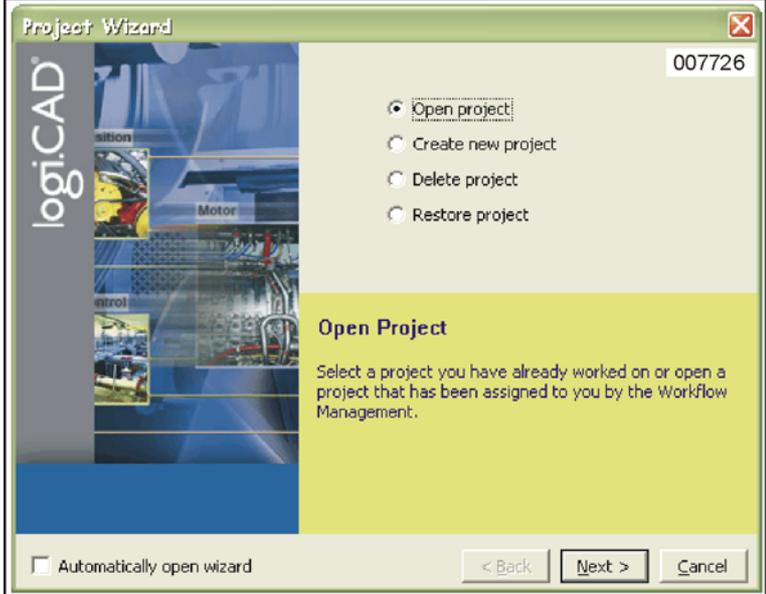
- Kibes KS32_Runtime software installed on PC (see under "To install Kibes KS32 Runtime-software on a PC")
- PC connected to diagnostic socket (see under "To connect PC to diagnostic socket")
- Program in computer module restored (see under "To restore the program in the Kibes computer module").
- Battery switch on

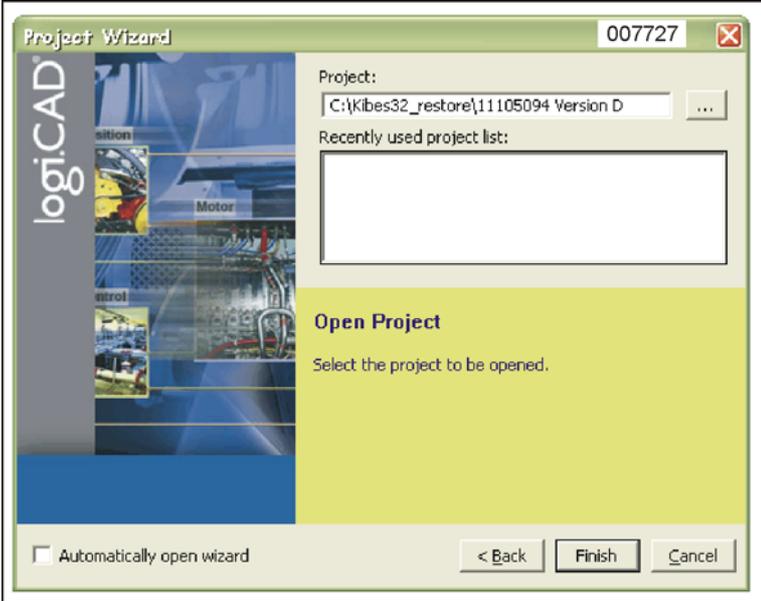
Procedure

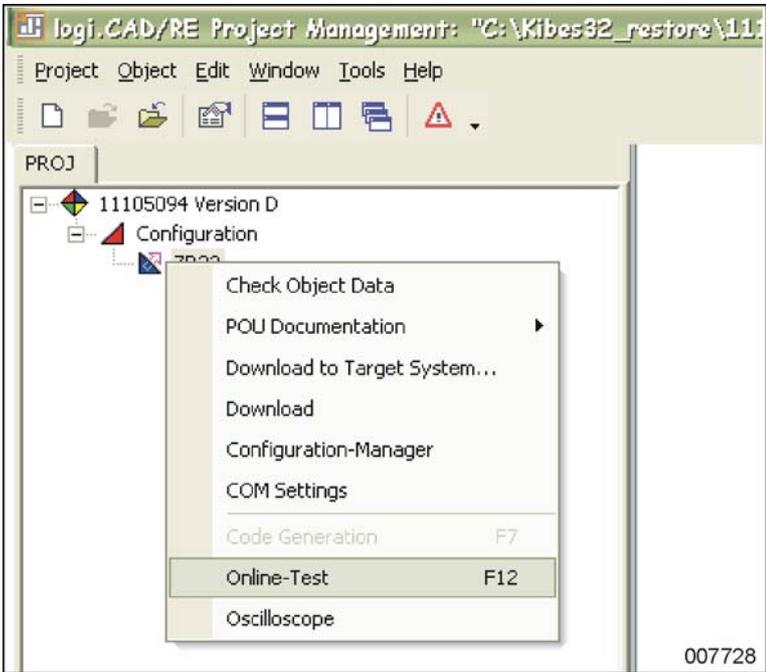
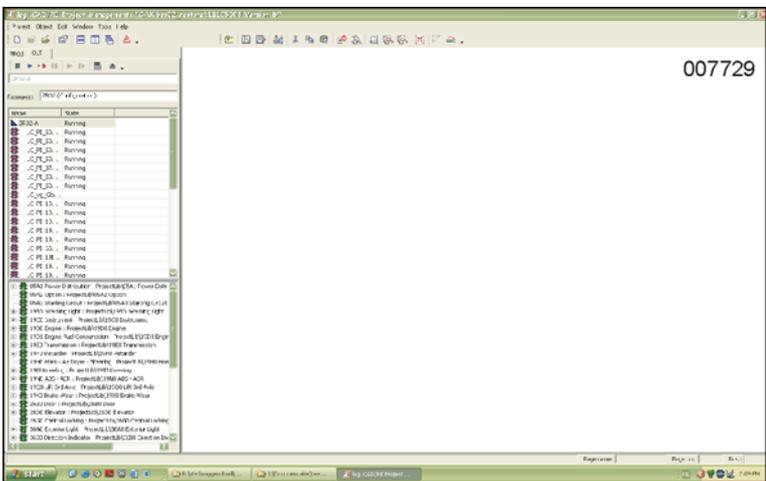
NOTE: The "Kibes32 restore" folder mentioned below was created during the installation of the "Kibes KS32 Runtime" software.

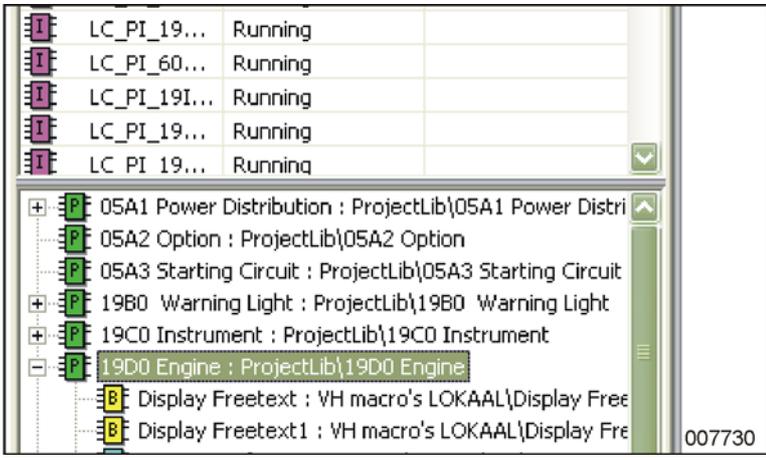
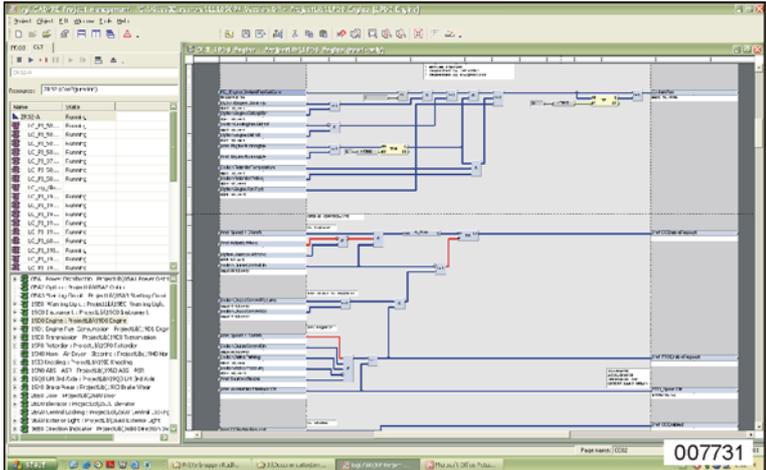
Step	Action
1	Connect the "USB hardware" key to the USB port of the PC.

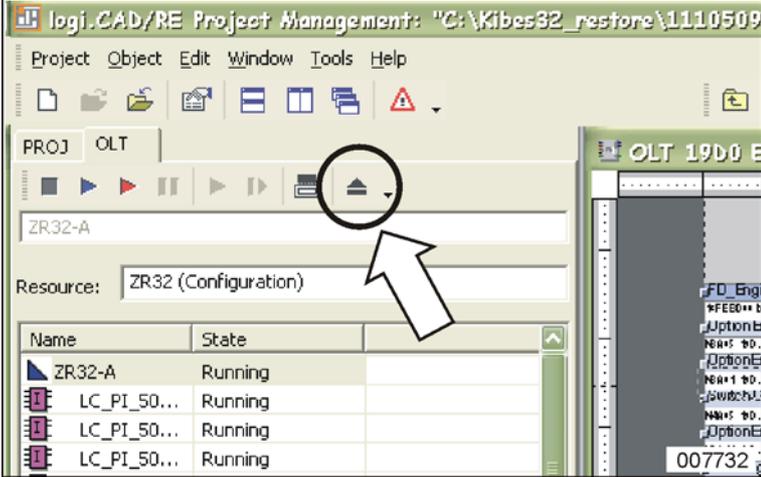
continued on next page

Step	Action
2	<p data-bbox="574 309 1260 342">Open the “logiCAD” program via the “START” menu.</p>  <p data-bbox="574 846 1236 880">The program is started. The following is displayed:</p> 
3	<p data-bbox="574 1545 798 1579">Click on "NEXT".</p>

Step	Action
4	<p>Click on the button with the three dots. Go to "C:\Kibes32 restore" and click on the program number (for example: 11105094).</p> 
5	Click on "FINISH".

Step	Action
6	<p>Click on "ZR32" under "CONFIGURATION". Press the right mouse button and choose "ONLINE-TEST".</p>  <p>The screenshot shows the 'logi.CAD/RE Project Management' interface. The tree view on the left shows a project structure with '11105094 Version D' expanded to 'Configuration', which contains 'ZR32'. A right-click context menu is open over 'ZR32', listing options: 'Check Object Data', 'POU Documentation', 'Download to Target System...', 'Download', 'Configuration-Manager', 'COM Settings', 'Code Generation F7', 'Online-Test F12', and 'Oscilloscope'. The 'Online-Test F12' option is highlighted.</p>
<p>The program overview displays on the screen (example):</p>	
 <p>The screenshot shows the 'Program Overview' window. The left pane displays a list of objects with columns for 'Name' and 'State'. The right pane shows a detailed view of the selected object, including its properties and connections. The interface includes a toolbar at the top and a status bar at the bottom.</p>	

Step	Action
7	<p>Select the page that contains the logic of the function to be tested.</p>  <p>You are now connected with the system. The following is displayed:</p> 

Step	Action
8	<p data-bbox="576 309 1158 338">Press the button below to end the diagnosis.</p> 

To retrieve information via the "Configuration-Manager"

Introduction

NOTE: The information can only be read, not changed.

Which information is available via the "Configuration-Manager"?

- system configuration of the vehicle
- addressing of the inputs and outputs
- programmed parameters of the components
- programmed texts
- programmed languages and language selection
- programmed texts for diagnosis
- programmed parameters per menu

Special tools

Cd-rom with Kibes KS32 Runtime-software (logiCAD5) + "USB hardware" key	Van Hool No. 11154536
---	-----------------------

Equipment condition

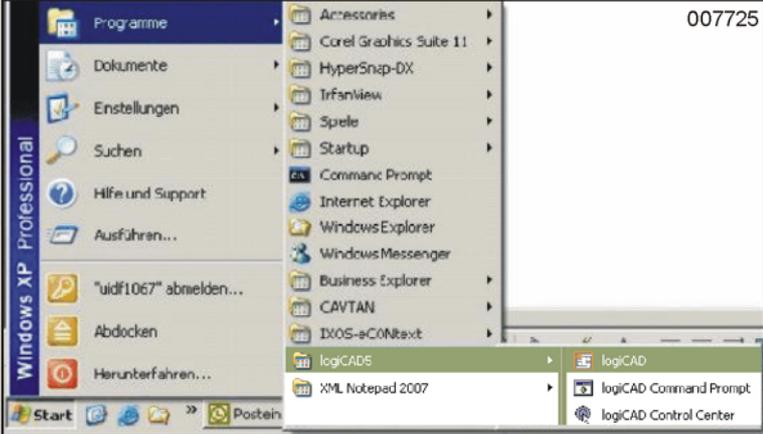
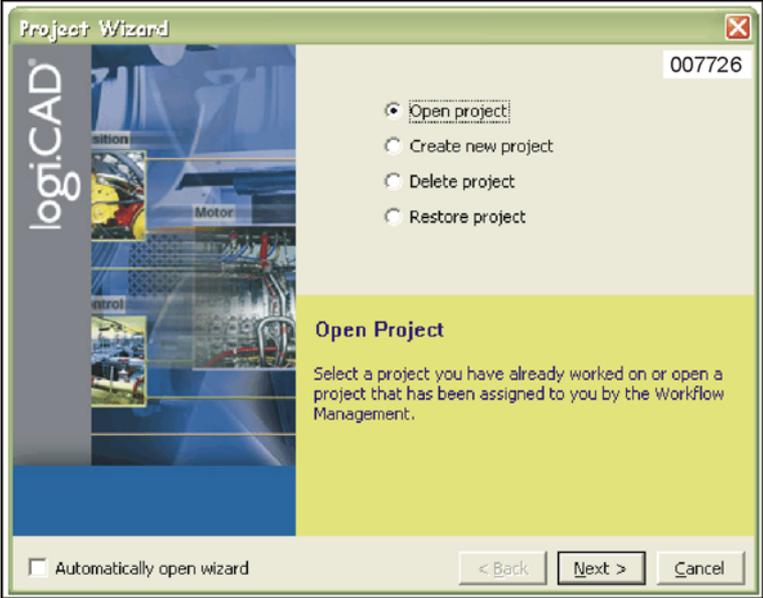
- Kibes KS32_Runtime software installed on PC (see under "To install Kibes KS32 Runtime-software on a PC")
- PC connected to diagnostic socket (see under "To connect PC to diagnostic socket")
- Battery switch on

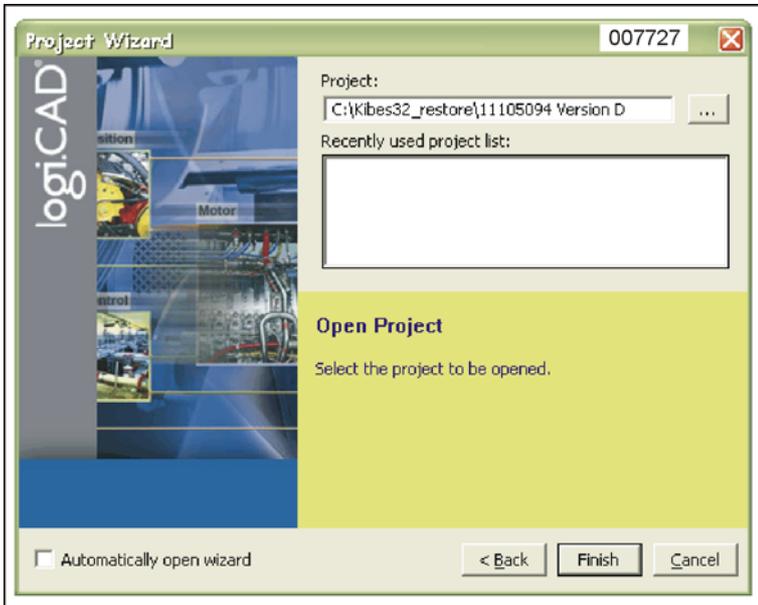
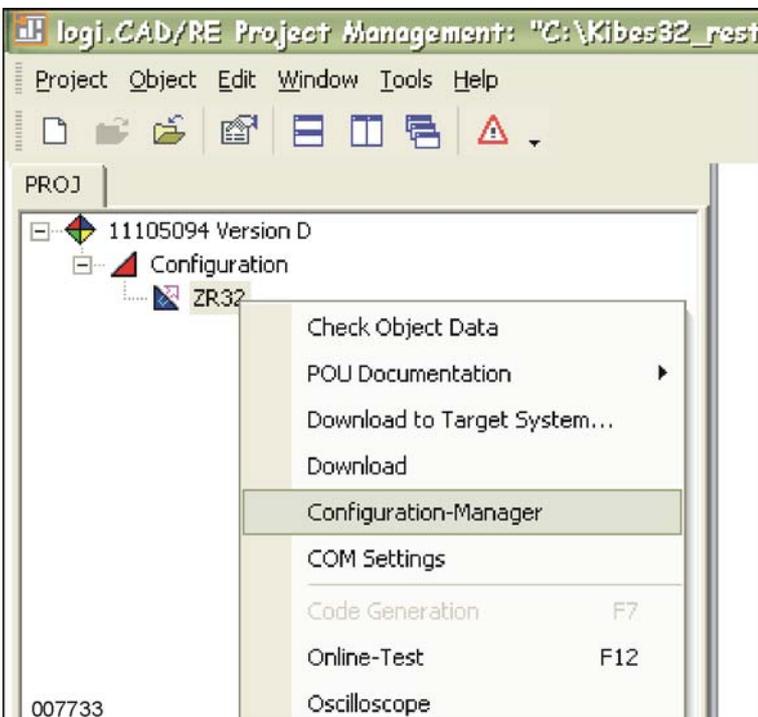
Procedure

NOTE: The "Kibes32 restore" folder mentioned below was created during the installation of the "Kibes KS32 Runtime" software.

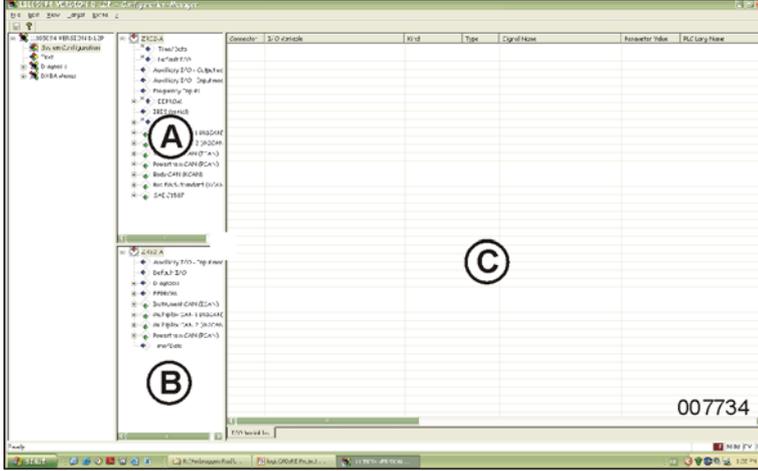
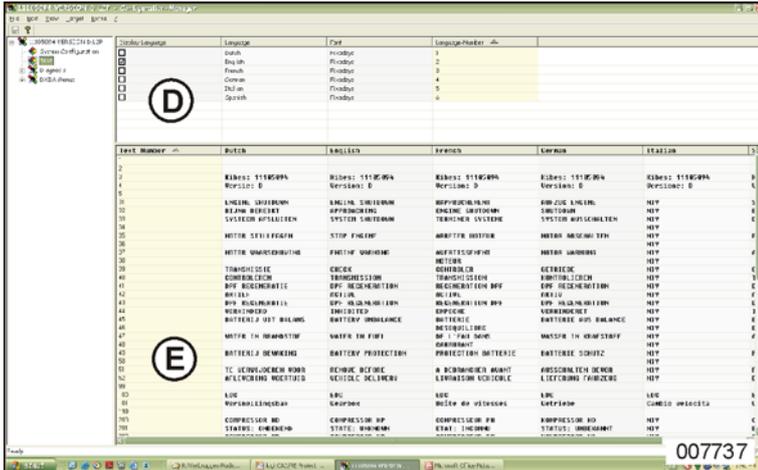
Step	Action
1	Connect the "USB hardware" key to the USB port of the PC.

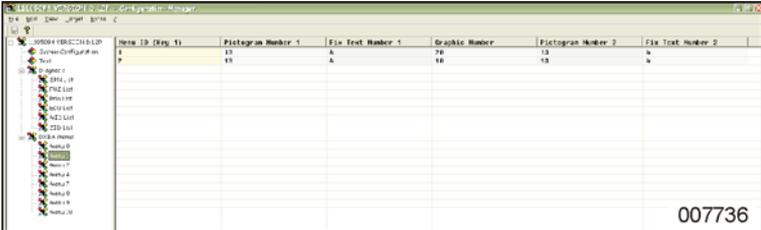
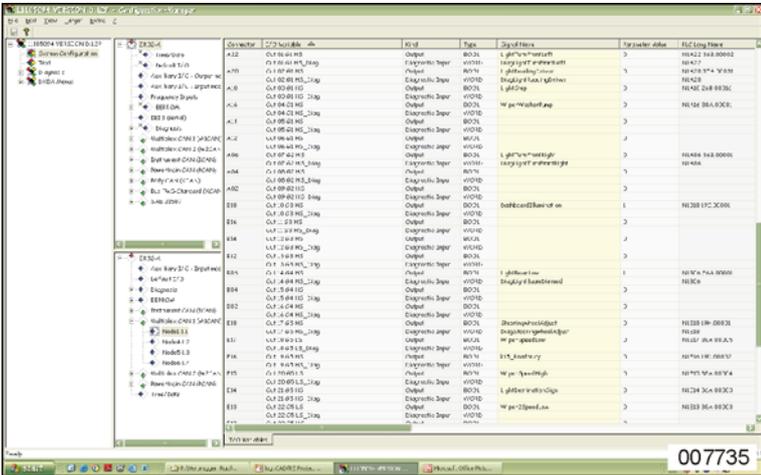
continued on next page

Step	Action
2	<p>Open the "LOGICAD" program via the "START" menu.</p>  <p>The program is started. The following is displayed:</p> 
3	Click on "NEXT".

Step	Action
4	<p>Click on the button with the three dots. Go to "C:\Kibes32 restore" and click on the program number (for example: 11105094).</p> 
5	Click on "FINISH".
6	<p>Click on "ZR32" under "CONFIGURATION". Click on the right mouse button and select "CONFIGURATION-MANAGER".</p> 

continued on next page

Step	Action
<p>7</p>	<p>Click on "System Configuration".</p> <p>The following is displayed:</p>  <ul style="list-style-type: none"> • Database (A): overview of all available components of the KS32 platform • Project configuration (B): overview of the components present in the vehicle • List of variables (C): overview of the parameters for each component
<p>8</p>	<p>Click on "Text".</p> <p>The following is displayed:</p>  <ul style="list-style-type: none"> • Languages (D): overview of the programmed languages • Texts (E): overview of the programmed languages

Step	Action
<p>9</p>	<p>Click on "Diagnosis".</p> <p>On the screen appears an overview of the texts that may appear during diagnosis.</p> <p><i>NOTE: To read the fault memory of the components supporting DM1 and DM4, refer to corresponding chapters in this manual.</i></p>
<p>10</p>	<p>Click on "DXBA Menus" and select a menu.</p> <p>On the screen appears an overview of the programmed parameters of the chosen menu.</p> 
<p>11</p>	<p>Click on "System Configuration". In the window with available components, select "Multiplex CAN 1 (M1CAN)", for example. Click on "Node 1.1".</p> <p>On the screen appears an overview of the inputs and outputs of Node 1 (Mux 1.1).</p> 

To load program in Kibes computer module

Introduction

Sometimes it is necessary to update the program in the Kibes computer module. The update (file with "L3P" extension) is supplied to you by Van Hool on a cd-rom or by e-mail.

Special tools

Cd-rom with Kibes KS32 Runtime-software (logiCAD5) + "USB hardware" key	Van Hool No. 11154536
---	-----------------------

Equipment condition

- Kibes KS32 Runtime software installed on PC (see under "To install Kibes KS32 Runtime software on PC")
- PC connected to diagnostic socket (see under "To connect PC to diagnostic socket")
- Vehicle at standstill
- Battery switch on

To call up program number and change code

See "Identification of the programs"



WARNING!

Do not load the program while the vehicle is being driven. All the electrical circuits connected to the multiplex system are temporarily deactivated during the loading of the program. This will cause you to lose control of the vehicle.

Operating sequence

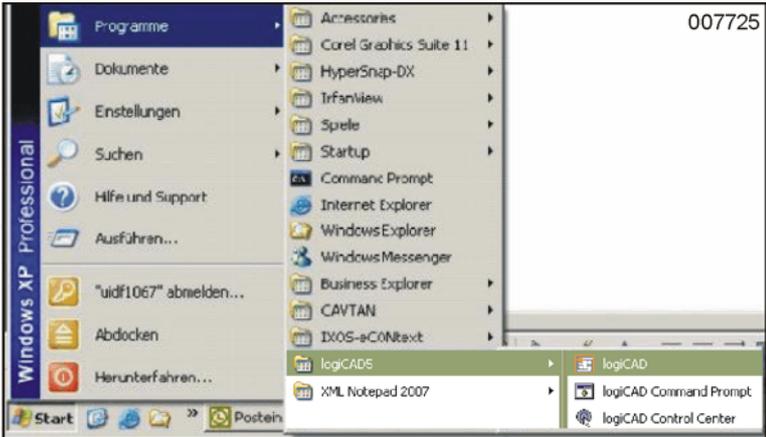
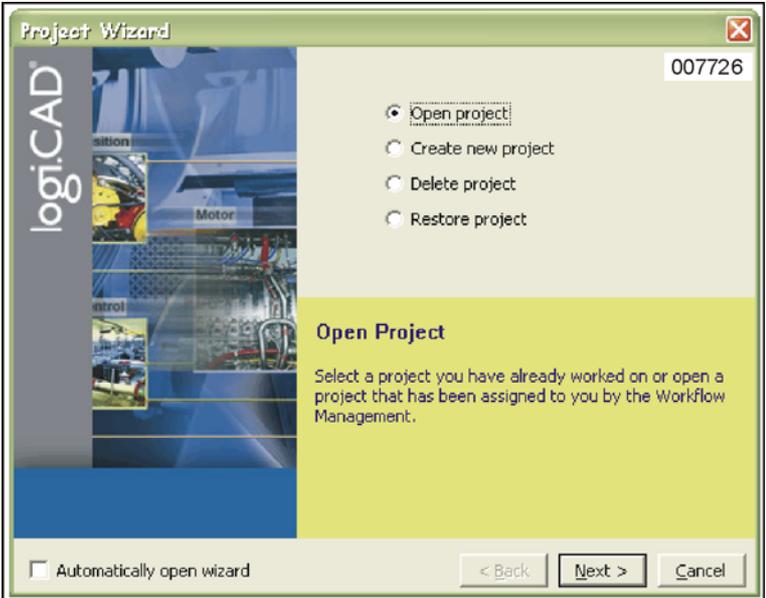
NOTE: The "Kibes32 restore" folder mentioned below was created during the installation of the "Kibes KS32 Runtime" software.

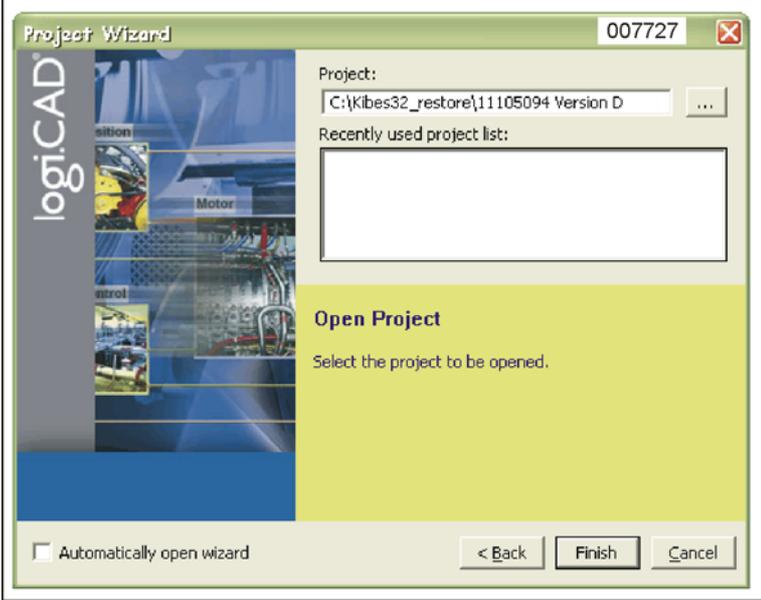
Step	Action
1	Connect the "USB hardware" key to the USB port of the PC.
2	Set the communication parameters, see below under "To set communication parameters".
3	Download the program, refer to "To download the program".

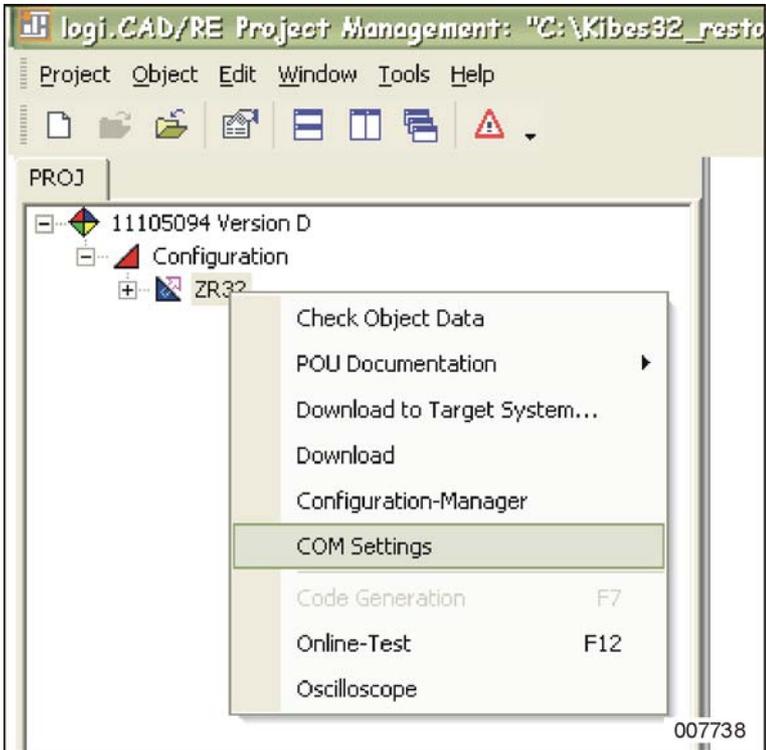
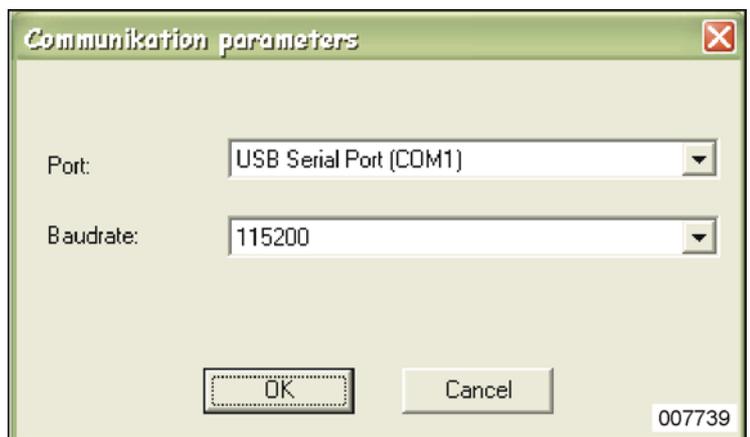
continued on next page

Step	Action
4	Download the parameters, refer to "To download the parameters".
5	Download the EEPROM, refer to "To download the EEPROM".

To set communication parameters

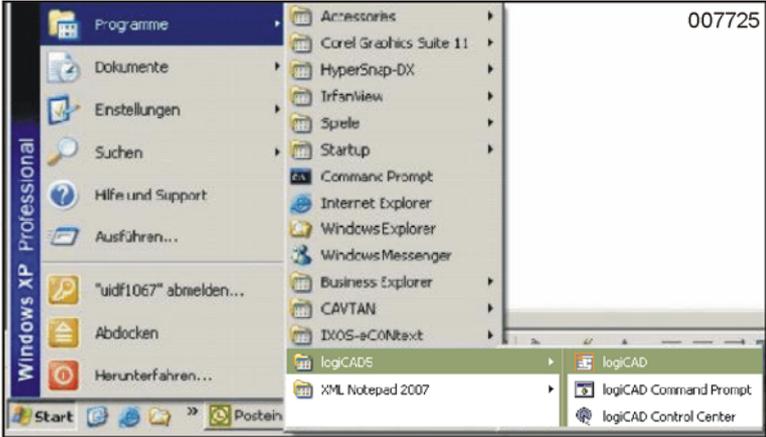
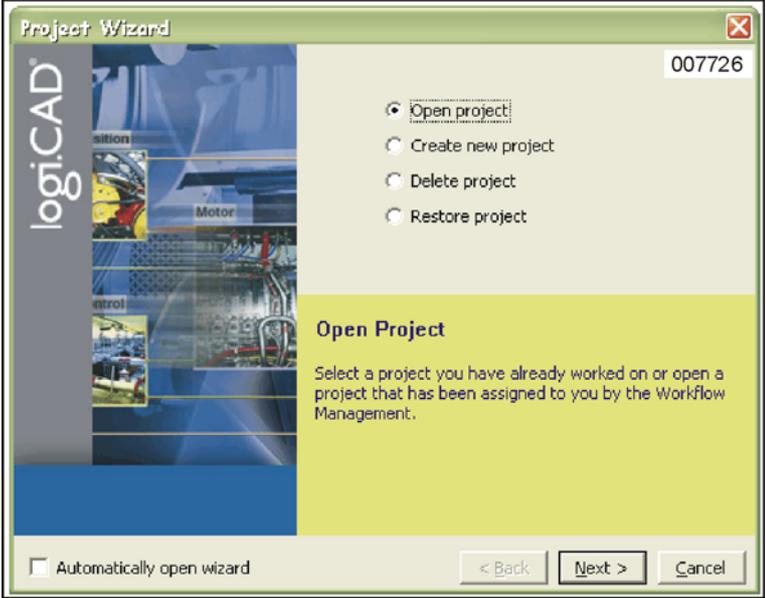
Step	Action
1	<p>Open the "LOGICAD" program via the "START" menu.</p>  <p>The program is started. The following is displayed:</p> 
2	Click on "NEXT".

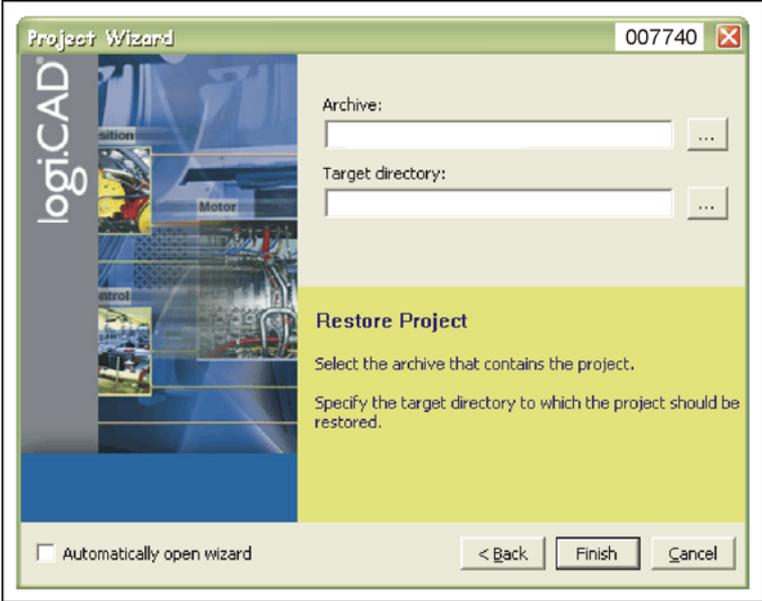
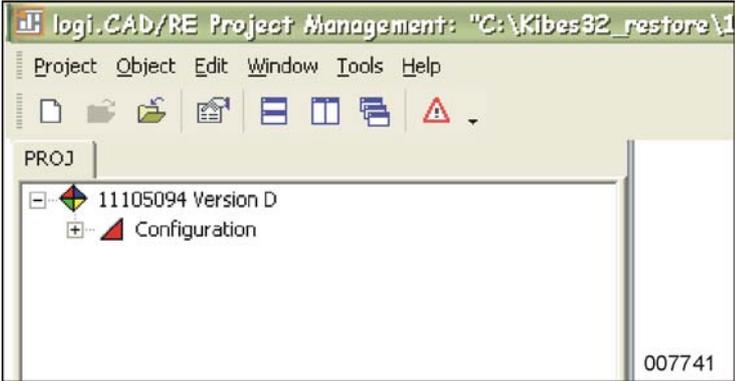
Step	Action
3	<p>Click on the button with the three dots. Go to "C:\Kibes32 restore" and click on the program number (for example: 11105094).</p> 
4	Click on "FINISH".

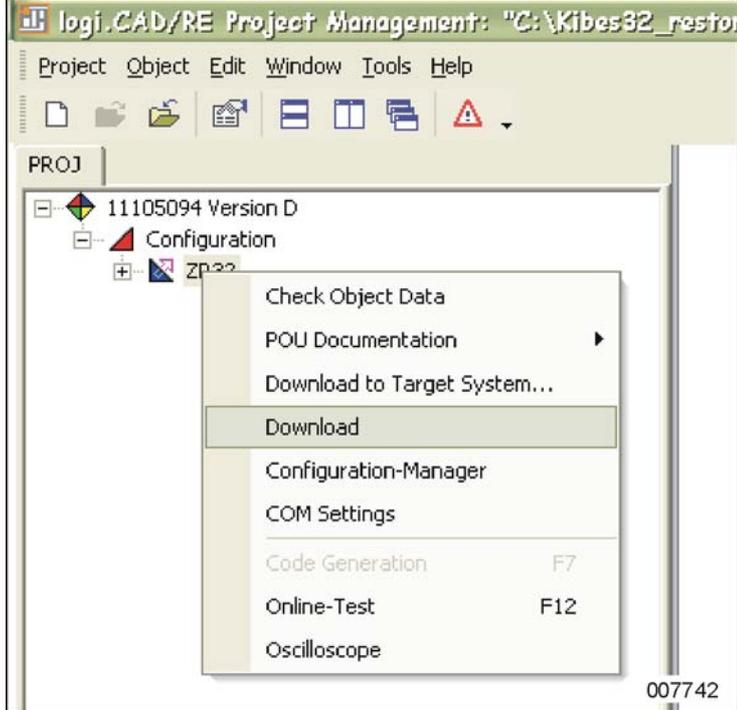
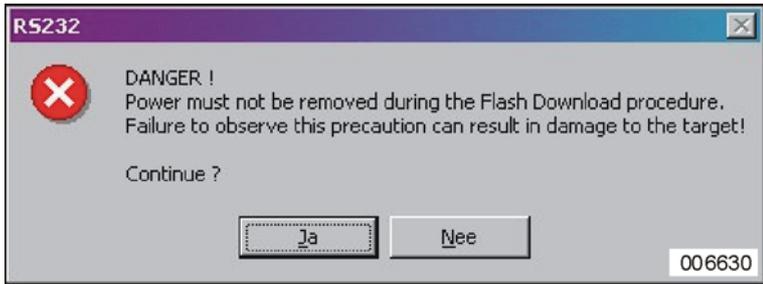
Step	Action
5	<p>Click on "ZR32" under "CONFIGURATION". Click on the right mouse button and select "COM SETTINGS".</p>  <p>You get an overview of all the COM-ports available on your PC.</p>
6	<p><i>NOTE: The view of the figure below might differ from that on your computer.</i></p> <p>At "PORT", select "USB SERIAL PORT".</p> <p>In the case "BAUDRATE", type the number 115200.</p> 
7	Click on "OK".

continued on next page

To download the program

Step	Action
1	Copy the update (file with L3P extension) to the "Kibes32 restore" folder.
2	<p data-bbox="577 472 1286 506">Open the "LOGICAD" program via the "START" menu.</p>  <p data-bbox="577 1014 1238 1048">The program is started. The following is displayed:</p> 
3	Select "RESTORE PROJECT" and click on "NEXT".

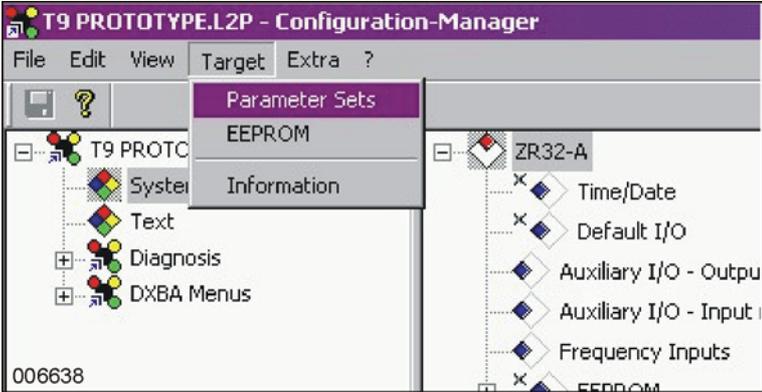
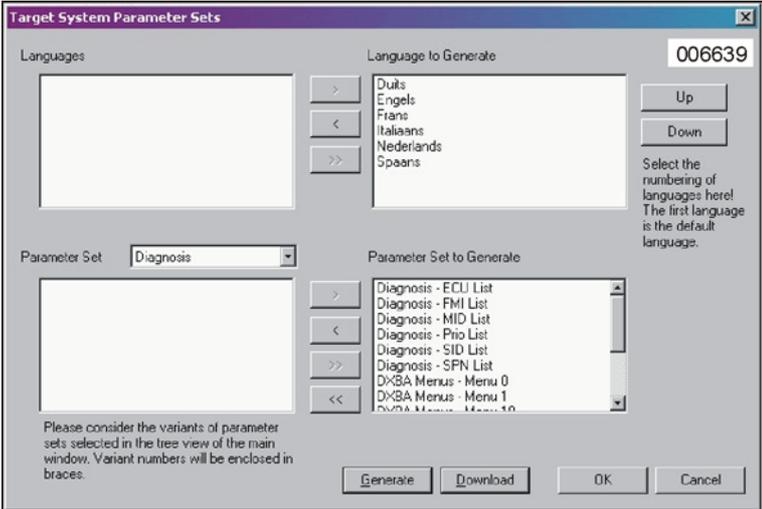
Step	Action
<p>4</p>	<p>In the "ARCHIVE" case, type the text "c:\Kibes32 restore" (location of the "L3P" file). Click on the button behind the case to trace the file.</p> <p>In the "TARGET DIRECTORY" case, type the same message as in the "ARCHIVE" case.</p> 
<p>5</p>	<p>Click on "FINISH".</p> <p>The program is started. This may take a while. Once the program is restored, the standard screen appears.</p> 

Step	Action
<p>6</p>	<p>Click on ZR32. Click on the right mouse button and select "DOWNLOAD".</p>  <p>On the screen appears a warning not to disconnect the power while downloading.</p> 

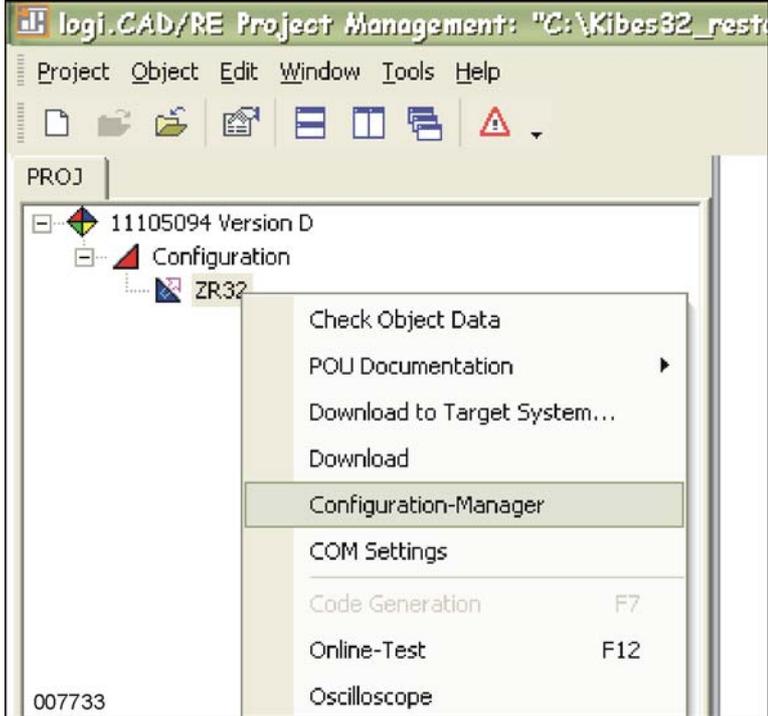
Step	Action
7	<p>Click on "YES".</p> <p>The following programs are downloaded subsequently: "MASTER", "PLC", "SLAVE" and "ASAM". The following text will appear when the program has been downloaded completely.</p> <div data-bbox="699 501 1299 846" data-label="Image"> </div>
8	Click on "OK".

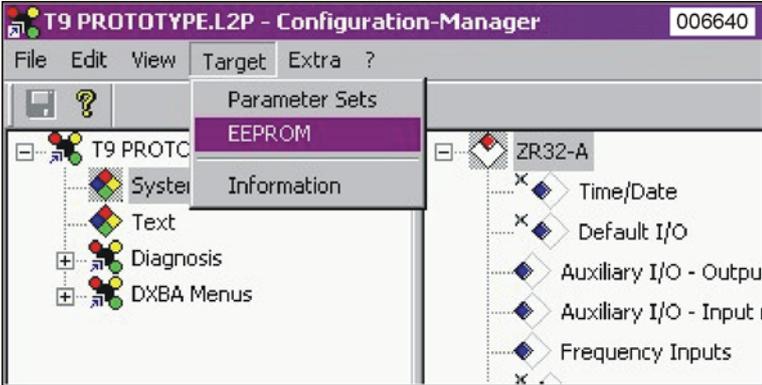
To download the parameters

Step	Action
1	<p>Click on "ZR32" under "CONFIGURATION". Click on the right mouse button and select "CONFIGURATION-MANAGER".</p> <div data-bbox="616 1182 1385 1904" data-label="Image"> </div>

Step	Action
2	<p data-bbox="576 309 1417 338">Click on the "TARGET" button and select "PARAMETER SETS".</p>  <p data-bbox="576 804 922 833">The following is displayed:</p> 
3	<p data-bbox="576 1417 1417 1480">If necessary, click on ">>" at "LANGUAGES" and "PARAMETER SET" in order to empty the LH windows.</p>
4	<p data-bbox="576 1496 895 1525">Click on "DOWNLOAD".</p>

To download EEPROM

Step	Action
1	<p>Click on "ZR32" under "CONFIGURATION". Click on the right mouse button and select "CONFIGURATION-MANAGER".</p>  <p>The screenshot shows the 'logi.CAD/RE Project Management' interface. The tree view on the left shows a project named '11105094 Version D' with a sub-tree 'Configuration' containing 'ZR32'. A right-click context menu is open over 'ZR32', listing options such as 'Check Object Data', 'POU Documentation', 'Download to Target System...', 'Download', 'Configuration-Manager' (which is highlighted), 'COM Settings', 'Code Generation F7', 'Online-Test F12', and 'Oscilloscope'. The status bar at the bottom left of the window displays '007733'.</p>

Step	Action
2	<p data-bbox="576 309 1278 338">Click on the "TARGET" button and select "EEPROM".</p>  <p data-bbox="576 797 924 826">The following is displayed:</p> 
3	If necessary, click on ">>" in order to empty the LH window.
4	Click on "DOWNLOAD".

To restore the program in the Kibes computer module

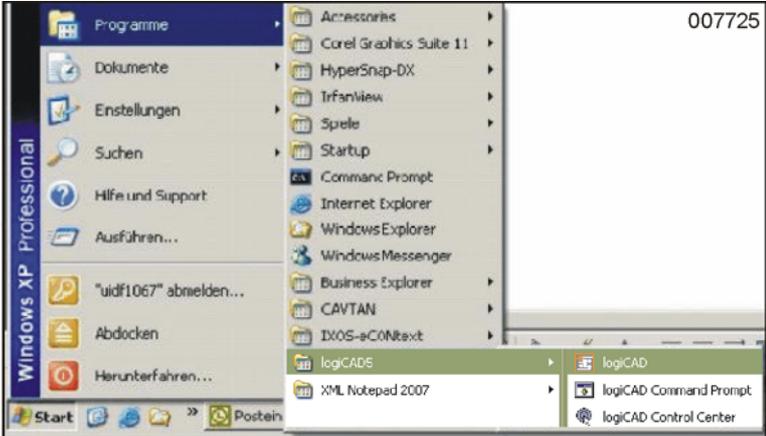
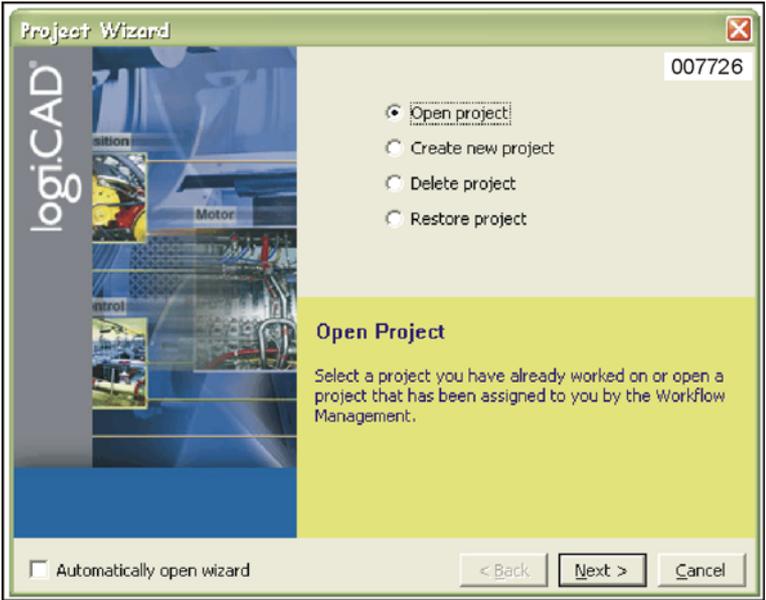
Special tools

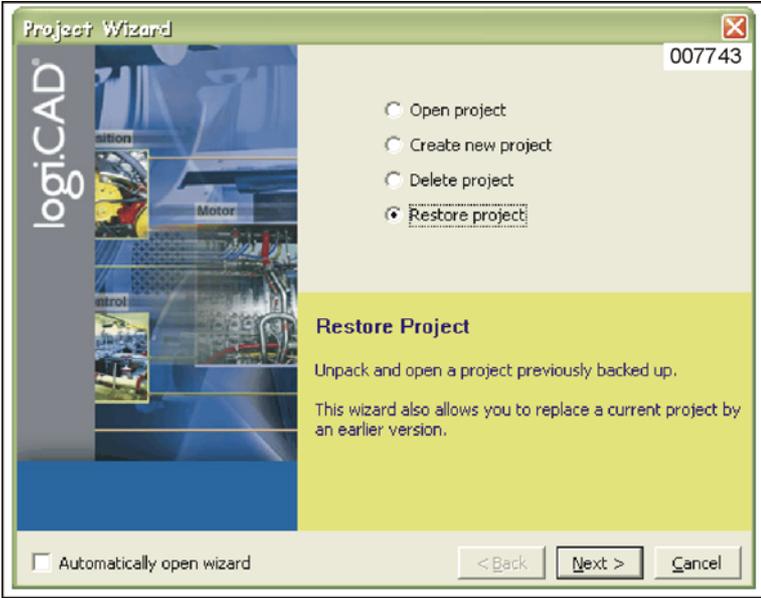
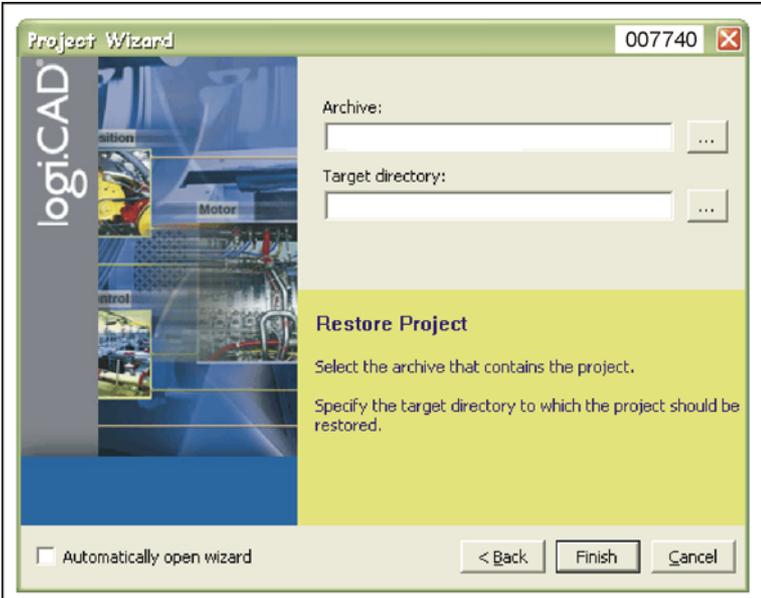
Cd-rom with Kibes KS32 Runtime-software (logiCAD5) + "USB hardware" key	Van Hool No. 11154536
---	-----------------------

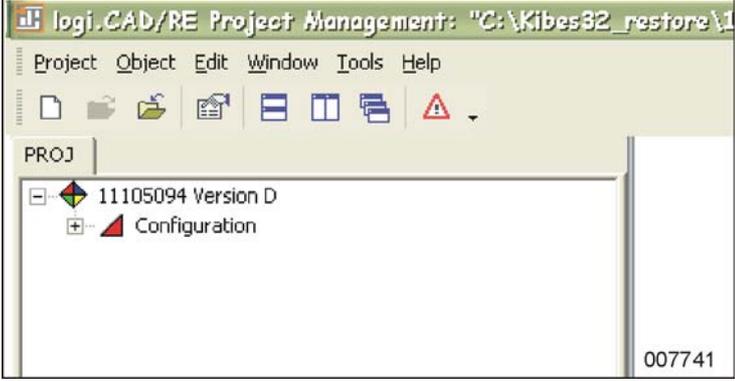
Procedure

NOTE: The "Kibes32 restore" folder mentioned below was created during the installation of the "Kibes KS32 Runtime" software.

Step	Action
1	Connect the "USB hardware" key to the USB port of the PC.

Step	Action
2	<p data-bbox="576 304 1286 338">Open the “LOGICAD” program via the “START” menu.</p>  <p data-bbox="576 846 1238 880">The program is started. The following is displayed:</p> 

Step	Action
3	<p>Select "RESTORE PROJECT" and click on "NEXT".</p> 
4	<p>In the "ARCHIVE" case, type the text "c:\Kibes32 restore". In the "TARGET DIRECTORY" case, type the same message as in the "ARCHIVE" case.</p> 

Step	Action
5	<p>Click on "FINISH".</p> <p>The program is started. This may take a while. Once the program is restored, the standard screen appears.</p> 

To connect a PC to the diagnostic socket

Introduction

Use a special adapter module to connect the PC to the vehicle diagnostic socket.

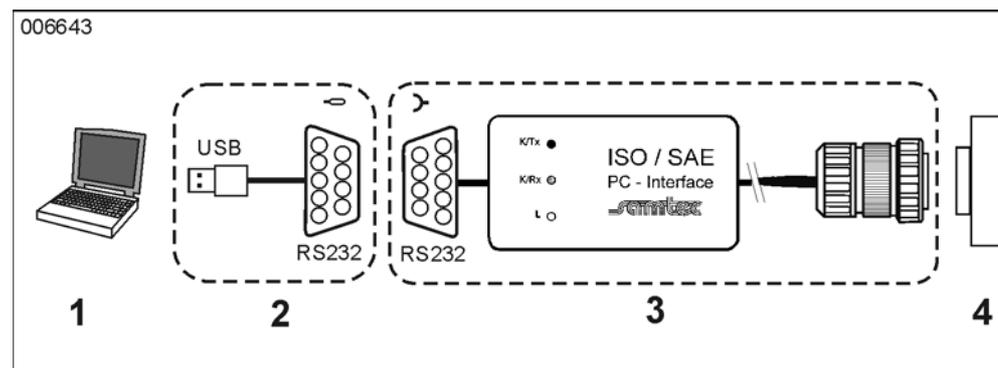
Special tools

Adapter module K-Line V24	Van Hool No. 10797942
"USB/RS232"-adapter	Van Hool No. 10901674

PC system requirements

Component	At least	Recommended
Processor	Pentium II 400 MHz	Pentium IV 1.2 GHz
Internal memory	128 MB RAM	512 MB RAM
Graphic card	XGA (1024 x 768) 256 colors	SXGA (1280 x 1024) True colors
Free space on hard disc	175 MB	
Ports	2x USB	
Driver	Windows 2000	Windows XP

Figure:
connection
diagram



- 1 Laptop
- 2 "USB/RS232"-adapter
- 3 Adapter module K-Line V24
- 4 Vehicle diagnostic socket

To install Kibes KS32 Runtime software on PC

Special tools

CD-ROM with Kibes KS32 Runtime-software (logiCAD5) + "USB hardware" key	Van Hool No. 11154536
---	-----------------------

How is software supplied?

The KS32 Runtime software is delivered to you by Van Hool on a CD-ROM. On the CD-ROM, you will find a folder "Kibes32 Runtime edition..." with the following subfolders: "Dokumentation", "Hardlock", "SW.SYS.ZR..." and "LogiCADV5.D...".

Recommendation

To find the folders and files quicker at a later time, we recommend you to create a new folder on the hard disk of your PC (for example "Kibes32 restore"). You can enter the name of this folder when, further in the installation procedure, you are asked for a location to copy the data to.

Operating sequence

Step	Action
1	Put the CD-ROM in the CD-ROM player.
2	Open the explorer and select the CD-ROM drive.
3	Install the standard package, refer to "To install standard package" later in the text.
4	Install the "USB hardware" key, refer to "To install USB hardware key" later in the text.
5	Install the "KS32 Runtime" software, refer to "To install KS32 Runtime-software" later in the text.
6	Install the client identification, refer to "To install client identification" later in the text.

To install standard package

Step	Action
1	Doubleclick on the "LogiCADV5.D..." folder.
2	Doubleclick on "STARTUP CD". The "LOGICAD INSTALLATION CENTER" window appears.
3	Click on the "INSTALL LOGI.CAD FULL VERSION" option and click on "NEXT".
4	Select the upper of the two options and click on "NEXT".

continued on next page

Step	Action
5	Change the file name to "C:\Program Files\logiCAD5" and click on "NEXT".
6	Change the file name again to "logiCAD5" and click on "NEXT".
7	Select the parts of the program you want to access through the start menu/desk and click on "NEXT".
8	Click on "INSTALL". <i>NOTE: Once the installation is finished, you automatically return to the "LOGICAD INSTALLATION CENTER".</i>

**To install
"USB
hardware" key**

Step	Action
1	Click on "SETUP DONGLE/NETWORK DONGLE".
2	Click on "HARDLOCK DRIVER".
3	Select the installation language.
4	Follow the instructions.

**To install
"KS32
Runtime"
software**

NOTE: The "KS32 Runtime" software has to be installed in the same folder as the standard package (LogiCAD5).

Step	Action
1	Doubleclick on the "SW.SYS.ZR..." folder.
2	Doubleclick on the "install" folder.
3	Doubleclick on the file "setup". Follow the instructions.

**To install
client identi-
fication**

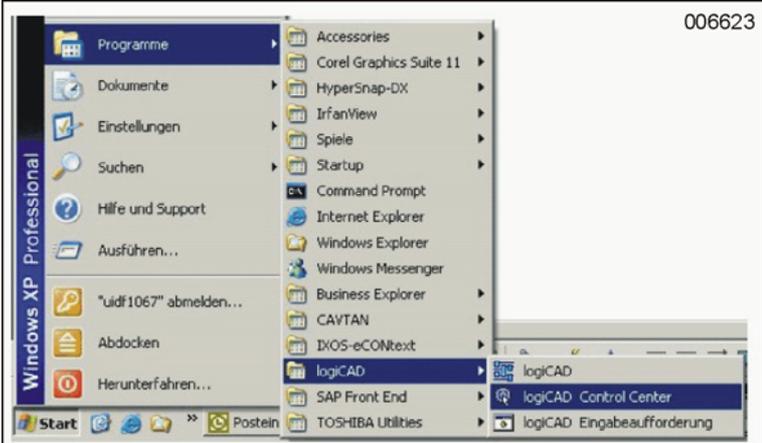
NOTE: The client identification has to be installed in the same folder as the standard package (LogiCAD5).

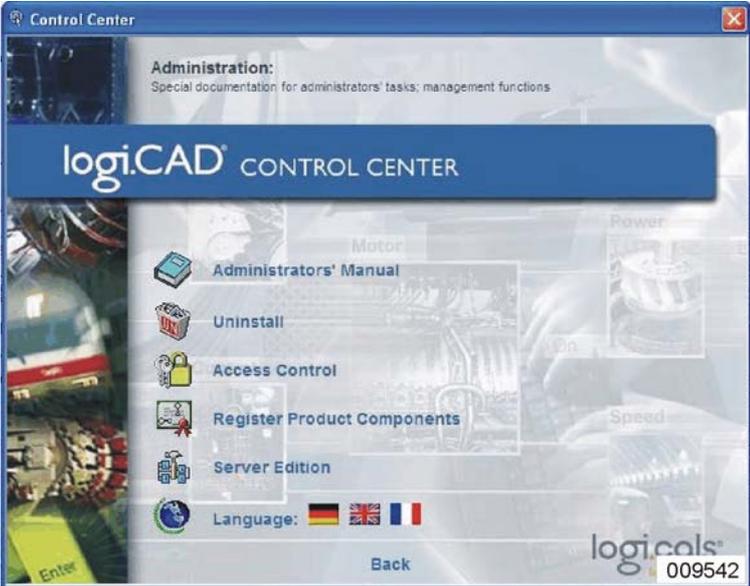
Step	Action
1	Doubleclick on the "SW.SYS.ZR..." folder.
2	Doubleclick on the "install_k500" folder.
3	Doubleclick on the file "setup_k005.exe". Follow instructions.

continued on next page

To change language

You can choose between German, English and French as language on the screens.

Step	Action
1	<p>Open the "LOGICAD CONTROL CENTER" via the "START" menu.</p> 
2	<p>Click on "ADMINISTRATION".</p> 

Step	Action
3	<p>Click on the flag of the desired language.</p> 

Function diagram (FUP)

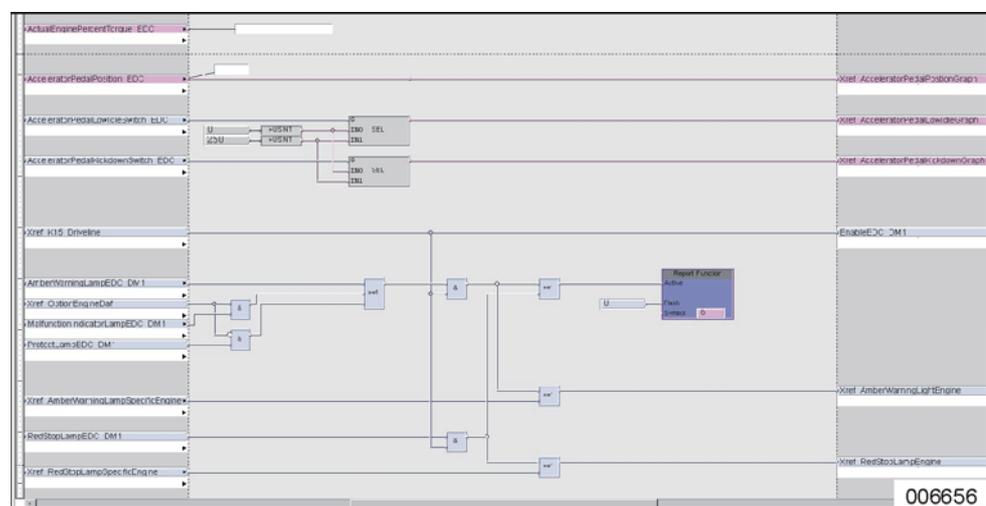
Introduction

The function diagram shows the sequence of logic circuits in the program. You need to know the logic functions to understand the function diagram (see under "Logic circuits").

Use the function diagram to:

- understand the functioning of the electrical system and ...
- to evaluate the "ONLINE" test (refer to "PC-aided diagnosis").

Figure: page of a function diagram



"Xref" marking

You will regularly see "Xref" markings on the function diagram. This marking is a software link between different pages of the function diagram.

Example: "Xref_KLR19B1". The letters "Xref" are followed by a description of the marking. In this example, the reference is to page 19B1.

Logic circuits

Introduction

The links between all the inputs and outputs are brought together in a program.

The functional diagram (FUP) shows the sequence of logic circuits in the program. You need to be familiar with the logic functions to understand the functional diagram.

Convention

Digital control systems use elements that can only accept two clearly different states ("0" and "1"). State "1", or active, means 0 V at a low-switching input, or +24 V at a high-switching input.

Simple logic functions

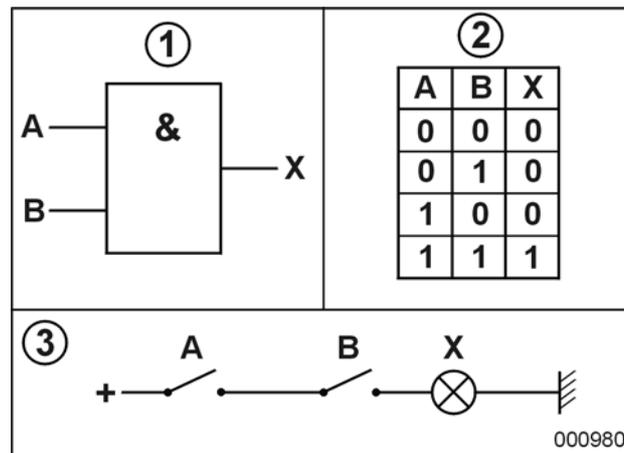
Simple logic functions are:

- "AND" function;
- "OR" function;
- "NOT" function.

"AND" function;

If output signal "X" is only present if all the input signals ("A" and "B" in this example) are present, this circuit fulfills an "AND" function.

Figure: "AND" gate



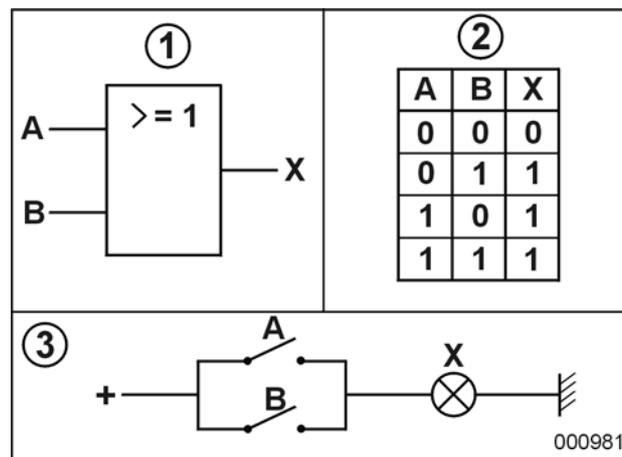
- 1 Symbolic representation
- 2 Truth table (shows all circuit statuses)
- 3 "AND" function with switches

"OR" function

If output signal "X" is present when one of the input signals ("A" or "B" in this example) is present, this circuit fulfills an "OR" function.

continued on next page

Figure: "OR" gate



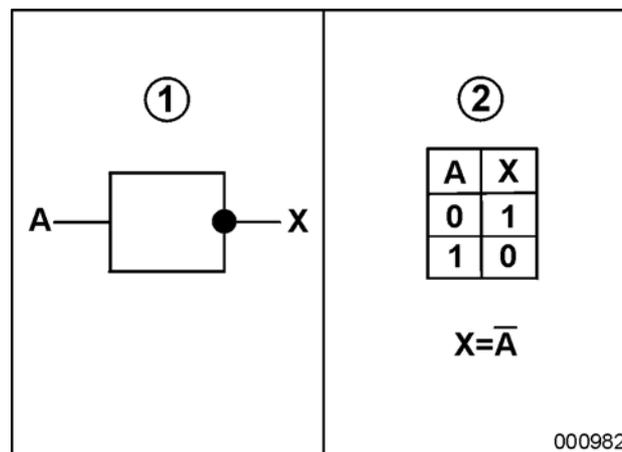
- 1 Symbolic representation
- 2 Truth table (shows all circuit statuses)
- 3 "OR" function with switches

"NOT" function.

A switch fulfills a NOT function (= inverter) when the output signal is present when input signal "A" is not present and vice versa.

NOTE: In the illustration, "X" is the inverted signal of "A". This is indicated in switching algebra by placing a bar above the "A".

Figure: "NOT" gate



- 1 Symbolic representation
- 2 Truth table (shows all circuit statuses)

Combined logic functions

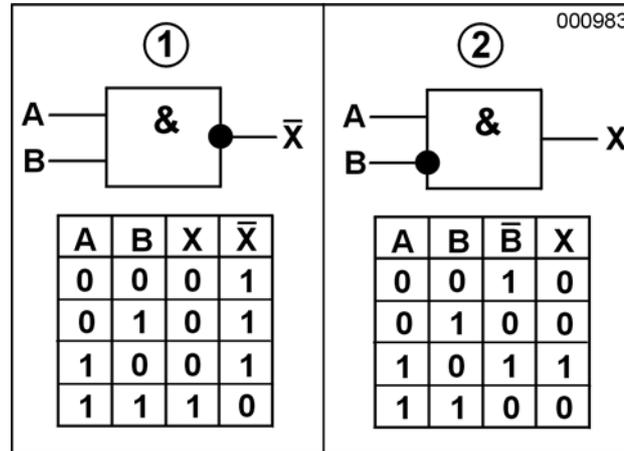
The previous simple logic functions can be combined in one and the same circuit. The following functions will be discussed briefly:

- "NOT-AND" function;

continued on next page

- "AND" function with an inverted input.

Figure:
combined
gates



1 "NOT-AND" gate

2 "AND" gate with inverted input

Overview of inputs and outputs

Introduction

The overview is contained in a publication with the title "Overview of inputs and outputs" supplied separately with your vehicle.

Overview of the inputs

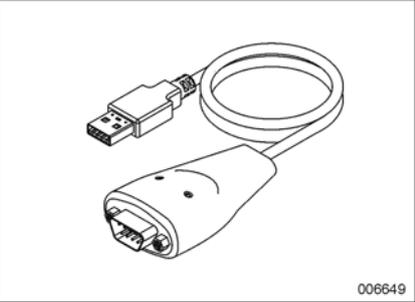
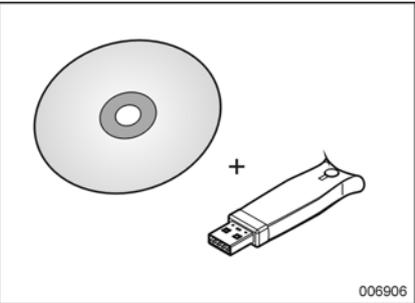
Denomination	Explanation
Connector	<ul style="list-style-type: none"> • Letter: connector name • Number: connector pin
Data	Address in the program + activating current <ul style="list-style-type: none"> • HS: high switching • LS: low switching • TRI-STATE: logic "1" if voltage at input is higher than 10 V or lower than 1,2 V, logic "0" at an input voltage between 1,2 and 10 V. • Resistance measurement • Voltage measurement
Kibes denomination	Denomination of the input mentioned on the function diagram
Description	Associated component on the electrical wiring diagram
Diagrams	Subdiagram number of the electrical wiring diagram on which the input is located

Overview of the outputs

Denomination	Explanation
Connector	<ul style="list-style-type: none"> • Letter: connector name • Number: connector pin
Data	Address in the software + maximal output current <ul style="list-style-type: none"> • HS: high switching • LS: low switching • PWM: pulse width modulated
Kibes denomination	Denomination of the output mentioned on the function diagram
Description	Associated component on the electrical wiring diagram
Diagrams	Subdiagram number of the electrical wiring diagram on which the output is located

continued on next page

Special tools: multiplex system

Ordering number	Description	Figure
Van Hool 10797942	Adapter module K-Line V24	 <p>002424</p>
Van Hool 10901674	"USB/RS232"-adapter	 <p>006649</p>
Van Hool 11154536	Cd-rom with Kibes KS32 Runtime-software (logiCAD5) + "USB hardware" key	 <p>006906</p>

Chapter 2: ATC

Overview

Introduction This chapter deals with the ATC system.

Number of pages 8

Chapter publication date 21 September 2016

Contents

Topic	See page
Precaution in case of performance tests on roller brake tester	11.2-2
Troubleshooting	11.2-4
To measure resistance of ATC valve	11.2-5
Technical data: ATC system	11.2-7

Precaution in case of performance tests on roller brake tester

Introduction

Switch off the ATC-system before carrying out the performance test.



WARNING!

If the ATC-system is not switched off during performance tests, dangerous situations could arise and you risk damaging the vehicle.

Control unit versions

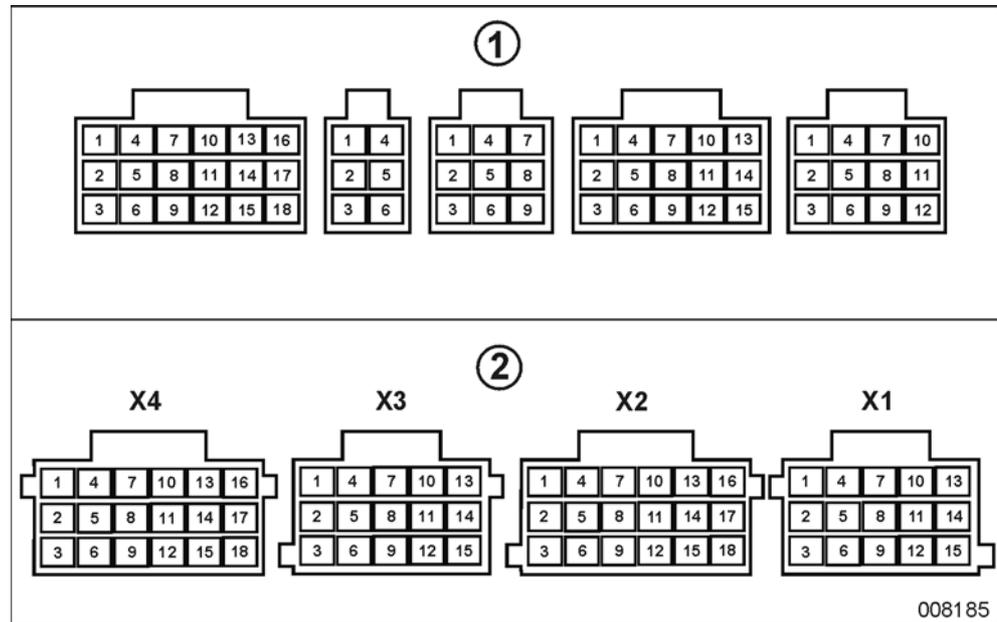
Refer to chapter 5.2, under "ABS: control unit versions".

Procedure

Step	Action
1	Switch off master switch on dashboard.
2	<ul style="list-style-type: none"> • "D" version control unit: disconnect 18-pin connector from the control unit. • "E" version control unit: disconnect connector "X1" from the control unit. <p>The power supply to the ABS/ATC system is now switched off.</p>

continued on next page

Figure:
connectors on
control unit



Connectors as seen from wire input side.

- 1 Connectors to "D"-version control unit
- 2 Connectors to "E"-version control unit. Connector "X4" is only present in case of electronic stability control (ESC)

Troubleshooting

Cross- reference

Refer to chapter 5.2, "Control systems".

To measure resistance of ATC valve

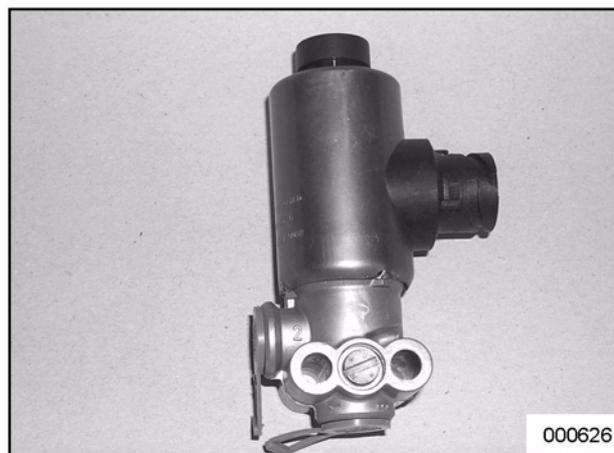
Checking values

Refer to "Technical data" at the end of this chapter.

Location of ASR valve

Refer to chapter 5.2, under "ABS: layout".

Figure: ATC valve



Control unit versions

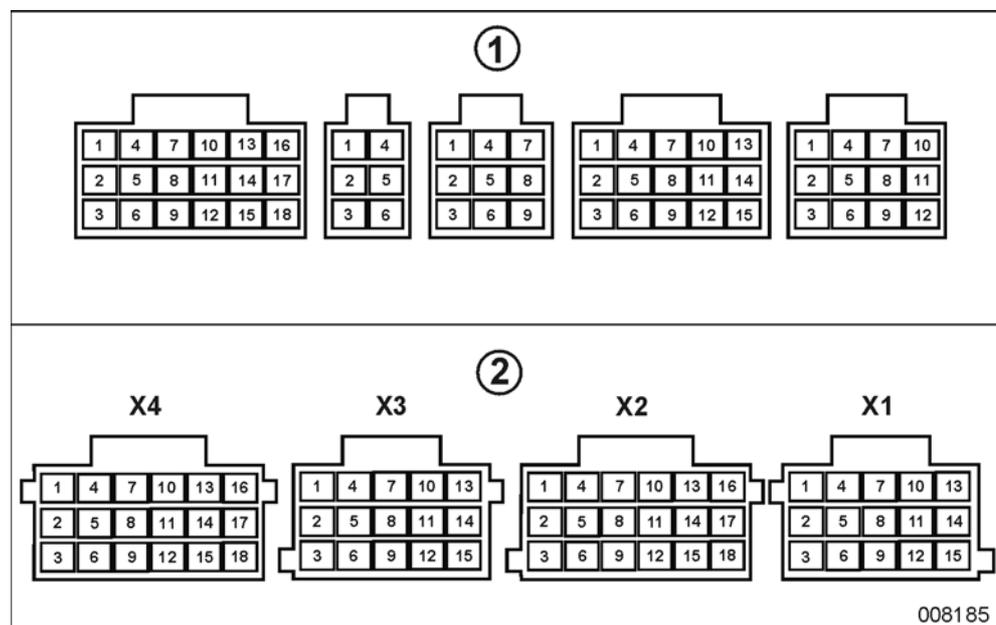
Refer to chapter 5.2, under "ABS: control unit versions".

Procedure

Step	Action
1	Switch off master switch on dashboard.
2	<ul style="list-style-type: none"> "D" version control unit: disconnect 15-pin connector from the control unit. "E" version control unit: disconnect connector "X2" from the control unit.
3	<ul style="list-style-type: none"> "D" version control unit: measure resistance between pins 4 and 7 of 15-pin connector. "E" version control unit: measure the resistance between pins 7 and 16 of connector "X2". <p>Compare measured value with value in technical data.</p>

continued on next page

Figure: pin numbering of connectors on electronic control unit



Connectors as seen from wire input side.

- 1 Connectors to "D"-version control unit
- 2 Connectors to "E"-version control unit. Connector "X4" is only present in case of electronic stability control (ESC)

Evaluation of measurement result

If...	then ...
resistance is too great	clean electrical pins of ATC valve.
you measure an interruption (= infinite resistance),	disconnect connector from ATC valve and measure straight at valve pins. <ul style="list-style-type: none"> • Change ATC valve, if ohmmeter still indicates an interruption. • Otherwise there is an interruption in wiring between electronic control unit and ATC valve.

Technical data: ATC system

ATC valve

Electrical resistance	26.3 to 49.0 ohms
-----------------------	-------------------

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Chapter 3: ESC

Overview

Introduction This chapter deals with the ESC system.

Number of pages 12

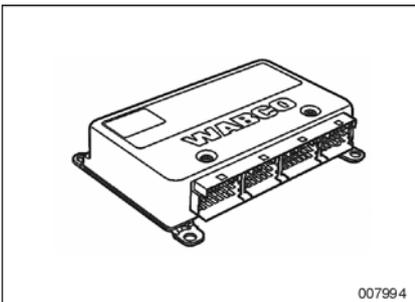
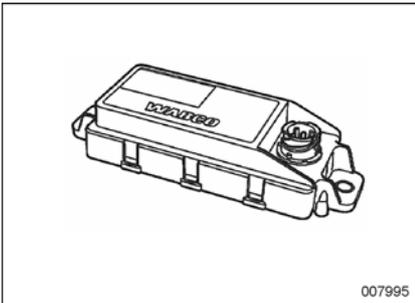
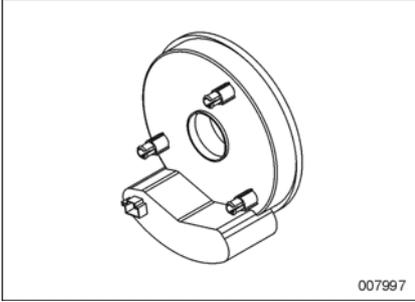
Chapter publication date 21 September 2016

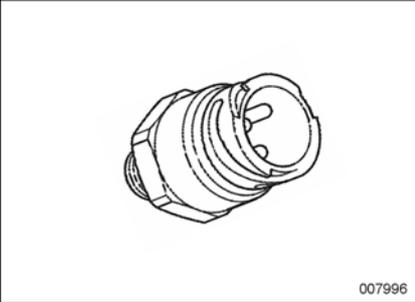
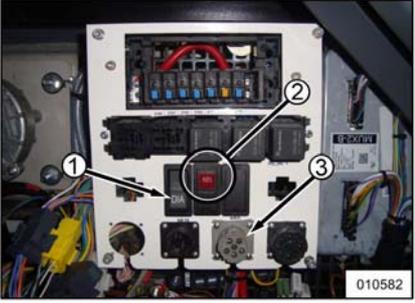
Contents

Topic	See page
Visual identification of components	11.3-2
Troubleshooting	11.3-4
To measure resistance of front-axle active brake valve	11.3-5
To check/mount steering-angle sensor	11.3-7
To check brake-pressure sensor	11.3-9
To check/mount the ESC module	11.3-10
Technical data: ESC system	11.3-11

Visual identification of components

Components

Denomination	Figure
Control unit with four connectors <i>NOTE: The control unit comprises not only the ESC function (electronic stability control), but also the ABS (anti-lock system) and ATC (automatic traction control) functions.</i>	 <p style="text-align: right;">007994</p>
ESC module	 <p style="text-align: right;">007995</p>
Active brake valve (3/2-way valve, electrically operated)	 <p style="text-align: right;">006626</p>
Steering-angle sensor	 <p style="text-align: right;">007997</p>

Denomination	Figure
<p>Brake pressure sensor</p>	 <p>007996</p>
<p>Diagnostics panel in front junction box</p> <ul style="list-style-type: none"> 1 Diagnostic switch 2 ABS diagnostics lamp 3 ABS diagnostic socket 	 <p>010582</p>

Troubleshooting

Cross- reference

Refer to chapter 5.2, "Control systems".

To measure resistance of front-axle active brake valve

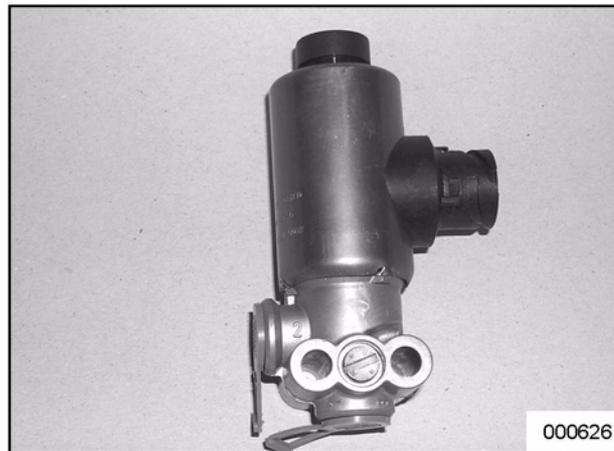
Checking values

Refer to "Technical data" at the end of this chapter.

Location of the front-axle active brake valve

Refer to chapter 5.2, under "ABS: layout".

Figure: active brake valve

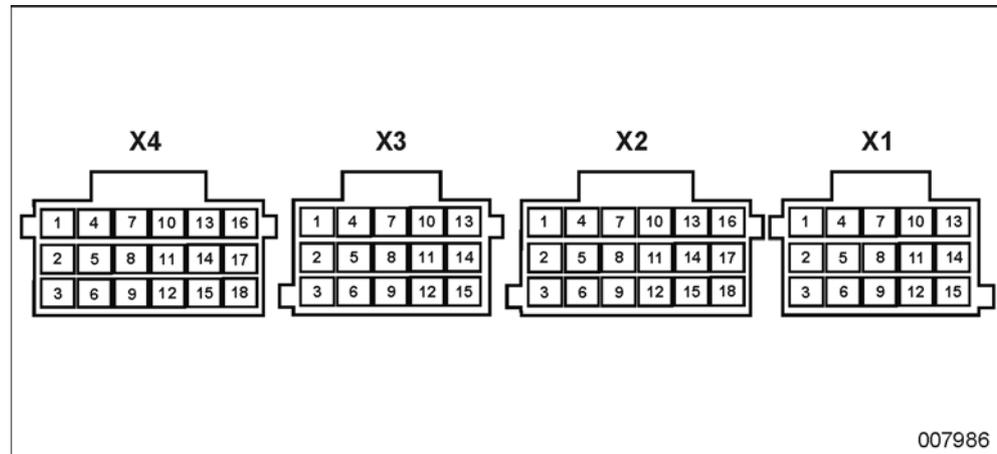


Procedure

Step	Action
1	Switch off master switch on dashboard.
2	Disconnect connector "X4" from the control unit.
3	Measure the resistance between pins 13 and 16 of connector "X4". Compare measured value with value in technical data.

continued on next page

Figure: pin numbering of connectors at control unit



Connectors as seen from wire input side.

Evaluation of measurement result

If...	then ...
resistance is too great	clean electrical pins of valve.
you measure an interruption (= infinite resistance),	disconnect connector from valve and measure straight at valve pins. <ul style="list-style-type: none"> • Change valve, if ohmmeter still indicates an interruption. • Otherwise there is an interruption in wiring between electronic control unit and valve.

To check/mount steering-angle sensor

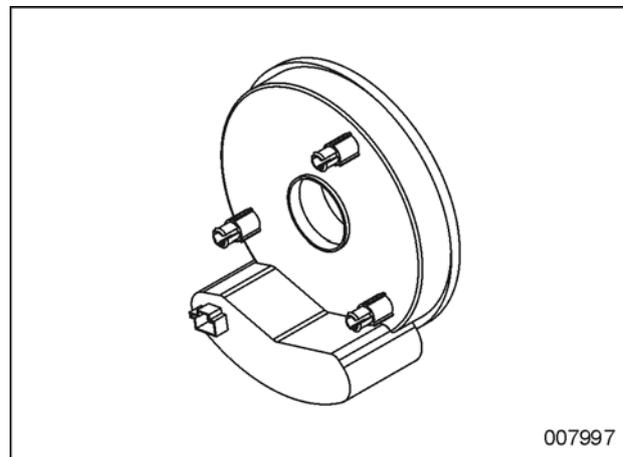
Checking values

Refer to "Technical data" at the end of this chapter.

Location of steering-angle sensor

Refer to chapter 5.2, under "ABS: layout".

Figure: steering-angle sensor

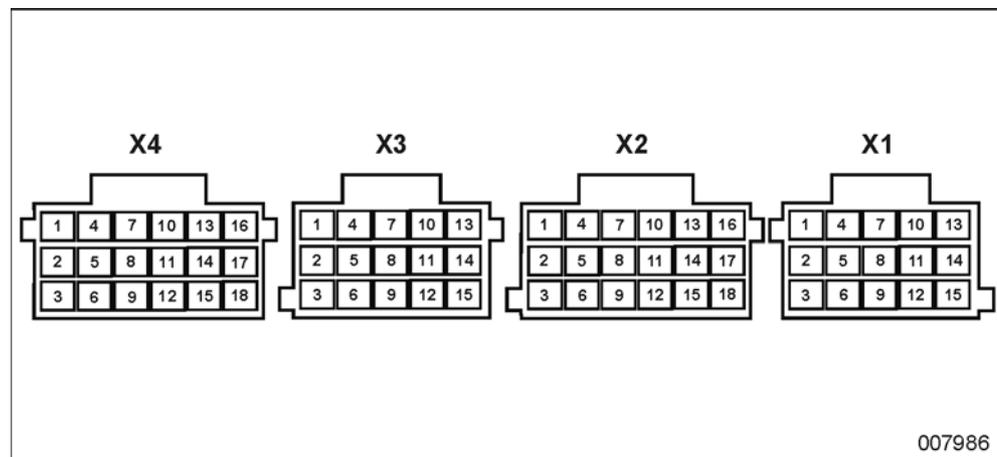


To check resistance of steering-angle sensor

Step	Action
1	Switch off master switch on dashboard.
2	Disconnect connector "X4" from the control unit.
3	Measure the resistance between pins 1 and 3 of connector "X4". Compare measured value with value in technical data.

continued on next page

Figure: pin numbering of connectors at control unit



Connectors as seen from wire input side.

Evaluation of measurement result

If...	then ...
resistance is too great	clean electrical pins of sensor.
you measure an interruption (= infinite resistance),	disconnect connector from sensor and measure straight at sensor (between pins 2 and 5). <ul style="list-style-type: none"> • Change sensor if ohmmeter still indicates an interruption. • Otherwise there is an interruption in wiring between electronic control unit and sensor.

To mount steering-angle sensor

Consult the Meritor Wabco maintenance manual MM-0112 via "www.meritor-wabco.com".

To check brake-pressure sensor

**Cross-
reference**

Consult the Meritor Wabco maintenance manual MM-0112 via "www.meritor-wabco.com".

To check/mount the ESC module

**Cross-
reference**

Consult the Meritor Wabco maintenance manual MM-0112 via "www.meritor-wabco.com".

Technical data: ESC system

Front-axle active brake valve

Electrical resistance	26.3 to 49.0 ohms
-----------------------	-------------------

Steering-angle sensor

Electrical resistance	
<ul style="list-style-type: none"> • at connector of control unit • at connector of steering-angle sensor 	<p>approximately 90 ohm</p> <p>approximately 180 ohm</p>

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Part 12 - Axles

Overview

Contents

Chapter	See page
Chapter 6: Front axle	12.6-1
Chapter 10: Drive axle	12.10-1
Chapter 14: Trailing axle	12.14-1

The following chapters have been *modified* since the former edition:

Chapter	See page
Chapter 6: Front axle	12.6-1
Chapter 10: Drive axle	12.10-1
Chapter 14: Trailing axle	12.14-1

Chapter 6: Front axle

Overview

Introduction This chapter deals with the front axle.

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Chapter publication date 14 October 2016

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Geometry	12.6-3
To check/adjust toe	12.6-4
To check/adjust steering lock angles	12.6-6
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To install axle half	12.6-11
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To replace control arm	12.6-14
To remove rubber bushings of control arm	12.6-15
To install rubber bushings of control arm	12.6-17
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To install kingpin lower needle bearing unit	12.6-51

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Topic	See page
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Special tools: front axle	12.6-55
Front axle, exploded view	12.6-57

The following subjects have been *added/modified* since the former edition:

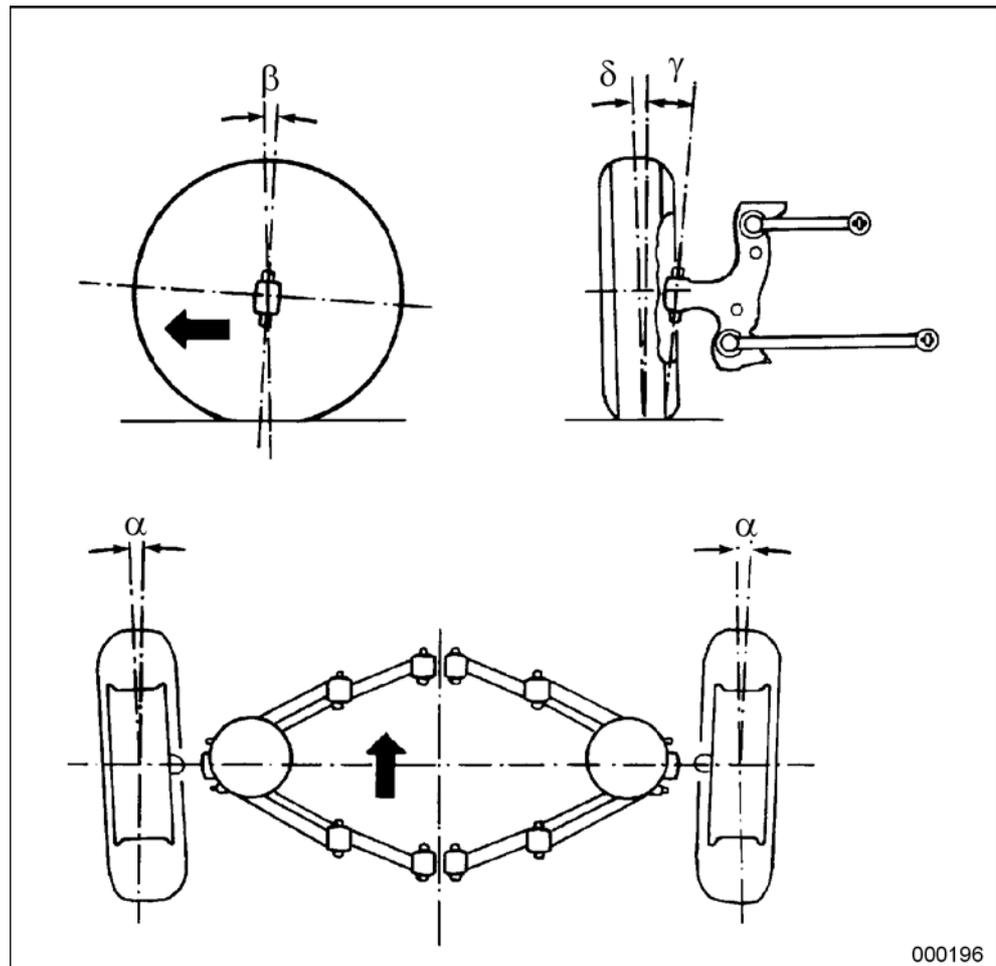
Topic	See page
To install rubber bushings of control arm	12.6-17
Technical data: front axle	12.6-53

Geometry

Setting values

Refer to "Technical data" at the end of this chapter.

Figure: geometry



000196

- α Toe
- β Castor
- δ Camber
- γ Kingpin inclination

To check/adjust toe

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Checking/ setting values

Refer to "Technical data" at the end of this chapter.

Tightening torques

Refer to "Technical data" at the end of this chapter.

Equipment condition

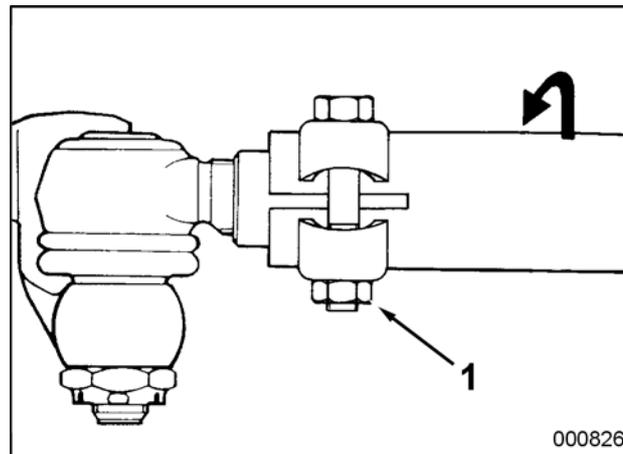
- Unladen vehicle;
- Wheels on the ground;
- Correct tire inflation pressure;
- Correct air spring height;
- No excessive out-of-balance on the road wheels;
- No excessive play on the steering knuckle;
- No play in the steering linkage ball-joints;
- Steering gear in the mid-position.

To check toe

Check toe for each wheel separately, with optical equipment. Follow the instructions by the manufacturer of the equipment.

NOTE: Toe setting may have changed in service due to impact deformation of the tie-rod, tie-rod arms or a control arm. This has to be checked.

Figure: tie-rod end



1 Clamping bolt

To adjust toe

Toe is adjusted by altering the effective length of the tie-rod of the relevant wheel.

Step	Action
1	Remove the clamping bolts of the rod ends. Discard the removed clamping bolts and their nuts.
2	Rotate tie-rod tube in appropriate direction.
3	Install new clamping bolts. Install new self-locking nuts on the clamping bolts.
4	 <p>CAUTION! Prevent the clamping bolt from turning along while tightening the nut.</p> <p>While retaining the bolt head, tighten the nuts to prescribed torque.</p>
5	Recheck toe.

To check/adjust steering lock angles

Setting values Refer to "Technical data" at the end of this chapter.

Figure:
steering lock
stop-screw



Check

Step	Action
1	Place front wheels on graduated turntables.
2	With wheels in straight-ahead position, turn LH wheel, until tie-rod arm contacts adjusting screw on steering knuckle carrier. Read angular movement and compare with "Maximum steering lock angle of inner wheel" value mentioned in technical data. If necessary, adjust steering lock angle.
3	Repeat step 2 for RH wheel.

To adjust

Step	Action
1	Loosen locknut of stop screw.
2	Turn stop screw in appropriate direction.
3	Retighten locknut of stop screw.
4	Check steering lock angle again.

To check straight-ahead position of wheels

To be carried out when?

Refer to "Steering system: to perform major inspection" in chapter 1.1, "Maintenance schedule".

Equipment condition

- Parking brake applied
- Chocks in front of and behind wheels of drive axle
- Vehicle jacked up at the front



WARNING!

If it is found that the straight-ahead position is out of adjustment, examine the complete steering system closely for deformation and cracks (impact damage). Remove the pitman arm with a special puller and check the pitman-arm shaft taper serrations. If they are no longer dead straight, the pitman-arm shaft is distorted. If there is the slightest indication of any defect, immediately change those parts. On no account must bent or twisted parts be straightened for re-use.

Procedure

Step	Action
1	Turn the steering wheel from lock to lock and count the number of revolutions.
2	Turn back half the number of revolutions and align the mark on the steering gear input shaft with the mark on the steering gear housing.
3	Check whether the front wheels are exactly aligned with the wheels of the drive axle (if necessary, approximate, by laying a straight ruler along the wheels at each side of the vehicle). Do take the toe into account. If the front wheels deviate excessively from the straight-ahead position, the drag-link is too long or too short.
4	If necessary, adjust the length of the drag link by loosening the clamps from the rod ends and turning the rod tube the correct direction.
5	Also check the play in the steering gear as described in "To check steering wheel play".

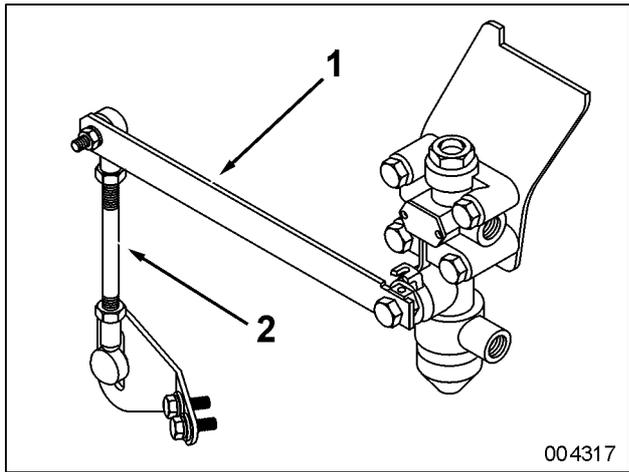
To remove axle half

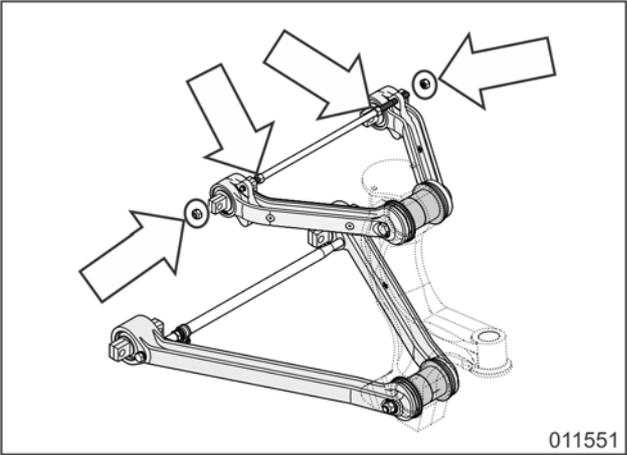
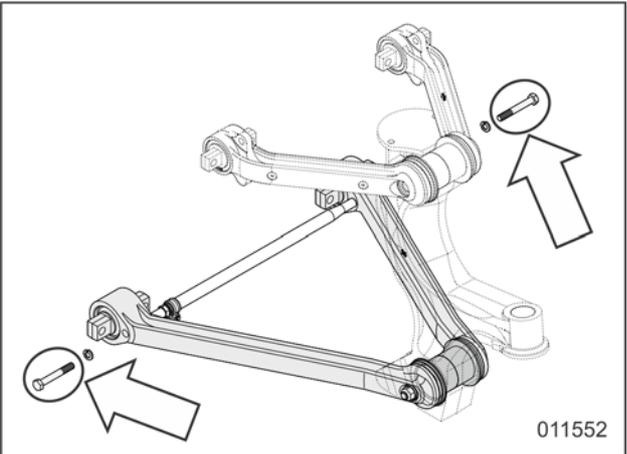


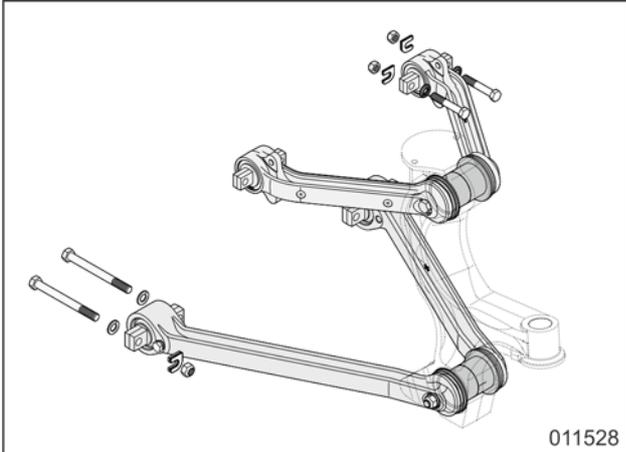
WARNING!

Ensure that the axle half is well supported before you loosen the fixing bolts.

Procedure

Step	Action
1	Apply the parking brake and place chocks in front of and behind the wheels of the drive axle.
2	Fully deplete the air suspension by means of the drain valve on the auxiliaries tank.
3	Slacken the wheel nuts on the side of the axle half that has to be removed by half a turn.
4	Put two jacks under the chassis. Raise the vehicle until the front wheels clear the ground. Support the chassis with axle stands or wooden blocks.
5	Mark the position of the wheel in relation to the hub (these parts are balanced together). Remove the wheel.
6	Disconnect vertical rod (1) of the leveling valve at its lower attachment. Pull control arm (2) downward to deflate the air bags. <div data-bbox="689 1290 1318 1762" data-label="Image">  <p style="text-align: right;">004317</p> </div>
7	Discharge the air from the brake system. Disconnect the compressed-air hose from the brake chamber.
8	Disconnect the tie rod from the tie-rod arm.

Step	Action
<p>9</p>	<p>Remove the outer nuts of the upper tie-rod of the wheel control arms. Screw the inner nuts of the upper tie-rod as far as possible away from the suspension arms. Pull the upper tie-rod out of the holes in the wheel control arms.</p>  <p style="text-align: right;">011551</p>
<p>10</p>	<p>Slacken the screws at the front and rear of the lower tie-rod of the wheel control arms. Because there is not enough space to remove the screws right away, the screws of the lower tie-rod will be removed further on in step 15.</p>  <p style="text-align: right;">011552</p>
<p>11</p>	<p>Roll a lifting device under the axle half.</p>
<p>12</p>	<p>Disconnect the shock absorber from the steering knuckle carrier.</p>
<p>13</p>	<p>Remove the screws that secure the air bag piston to the steering knuckle carrier.</p>

Step	Action
14	<p><i>NOTE: Make note of the number and the position of the camber adjustment shims for re-use during assembly.</i></p> <p>Unscrew the four nuts of the bolts securing the upper wheel control arms to the chassis, then remove the four nuts of the lower wheel control arms. To keep the opposite axle half in place, reinstall the fixing bolts and nuts of the lower control arms.</p> <div data-bbox="692 573 1318 1025"></div>
15	<p>Carefully withdraw the axle half from under the vehicle. Remove the screws at the front and the rear of the lower tie-rod of the wheel control arms and remove the tie-rod when the axle half is withdrawn a little from under the vehicle.</p>

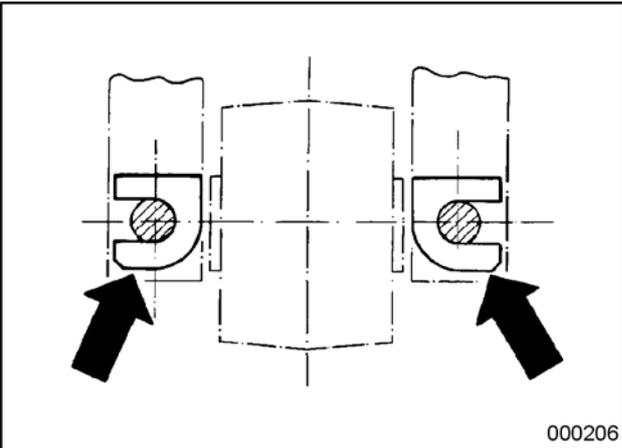
To install axle half

Tightening torques

Refer to "Technical data" at the end of this chapter.

Procedure

Step	Action
1	Use a mobile lifting device to place the complete axle half under the vehicle.
2	 <p>CAUTION!</p> <p>Only TD9.. Astromega/TDX.. Astromega: make sure that the recessed section of the tie-rod of the lower wheel control arms face the middle tie-rod of the front axle steering.</p> <p>Secure the tie-rod of the lower wheel control arms before the axle half is completely in position under the vehicle. Installation at a later stage is not possible!</p>
3	 <p>CAUTION!</p> <p>If it is difficult to insert the fixing bolts of the wheel control arms through the holes in the chassis, you need to extend or shorten the tie-rods of the control arms until the bolt holes in the wheel control arms exactly line up with the holes in the chassis. This way you prevent that the flexible ball joints will be preloaded when the bolts are tightened.</p> <p>Install the tie-rods of the wheel control arms and adjust the length of the tie-rods as explained further on in the chapter.</p>

Step	Action
4	<p>Secure the control arms - upper ones first, then the lower ones - to the chassis, but only hand-tighten the bolts.</p> <p>Ensure that you install the shims for the wheel alignment, the ones you found while removing the axle half, at the original place. The shims must be placed with the opening horizontally and to the outside, see figure.</p> <div data-bbox="694 571 1316 1019" style="text-align: center;">  <p style="text-align: right;">000206</p> </div>
5	<p>Finally tighten the fixing nuts of the wheel control arms.</p> <p><i>NOTE: Tighten the assembly bolt of the rubber bushings at the steering knuckle side while the control arms are horizontal (refer to "To install rubber bushings of control arms").</i></p>
6	<p>Reinstall the tie rod.</p> <p>Refer to "To check security of steering gear, rods and levers" in chapter 7.6 for tightening torques.</p>
7	<p>Secure air spring piston to the steering knuckle carrier. Tighten the screws to the prescribed torque.</p>
8	<p>Secure the shock absorber to the steering knuckle carrier. Tighten the self-locking nut to the prescribed torque.</p>
9	<p>Secure compressed-air hose to the brake chamber.</p>
10	<p>Connect the vertical rod from the leveling valve to its connection support.</p>
11	<p>Place the wheel and lower the vehicle.</p>
12	<p>Pressurize the air system and adjust the height of the air springs as described in "To adjust air spring height" in chapter 3.6.</p>
13	<p>Adjust toe, refer to "To check/adjust toe".</p>
14	<p>Road-test the vehicle and recheck the toe.</p>

To check security of control arms

Tightening torques

Refer to "Technical data" at the end of this chapter.

Procedure

Visually check those bolts, screws and nuts that are locked by means of a cotter pin, a locking plate or locking adhesive (Loctite). The security of all others must be checked mechanically. Retighten, if necessary.

**WARNING!**

Never retighten bolts, screws or nuts that are fitted with locking adhesive, as this would destroy locking properties.

To replace control arm



CAUTION!

Control arms are not interchangeable.

Location of the control arms

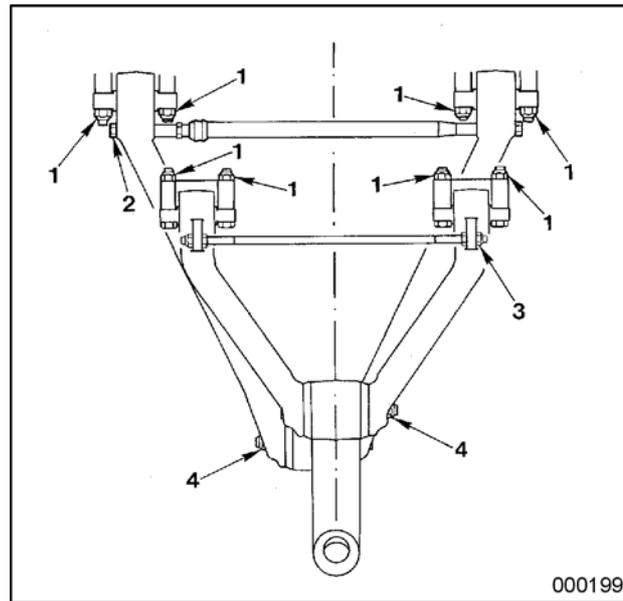
A(n)... is located correctly	If...
upper control arm	the snap ring of the flexible ball-joint is located at the front, and the cast rib with the hole to connect the tie rod is on top.
lower control arm	the snap ring of the flexible ball-joint is at the rear.

To remove rubber bushings of control arm

Special tools

Tool kit to remove rubber bushings of control arm	Van Hool No. 10695670
---	-----------------------

Figure: left axle half, view from above



- 1 Nuts of control arm fixing bolts
- 2 Bolt of lower tie rod
- 3 Nut for upper tie rod
- 4 Articulation assembly bolt

Procedure

Step	Action
1	Slacken the nuts (1) of bolts securing the two control arms to the chassis by a few turns.
2	Depending on the joint that has to be removed, remove bolt (2) or nut (3) from the tie rod from the corresponding suspension triangle.
3	Remove articulation assembly bolt (4).

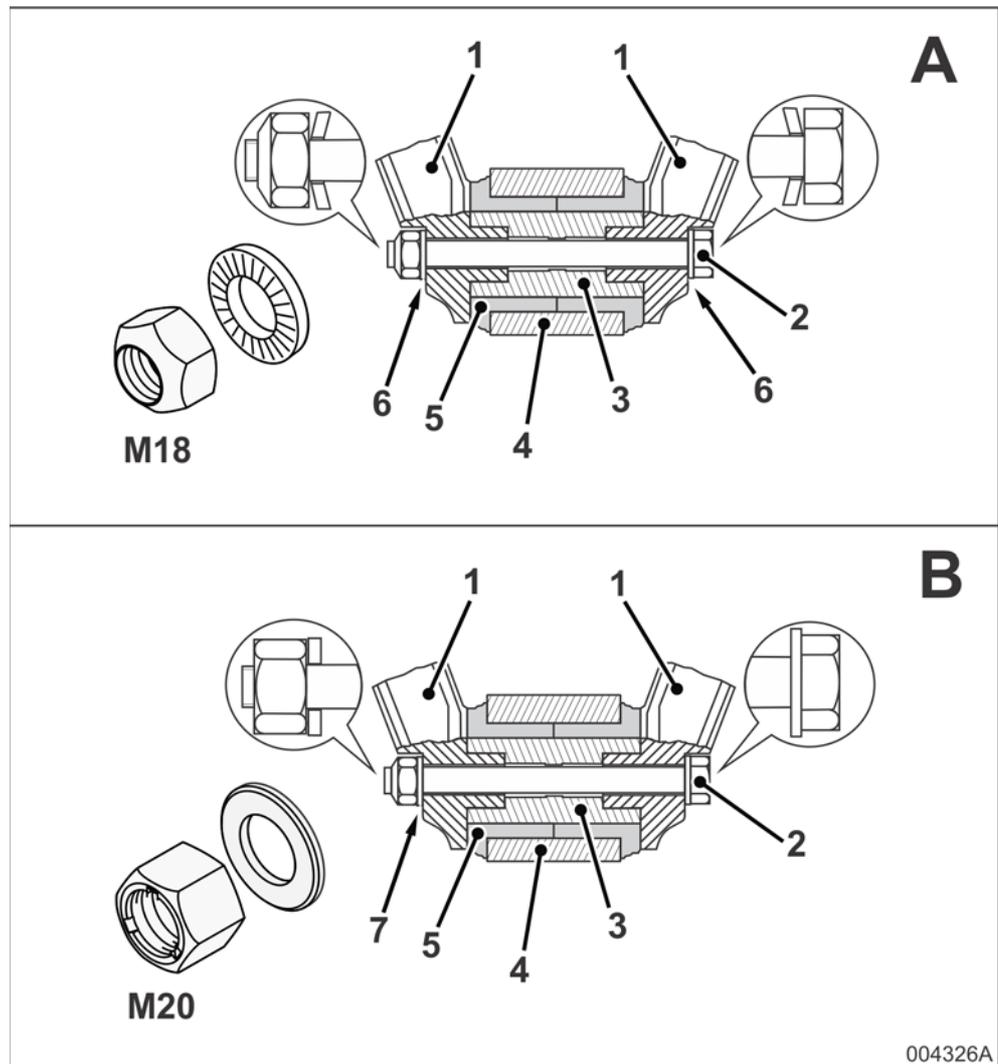
Step	Action
<p>4</p>	<p>Use the two M22 bolts and the long 0.6 in dia pin to separate the first control arm.</p> <div data-bbox="692 421 1318 875" data-label="Image"> </div>
<p>5</p>	<p>Use two M22 bolts and the short 0.6 in dia pin to separate the second control arm.</p> <div data-bbox="692 1010 1318 1464" data-label="Image"> </div>
<p>6</p>	<p>Push the articulation shaft out of the steering knuckle carrier, and remove the two rubber bushings.</p>

To install rubber bushings of control arm

Consumables Refer to Van Hool spare parts manual

Tightening torques Refer to "Technical data" at the end of this chapter.

Figure: control arm joint



A Version with M18 assembly bolt

B Version with M20 assembly bolt

Legend to figure

Number in figure	Explanation
1	Control arm
2	Assembly bolt (with self-locking nut)
3	Articulation assembly shaft
4	Steering-knuckle carrier
5	Rubber bushing
6	Special spring washer
7	Special washer

Procedure

Step	Action
1	Degrease the steering knuckle carrier bore. Wipe with clean cloth.
2	Apply clean water (no soapy water) to the rubber bushings and the bore in the steering knuckle to help assembly.
3	Push both rubber bushings and the articulation assembly shaft into the bore of the steering knuckle carrier.
4	Ensure the nuts of the bolts securing the control arms to the chassis are loose. Push the control arms in the articulation assembly shaft. If necessary, use a soft hammer.
5	<ul style="list-style-type: none"> Version with M18 assembly bolt: install the new assembly bolt with the special spring washers and a new nut. The "hollow" side of the special spring washer must be directed towards the control arm. Hand-tighten the nut of the assembly bolt. Version with M20 assembly bolt: install the new assembly bolt with the special washer and a new nut. Hand-tighten the nut of the assembly bolt.
6	Connect the tie rod of the control arms. Refer to "To adjust length of control arm tie-rod" if the bolt holes do not line up with the holes in the chassis.
7	Tighten the fixing bolts of the control arms.
8	Jack up the steering knuckle carrier until the control arms are horizontal. <i>NOTE: Both rubber bushings must be twisted equally strong when the wheel deflects and rebounds. For this reason, the articulation assembly bolt may only be fastened while the control arms are horizontal.</i>
9	Tighten the articulation assembly bolt with the prescribed torque.

continued on next page

To replace flexible ball joint of control arm

Introduction

The ball joint in the eye of the control arm can be replaced in the usual way with a drift (bush of appropriate diameter and wall thickness).

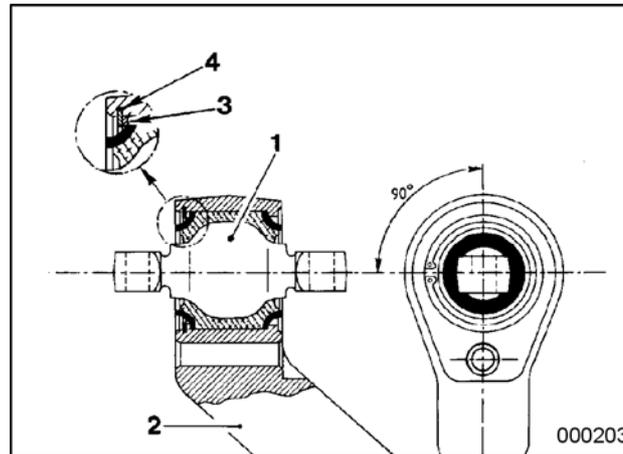
Consumables

Flexible ball joint	Van Hool No. 634301140
---------------------	------------------------

Equipment condition

Control arm removed

Figure: control arm end, chassis side



- 1 Flexible ball joint
- 2 Control arm
- 3 Spacer
- 4 Snap ring

To remove

Step	Action
1	Remove snap ring (4) and spacer (3). <i>NOTE: This is only possible if joint (1) is slightly pressed at the snap ring side.</i>
2	Press ball joint (1) out.

To install

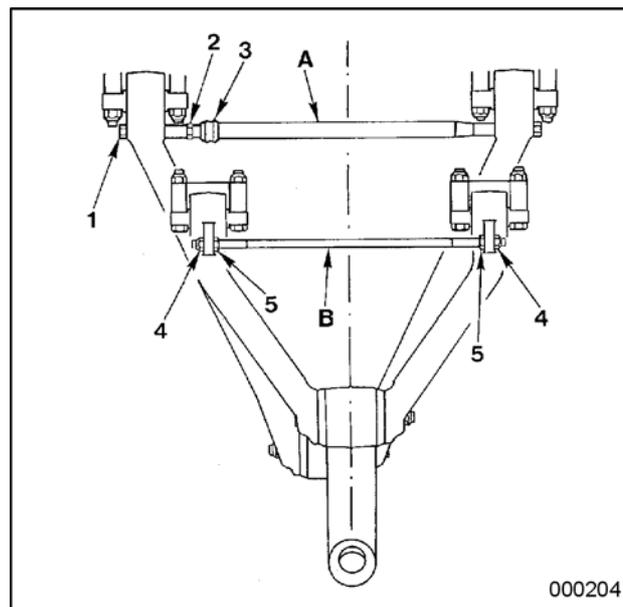
Step	Action
1	<p><i>NOTE: The joint has to be pressed in dry.</i></p> <p>Place the ball joint on the hole in the control arm so that the bolt holes in the ball-joint shaft are orientated as shown in the figure.</p>
2	<p>Press the joint into the eye of the control arm.</p>
3	<p>Install spacer (3) and snap ring (4) while the joint is under pressure.</p> <p><i>NOTE: The opening of spacer (3) must be directed in such way that it comes on top when the control arm is secured to the chassis. The opening in the snap ring circumference must be directly opposite to the opening of the spacer (i.e. on the bottom when the control arm is secured to the chassis).</i></p>

To adjust length of control arms tie-rod

Introduction

Before the control arms are finally tightened to the chassis, the length of the tie rods has to be adjusted in such way that the bolt holes of the control arms line up exactly with those in the chassis. The tightening of the fixing nuts should not preload the flexible ball joints of the control arms.

Figure: left axle half, view from above



- 1 Fixing bolt
- 2 Hexagon to adjust the tie rod
- 3 Clamp
- 4 Self-locking nut
- 5 Nut to adjust the tie rod
- A Lower connection rod
- B Upper connection rod

Procedure for lower control arms

Step	Action
1	Untighten bolt (1) and the nut of clamping bolt (3).
2	Rotate hexagon (2) to change the length of the tie rod.
3	Tighten bolt (1) and the nut of clamping bolt (3).

**Procedure for
upper control
arms**

Step	Action
1	Loosen nuts (4).
2	Rotate nuts (5) to change the length of the tie rod.
3	Tighten nuts (4).

To check hub unit for wear

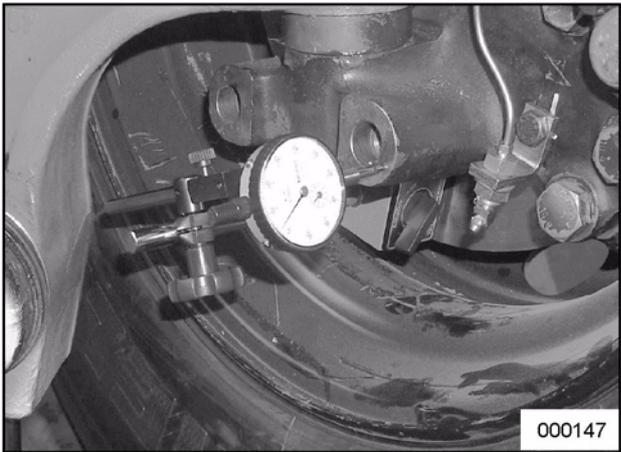
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment condition

- Parking brake applied
- Wheels remaining on the ground chocked
- Vehicle raised so that the wheels of the axle that will be worked upon clear the ground

To check wheel bearing end-play

Step	Action
1	<p>Attach dial indicator with magnetic base below at inside of brake disc. Position stylus of dial indicator at right angle to machined surface of steering knuckle, right next to the front tapped hole. Set the dial indicator to zero.</p> 
2	<p>Grab wheel and tilt it as far as possible inwards and outwards (pull and push). At the same time an assistant notes the total variation shown by the dial indicator.</p> <p>The measured tilt course must not exceed 0.01 in (which corresponds to an axial wheel bearing clearance of 0.008 in).</p>

To check the sound of the wheel bearings

By hand, turn the wheel in both directions.

If...	then ...
the wheel bearing feels tight and you hear a "grinding" noise,	the complete hub unit has to be replaced.
the wheel bearing makes a ticking or clicking sound,	that does not mean there is something wrong with the bearing. With lifted wheel, there is no load on the bearing so that the bearing rollers are able to move in axial direction.

To check hub unit for grease leakage

To be carried out when?

When replacing a brake disc



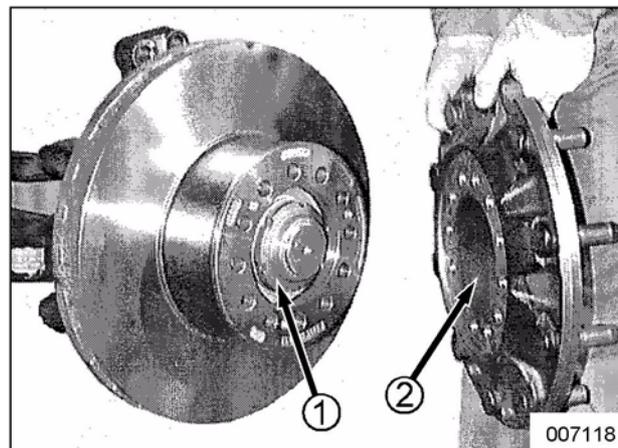
CAUTION!

If the brakes have been overheated, the complete hub unit must be replaced.

Hub unit

The hub unit combines two bearings, a grease seal and an ABS pulse ring. If one of these components is damaged, the entire unit must be replaced by a new one.

Figure: check of hub unit for grease leakage



Wheel hub (wheel removed)

- 1 Hub nut
- 2 Inside of wheel flange

Procedure

Check the inside of wheel flange (2) and the surroundings of hub nut (1) for presence of grease.

Evaluation

If...	then ...
grease has spread in the whole hollow space of the wheel hub (inside of the wheel flange/surrounding of the wheel nut),	this indicates grease leakage coming from the hub unit. The complete hub unit must then be replaced. <i>NOTE: Grease leakage is usually accompanied by a pronounced discoloration (blue) of the wheel flange.</i>
there is only some grease at the lower edge of the hub unit seal,	this is to be considered normal, and not as a real leak.

To remove wheel hub

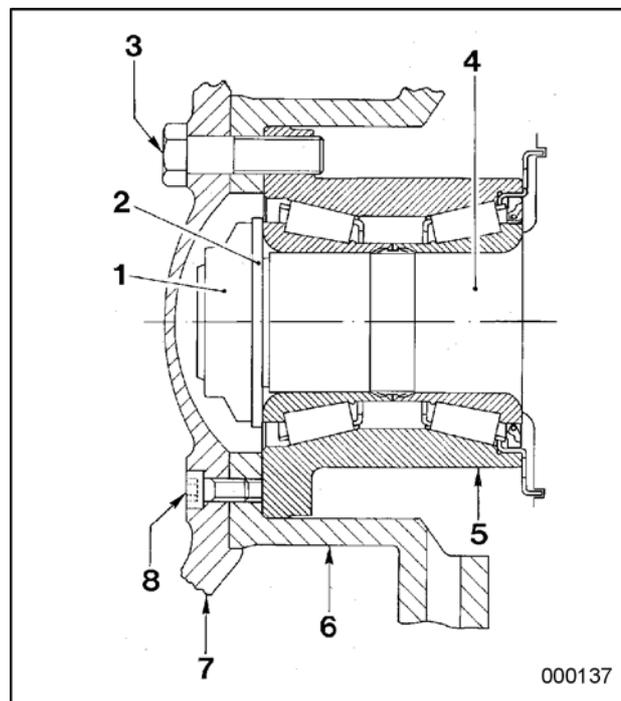
Special tools

Hub nut wrench	Van Hool No. A996030253
Tool set to remove hub unit from steering knuckle spindle	
<ul style="list-style-type: none"> • Spindle • Flange • Threaded bush • Cover 	<ul style="list-style-type: none"> • Van Hool No. A996060240 • Van Hool No. A996060464 • Van Hool No. A996060251 • Van Hool No. A996060238

Equipment conditions

- Parking brakes applied
- Wheels remaining on the ground chocked
- Vehicle jacked up at the front
- Road wheel removed
- Brake caliper/brake carrier removed, refer to "To remove brake caliper/brake carrier" in chapter 5.10.

Figure:
section
through wheel
hub



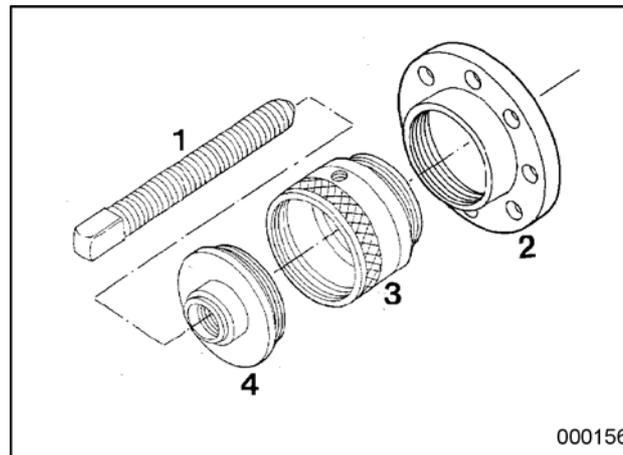
Legend to figure

Number in figure	Explanation
1	Hub nut
2	Thrust washer
3	Screw retaining brake disc and wheel flange to hub unit
4	Steering knuckle
5	Hub unit
6	Brake disc
7	Wheel flange
8	Hexagonal socket screw

Hub unit

The hub unit combines two bearings, a grease seal and an ABS pulse ring. If one of these components is damaged, the entire unit must be replaced by a new one.

Figure: tool set



Tool set to remove hub unit from steering knuckle spindle

- 1 Spindle
- 2 Flange
- 3 Threaded bush
- 4 Cover

**WARNING!**

The wheel flange and the brake disc are heavy. Be sure they are well supported, before undoing the fixing screws.

Procedure

Step	Action
1	Remove hexagonal socket screw (8).
2	Remove the twelve screws (3) retaining wheel flange and brake disc to hub unit.
3	Remove wheel flange (7)
4	Thread puller screws into the three M12 x 1,5 tapped holes in brake disc. Free brake disc from hub unit using puller screws. Remove brake disc.
5	Remove hub nut (1) using hub nut wrench.
6	Remove washer (2).
7	Secure flange (2) of tool set to hub unit with three screws.
8	Screw threaded bush (3) of tool set into flange (2).
9	Screw cover (4) of tool set into threaded bush (3).
10	Screw spindle (1) of tool set into cover (4).
11	Remove hub unit by turning spindle (1) of tool set clockwise.

To install wheel hub

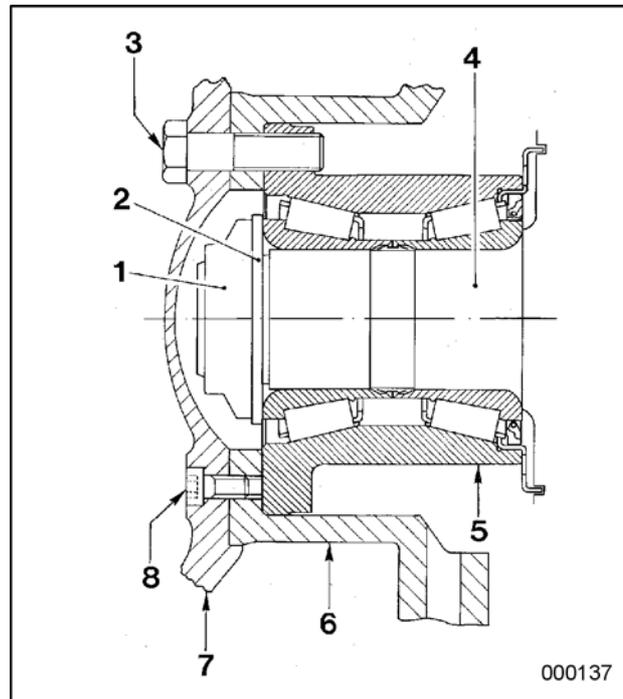
Consumables Refer to Van Hool spare parts manual

Special tools

Tool set to install the hub unit on the steering knuckle spindle	Van Hool No. 10678700
--	-----------------------

Tightening torques Refer to "Technical data" at the end of this chapter.

Figure:
section
through wheel
hub



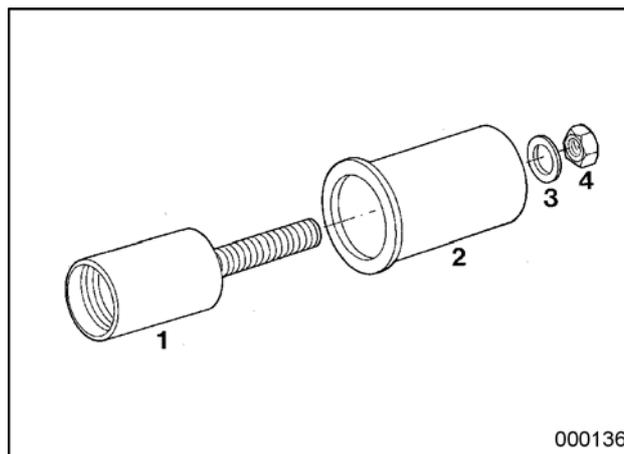
Legend to figure

Number in figure	Explanation
1	Hub nut
2	Thrust washer
3	Screw retaining brake disc and wheel flange to hub unit
4	Steering knuckle
5	Hub unit

continued on next page

Number in figure	Explanation
6	Brake disc
7	Wheel flange
8	Hexagonal socket screw

Figure: tool set



Tool set to install the hub unit on the steering knuckle spindle

- 1 Guide sleeve
- 2 Press sleeve
- 3 Washer
- 4 Nut

Procedure

Step	Action
1	Apply thin film of "Never Seez" to steering knuckle spindle (4).
2	Screw guide sleeve (1) of tool set onto the steering knuckle spindle
3	Slide hub unit on the guide sleeve (1) of the tool set.
4	Slide press sleeve (2) of the tool set on the guide sleeve.
5	Install washer (3) and nut (4) of the tool set on the threaded rod of the guide sleeve.
6	Turn nut (4) of the tool set clockwise to install the hub unit on the steering knuckle spindle.
7	Remove the tools.
8	Install thrust washer (2).

Step	Action
<p>9</p>	 <p>WARNING! Never refit an old hub nut after removal, since it is self-locking.</p> <p>Install a new hub nut on the steering knuckle spindle. Tighten the nut to the prescribed torque and simultaneously rotate the hub unit in both directions to settle the roller bearings.</p>
<p>10</p>	<p>Apply a thin film of NLGI No. 2 grade high temperature lithium grease to the contact surfaces between brake disc (6) and hub unit (5).</p>
<p>11</p>	<p>Put brake disc (6) on a flat surface. Position wheel flange (7) on brake disc (6) in such a way that the holes for screw (8) coincide. Secure wheel flange (7) to brake disc (6) with hexagonal socket screw (8).</p>
<p>12</p>	<p>Position the wheel flange/brake disc assembly to the hub unit in such a way that the screw holes coincide. Install twelve fixing screws (3) and tighten them crosswise in steps.</p>
<p>13</p>	<p>Install the brake caliper/brake carrier assembly. Refer to "To install brake caliper/brake carrier" in chapter 5.10.</p>

To grease king-pin bearings

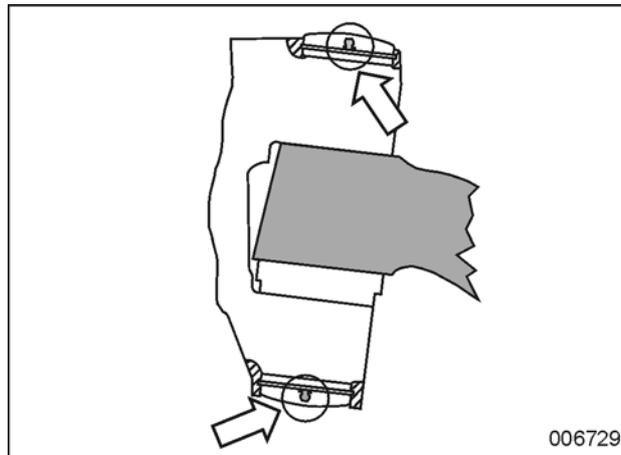
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Grease type

Refer to chapter 1.1, "Fluids and lubricants".

Figure: grease nipples of king-pin bearings



On some vehicles, the grease nipples are located under a protective cover.

Number of grease nipples

Each steering knuckle has two grease nipples.

Procedure

Step	Action
1	Remove the wheel.
2	Remove the protective covers if present.
3	Press grease into each of the grease nipples until fresh grease comes out of the gaps between the steering knuckle and the axle end/steering knuckle carrier.

To check play between steering knuckle and axle center

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

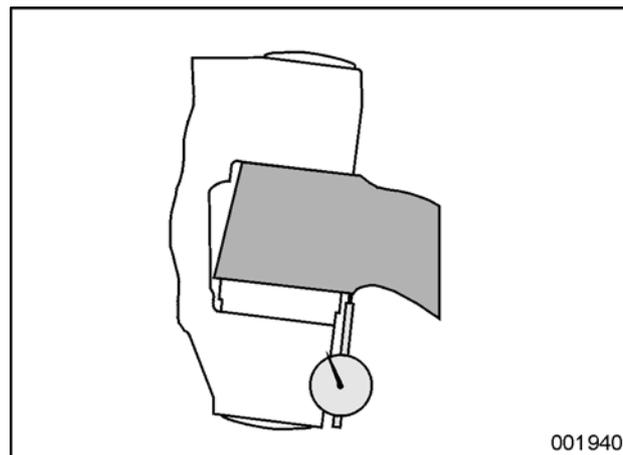
Checking values

Refer to "Technical data" at the end of this chapter.

Equipment condition

- Vehicle over inspection pit
- Wheels remaining on the ground chocked

Figure: measurement setup



Procedure

Step	Action
1	Attach dial indicator to lower steering knuckle yoke. Position stylus of dial indicator to lower edge of axle center. Distance between stylus and dial indicator support should be as short as possible.
2	Jack up axle, until wheels clear ground.
3	Set the dial indicator to zero.
4	Lower axle onto ground.

continued on next page

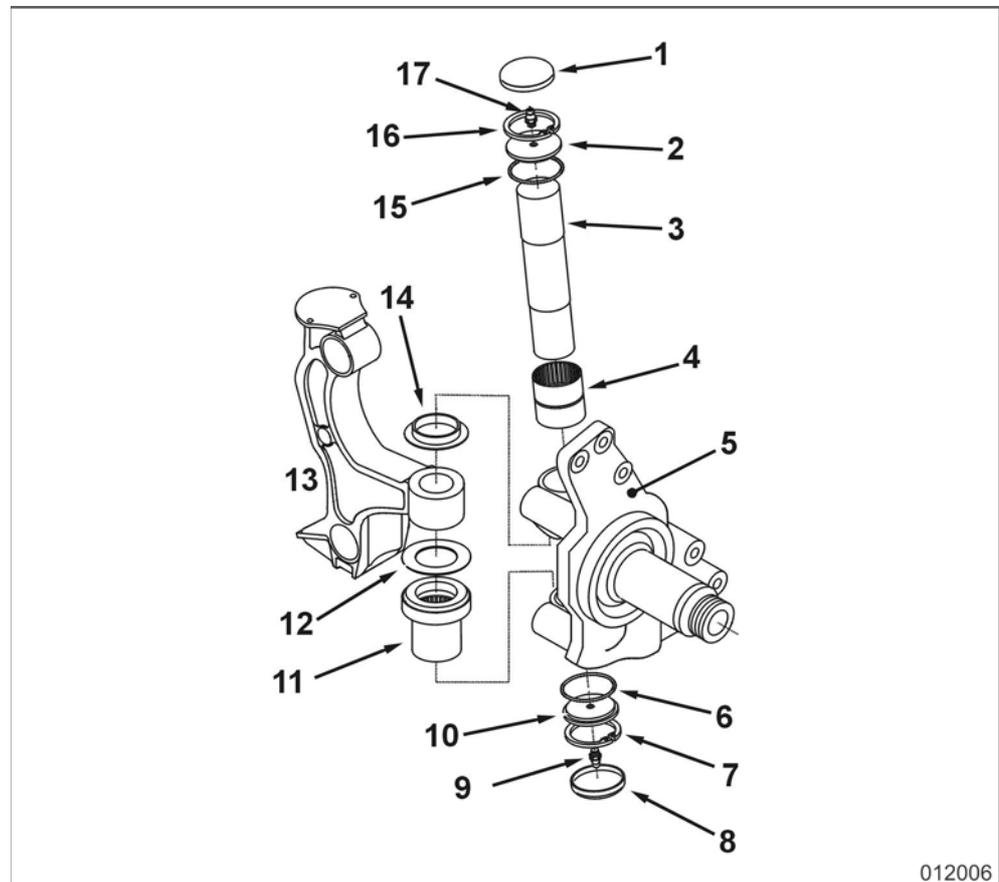
Step	Action
5	<p data-bbox="576 309 1075 338">Note variation shown by dial indicator.</p> <p data-bbox="576 356 1278 385">Is variation smaller than maximum permissible value?</p> <ul data-bbox="576 409 1434 490" style="list-style-type: none"><li data-bbox="576 409 1023 439">• If so, axial clearance is correct.<li data-bbox="576 459 1434 490">• If not, remove steering knuckle and replace all damaged parts.

To remove kingpin

Special tools

Press	Van Hool No. A996066146
Pump	Van Hool No. A996206008
Drift	Van Hool No. A996170183
Drift	Van Hool No. A996170179
Distance sleeve	Van Hool No. A996040228

Figure: RH steering knuckle, exploded view



Legend to figure

Number in figure	Explanation
1	Protective cover (if installed)
2	Plug plate
3	Kingpin

continued on next page

Number in figure	Explanation
4	Upper needle bearings
5	Steering knuckle
6	O-ring
7	Snap ring
8	Protective cover (if installed)
9	Grease nipple
10	Plug plate
11	Lower needle bearing unit
12	Spacer
13	Steering-knuckle carrier
14	Grease seal
15	O-ring
16	Snap ring
17	Grease nipple

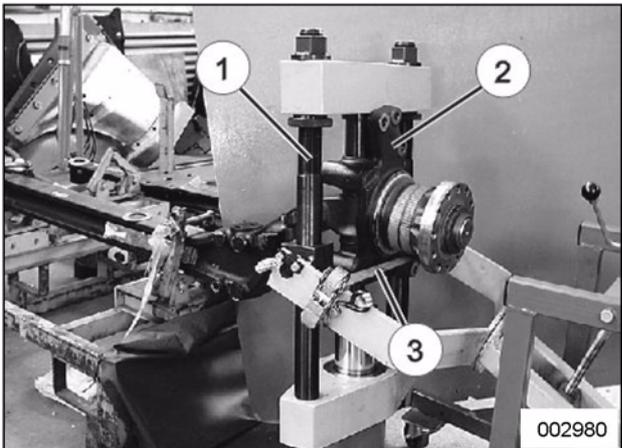
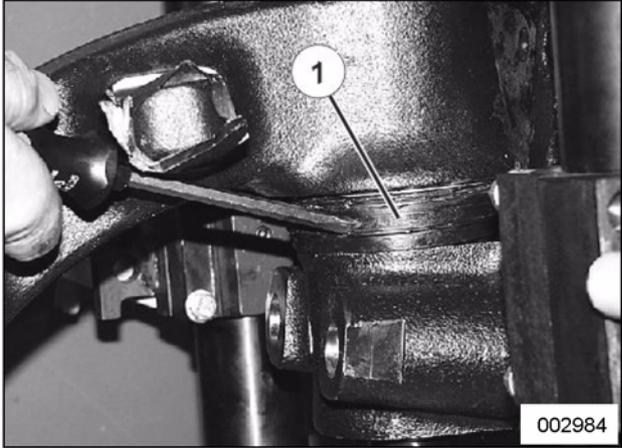
Equipment conditions

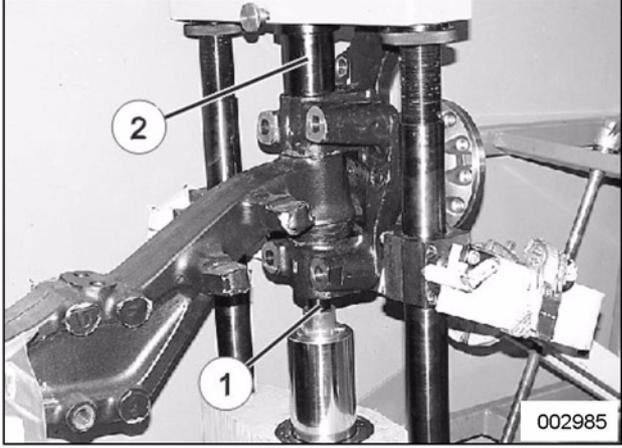
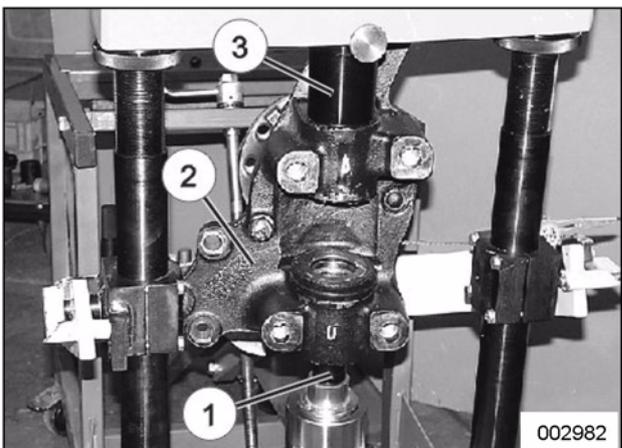
- Chocks in front of and behind the wheels remaining on the ground
- Vehicle jacked up at the front
- Road wheel removed
- Brake caliper/brake carrier removed, refer to "To remove brake caliper/brake carrier" in chapter 5.10.
- Brake disc removed, refer to "To remove wheel hub"

Procedure

Step	Action
1	Remove the nut of the ball-joint pillar securing the tie rod to the tie-rod arm.
2	Disconnect the tie rod by using a ball-joint puller.
3	If present, pry out protective covers (1) and (8).
4	Only on vehicles with a steered trailing axle and the angle sensor of the trailing-axle steering system mounted on top of the steering knuckle: remove the angle sensor.
5	Remove snap rings (7) and (16).
6	Remove plug plates (2) and (10).
7	Remove O-rings (6) and (15).

continued on next page

Step	Action
<p>8</p>	<p><i>NOTE: The kingpin can only be removed upwards.</i></p> <p>Roll portable press (1), with the ram at the bottom, under the steering knuckle. Align the ram with the kingpin. Secure steering knuckle (2) with tensioning belt (3). Connect the hydraulic pump to the press.</p> 
<p>9</p>	<p>Push down lip (1) of the lower needle bearing unit dust shield.</p> 

Step	Action
10	<p>Position drift A996170183 (1) on top of the ram and distance sleeve A996040228 (2) on top of the steering knuckle. Press out the kingpin from the bottom to the top.</p> 
11	<p>Remove the kingpin by using a magnet.</p>
12	<p>Lower the ram. Replace drift A996170183 by drift A996170179 (1). Lift the ram and center steering knuckle (2) between distance bush A996040228 (3) and drift A996170179 (1). Remove the complete steering knuckle from the steering-knuckle carrier.</p> 
13	<p>If necessary, press out the kingpin needle bearings as described under "To remove kingpin needle bearings".</p>

To install kingpin

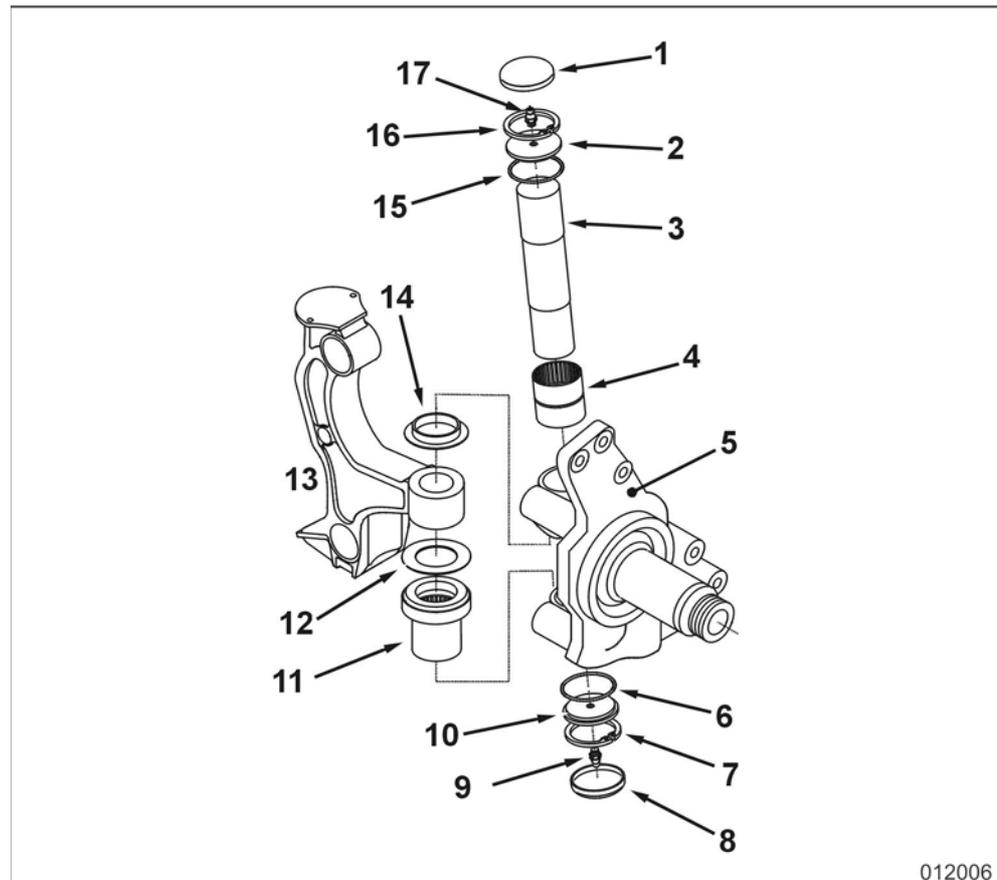
Grease type

Refer to chapter 1.1, under "Fluids and lubricants".

Special tools

Press	Van Hool No. A996066146
Pump	Van Hool No. A996206008
Pliers	Van Hool No. A996256001
Drift	Van Hool No. A996170179
Distance sleeve	Van Hool No. A996040228
Guide sleeve	Van Hool No. A996170196
Magnetic guide	Van Hool No. A996170197

Figure: RH steering knuckle, exploded view



012006

Legend to figure

Number in figure	Explanation
1	Protective cover (if installed)
2	Plug plate
3	Kingpin
4	Upper needle bearings
5	Steering knuckle
6	O-ring
7	Snap ring
8	Protective cover (if installed)
9	Grease nipple
10	Plug plate
11	Lower needle bearing unit
12	Spacer
13	Steering-knuckle carrier
14	Grease seal
15	O-ring
16	Snap ring
17	Grease nipple

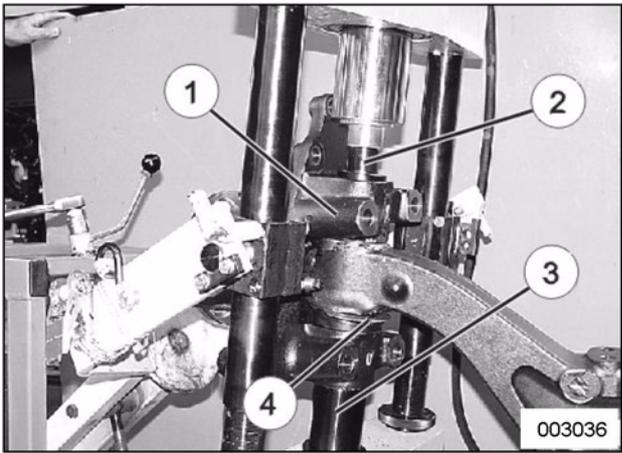
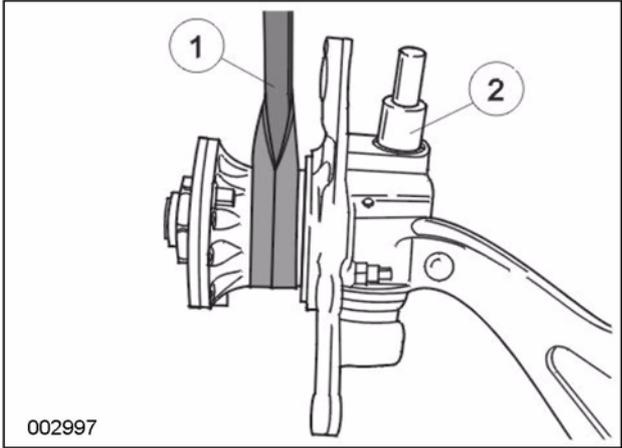
Equipment conditions

- Upper needle bearings, lower needle bearing unit and grease seal installed in steering knuckle
- Kingpin dry, free of grease and clean

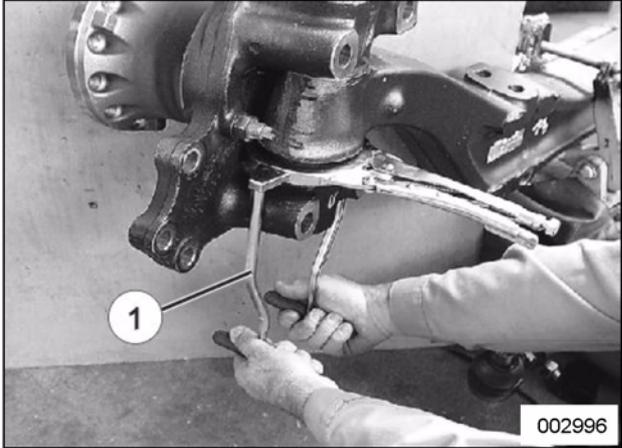
To install kingpin

Step	Action
1	Measure the axial play to determine the appropriate spacer thickness. For procedure, refer to further on in the text under "To determine spacer thickness".

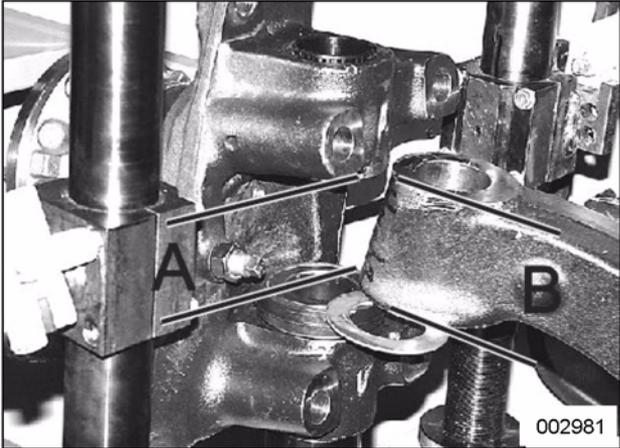
continued on next page

Step	Action
<p>2</p>	<p>With the ram of the press at the top, center steering knuckle (1) between drift A996170179 (2) and distance bush A996040228 (3). Position the steering-knuckle assembly on the steering-knuckle carrier center while sliding the appropriate spacer (4) between the lower face of the steering-knuckle carrier center and the lower needle-bearing unit.</p> 
<p>3</p>	<p>Carefully remove the portable press. Secure the steering knuckle with a sling (1) and hoist against falling down. With one hand, shift the steering knuckle back and forth, and with the other hand insert guide pin A996170196 (2) from above into the kingpin bore. Carefully center the steering knuckle and the spacer with regard to the kingpin bore.</p> 

Step	Action
4	<div data-bbox="582 324 662 403" data-label="Image"> </div> <p data-bbox="694 369 885 414">CAUTION!</p> <p data-bbox="574 414 1404 526">The kingpin can only be removed from above. The kingpin and the steering-knuckle carrier bore must be dry, free of grease and clean.</p> <p data-bbox="574 548 1428 616">Position kingpin (1), with smaller diameter at the bottom, together with magnetic guide A996170197 (2) in the steering knuckle.</p> <div data-bbox="694 660 1316 1108" data-label="Image"> </div>
5	Remove the sling and the hoist. Roll the portable press, with the ram at the top, under the steering knuckle.
6	<p data-bbox="574 1220 1412 1288">Position drift A996170179 (2) on top of kingpin (1). Press in the kingpin until stop.</p> <div data-bbox="694 1332 1316 1780" data-label="Image"> </div>
7	Remove the pressing equipment.

Step	Action
<p>8</p>	<p>With special pliers A996256001 (1), lift the dust-shield lip of the lower needle-bearing unit until it locks into position.</p> 
<p>9</p>	<p>Only on vehicles with a steered trailing axle and the angle sensor of the trailing-axle steering system mounted on top of the steering knuckle: mount the angle sensor. For procedure, refer to chapter 7.10 under "Mobil Elektronik steered trailing axle: to install angle sensor".</p>
<p>10</p>	<p>Install plug plate (2) with O-ring (15) and snap ring (16).</p>
<p>11</p>	<p>Install plug plate (10) with O-ring (6) and snap ring (7).</p>
<p>12</p>	<p>With a high-pressure grease pump, lubricate the upper and lower needle bearings with the prescribed grease. For procedure, refer to chapter 12.6 under "To grease kingpin bearings".</p>

**To determine
spacer
thickness**

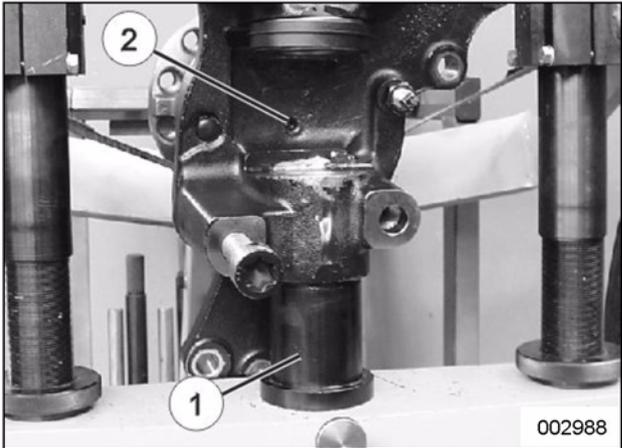
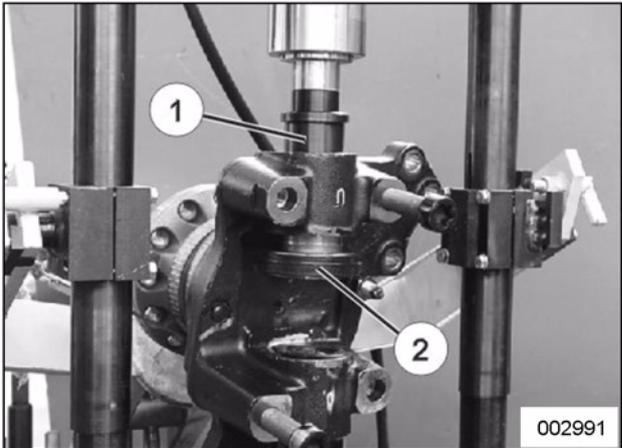
Step	Action
1	Measure the inner distance between the lower needle-bearing unit and the upper steering-knuckle yoke (measure "A"). 
2	Measure the height of the steering-knuckle carrier center (measure "B").
3	Measure the thickness of the spacer (measure "C").
4	Calculate the axial play: $E = A - (B + C)$. The maximum allowable axial play is 0.008 inch. If necessary, install a thicker spacer.

To remove kingpin needle bearings

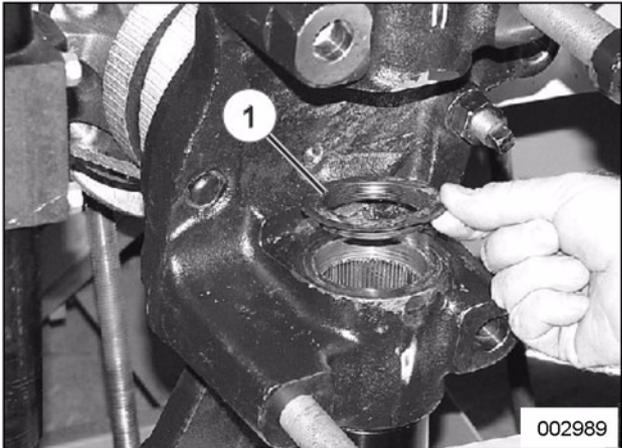
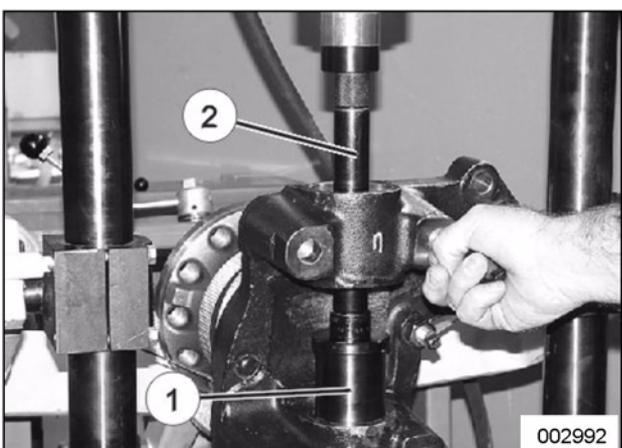
Special tools

Distance sleeve	Van Hool No. A996170183
Drift	Van Hool No. A996350051
Mandrel	Van Hool No. A996170190

To remove lower needle bearing unit

Step	Action
1	<p>Install steering knuckle (2) upside down on distance sleeve A996170183 (1). Position the steering-knuckle assembly into the press with the ram on top. Secure the steering knuckle with a tension belt.</p> 
2	<p>Press out needle-bearing unit (2) by using drift A996350051 (1).</p> 

To remove upper needle bearings

Step	Action
1	<p>With the steering knuckle in the same position as for the removal of the lower needle bearing unit, remove grease seal (1).</p>  <p style="text-align: right;">002989</p>
2	<p>Press out the needle bearings by using mandrel A996170190 (2) and drift A996350051 (1).</p>  <p style="text-align: right;">002992</p>

Are bearings and grease seals reusable?

The bearings and grease seals that are removed cannot be reused.

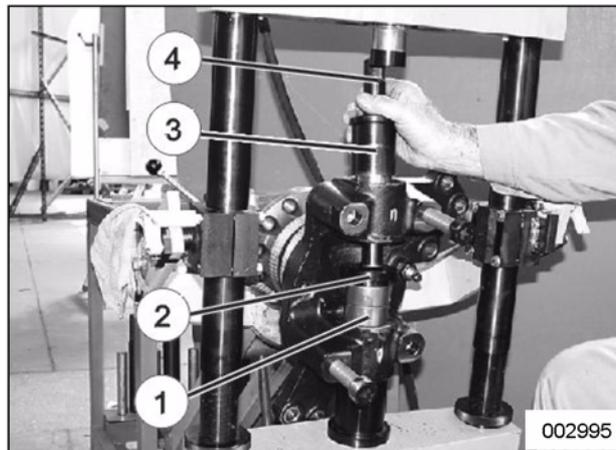
To install kingpin upper needle bearings

Consumables Refer to Van Hool spare parts manual.

Special tools

Drift	Van Hool No. A996350050
Guide bush	Van Hool No. A996350051
Mandrel	Van Hool No. A996170190

Figure: to install upper needle bearings



- 1 Upper needle bearings
- 2 Drift
- 3 Guide bush
- 4 Mandrel

Procedure



CAUTION!

To prevent needle bearings from falling out, first install the needle-bearings packing insert before moving the steering knuckle.

Step	Action
1	Invert the steering knuckle.
2	Remove the upper needle-bearings packing insert
3	Slide the upper needle bearings on drift A996350050 (2).
4	Install drift A996350050 (2) together with the upper needle bearings on top of the steering-knuckle bore.

continued on next page

Step	Action
5	Install mandrel A996170190 (4).
6	Locate guide bush A996350051 (3) in the steering-knuckle lower yoke to act as a pilot for the mandrel.
7	Press the upper needle bearings into the bore until stop by using mandrel (4).

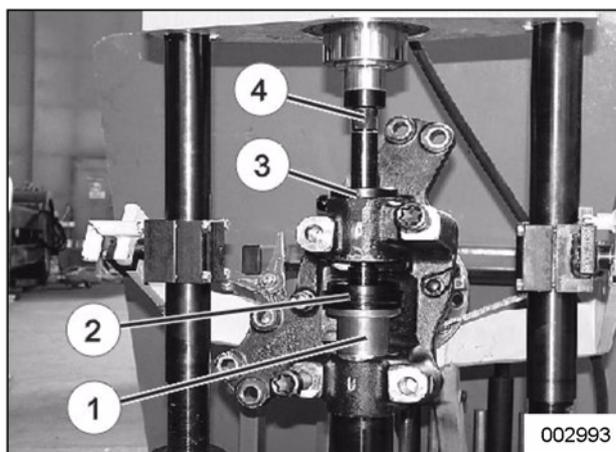
To install kingpin lower needle bearing unit

Consumables Refer to Van Hool spare parts manual.

Special tools

Drift	Van Hool No. A996350049
Drift	Van Hool No. A996350050
Mandrel	Van Hool No. A996170190

Figure: to install lower needle bearing unit



- 1 Lower needle bearing unit
- 2 Drift A996350049
- 3 Drift A996350050
- 4 Mandrel

Procedure

Step	Action
1	Invert the steering knuckle so that the upper yoke is on top.
2	Slide needle bearing unit (1) on drift A996350049 (2). Leave the packing insert in its place.
3	Position drift A996350049 (2) together with the needle-bearing unit on top of the steering-knuckle bore.
4	Install mandrel A996170190 (4).
5	Position drift A996350050 (3) in the steering-knuckle upper yoke to act as a pilot for the mandrel.
6	Press the needle-bearing unit into the bore until stop using mandrel (4).

continued on next page



Step	Action
7	Install the grease seal.

Technical data: front axle

Make Van Hool

Geometry

Caster	3° ± 15'
Camber	+15' ± 15'
King-pin inclination	7°
Toe-out (degrees)	-5' ± 2'
Toe-out (inch)	-0.02 ± 0.006 in/ft
Maximum steering angle, inner wheel	
<ul style="list-style-type: none"> • 22.5" x 8.25" wheel • 22.5" x 9" wheel 	57° 55°

Hub

Wheel bearing end-play	maximum 0.01 in
------------------------	-----------------

Steering knuckle

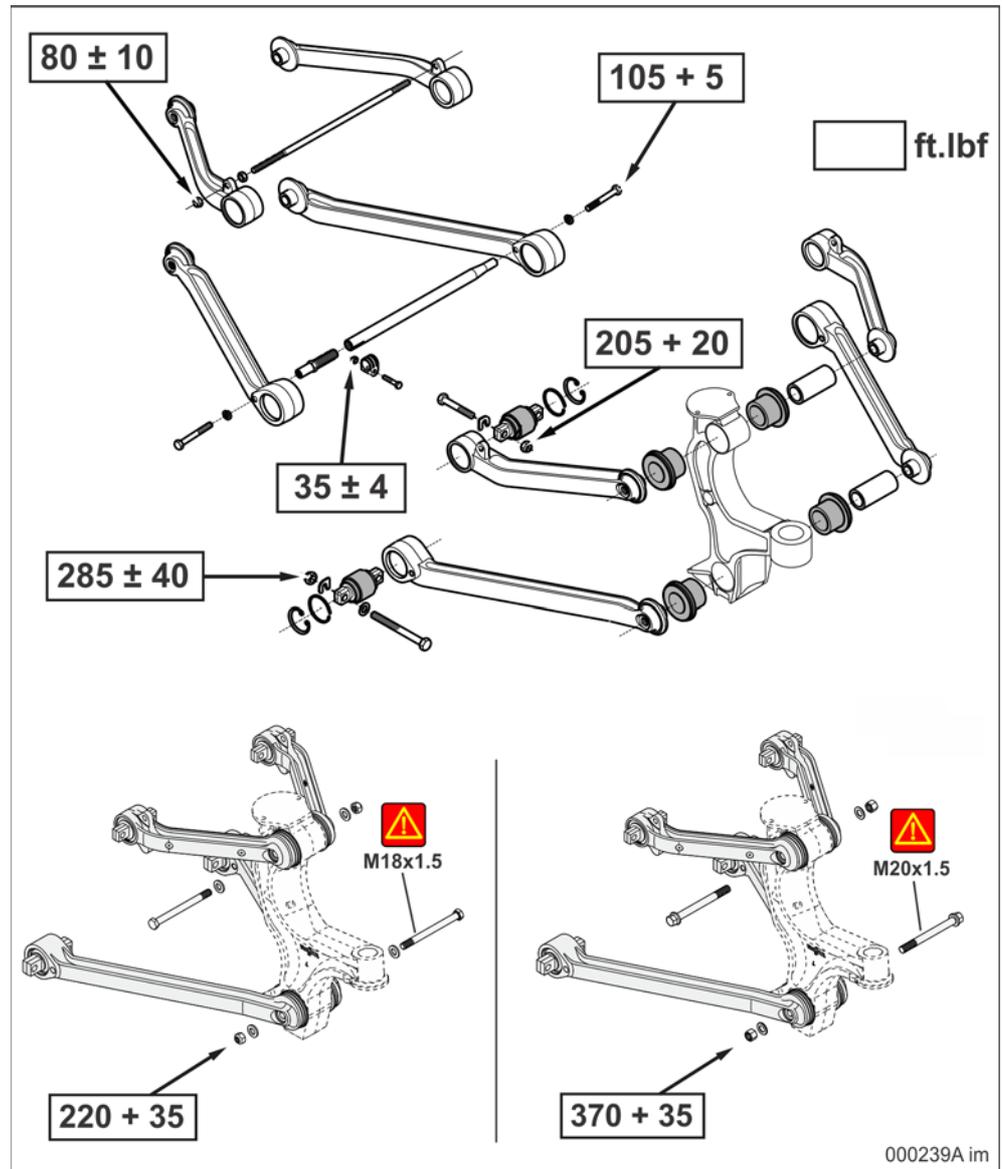
Axial clearance <ul style="list-style-type: none"> • new • at routine checks according to maintenance schedule 	maximum 0.008 in maximum 0.016 in
--	--------------------------------------

Tightening torques

Hub nut	545 ± 30 ft.lbf
Hexagonal socket screw for securing wheel flange to brake disc (M12 x 1.5)	55 ± 7 ft.lbf
Screws for securing wheel flange/brake disc to hub unit (M18 x 1.5-10.9)	320 ± 20 ft.lbf
Air spring piston to steering knuckle carrier	52 ± 7 ft.lbf
Shock absorber to steering knuckle carrier	70 ft.lbf
Nut of tie-rod clamping bolt	60 ± 7 ft.lbf

continued on next page

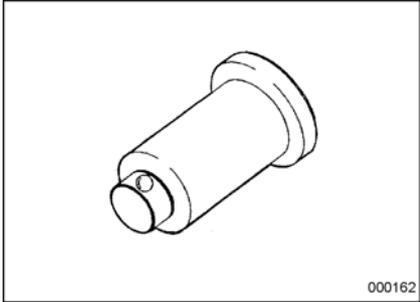
Figure:
tightening
torques



Security of wheel control arms.

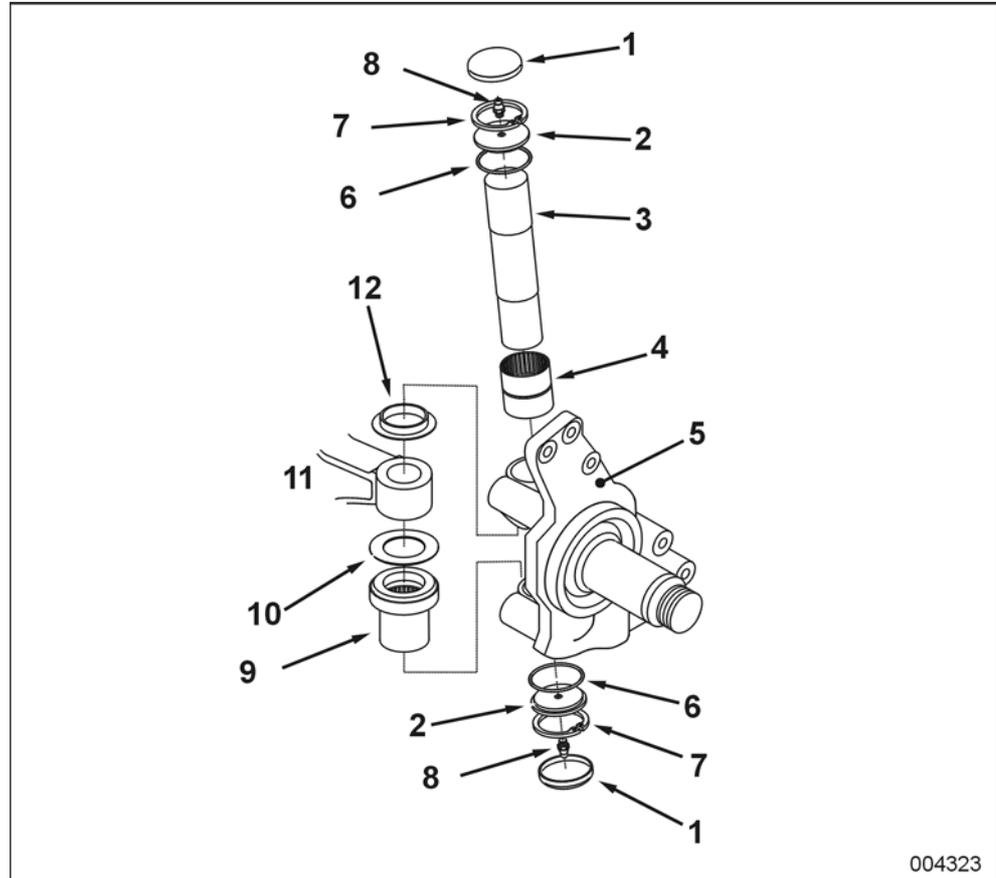
Special tools: front axle

Ordering number	Description	Figure
Van Hool No. 10695670	Tool kit to remove rubber bushings of control arm	<p>000207 im</p>
Van Hool No. A996030253	Hub nut wrench	<p>000157</p>
Van Hool No. A996060240 Van Hool No. A996060464 Van Hool No. A996060251 Van Hool No. A996060238	Tool set to remove hub unit from steering knuckle spindle 1 Spindle 2 Flange 3 Threaded bush 4 Cover	<p>000156</p>
Van Hool No. 10678700	Tool set to install the hub unit on the steering knuckle spindle	<p>000158</p>

Ordering number	Description	Figure
Van Hool No. A996066146	Press	
Van Hool No. A996206008	Pump	
Van Hool No. A996170183	Drift to press out kingpin	
Van Hool No. A996170179	Drift to install kingpin	
Van Hool No. A996040228	Distance sleeve	
Van Hool No. A996350050	Drift to install kingpin upper needle bearings	
Van Hool No. A996350051	Guide bush	
Van Hool No. A996170190	Mandrel	
Van Hool No. A996350049	Drift to install kingpin lower needle bearing unit	
Van Hool No. A996256001	Pliers	
Van Hool No. A996170196	Guide sleeve	
Van Hool No. A996170197	Magnetic guide	

Front axle, exploded view

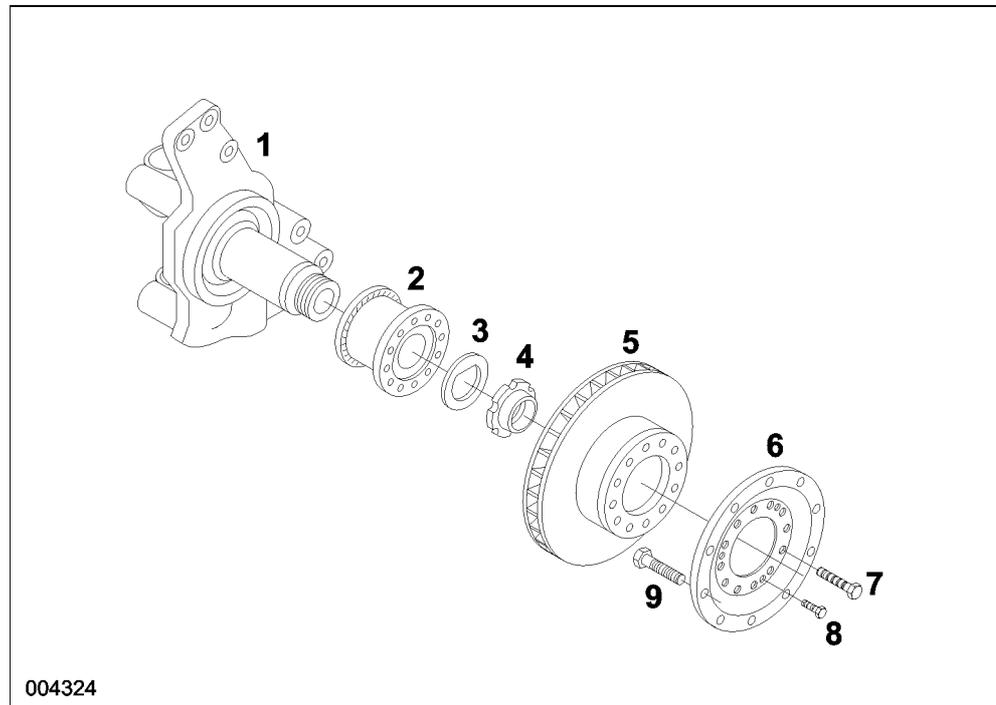
Steering knuckle, exploded view



004323

- 1 Cover (if fitted)
- 2 Plug plate
- 3 King pin
- 4 Upper needle bearing
- 5 Steering knuckle
- 6 O-ring
- 7 Snap ring
- 8 Grease nipple
- 9 Lower needle bearing
- 10 Spacer
- 11 Axle end
- 12 Grease seal

continued on next page

Hub, exploded view

- 1 Steering knuckle
- 2 Hub unit
- 3 Washer
- 4 Hub nut
- 5 Brake disc
- 6 Wheel flange
- 7 Screw retaining brake disc and wheel flange to hub unit
- 8 Hexagonal socket screw
- 9 Wheel bolt

Chapter 10: Drive axle

Overview

Introduction This chapter deals with the drive axle.

Number of pages 30

Chapter publication date 14 October 2016

Contents

Topic	See page
To check oil level	12.10-2
To change oil	12.10-4
Types of wheel bearings	12.10-5
To check wheel bearing end-play	12.10-7
To remove wheel bearing	12.10-10
To remove wheel bearing	12.10-12
To install wheel bearing	12.10-17
To install wheel bearing	12.10-20
To check breather	12.10-26
Technical data: drive axle	12.10-27
Special tools: drive axle	12.10-28

The following subjects have been *added/modified* since the former edition:

Topic	See page
Special tools: drive axle	12.10-28

To check oil level

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

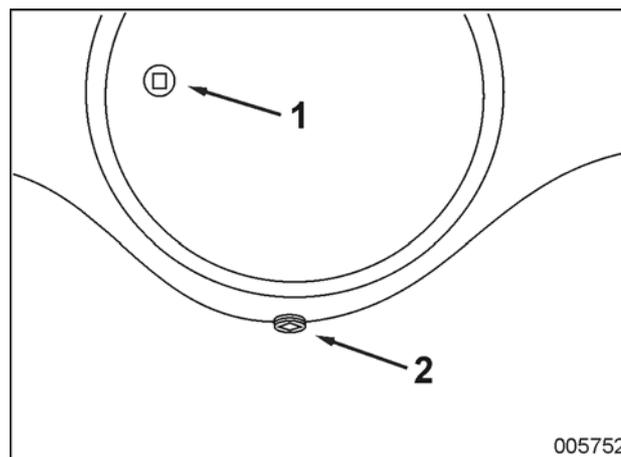
Oil type

Refer to chapter 1.1, "Fluids and lubricants".

All brand oils that meet the MIL-L-2105D specification are suitable and can be mixed provided they belong to the same viscosity class.

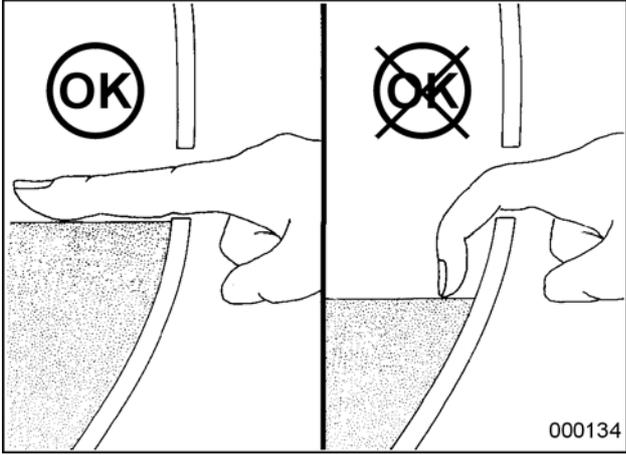
Equipment condition

- Cold oil
- Vehicle on level ground

**Figure:
housing bowl**

- 1 Filler/level plug
2 Drain plug

Procedure

Step	Action
1	<p>Unscrew cap (1). The oil must reach the edge of the opening.</p> 
2	If necessary, top up with oil through the same opening.

To change oil

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Oil capacity and oil type

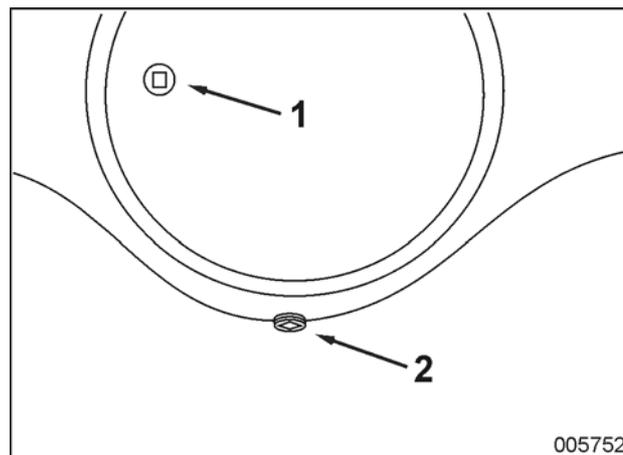
Refer to chapter 1.1, "Fluids and lubricants".

- The specified oil capacity is only a guideline; only the level determines the exact amount of oil needed for a correct operation of the axle.
- The axle manufacturer does not allow that you add additives of any kind.

Equipment conditions

- Warm oil (service temperature)
- Vehicle on level ground

Figure: housing bowl



- 1 Filler/level plug
2 Drain plug

Procedure

Step	Action
1	Unscrew plug (2).
2	Clean the magnetic drain plug and put it back when all the oil has drained.
3	Fill the axle through orifice (1), until oil begins to flow from orifice edge.

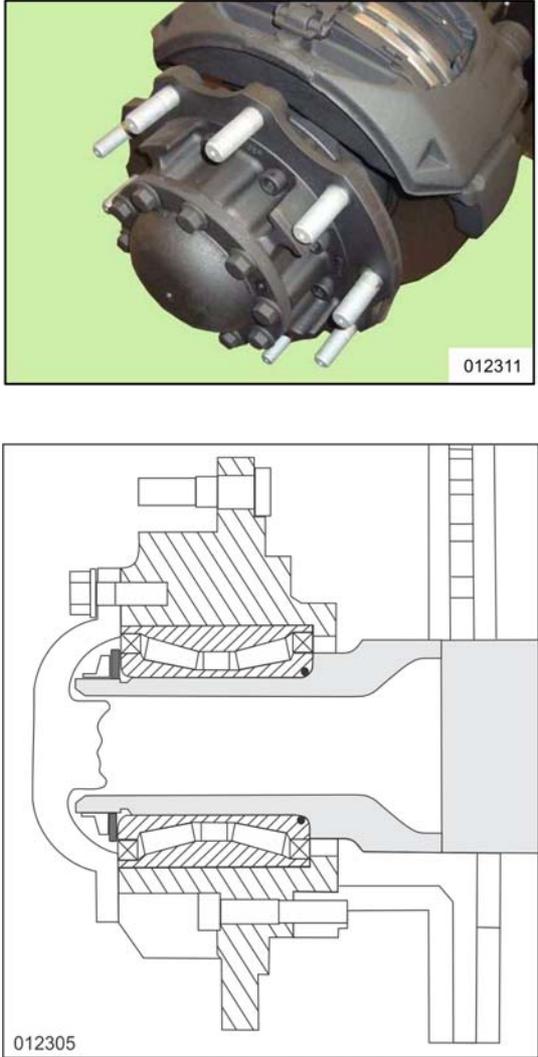
Types of wheel bearings

How to recognise?

The axle manufacturer DANA has changed halfway 2015 the wheel bearings of its drive axle.

Use the figures below to determine which drive axle type has been installed on your vehicle.

Figure: axle end

Drive axle	Figure
<p>Axle with "unitized" wheel bearings</p>	 <p>The figure consists of two parts. The top part is a 3D perspective view of a unitized wheel bearing assembly, showing a dark grey housing with several silver-colored bolts and a central hub. The bottom part is a technical cross-section diagram of the same assembly, showing the internal components like the axle, bearings, and housing. The 3D view is labeled '012311' and the cross-section is labeled '012305'.</p>

Drive axle	Figure
<p>Axle with "compact" wheel bearings</p>	<p>The figure consists of two parts. The top part is a photograph of a compact wheel bearing assembly, showing a dark metal housing with several white cylindrical rollers protruding from the front. The bottom part is a technical cross-section diagram of the axle and bearing assembly, showing the internal components like the axle, rollers, and housing. The diagram is labeled with the number 012306 in the bottom right corner.</p>

To check wheel bearing end-play

Applicable to which axle?

- DANA axle with wheel bearings of the unitised type.
- DANA axle with wheel bearings of the compact type.

NOTE: Refer to "Types of wheel bearings" in this chapter to know which drive axle is mounted on your vehicle.

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Procedure

Step	Action
1	Jack up the drive axle until the wheels clear the ground.
2	Give the wheel a couple of turns in both directions to allow the wheel bearings to settle.
3	 <p>CAUTION! Once the dial indicator has been set to zero, it is no longer permitted to turn the wheel. Neither should you touch the stylus of the dial indicator any more.</p> <p>Place a dial indicator with a magnetic support on the axle housing. Position the stylus of the dial indicator against the inside of the brake disk. Set the dial indicator to zero.</p>
4	Grab the wheel halfway its height and push it straight towards the inside as far as it will go. At the same time have an assistant note the displacement on the dial indicator.
5	<p>Hands still halfway its height, now pull the wheel towards the outside as far as it will go. At the same time have an assistant note the displacement on the dial indicator.</p> <p>The difference between both measured displacements represents the wheel bearing end-play at that side.</p>
6	Repeat steps 4 and 5 until you obtain two consecutive reliable measurements.
7	Compare the measured end-play with the maximum permissible value mentioned further on in the text.
8	Repeat this procedure for the other side of the vehicle.

continued on next page

Admissible end-play in case of new bearings

End-play	Action
0 inch	End-play OK. No further action required.
more than 0 inch	Tighten the hub nut to the prescribed torque. Then check the wheel bearing end-play once again. If the wheel bearing end-play is still above 0 inch, this means that the hub is damaged and that you have to change the hub together with the wheel bearing.

Admissible end-play in case of used bearings

End-play	Action
between 0 and 0.002 inch	End-play OK. No further action required.
between 0.002 and 0.008 inch	Tighten the hub nut to the prescribed torque. Then check the wheel bearing end-play once again. If the wheel bearing end-play is still above 0.002 inch, you have to change the wheel bearing.
more than 0.008 inch	Change the wheel bearing.

To tighten hub nut

Step	Action
1	Remove the axle shaft.
2	 <p>CAUTION! Not fully undoing the staking of the hub nut can lead to damage of the thread of the axle spindle, when tightening the hub nut further on in the text.</p> <p>With a pointed tool, fully undo the staking of the hub nut.</p>
3	Using the special hub-nut wrench, tighten the hub nut to the prescribed torque (refer to "Technical data" at the end of this chapter).
4	Lock the hub nut by staking its collar into the groove of the axle spindle.
5	Clean the contact surfaces between the axle shaft and the hub.
6	Apply Loctite 518 on the contact surfaces between the axle shaft and the hub.

continued on next page

Step	Action
7	Slide the axle shaft into the axle housing. Install the fixing screws and tighten them to the prescribed torque (refer to "Technical data" at the end of this chapter).

To remove wheel bearing

Applicable to which axle?

DANA axle with wheel bearings of the unitised type

NOTE: Refer to "Types of wheel bearings" in this chapter to know which drive axle is mounted on your vehicle.

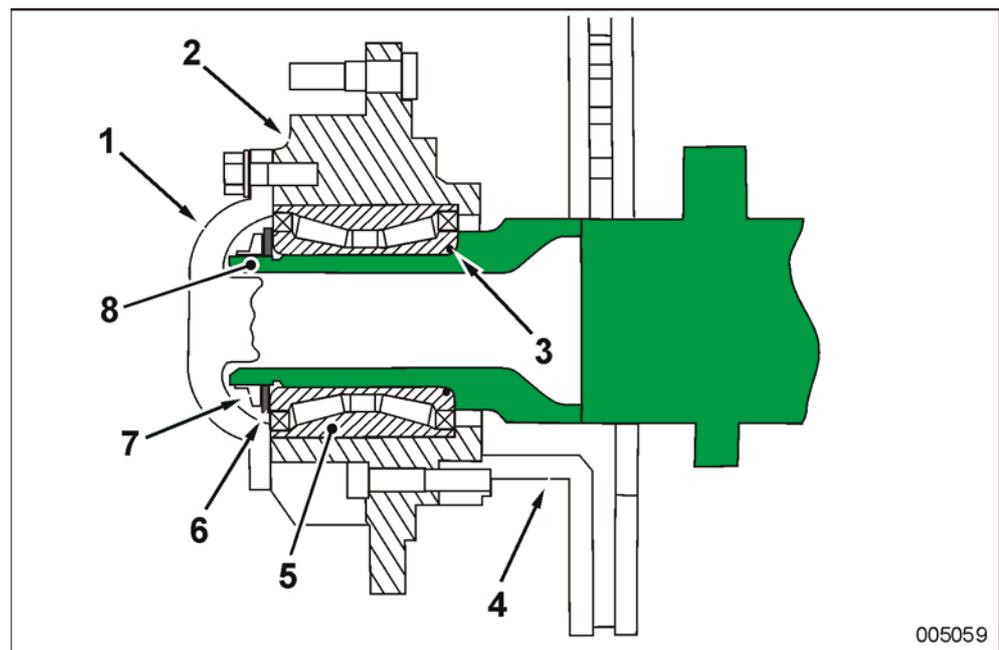
Special tools

Hub nut wrench	Van Hool No. 10732280
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Equipment conditions

- Chocks in front of and behind the wheels remaining on the ground
- Drive axle lifted
- Road wheel removed

Figure:
section
through axle
end



Legend to figure

Number in figure	Explanation
1	Axle shaft
2	Hub
3	Sealing ring (part of wheel bearing)

Number in figure	Explanation
4	Brake disk
5	Wheel bearing
6	Thrust washer
7	Hub nut
8	Axle spindle

Procedure

Step	Action
1	Release the parking brake by means of the mechanical emergency release unit, see below.
2	Remove the brake caliper/brake carrier assembly, refer to "To remove brake caliper/brake carrier" in chapter 5.10.
3	Remove axle shaft (1).
4	 <p>CAUTION! Not fully undoing the locking by staking of hub nut (7) may cause damage to the thread of axle spindle (8), when you remove hub nut further on.</p> <p>Fully undo the locking by staking of hub nut (7) using a pointed tool.</p>
5	Remove hub nut (7) using the special hub nut wrench.
6	 <p>WARNING! The hub/brake disk assembly is heavy. Support it well before removing it.</p> <p>Pull the hub/brake disk assembly from the axle spindle.</p>
7	Remove brake disk (4) from hub (2).
8	Using a press, push wheel bearing (5) out of hub (2).

To release parking brake mechanically

Step	Action
1	Remove dust cover from release bolt at parking brake cylinder rear side.
2	Unscrew the release bolt as far as it will go.

To remove wheel bearing

Applicable to which axle?

DANA G171 with "compact" wheel bearings

NOTE: Refer to "Types of wheel bearings" in this chapter to know which drive axle is mounted on your vehicle.

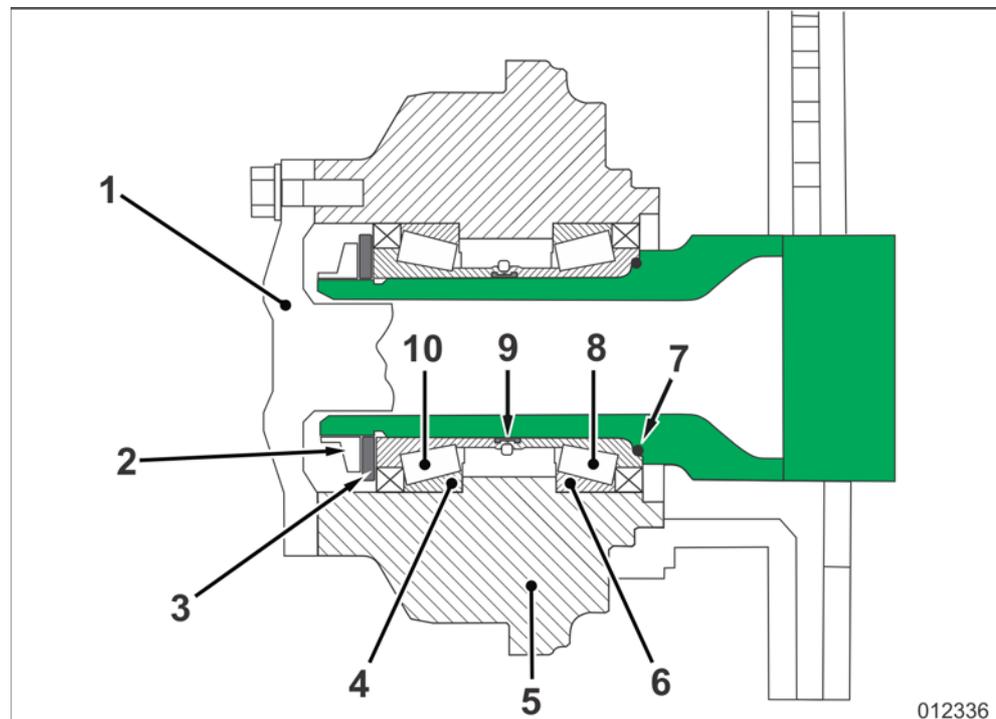
Special tools

Hub nut wrench	Van Hool No. 11491994
Drift to remove wheel-bearing outer ring	Van Hool No. 11484272
Distance piece for drift 11484272	Van Hool No. 11484279

Equipment conditions

- Chocks in front of and behind the wheels remaining on the ground
- Drive axle lifted
- Road wheel removed

Figure:
section
through axle
end



012336

Legend to figure

Number in figure	Explanation
1	Axle shaft
2	Hub nut
3	Thrust washer
4	Outer ring of outer roller bearing
5	Hub
6	Outer ring of inner roller bearing
7	O-ring
8	Inner roller bearing
9	Clamp spring
10	Outer roller bearing

Procedure

Step	Action
1	Release the parking brake by means of the mechanical emergency release unit, see below.
2	Remove the brake caliper/brake carrier assembly, refer to "To remove brake caliper/brake carrier" in chapter 5.10.
3	Remove the axle shaft.
4	 <p>CAUTION! Not fully undoing the staking of the hub nut can cause damage to the axle spindle thread when the hub nut is removed further on. Fully undo the staking of the hub nut by using a pointed tool.</p>
5	Remove the hub nut by using the special hub nut wrench. Remove the thrust washer.
6	 <p>WARNING! The hub/brake disc assembly is heavy. Support it well before removing it. Pull the hub/brake disc assembly from the axle spindle.</p>
7	Remove the brake disc from the hub.
8	Remove the wheel bearing from the hub as explained further on under "To remove wheel bearing".

continued on next page

**To remove
wheel bearing**

Step	Action
1	Place the hub on a flat surface.
2	Remove the clamp spring located between the wheel bearings by using a flat blade screwdriver. 
3	By using a hammer and a punch, drift the inner roller bearing together with the O-ring from the hub.
4	Turn the hub round and remove the other roller bearing in the same way.

Step	Action
5	<div data-bbox="577 318 667 405" data-label="Image"> </div> <p data-bbox="699 376 880 409">CAUTION!</p> <p data-bbox="577 421 1428 566">Check the pressing force necessary to remove the outer ring. Is the force less than 2250 lbf, than it not allowed to use the hub. Change the hub by a complete new hub/wheel bearing assembly.</p> <p data-bbox="577 589 1428 656">Press the outer ring of the roller bearing from the hub by using the special drift.</p> <div data-bbox="577 698 1428 1025" data-label="Image"> </div> <div data-bbox="769 1081 1241 1556" data-label="Image"> </div>
6	<p data-bbox="577 1585 1428 1686">Turn the hub round and remove the other outer ring in the same manner. Check here also the pressing force necessary to remove the outer ring.</p>

To release parking brake mechanically

Step	Action
1	Remove dust cover from release bolt at parking brake cylinder rear side.
2	Unscrew the release bolt as far as it will go.

continued on next page



To install wheel bearing

Applicable to which axle?

DANA axle with wheel bearings of the unitised type

NOTE: Refer to "Types of wheel bearings" in this chapter to know which drive axle is mounted on your vehicle.

Consumables

Refer to Van Hool spare parts manual

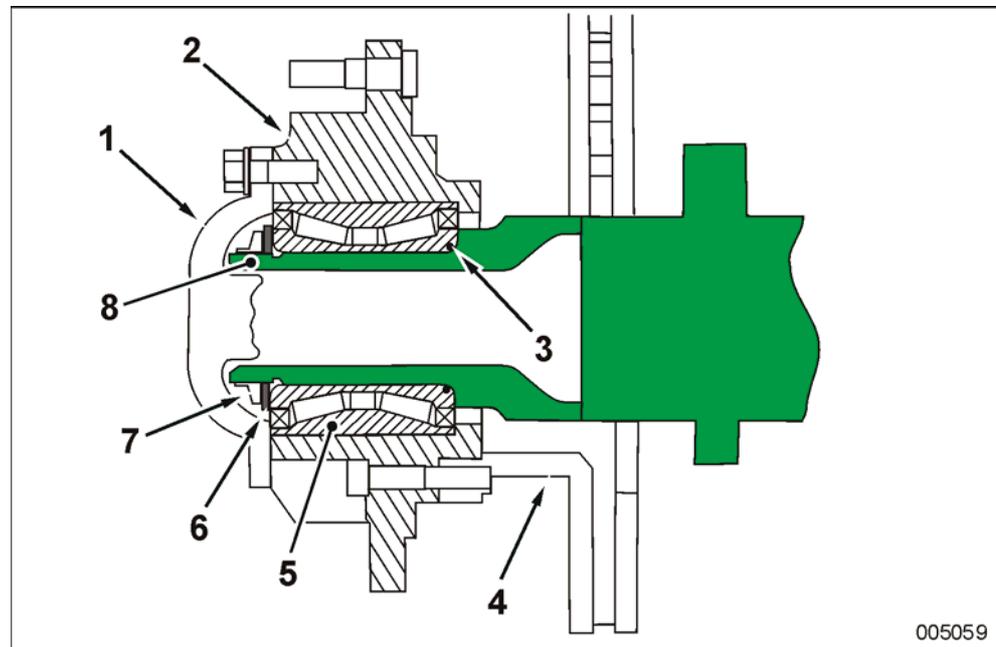
Special tools

Hub nut wrench	Van Hool No. 10732280
Drift to press wheel bearing in hub	Van Hool No. 10914289
Guide sleeve to slide hub on axle spindle	Van Hool No. 10920992

Tightening torques

Refer to "Technical data" at the end of this chapter.

Figure:
section
through axle
end



005059

Legend to figure

Number in figure	Explanation
1	Axle shaft
2	Hub
3	Sealing ring (part of wheel bearing)
4	Brake disk
5	Wheel bearing
6	Thrust washer
7	Hub nut
8	Axle spindle

Procedure

Step	Action
1	Put wheel bearing (5) on the bore in nut (2) so that sealing ring (3) is at the bottom.
2	By using the special drift, press wheel bearing (5) in hub (2).
3	Install brake disk (4) on hub (2). Install the fixing bolts and tighten them to the prescribed torque.
4	Clean axle spindle (8).
5	Check the thread of axle spindle (8) for damage. If necessary, repair thread.
6	Apply a thin film of "Never-Seez" to axle spindle (8).
7	Screw the special guide sleeve on axle spindle (8).
8	 WARNING! The hub/brake disk assembly is heavy. Slide the hub/brake disk assembly on axle spindle (8).
9	Remove the special guide sleeve.
10	Install thrust washer (6).
11	Install a new hub nut on the axle spindle. Tighten the hub nut to a torque of 280 ± 15 ft.lbf.
12	Turn hub (2) ten turns in direction of travel so that wheel bearings can set.
13	Tighten nut (7) to the prescribed torque.
14	Lock hub nut (7) by staking its collar into the slot of axle spindle (8).
15	Clean the contact surfaces between axle spindle (1) and hub (2).

continued on next page

Step	Action
16	Apply Loctite 518 on the contact surfaces between axle shaft (1) and hub (2).
17	Slide the axle shaft into the axle housing. Install the fixing screws and tighten them to the prescribed torque.
18	Install the brake caliper/brake carrier assembly, refer to "To install brake caliper/brake carrier" in chapter 5.10.
19	Restore parking brake operation by screwing home the release bolt as far as it will go and tightening it with a torque of 23 to 26 ft.lbf.

To install wheel bearing

Applicable to which axle?

DANA G171 with "compact" wheel bearings

NOTE: Refer to "Types of wheel bearings" in this chapter to know which drive axle is mounted on your vehicle.

Consumables

Refer to Van Hool spare parts manual

Special tools

Hub nut wrench	Van Hool No. 11491994
Pressure disc for drift to press wheel bearing in hub	Van Hool No. 11484292

Tightening torques

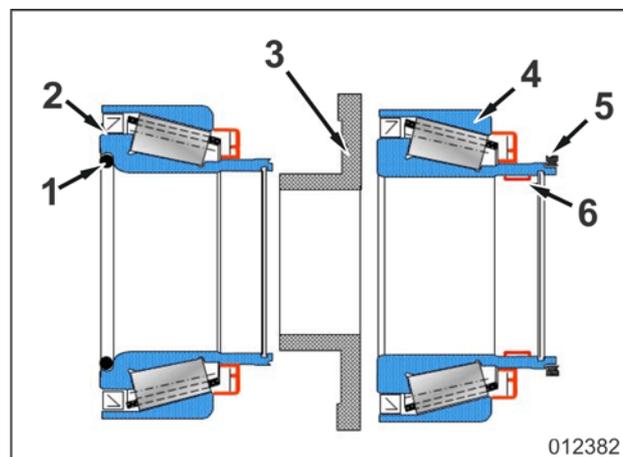
Refer to "Technical data" at the end of this chapter.

To check condition of hub

Step	Action
1	Thoroughly clean the inside of the hub. 

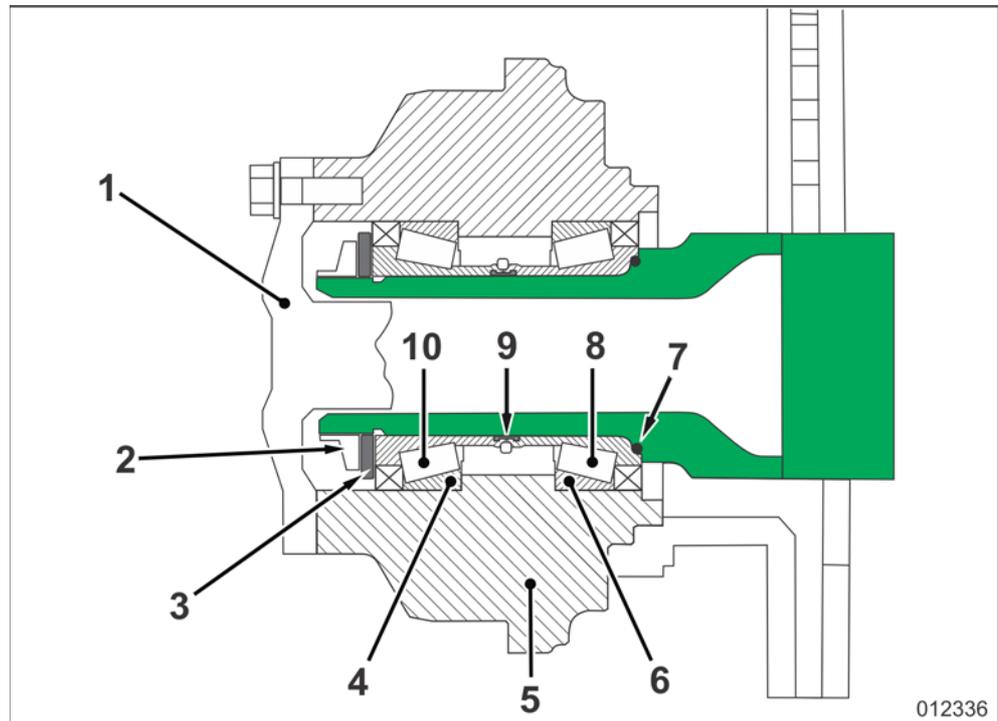
Step	Action
2	<div data-bbox="577 318 667 405" data-label="Image"> </div> <p data-bbox="694 376 880 414">CAUTION!</p> <p data-bbox="577 421 1428 638">Change the hub by a new hub/wheel bearing assembly if circumferential scratches, grooves, notches, gradual wear or pitting are visible. Such wear indicates that the outer ring of the roller bearing has rotated in the hub. Longitudinal marks (refer to figure) due to removal/installation of the outer ring are allowed</p> <p data-bbox="577 660 1324 694">Carefully check the seats for the roller bearing in the hub.</p> <div data-bbox="577 734 1433 1064" data-label="Image"> </div>

Figure: parts of wheel bearing kit



- 1 O-ring
- 2 Inner roller bearing
- 3 Drift to press in roller bearing
- 4 Outer roller bearing
- 5 Central sealing ring
- 6 Clamp spring

Figure:
section
through axle
end



012336

**Legend to
figure**

Number in figure	Explanation
1	Axle shaft
2	Hub nut
3	Thrust washer
4	Outer ring of outer roller bearing
5	Hub
6	Outer ring of inner roller bearing
7	O-ring
8	Inner roller bearing
9	Clamp spring
10	Outer roller bearing

**To install
wheel bearing**

This procedure may only be performed if the hub can be reused. Otherwise you have to install a complete new hub/wheel bearing assembly.

Step	Action
1	Clean the seats for the roller bearings in the hub.

continued on next page

Step	Action
2	Position the hub on a flat supporting face under the pressing tool, the contact surface for the axle shaft resting on this face.
3	Remove the O-ring from the inner roller bearing to prevent possible damage.
4	<div data-bbox="579 477 667 562" data-label="Image"> </div> <p data-bbox="699 533 879 568">CAUTION!</p> <p data-bbox="579 580 1414 759">Make sure that the hub, the roller bearing and the pressing tool are aligned. Use pressure disc 11484292 to make sure that the pressing force applies to the outer ring of the roller bearing. Never apply pressing force to the inner ring, otherwise the roller bearing will be damaged!</p> <p data-bbox="579 781 1406 848">Place the special drift from the kit in the inner roller bearing and position the assembly above the aperture in the hub.</p> <p data-bbox="579 869 1422 999">The force during pressing is ranged from 6750 à 11250 lbf. If the bearing doesn't move with a pressing force of 11250 lbf, first check the alignment of the components. Press the bearing home with a force of 22 500 lbf.</p> <div data-bbox="692 1048 1318 1352" data-label="Image"> </div>

Step	Action
5	<div data-bbox="579 320 667 405" data-label="Image"> </div> <p data-bbox="695 376 879 409">CAUTION!</p> <p data-bbox="579 423 1423 526">Check if the central sealing ring is positioned correctly. This will avoid damage to the sealing ring and ensure proper sealing after installation.</p> <p data-bbox="579 551 1380 613">Turn the hub round and use the same procedure for the outer roller bearing.</p> <div data-bbox="692 663 1318 965" data-label="Image"> </div>
6	<p data-bbox="579 994 1386 1093">Push the clamp ring in position by using a soft tool. The clamp ring is properly located when you hear a click and it can rotate freely.</p> <div data-bbox="692 1140 1318 1442" data-label="Image"> </div>
7	<p data-bbox="579 1473 1369 1536">Place the brake disc on the hub. Install the fixing screws and tighten to a torque of 215 ± 10 ft.lbf.</p>
8	<p data-bbox="579 1556 1214 1588">Place the O-ring in the inner roller bearing again.</p>
9	<p data-bbox="579 1601 874 1632">Clean the axle spindle.</p>
10	<p data-bbox="579 1646 1386 1709">Check the thread of the axle spindle for damage. If necessary, repair thread.</p>
11	<p data-bbox="579 1729 1257 1760">Apply a thin film of "Never-Seez" to the axle spindle.</p>
12	<div data-bbox="579 1778 667 1863" data-label="Image"> </div> <p data-bbox="695 1834 890 1868">WARNING!</p> <p data-bbox="579 1881 1118 1912">The hub/brake disc assembly is heavy.</p> <p data-bbox="579 1937 1286 1968">Slide the hub/brake disc assembly on the axle spindle.</p>

Step	Action
13	Install the thrust washer.
14	Install a new hub nut on the axle spindle. Tighten the hub nut to a torque of 280 ± 15 ft.lbf.
15	Turn the hub ten turns in direction of travel to settle the wheel bearings
16	Tighten the hub nut to the prescribed torque.
17	Lock the hub nut by staking its collar into the groove of the axle spindle.
18	Clean the contact surfaces between the axle shaft and the hub.
19	Apply Loctite 518 on the contact surfaces between the axle shaft and the hub.
20	Slide the axle shaft into the axle housing. Install the fixing screws and tighten to the prescribed torque.
21	Install the brake caliper/brake carrier assembly, refer to "To install brake caliper/brake carrier" in chapter 5.10.
22	Restore parking brake operation by screwing home the release bolt as far as it will go and tightening it with a torque of 23 to 26 ft.lbf.

To check breather

**To be carried
out when?**

Refer to chapter 1.1, "Maintenance schedule".

Procedure

Check whether breather passage is open (clean if necessary).

Technical data: drive axle

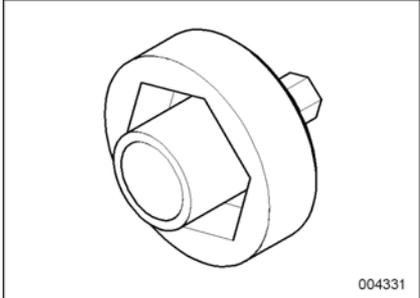
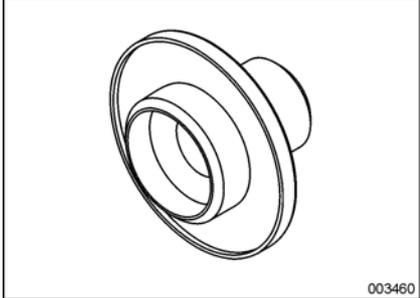
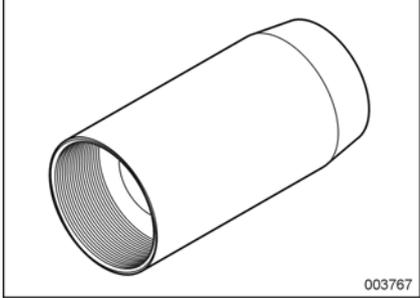
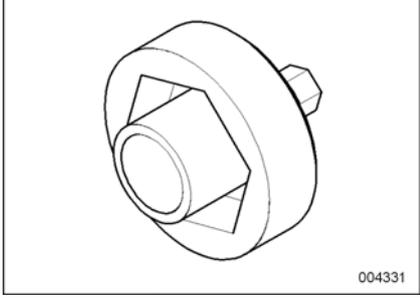
Make DANA

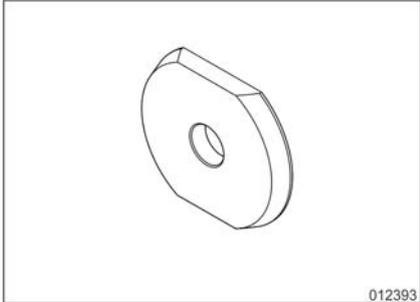
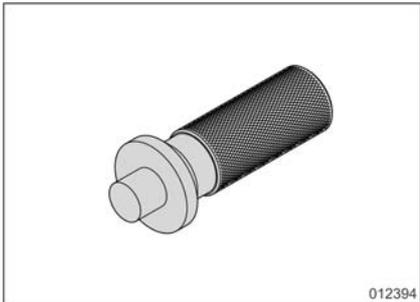
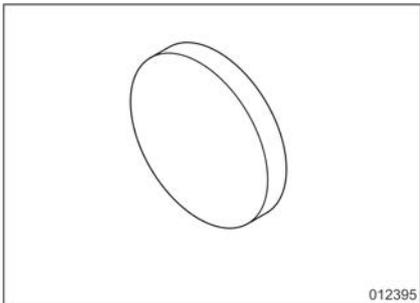
Type G171

Tightening torques

Hub nut <ul style="list-style-type: none"> • in case of "unitized" wheel bearings 	1st step: 175 ± 7 ft.lbf 2nd step: 700 ± 35 ft.lbf
<ul style="list-style-type: none"> • in case of "compact" wheel bearings 	1st step: 175 ± 7 ft.lbf 2nd step: 730 ± 7 ft.lbf
Screws for securing half shaft to wheel hub <ul style="list-style-type: none"> • in case of "unitized" wheel bearings • in case of "compact" wheel bearings 	245 ± 10 ft.lbf 235 ± 10 ft.lbf

Special tools: drive axle

Ordering number	Description	Figure
Van Hool No. 10732280	DANA axle with wheel bearings of the unitized type: hub nut wrench (width across flats: 4.1 inch)	 <p>004331</p>
Van Hool No. 10914289	DANA axle with wheel bearings of the unitized type: drift to press wheel bearing in hub	 <p>003460</p>
Van Hool No. 10920992	DANA axle with wheel bearings of the unitized type: guide sleeve to slide hub on axle spindle	 <p>003767</p>
Van Hool No. 11491994	DANA axle with wheel bearings of the compact type: hub nut wrench (width across flats: 4.7 inch)	 <p>004331</p>

Ordering number	Description	Figure
Van Hool No. 11484272	DANA axle with wheel bearings of the compact type: drift to remove wheel-bearing outer ring	 <p style="text-align: right; font-size: small;">012393</p>
Van Hool No. 11484279	DANA axle with wheel bearings of the compact type: auxiliary piece for drift 11484272	 <p style="text-align: right; font-size: small;">012394</p>
Van Hool No. 11484292	DANA axle with wheel bearings of the compact type: pressure disk to press wheel bearing in hub	 <p style="text-align: right; font-size: small;">012395</p>

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Chapter 14: Trailing axle

Overview

Introduction This chapter deals with the trailing axle.

Number of pages 30

Chapter publication date 14 October 2016

Contents

Topic	See page
Geometry	12.14-3
To check/adjust toe	12.14-4
To remove axle half	12.14-6
To install axle half	12.14-8
To check control arms for security	12.14-10
To replace control arm	12.14-11
To remove rubber bushings of control arm	12.14-12
To install rubber bushings of control arm	12.14-13
To replace flexible ball-joint of control arm	12.14-14
To adjust length of control arms tie rod	12.14-15
To check hub unit for wear	12.14-16
To check hub unit for grease leakage	12.14-18
To remove wheel hub	12.14-19
To install wheel hub	12.14-23
Technical data: trailing axle	12.14-26
Special tools: trailing axle	12.14-28
Trailing axle, exploded view	12.14-29

The following subjects have been *added/modified* since the former edition:

Topic	See page
To check hub unit for wear	12.14-16
Technical data: trailing axle	12.14-26

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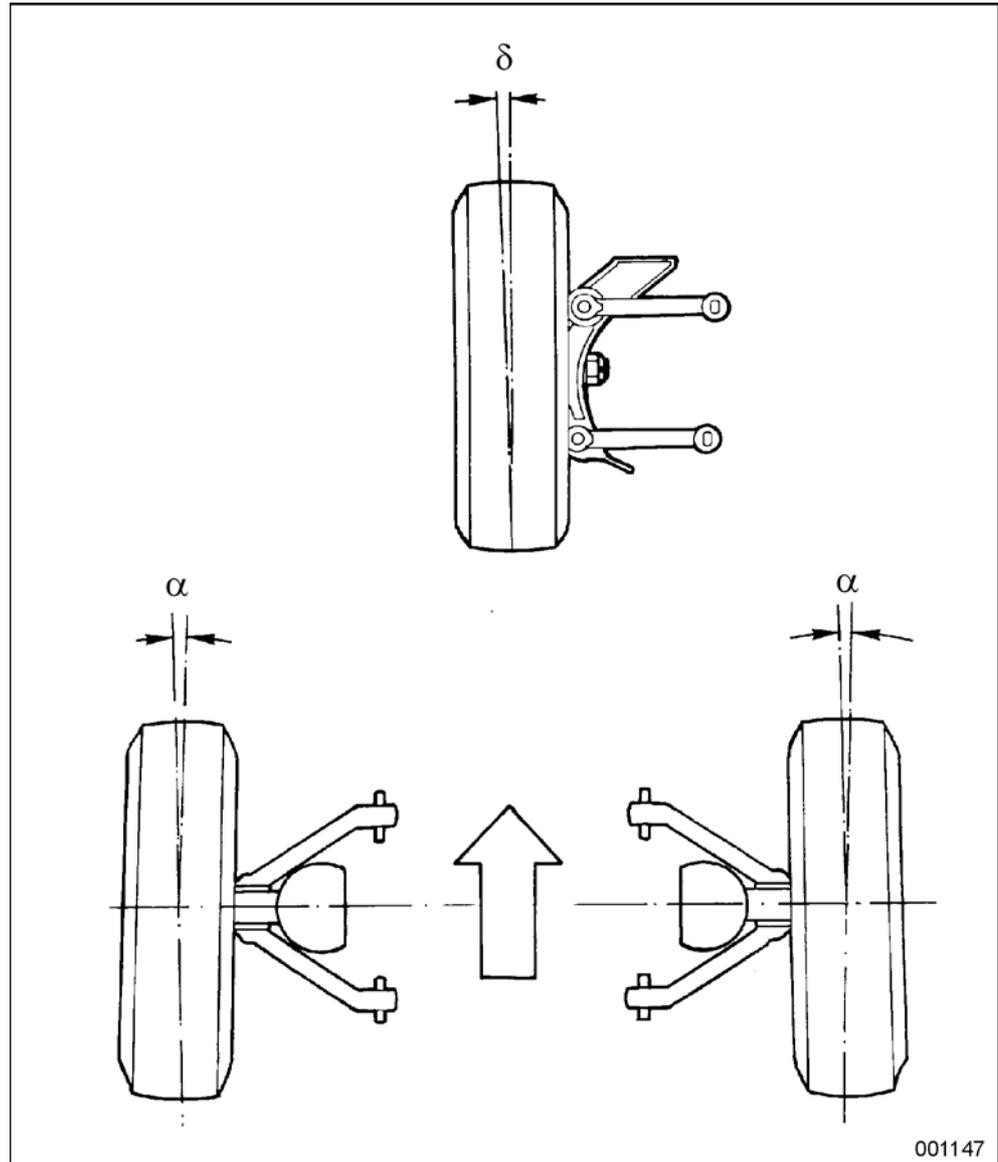


Geometry

Setting values

Refer to "Technical data" at the end of this chapter.

Figure: geometry



α Toe
 δ Camber

To check/adjust toe

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Checking/setting values

Refer to "Technical data" at the end of this chapter.

Tightening torques

Refer to "Technical data" at the end of this chapter.

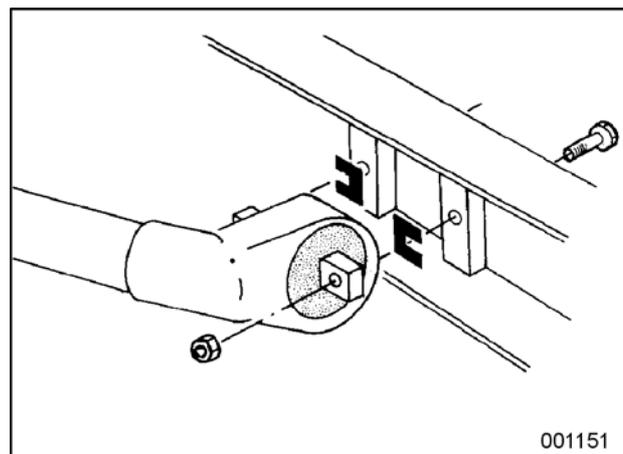
Equipment condition

- Unladen vehicle;
- Wheels on the ground;
- Correct tire inflation pressure;
- Correct air spring height;
- No excessive out-of-balance on the road wheels;

To check toe

Check toe for each wheel separately with optical equipment. Follow the instructions by the manufacturer of the equipment.

Figure: to adjust toe



To adjust toe

You can alter the toe by changing the number or the thickness of the shims between the chassis and control arms.

NOTE: The adjustment of the toe affects the camber. Check the camber after each adjustment of the toe.

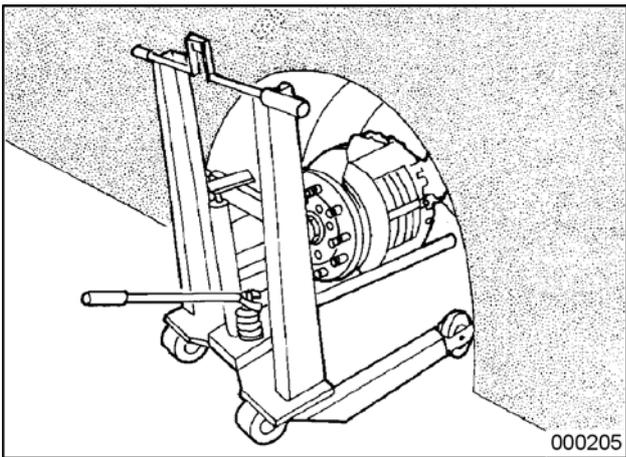
To remove axle half



WARNING!

Ensure that the axle half is well supported before you loosen the fixing bolts.

Procedure

Step	Action
1	Apply the parking brake and place chocks in front of and behind the wheels of the front axle.
2	Fully deplete the air suspension by means of the drain valve on the auxiliaries tank.
3	Slacken the wheel nuts on the side of the axle half that has to be removed by half a turn.
4	Put two jacks under the chassis. Raise the front of the vehicle until wheels clear ground. Support the chassis with axle stands or wooden blocks.
5	Mark the position of the wheel in relation to the hub (these parts are balanced together). Remove wheel.
6	Disconnect the control rod of the two leveling valves on the drive axle. Pull the control rod downward to deplete the air from the air bags.
7	Roll a lifting device under the axle half. 
8	Discharge the air from the brake system. Disconnect the compressed-air hose from the brake chamber.
9	Disconnect the shock absorber from the hub carrier.

continued on next page

Step	Action
10	Remove the bolts securing the air bag piston to the hub carrier.
11	<p><i>NOTE: Make note of the number and the position of the camber adjustment shims for re-use during assembly.</i></p> <p>Unscrew the nuts of the four bolts securing the upper control arms to the chassis, then remove the four nuts of the lower control arms.</p>
12	Withdraw the axle half from the vehicle.

To install axle half

Tightening torques

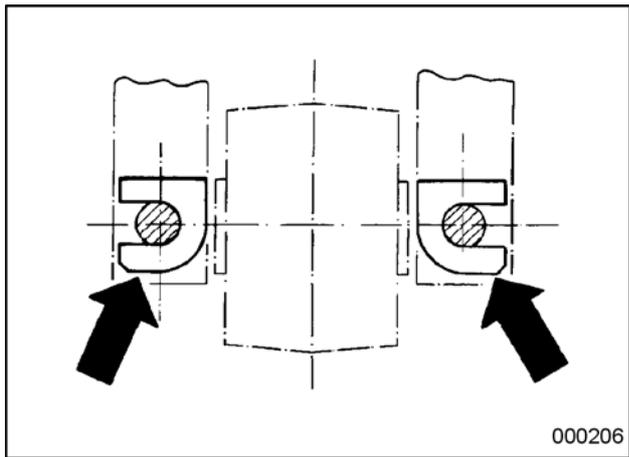
Refer to "Technical data" at the end of this chapter.



CAUTION!

If it is difficult to insert the fixing bolts of the control arms through the holes in the chassis, you need to extend or shorten the tie-rods of the arms until the bolt holes in the control arms exactly line up with the holes in the chassis. This way you prevent that the flexible ball joints will be preloaded when the bolts are tightened.

Procedure

Step	Action
1	Use a mobile lifting device to place the complete axle half under the vehicle.
2	<p>Secure the control arms - upper ones first, then the lower ones - to the chassis, but only hand-tighten the bolts.</p> <p>Ensure that you install the shims for the wheel alignment, the ones you found while removing the axle half, at the original place. The shims must be placed with the opening horizontally and to the outside, see figure.</p> <div data-bbox="689 1339 1318 1796" data-label="Image">  <p style="text-align: right;">000206</p> </div>
3	<p>Finally tighten the fixing nuts of the control arms.</p> <p><i>NOTE: Tighten the assembly bolt rubber bushings at the hub side only while the control arms are horizontal (refer to "To install rubber bushings of control arms").</i></p>

continued on next page

Step	Action
4	Secure air spring piston to the hub carrier. Tighten the screws to the prescribed torque.
5	Secure shock absorber to the hub carrier. Tighten self-locking nut to prescribed torque.
6	Secure compressed-air hose to the brake chamber.
7	Reconnect the control rod of the two leveling valves to its connection support.
8	Place the wheel and lower the vehicle.
9	Pressurize the air system and adjust the height of the air springs as described in "To adjust air spring height" in chapter 3.6.
10	Adjust toe, refer to "To check/adjust toe".
11	Road-test vehicle and recheck the toe.

To check control arms for security

Tightening torques

Refer to "Technical data" at the end of this chapter.

Procedure

Visually check those bolts, screws and nuts that are locked by means of a cotter pin, a locking plate or locking adhesive (Loctite). The security of all others must be checked mechanically. Retighten, if necessary.



WARNING!

Do not retighten bolts, screws or nuts that have been locked by means of locking adhesive (Loctite), as this would destroy the locking properties.

To replace control arm



CAUTION!

Control arms are not interchangeable.

Location of the control arms

A(n)... is located correctly	if...
upper control arm	the cast rib with the hole for the tie rod is on top.
lower control arm	the cast rib with the hole for the tie rod is at the bottom.

To remove rubber bushings of control arm

**Cross-
reference**

Refer to chapter 12.6, "To remove rubber bushings of control arm".

To install rubber bushings of control arm

**Cross-
reference**

Refer to chapter 12.6, "To install rubber bushings of control arm".

To replace flexible ball-joint of control arm

**Cross-
reference**

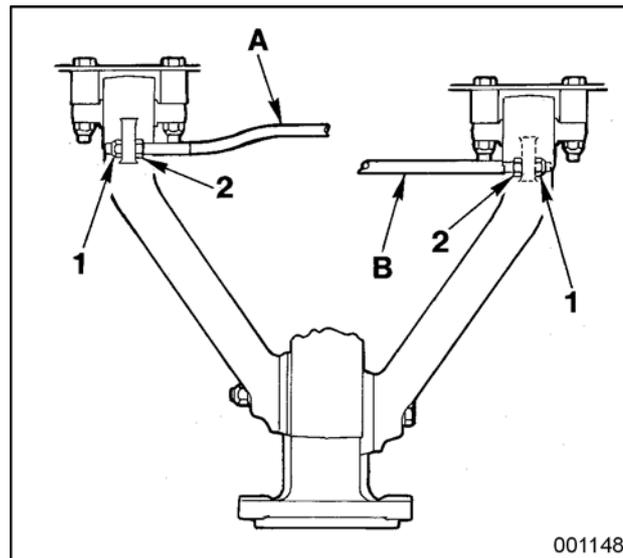
Refer to chapter 12.6, "To replace flexible ball-joint of control arm".

To adjust length of control arms tie rod

Introduction

Before the controls arms are finally tightened to the chassis, the length of the tie rods has to be adjusted in such way that the bolt holes of the control arms line up exactly with those in the chassis. The tightening of the fixing nuts should not preload the flexible ball joints of the control arms.

Figure: left axle half, view from above



- 1 Self-locking nut
- 2 Nut to adjust the tie rod
- A Upper tie rod
- B Bottom tie rod

Procedure

Step	Action
1	Loosen nuts (1).
2	Turn nuts (2) to change the length of the tie rod.
3	Tighten nuts (1).

To check hub unit for wear

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Equipment conditions

- Chocks in front of and behind the wheels remaining on the ground
- Vehicle raised so that the wheels of the axle that will be worked upon clear the ground

To check wheel bearing end-play

Step	Action
1	<p>Attach dial indicator with magnetic base at inside of brake disc. Place the indicator stylus square to the hub carrier. Set the dial indicator to zero.</p> 
2	<p>Grab wheel and tilt it as far as possible inwards and outwards (pull and push). At the same time have an assistant note the displacement on the dial indicator.</p> <p>The measured tilt course must not exceed 0.01 in (which corresponds to an axial wheel bearing clearance of 0.008 in).</p>

To check the sound of the wheel bearings

By hand, turn the wheel in both directions.

If...	then ...
the wheel bearing feels tight and you hear a "grinding" noise,	the complete hub unit has to be replaced.

continued on next page

If...	then ...
the wheel bearing makes a ticking or clicking sound,	that does not mean there is something wrong with the bearing. With lifted wheel, there is no load on the bearing so that the bearing rollers are able to move in axial direction.

To check hub unit for grease leakage

**Cross-
reference**

Refer to chapter 12.6, "Front axle".

To remove wheel hub

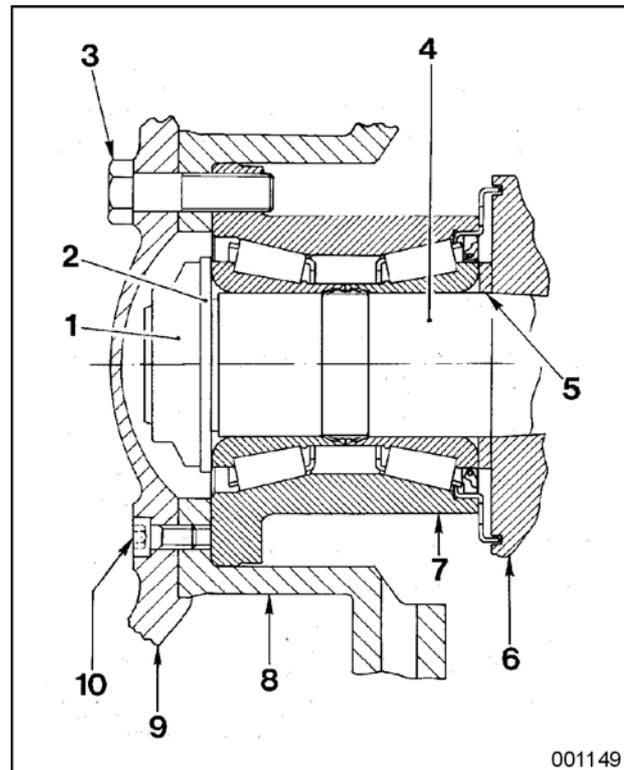
Special tools

Hub nut wrench	Van Hool No. A996030253
Tool set to remove hub unit from axle spindle <ul style="list-style-type: none"> • Spindle • Flange • Threaded bush • Cover 	<ul style="list-style-type: none"> • Van Hool No. A996060240 • Van Hool No. A996060464 • Van Hool No. A996060251 • Van Hool No. A996060238

Equipment condition

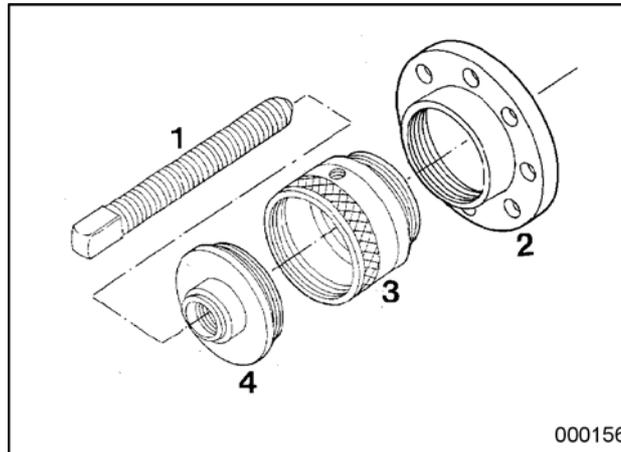
- Wheels remaining on the ground chocked
- Trailing axle jacked up
- Road wheel removed
- Brake caliper/brake carrier removed, refer to "To remove brake caliper/brake carrier" in chapter 5.10.

Figure:
section
through wheel
hub



- 1 Hub nut
- 2 Washer
- 3 Screw retaining brake disc and wheel flange to hub unit
- 4 Axle spindle
- 5 Spacer
- 6 Hub carrier
- 7 Hub unit
- 8 Brake disc
- 9 Wheel flange
- 10 Hexagonal socket screw

Figure: tool set



Tool set to remove hub unit from axle spindle

- 1 Spindle
- 2 Flange
- 3 Threaded bush
- 4 Cover

Hub unit

The hub unit combines two bearings, a grease seal and an ABS pulse ring. If one of these components is damaged, the entire unit must be replaced by a new one.



WARNING!

The wheel flange and the brake disc are heavy. Be sure they are well supported, before undoing the fixing screws.

Procedure

Step	Action
1	Remove hexagonal socket screw (10).
2	Remove the twelve screws (3) retaining wheel flange and brake disc to hub unit.
3	Remove wheel flange (9)
4	Thread puller screws into the three M12 x 1.5 tapped holes in brake disc. Free brake disc from hub unit using puller screws. Remove brake disc.
5	Remove hub nut (1) using hub nut wrench.
6	Remove washer (2).

continued on next page

Step	Action
7	Secure flange (2) of tool set to hub unit with three screws.
8	Screw threaded bush (3) of tool set into flange (2).
9	Screw cover (4) of tool set into threaded bush (3).
10	Screw spindle (1) of tool set into cover (4).
11	Remove hub unit by turning spindle (1) of tool set clockwise.

To install wheel hub

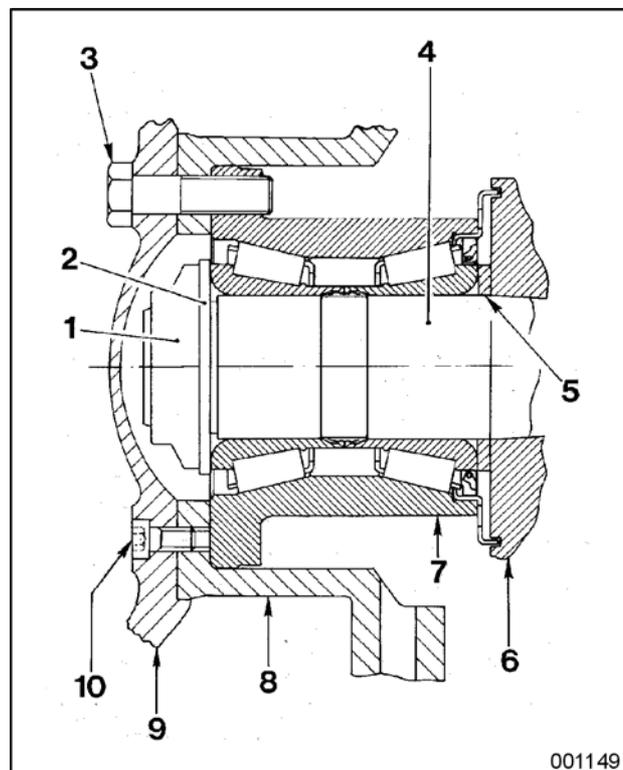
Special tools

Tool set to install the hub unit on the axle spindle	Van Hool No. 10678700
--	-----------------------

Tightening torques

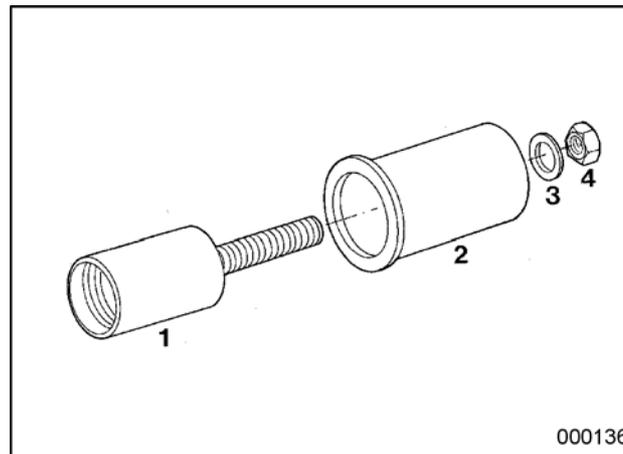
Refer to "Technical data" at the end of this chapter.

Figure:
section
through wheel
hub



- 1 Hub nut
- 2 Washer
- 3 Screw retaining brake disc and wheel flange to hub unit
- 4 Axle spindle
- 5 Spacer
- 6 Hub carrier
- 7 Hub unit
- 8 Brake disc
- 9 Wheel flange
- 10 Hexagonal socket screw

Figure: tool set



Tool set to install the hub unit on the axle spindle

- 1 Guide sleeve
- 2 Press sleeve
- 3 Washer
- 4 Nut

Step	Action
1	Apply thin film of "Never Seez" to axle spindle (4).
2	Slide spacer (5) on axle spindle.
3	Screw guide sleeve (1) of tool set onto the axle spindle
4	Slide hub unit on the guide sleeve (1) of the tool set.
5	Slide press sleeve (2) of the tool set on the guide sleeve.
6	Install washer (3) and nut (4) of the tool set on the threaded rod of the guide sleeve.
7	Turn nut (4) of the tool set clockwise to install the hub unit on the axle spindle.
8	Remove the tools.
9	Install washer (2).
10	Screw hub nut (1) on the axle spindle, tighten to the prescribed torque and simultaneously rotate the hub unit a couple of times in both directions to settle the roller bearings.
11	Apply a thin film of NLGI No. 2 grade high temperature lithium grease to the contact surfaces between brake disc (8) and hub unit (7).

Step	Action
12	Put brake disc (8) on a flat surface. Position wheel flange (9) on brake disc (8) in such a way that the holes for screw (10) coincide. Secure wheel flange (9) to brake disc (8) with hexagonal socket screw (8).
13	Position the wheel flange/brake disc assembly to the hub unit in such a way that the screw holes coincide. Install twelve fixing screws (3) and tighten them crosswise in steps.
14	Install the brake caliper/brake carrier assembly. Refer to "To install brake caliper/brake carrier" in chapter 5.10.

Technical data: trailing axle

Make

Van Hool

Geometry

Camber	+15' ± 15'
Toe (degrees)	0° ± 3'
Toe (inches)	0 ± 0.012 in/ft

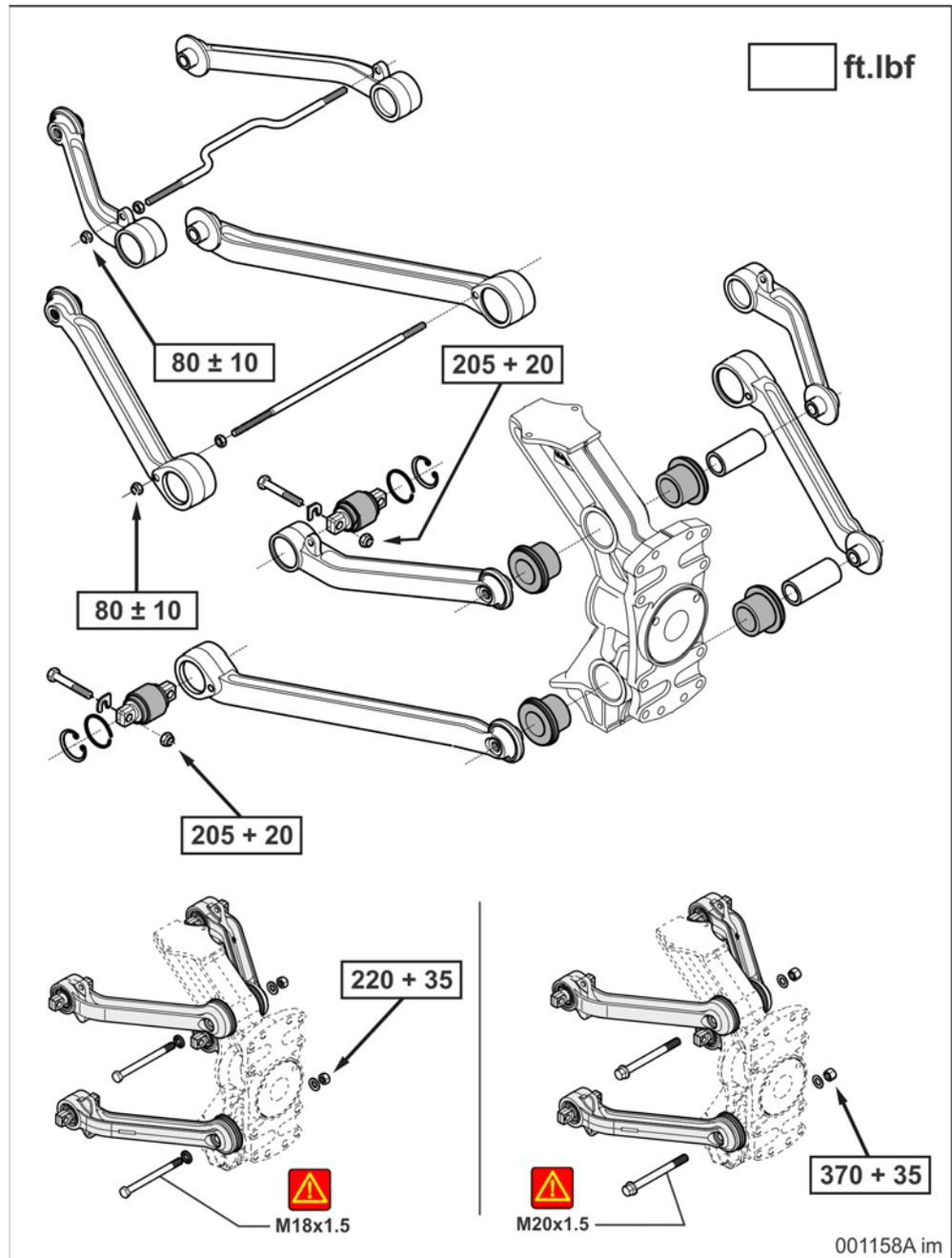
Hub

Wheel bearing end-play, checking value	maximum 0,01 in
--	-----------------

Tightening torques

Hub nut	545 ± 30 ft.lbf
Hexagonal socket screw for securing wheel flange to brake disc (M12 x 1,5)	55 ± 7 ft.lbf
Screws for securing wheel flange/brake disc to hub unit (M18 x 1,5 -10.9)	320 ± 20 ft.lbf
Air spring piston to the hub carrier	52 ± 7 ft.lbf
Shock absorber to hub carrier	70 ft.lbf

Figure:
tightening
torques



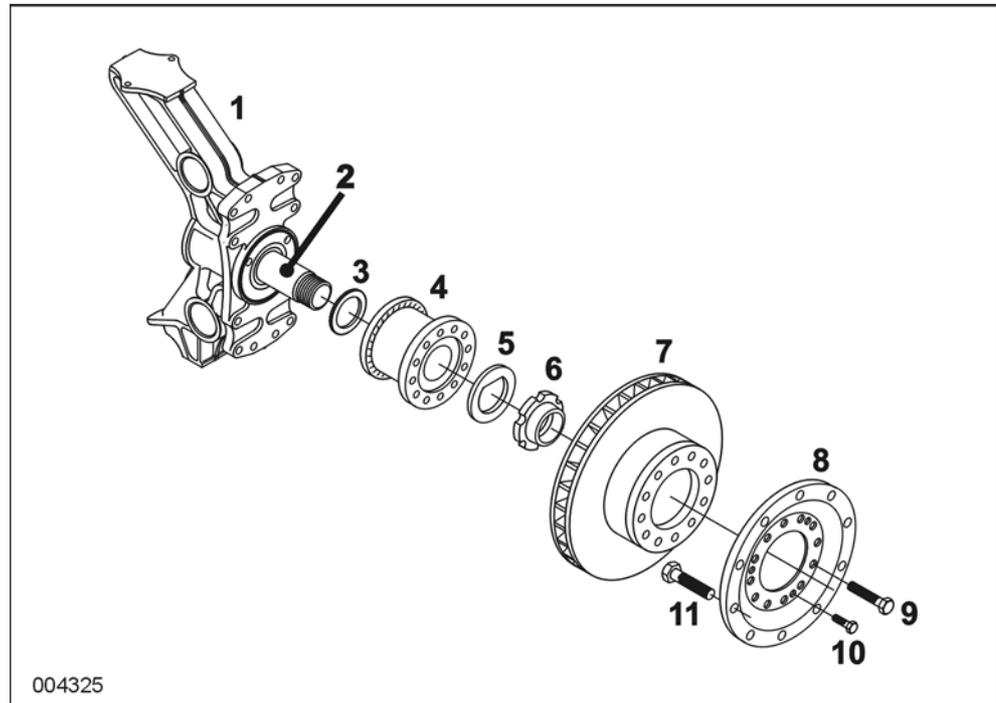
Security of wheel control arms.

Special tools: trailing axle

Ordering number	Description	Figure
Van Hool 10695670	Tool kit to remove rubber bushings from the control arm	<p>M22 x 1.5 x 60 DIN 961</p> <p>5.5 in 0.6 in dia</p> <p>2.95 in 0.6 in dia</p> <p>000207 im</p>
Van Hool A996030253	Hub nut wrench	<p>000157</p>
Van Hool A996060240 Van Hool A996060464 Van Hool A996060251 Van Hool A996060238	Tool set to remove hub unit from axle spindle 1 Spindle 2 Flange 3 Threaded bush 4 Cover	<p>000156</p>
Van Hool 10678700	Tool set to install the hub unit on the axle spindle	<p>000158</p>

Trailing axle, exploded view

Hub, exploded view



- 1 Hub carrier
- 2 Axle spindle
- 3 Spacer
- 4 Hub unit
- 5 Washer
- 6 Hub nut
- 7 Brake disc
- 8 Wheel flange
- 9 Screw retaining brake disc and wheel flange to hub unit
- 10 Hexagonal socket screw
- 11 Wheel bolt

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Part 13 - Compressed-air feed system

Overview

Contents

Chapter	See page
Chapter 1: Complete compressed-air system	13.1-1
Chapter 9: Air purifying devices	13.9-1
Chapter 13: Valves	13.13-1
Chapter 17: Tanks	13.17-1
Chapter 21: Pressure switches and pressure sensors	13.21-1
Chapter 25: Air lines	13.25-1

Chapter 1: Complete compressed-air system

Overview

Introduction This chapter deals with the complete compressed-air system.

Number of pages 4

Chapter publication date 21 September 2016

Contents

Topic	See page
Safety precautions concerning compressed air	13.1-2
Layout	13.1-3
To charge compressed-air tanks externally	13.1-4

Safety precautions concerning compressed air

**WARNING!**

Always wear safety goggles, when you are working with compressed air. Never look into a stream of escaping air.

**WARNING!**

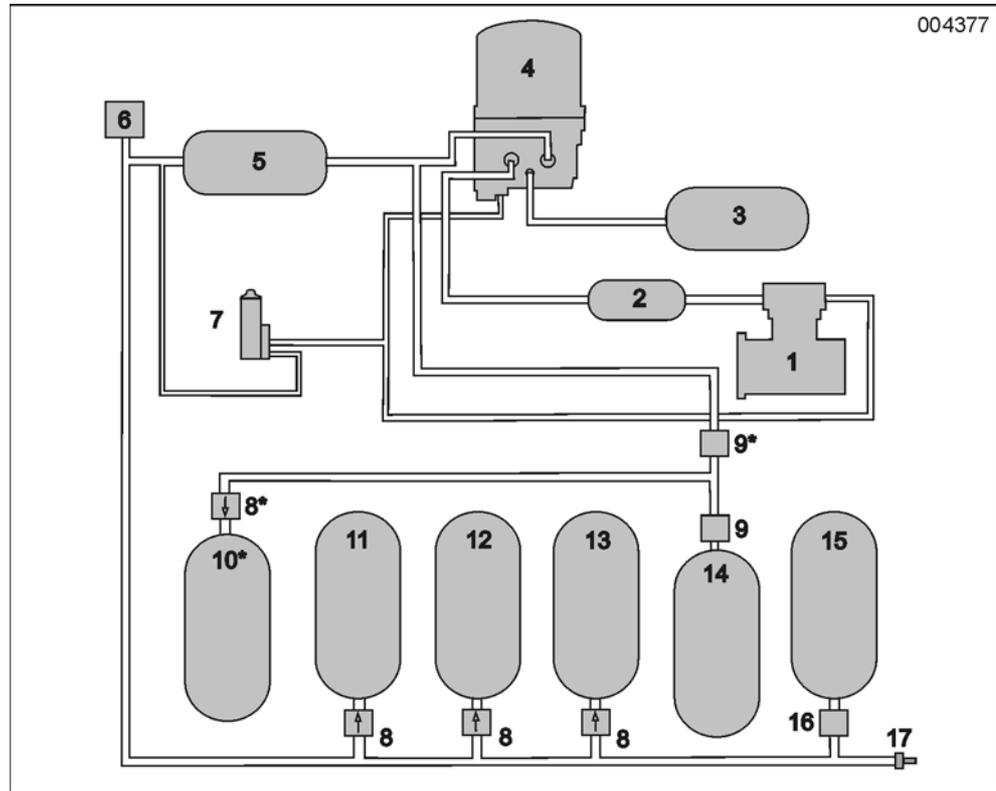
It is dangerous to disconnect lines, while the compressed-air system is still pressurized: disconnected lines through which air is escaping can be slung about.

**WARNING!**

It is dangerous to unscrew plugs or to open compressed-air apparatuses, while the system is pressurized. Parts that are slung about by compressed air can cause serious injuries.

Layout

Figure: layout



* Only for ZF Astronic

- 1 Air compressor
- 2 Damper tank
- 3 Purge tank
- 4 Air dryer
- 5 Wet tank
- 6 Safety valve
- 7 Governor
- 8 Single check valve
- 9 Overflow valve with limited return
- 10 ZF Astronic tank
- 11 Trailing axle brakes tank
- 12 Drive axle service brakes tank
- 13 Front axle brakes tank
- 14 Auxiliaries tank
- 15 Emergency parking brake release tank
- 16 Overflow valve without return
- 17 Fill coupling

To charge compressed-air tanks externally



CAUTION!

Make sure the air is dry and clean. In addition, air pressure should not exceed 130 psi.

Fill coupling

As to the location of the fill coupling, refer to "Access doors and controls at the outside".

If necessary, you can charge the entire compressed-air system of the vehicle via the fill coupling.

Chapter 9: Air purifying devices

Overview

Introduction

This chapter deals with the air purifying devices.

Number of pages

2

Chapter publication date

21 September 2016

Contents

Topic	See page
To change air dryer element	13.9-2

To change air dryer element

To be carried out when?

Change the element at the intervals indicated in the maintenance schedule (chapter 1.1) and whenever a check of the compressed-air tanks reveals that there is too much condensation in it.

Equipment condition

- Vehicle on a flat level surface, over an inspection pit;
- Chocks in front of and behind wheels.

Consumables

Air dryer element	Van Hool No. 10898619
-------------------	-----------------------

Location of air dryer

Refer to chapter 1.1, "Maintenance schedule".

Procedure

Step	Action
1	Depressurize the air dryer circuit completely by opening the drain valve on the wet tank. For the location of the air tanks refer to "Location of compressed-air tanks" in chapter 13.17.
2	Wait until no more air escapes from the drain valve.
3	Follow the Haldex instructions provided with the new air dryer element.

Chapter 13: Valves

Overview

Introduction This chapter deals with the valves.

Number of pages 6

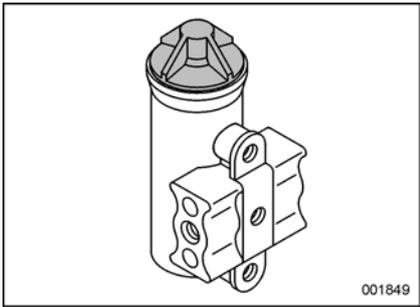
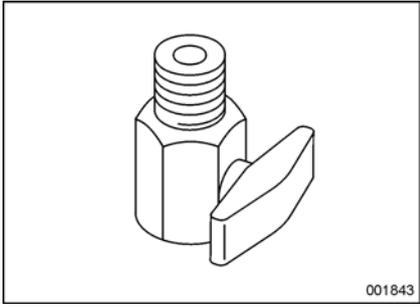
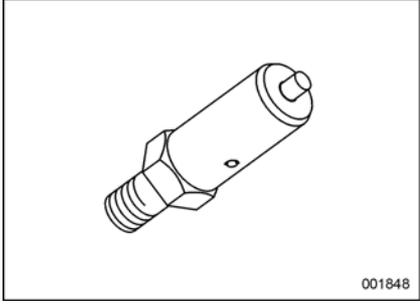
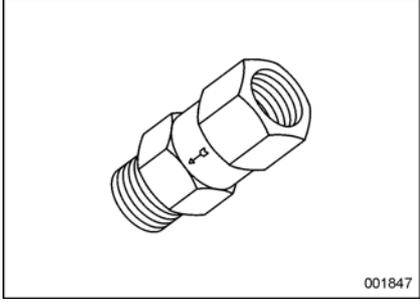
Chapter publication date 21 September 2016

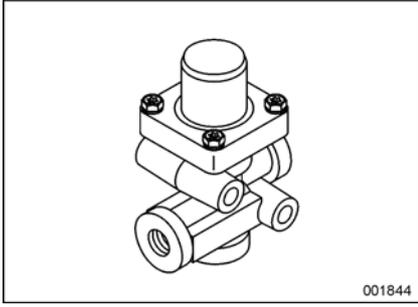
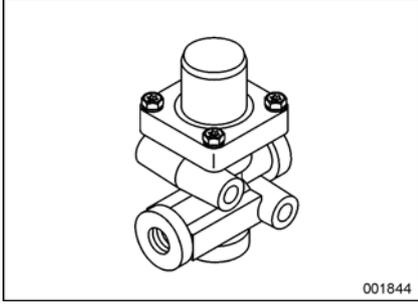
Contents

Topic	See page
Visual identification of valves	13.13-2
To check governor operation	13.13-4
Technical data: valves	13.13-5

Visual identification of valves

Components

Name	Figure
Governor	 <p style="text-align: right;">001849</p>
Compressed-air tank drain valve	 <p style="text-align: right;">001843</p>
Pressure-relief valve	 <p style="text-align: right;">001848</p>
Single check valve	 <p style="text-align: right;">001847</p>

Name	Figure
Overflow valve without return	
Overflow valve with limited return	
Fill coupling	

To check governor operation

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Checking values

Refer to "Technical data" at the end of this chapter.

Location of governor

The governor is mounted on the air compressor.

Procedure

Step	Action
1	Connect a class 0.6 pressure gauge with a range of 145 psi to the fill coupling of the compressed-air system. As to the location of the fill coupling, refer to "Access doors and controls at the outside".
2	Start engine to have pressure build-up in compressed-air tanks. Filling should be effected at 1 000 to 1 500 rpm. Follow pressure build-up on the gauge.
3	Make note of pressure reading at point where governor switches off (you will hear air dryer blow off).
4	Compare value with cut-out pressure value in technical data.
5	Have engine idle and keep an eye on pressure gauge. Try and get pressure in tanks to drop back to 105 psi by pumping brake pedal. Wait for a few seconds after each time you have depressed brake pedal.
6	At one point compressor begins to fill compressed-air tanks (governor cuts in). Make note of pressure gauge reading, exactly at point where pointer starts to climb.
7	Compare value with cut-in pressure value in technical data.

Technical data: valves

Governor

Make	Allied Signal
Type	D2
Cut-out pressure	130 to 140 psi
Cut-in pressure	110 to 115 psi



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Chapter 17: Tanks

Overview

Introduction This chapter deals with the compressed-air tanks.

Number of pages 4

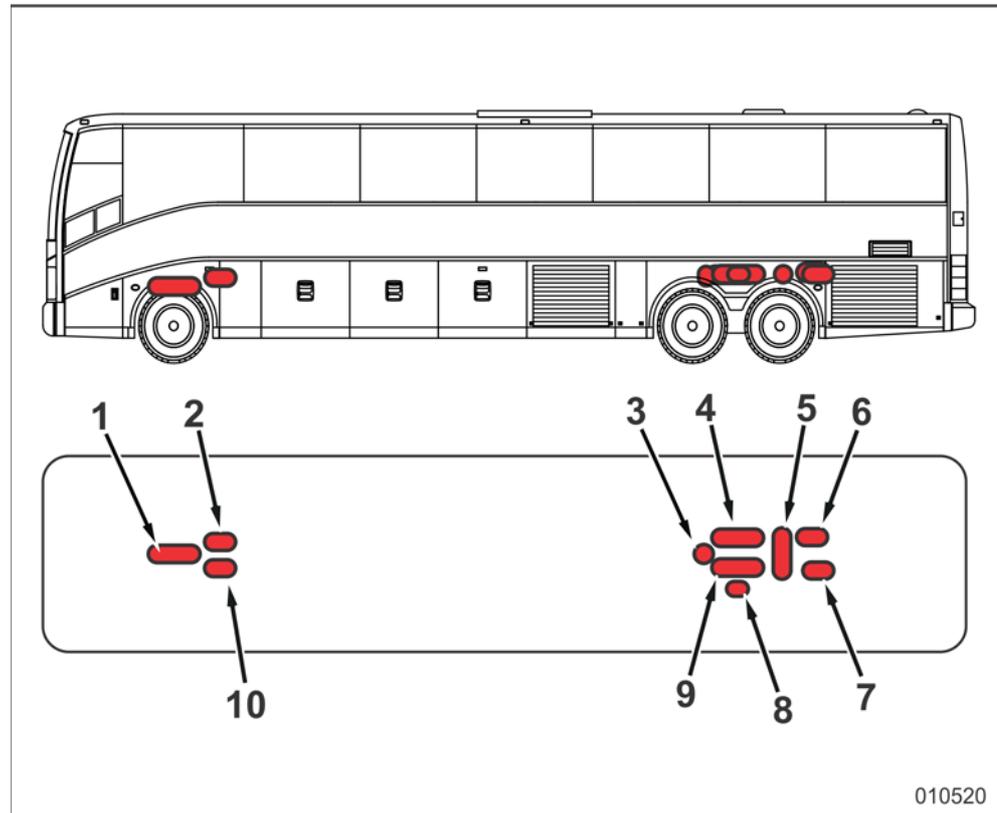
Chapter publication date 21 September 2016

Contents

Topic	See page
Location of compressed-air tanks	13.17-2
To check compressed-air tanks for absence of moisture	13.17-3
To check security of compressed-air tanks	13.17-4

Location of compressed-air tanks

Figure:
location of
compressed-
air tanks



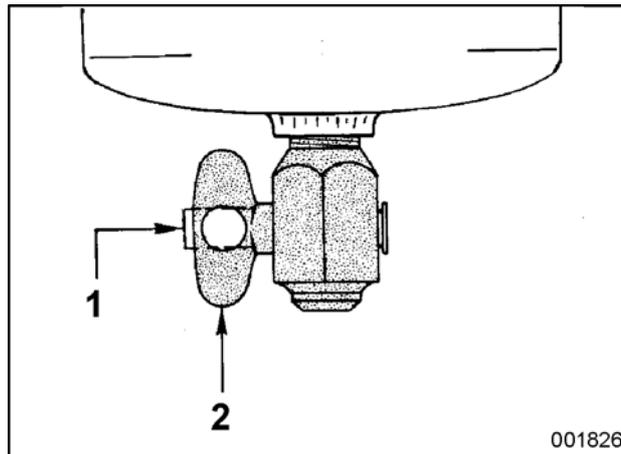
- 1 ZF Astronic (vehicles with ZF Astronic transmission only)
- 2 Rear raising
- 3 Air-dryer regeneration
- 4 Drive axle service brakes
- 5 Kneeling system
- 6 Front-axle brakes
- 7 Parking brake emergency release
- 8 Wet tank
- 9 Accessories
- 10 Trailing axle brakes

To check compressed-air tanks for absence of moisture

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Figure:
compressed-air tank drain valve



1 Closed
2 Open

Procedure

Momentarily open drain valve of each tank.

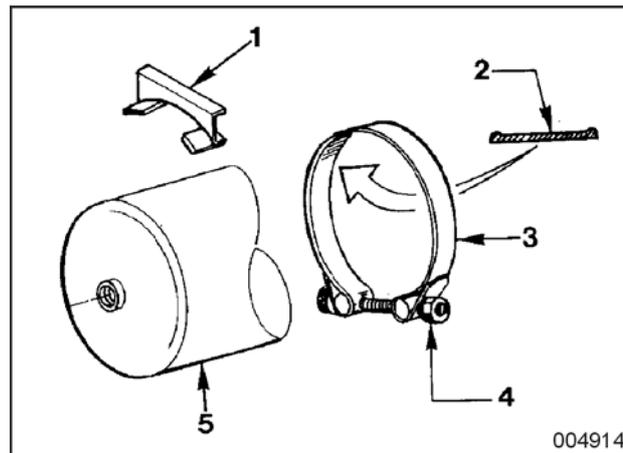
If...	then...
only some light mist escapes with the air,	system air dryer is functioning properly.
a lot of water or other impurities come out,	drain compressed-air tanks completely and change air-dryer element.

To check security of compressed-air tanks

To be carried out when?

Refer to chapter 1.1, "Running-in service".

Figure: security of compressed- air tank



- 1 Support
- 2 Rubber profile
- 3 Clamping ring
- 4 Fixing bolt
- 5 Compressed-air tank

To check security

Mechanically check the fixing bolts for tightness. If necessary, hand-tighten the fixing bolts.

Chapter 21: Pressure switches and pressure sensors

Overview

Introduction This chapter deals with the pressure switches and pressure sensors.

Number of pages 4

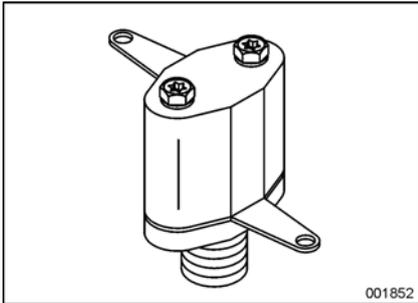
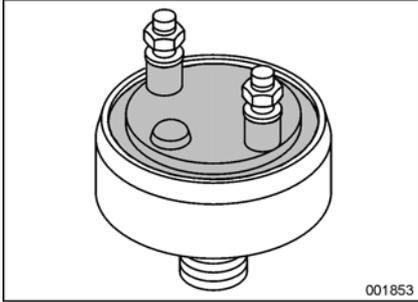
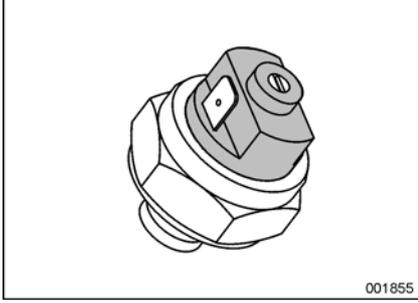
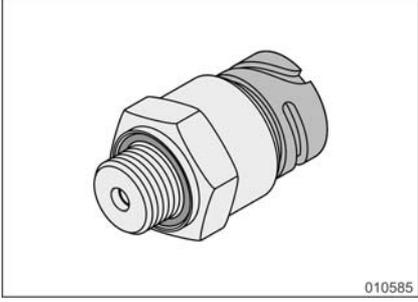
Chapter publication date 21 September 2016

Contents

Topic	See page
Visual identification of pressure switches and pressure sensors	13.21-2

Visual identification of pressure switches and pressure sensors

Components

Denomination	Figure
Pressure switch (Bendix LP-3)	 <p style="text-align: right;">001852</p>
Pressure switch (Bendix SL-5)	 <p style="text-align: right;">001853</p>
Pressure switch (Wabco 441014....)	 <p style="text-align: right;">001855</p>
Pressure sensor	 <p style="text-align: right;">010585</p>

continued on next page



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Chapter 25: Air lines

Overview

Introduction This chapter deals with the air lines.

Number of pages 4

Chapter publication date 21 September 2016

Contents

Topic	See page
Air line color codes	13.25-2
To check air-compressor discharge line for carbon deposit	13.25-3

Air line color codes

Introduction

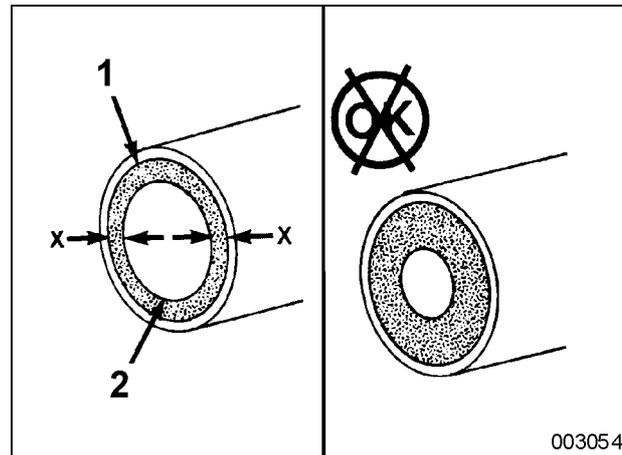
The end of each air line bears one or two color rings. You can tell by these color rings what is the function of the line. The table below lists the meaning of the colors.

Color codes

Van Hool color code	Letter representation on compressed-air diagram	Function
2 x red	R-R	General pressure supply
1 x red, 1 x green	R-GN	Tank pressure, service brake 1st axle
1 x green	GN	Braking pressure, service brake 1st axle
1 x red, 1 x yellow	R-GE	Tank pressure, service brake 2nd axle
1 x yellow	GE	Braking pressure, service brake 2nd axle
1 x red, 1 x white	R-W	Tank pressure, bus stop brake and parking brake
1 x white	W	Pressure in parking brake cylinders
1 x brown	BR	Pilot pressure for bus stop brake
1 x red, 1 x gray	R-GS	Tank pressure, accessories
1 x gray	GS	Accessories (air suspension, door control, etc.)
1 x red, 1 x blue	R-B	Tank pressure, parking brake cylinders emergency release
1 x blue	B	Emergency release pressure for parking brake cylinders
1 x orange	O	Bleeding

To check air-compressor discharge line for carbon deposit

Figure: air-compressor discharge line



- 1 Inner diameter discharge line
 2 Inner diameter carbon deposit

Procedure

Step	Action
1	Release pressure from air system by actuating drain valve on wet tank.
2	Disconnect the discharge line from the air compressor.
3	Measure the total thickness (X + X) from the carbon deposit in the discharge line.
4	Is the carbon discharge thicker than 1/16 in? If yes, go to step 5. If not, go to step 6.
5	Check: <ul style="list-style-type: none"> the condition of the air compressor; the lines and couplings further up in the compressed-air system (up to the air dryer and the governor) for excessive carbon deposit. If necessary, clean/replace lines and couplings.
6	Install the discharge line to the air compressor.



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Part 14 - Electrical

Overview

Contents

Chapter	See page
Chapter 2: Electric power supply	14.2-1
Chapter 6: Junction boxes	14.6-1
Chapter 10: Wiring	14.10-1
Chapter 18: Electric circuit diagrams	14.18-1

The following chapters have been *modified* since the former edition:

Chapter	See page
Chapter 2: Electric power supply	14.2-1
Chapter 10: Wiring	14.10-1

Chapter 2: Electric power supply

Overview

Introduction This chapter deals with the electric power supply.

Number of pages 18

Chapter publication date 14 October 2016

Contents

Topic	See page
General safety instructions	14.2-2
To retrofit electrical equipment	14.2-3
Alternator: general	14.2-4
Alternator: to fit a new or exchange alternator	14.2-6
Safety precautions concerning batteries	14.2-7
Batteries: general	14.2-8
Batteries: general maintenance	14.2-10
Batteries: to check charge	14.2-12
Jump starting instructions	14.2-13
120 VAC system: layout	14.2-17

The following subjects have been *added/modified* since the former edition:

Topic	See page
To retrofit electrical equipment	14.2-3

General safety instructions



WARNING!

The use of mobile phones and transmitting equipment inside the vehicle may disturb the operation of vehicle electronics and therefore jeopardize vehicle operational safety. In order not to jeopardize vehicle operational safety, mobile phones and transmitting equipment must not be used inside the vehicle, unless they are connected to an external vehicle antenna.



CAUTION!

Never remove battery clamps while engine is running or with battery switch closed. If you have to remove the battery clamps, always start with the negative terminal (marked with “-” or a blue or green plastic ring). The other way round, always connect the positive terminal first (“+” or red plastic ring), before connecting the negative terminal. Connecting the wrong polarity will damage the electrical system.



CAUTION!

Van Hool cannot be held liable for the consequences of others adding electrical devices or modifying electrical circuits.



CAUTION!

Never test an electrical circuit by applying voltage.



CAUTION!

Never use an external electrical source to power or test devices on the vehicle.

To retrofit electrical equipment

Introduction

If you want to add electrical devices to the vehicle equipment yourself, you should proceed in such a way that the original electrical system is not interfered with.

Conditions

- To power the additional devices, you will have to fit electrical wires of your own. The wiring you installed yourself will have to be protected with fuses that you will have to provide yourself as well.
- If the combined power consumption of the additional devices exceeds 25 A, you will have to install an additional main fuse with the vehicle batteries.

What equipment is allowed?

If electrical or electronic systems are being modified, replaced or added, the devices or systems involved must comply with the latest version of UN regulation No. 10 with regard to electromagnetic compatibility (EMC).

Parts of the alternator

The three phase current coil (3) is in the stator of the alternator and the field coil (4) is in the rotor. The stator winding (3) is permanently connected with the batteries (BA.1) and (BA.2). The D+ terminal is connected with the field coil through sliprings with carbon brushes. Six Zener diodes (2) serve to rectify the generated three phase alternating current in the stator for usage in the vehicle system. Three ordinary diodes (1) serve to rectify a smaller part of the generated current for feeding the field coil. An electronic voltage regulator (5) is under the cap at the end of the alternator.

Operation

Stage	Description
1	When the alternator is engaged it cannot power itself. The batteries (BA.1) and (BA.2) must power the field coil (4) first of all.
2	With a closed master switch (RL511) and ignition switch (KS) the battery current runs through the alternator indicator light (KL) and the D+ terminal to the field winding (4) through the current regulator to the ground. <i>NOTE: In some vehicles the alternator indicator light is replaced by a simple resistor.</i>
3	The alternator voltage increases as the number of revolutions increases. With this a rectified current runs through the field diodes (1). The voltage difference between the the D+ point and the batteries decreases. Because of this the current that runs through the indicator light (KL) decreases and the latter lights less brightly.
4	As soon as the alternator voltage is of the same value as the battery voltage the indicator light (KL) will go out. All of the field current is then generated by the alternator itself and rectified by the field diodes (1).
5	When the alternator voltage increases even more, the alternator begins to charge the batteries.

Voltage Regulator

The task of the electronic voltage regulator is to upwardly limit the current generated by the alternator, even with strongly varying revolutions and varying load. This limit value is not adjustable. A defective regulator cannot be fixed and must be replaced.

Limitation of voltage peaks

Voltage peaks are limited by the use of Zener diodes as power rectifiers.

Alternator: to fit a new or exchange alternator

Compensating sleeve

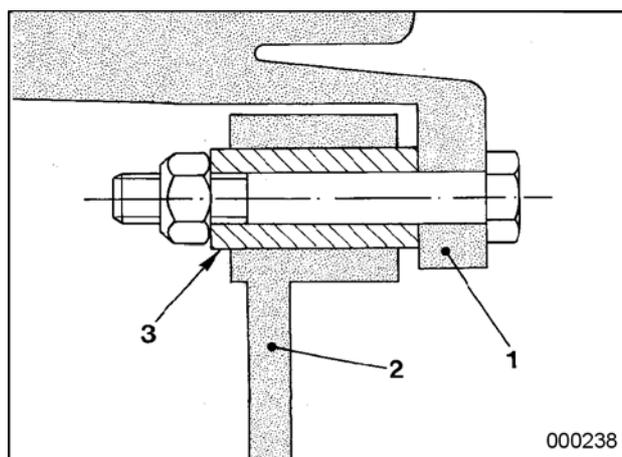
The distance between the front and back alternator-swinging arm is never exactly the same on alternators of the same model. A compensating sleeve may be necessary when installing the alternator to compensate for the differences. This sleeve is located in the eye of the swinging arm or in the alternator support (depending on the way the alternator is attached on your vehicle).



CAUTION!

Check, before installing the alternator, that the compensating sleeve is sufficiently loose for it to shift while the pivot bolt is tightened. If the sleeve is stuck, loosen it, otherwise you run the risk that the swinging arms are stressed and break off.

Figure:
alternator
mounting



Example of rear alternator mounting (sectional view)

- 1 Alternator (swinging arm in detail)
- 2 Alternator support
- 3 Compensating sleeve

Safety precautions concerning batteries



WARNING!

Battery fluid is a corrosive acid. Avoid any contact with the eyes, skin, clothing and painted surfaces. In the event of contact, immediately rinse the affected area with ample water; have a doctor attend to the eyes immediately. Avoid spilling battery fluid. Always hold a battery upright, when moving it.



WARNING!

Take care that no flames or sparks get in the vicinity of batteries. Do not smoke near batteries. Battery fumes are flammable and explosive. Prolonged inhalation of these fumes is harmful. Wear gloves and safety goggles. Work in a well-ventilated space.



WARNING!

Take care that no metal tools touch the positive battery terminal (or parts attached to it) and the body metal at the same time. After all, this will trigger a short circuit, which can cause burn injuries and explosions.



CAUTION!

Never remove battery clamps while engine is running or with battery switch closed. If you have to remove the battery clamps, always start with the negative terminal (marked with “-” or a blue or green plastic ring). The other way round, always connect the positive terminal first (“+” or red plastic ring), before connecting the negative terminal. Connecting the wrong polarity will damage the electrical system.

Batteries: general

Applicable models	Vehicles with one battery group consisting of two 12-volt batteries, connected in series.
Battery type	The batteries are of the "starter battery" type. As the name suggests, this type can only be used to start the engine, i.e. to provide a large supply of energy very briefly. Starter batteries are not appropriate for use that implies extended discharges on a repeated basis. If the battery has to supply power for long periods, its useful life will be greatly reduced.
Disruptions of charging process	<p>If disruptions occur in the charging process, the batteries will be recharged inadequately. Insufficient charging for a longer period will cause irretrievable loss of capacity. Disruptions of the charging process can occur, when:</p> <ul style="list-style-type: none"> • the vehicle is operated for short trips mainly and the big power consumers are used intensively at the end of the trip; The batteries are not fully recharged, which can cause problems next time you try to start the engine; • you make a 12-volt tap from the batteries to power a 12-volt system (such as a communications system). The batteries become imbalanced, which will lead to defective batteries in the short run. • you connect extra devices directly to the batteries. The power used with electrical battery switch in the off-position will be greater in this case, which will cause the batteries to drain more quickly. • power is drained with the engine off on a regular basis (for example by turning on interior lighting to clean the vehicle).
With high ambient temperature	The batteries of a vehicle that is parked in the garage discharge due to a phenomenon known as "self-discharge". In the tropics self-discharge progresses exceptionally fast. After one month without recharging for instance, charge will have dropped to about 50% of normal charge. If the battery discharges even further, it will become unusable on a permanent basis. In order to prevent premature malfunction of batteries, they have to be recharged on a regular basis (by driving the vehicle or using an external battery charger).
Electronic engine management system	Contemporary engines with electronic management systems are very "voltage sensitive": the engine-management electronics do not function, if voltage is too low. In such case starting is impossible, even when the starter motor is running properly.

continued on next page

**To recharge
batteries from
external
source**

Only use professional battery chargers. Before charging "low-maintenance" batteries, unscrew all plugs to allow for the gas to escape.

**To use a quick
charger**

Using a so called quick charger is not good for the battery. In general they supply too high an output voltage. If you want to use a quick charger after all, at least remove the clamp from the negative terminal of the battery group before charging. If you neglect to do this, there is a risk of damage to vehicle electronic equipment. As soon as the battery begins to gas, stop quick charging.

**Freeze
protection**

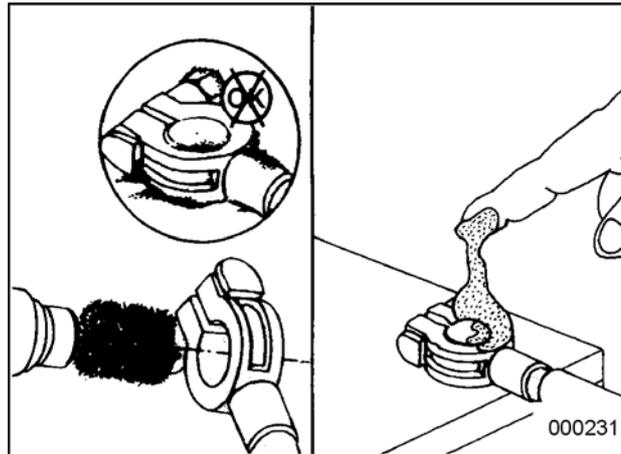
Always keep the batteries properly charged. Their frost resistance depends on how well their charging conditions are. A fully charged battery does not freeze until -25 °F, a drained battery on the other hand freezes at 23 °F. Never attempt to charge a battery that is frozen; it has to be defrosted first.

Batteries: general maintenance

To be carried out when?

Refer to chapter 1.1 under "Maintenance schedule".

Figure: terminals maintenance



Clean and smear terminals with acid-proof vaseline



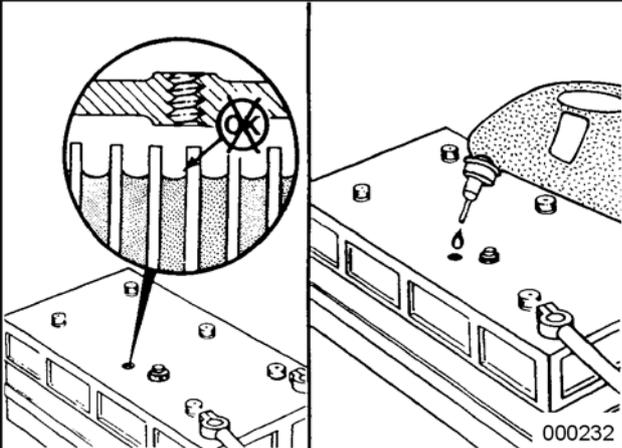
CAUTION!

Never disconnect battery terminals, while the engine is running.

Procedure

Step	Action
1	Switch off the electric battery switch and wait for the delayed cut-off of the batteries. Take into account a waiting time of 90 seconds to be sure that on-board voltage is no more present.
2	Open the mechanical battery switch.
3	Remove the two terminal clamps (start with negative terminal) and clean them inside and outside with metal brush.
4	Clean battery compartment and top of batteries.
5	Re-attach clamps to terminals (positive clamp first).
6	Smear terminals and clamps with a thin layer of acid-proof vaseline to combat oxidation.

continued on next page

Step	Action
<p>7</p>	<p>If there are caps on top of batteries, as is the case with non-maintenance-free batteries, check electrolyte liquid level.</p> <p>Liquid should be about 0.4 in above metal plates in battery.</p> 
<p>8</p>	<p>Top up with distilled or completely demineralized water, if necessary.</p>

Batteries: to check charge

To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Acid tester

The acid tester indicates the specific gravity of the battery fluid.

Specific gravity

Specific gravity will increase during charging and decrease during discharging.

To check charge with acid tester

Measure the charge of non-maintenance-free batteries using an acid tester. Check each battery cell individually. The reading should be approximately the same for all cells. A difference of 0.05 between two cells of the same battery indicates that the battery is defective.

The values in the table below apply for an ambient temperature of 68 to 80 °F. If temperature is higher or lower, make the following correction:

- Add 0.004 to the acid tester reading for each 10 °F above 80 °F;
- Subtract 0.004 from the acid tester reading for each 10 °F below 68 °F.

Specific gravity at 68 °F to 80 °F	Charging condition
1.265 to 1.280	Battery fully charged
1.220 to 1.265	Battery 3/4 charged
1.190 to 1.220	Battery half charged
1.120	Battery drained

To check charge with voltmeter

A quick but less accurate method to check charge is the one using a voltmeter. A prerequisite for correct measurement is that the battery be completely at rest. This means that no charging or discharging should have taken place within one hour prior to measurement. Perform a separate measurement for each battery.

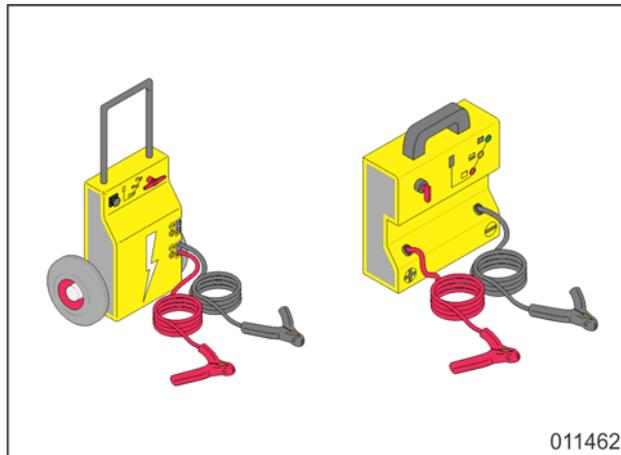
Voltage measured for a 12-volt battery	Charging condition
approx. 12.60 V	Battery fully charged
approx. 12.40 V	Battery 3/4 charged
approx. 12.20 V	Battery half charged
approx. 11.70 V	Battery drained

Jump starting instructions



WARNING!

The use of a "Startbooster" (mobile device with own battery) to jump-start the vehicle is entirely the responsibility of whoever uses the device. Always check before whether the device does not exceed the authorized on-board voltage and current. Any damage related to the use of such devices is not covered by the warranty of the vehicle manufacturer.



WARNING!

Before jump starting through another vehicle, check whether that vehicle has a negative ground 24 volt electrical system. Also check whether the batteries of that vehicle have sufficient capacity. Do not jump start unless both of these conditions have been met. This is necessary in order to prevent injuries as well as material damage.



CAUTION!

First check fluid level of all batteries. Top up if necessary.

**Before
connecting
jumper cables****CAUTION!**

Use jumper cables with a minimum cross section size of 3/0 AWG.

First:

- apply parking brake;
- put transmission in neutral;
- stop engine;
- switch off all power consumers;
- turn off vehicle ignition;
- switch off master switch.

NOTE: If jump starting involves the assistance of a host vehicle, these instructions apply to both vehicles.

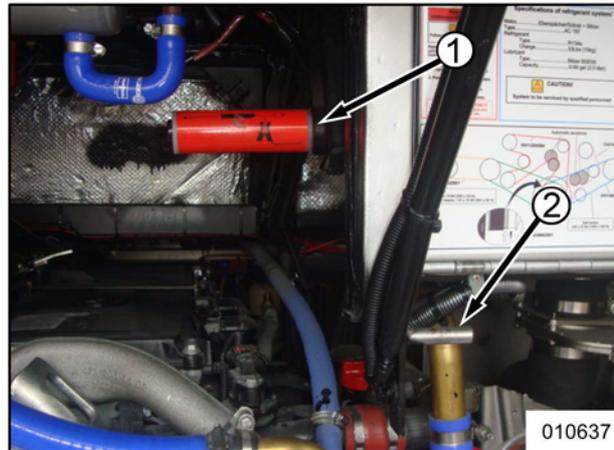
**WARNING!**

Do not attach jumper cable to pipes or moving parts.

**WARNING!**

Do not lean over batteries (neither while starting).

Figure: jump-starting terminals



In engine compartment

- 1 "+" terminal
- 2 Ground terminal

To connect jumper cables

Step	Action
1	With the first jumper cable, connect the positive terminal of the host battery set (positive terminals marked with "+" or red plastic collar) with terminal (1). To be able to connect the cable to terminal (1), first pull the spring-loaded protection back.
2	Connect one end of the second jumper cable to the negative terminal (marked with "-" or either blue or green plastic collar) of the host battery set.
3	 <p>WARNING! Never connect the other cable end directly to the negative terminal of the depleted battery set.</p> <p>Clamp the other end of the negative cable to the jump starting ground terminal (2) of the vehicle requiring jump starting.</p>
4	Start the engine of the vehicle requiring assistance.
5	Let the engine idle for a few minutes to allow the voltage of both battery sets to stabilize. This will reduce sparking when disconnecting the jumper cables.

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**To remove the
jumper cables**

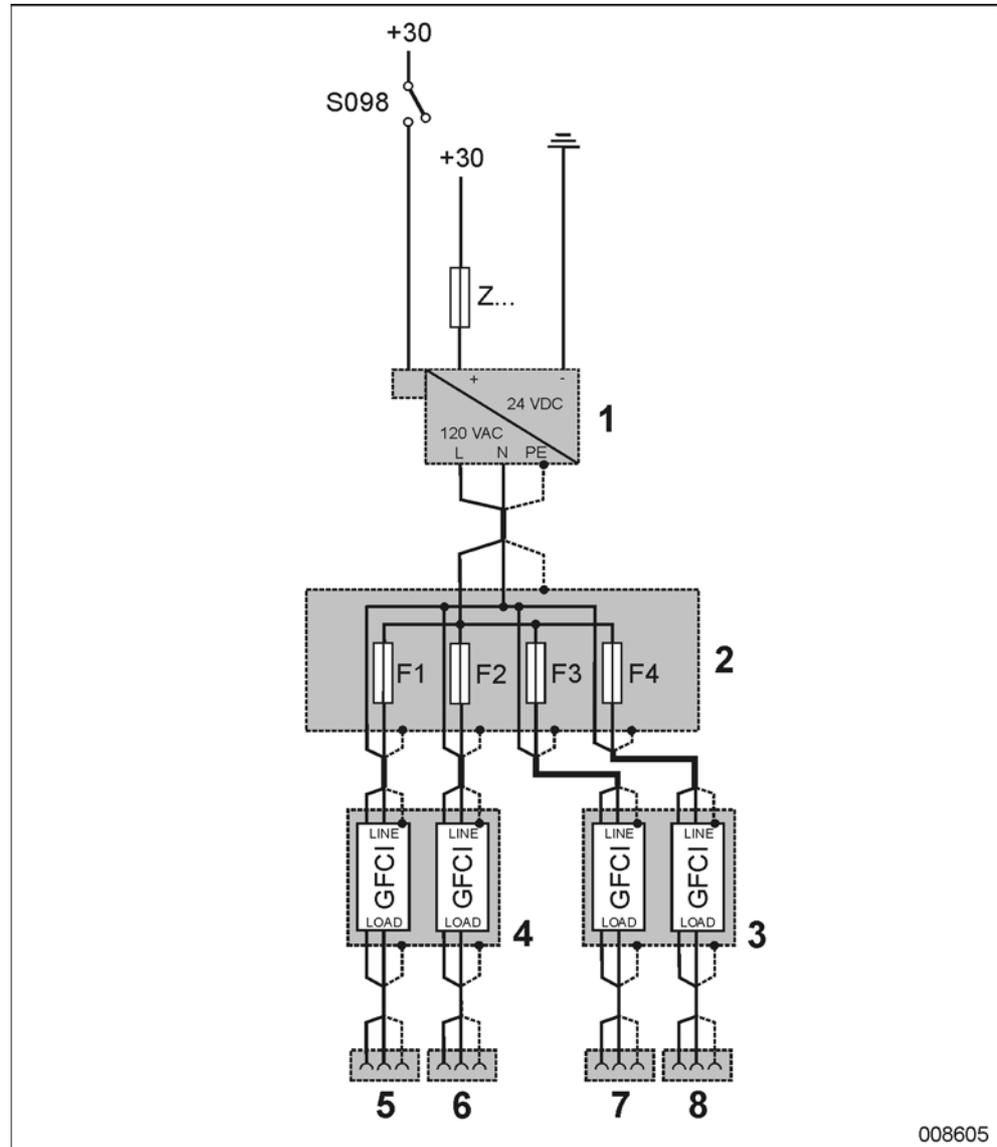
Step	Action
1	Disconnect the negative jumper cable from the jump-starting ground terminal.
2	Disconnect the other end of the negative jumper cable from the batteries.
3	Remove the positive jumper cable.

**Battery
equalizer
fuses**

After jump starting, check the battery equalizer fuses. For location of fuses, refer to "Circuit breakers and fuses".

120 VAC system: layout

Figure: lay-out of the 120 VAC system (example)



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References in figure

Reference in figure	Explanation
1	Voltage inverter
2	120 VAC fuse box
3	Box with ground-fault circuit interruptors of circuits 3 and 4

Reference in figure	Explanation
4	Box with ground-fault circuit interruptors of circuits 1 and 2
5	120 VAC sockets of circuit 1
6	120 VAC sockets of circuit 2
7	120 VAC sockets of circuit 3
8	120 VAC sockets of circuit 4
F.	120 VAC circuit breakers
+30	Voltage after battery switch
GFCI	Ground-fault circuit interruptor
S098	Switch to switch on 120 VAC system
Z...	24 VDC circuit breakers

Chapter 6: Junction boxes

Overview

Introduction This chapter deals with the junction boxes.

Number of pages 2

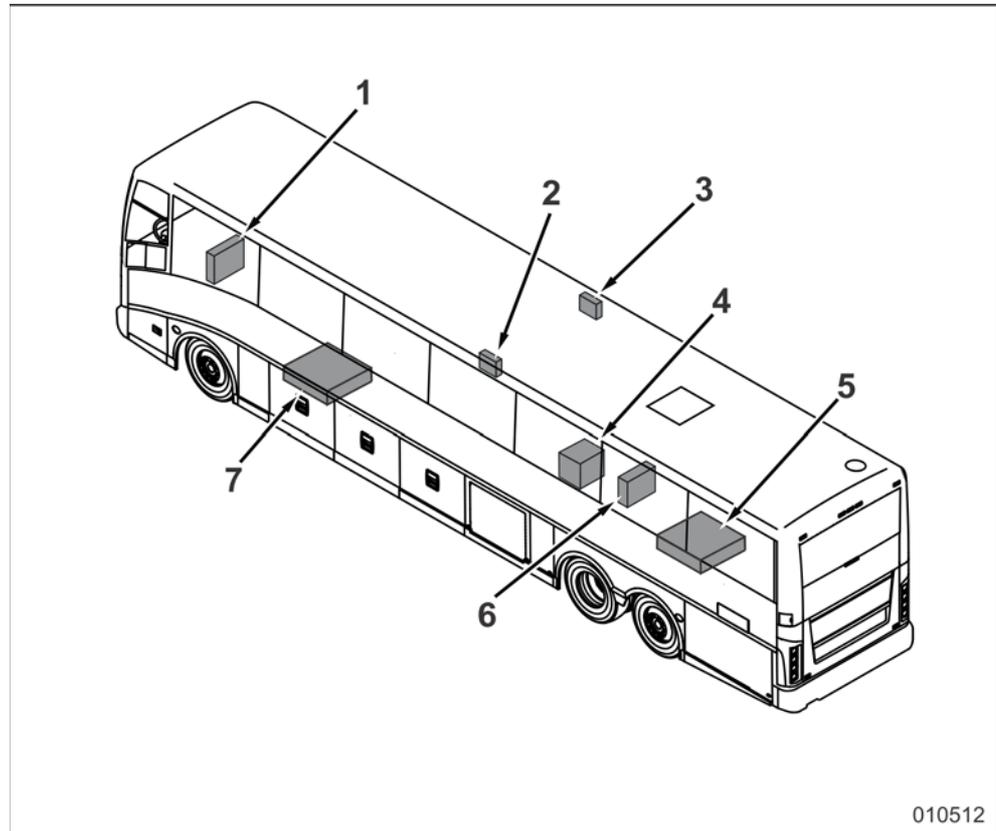
Chapter publication date 21 September 2016

Contents

Topic	See page
Location of junction boxes	14.6-2

Location of junction boxes

Figure:
location of
junction boxes



- 1 Junction box EKF
- 2 Junction box of left-hand evaporator fans
- 3 Junction box of right-hand evaporator fans
- 4 Junction box of 120 VAC system voltage inverter
- 5 Junction box EKA
- 6 Junction box EKB
- 7 Junction box EKV

Chapter 10: Wiring

Overview

Introduction This chapter deals with the wiring.

Number of pages 16

Chapter publication date 14 October 2016

Contents

Topic	See page
Battery switch: general	14.10-2
Mechanical battery switch	14.10-5
120 VAC system: to test ground-fault circuit interrupters (GFCI)	14.10-6
Circuit breakers and fuses	14.10-8

The following subjects have been *added/modified* since the former edition:

Topic	See page
Circuit breakers and fuses	14.10-8

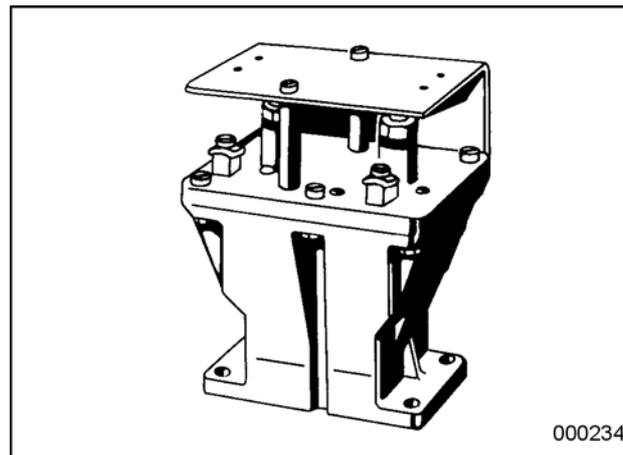
Battery switch: general

Types of battery switches

The two types that may occur are:

- an electric remote-controlled battery relay;
- a mechanically operated battery switch near the batteries.

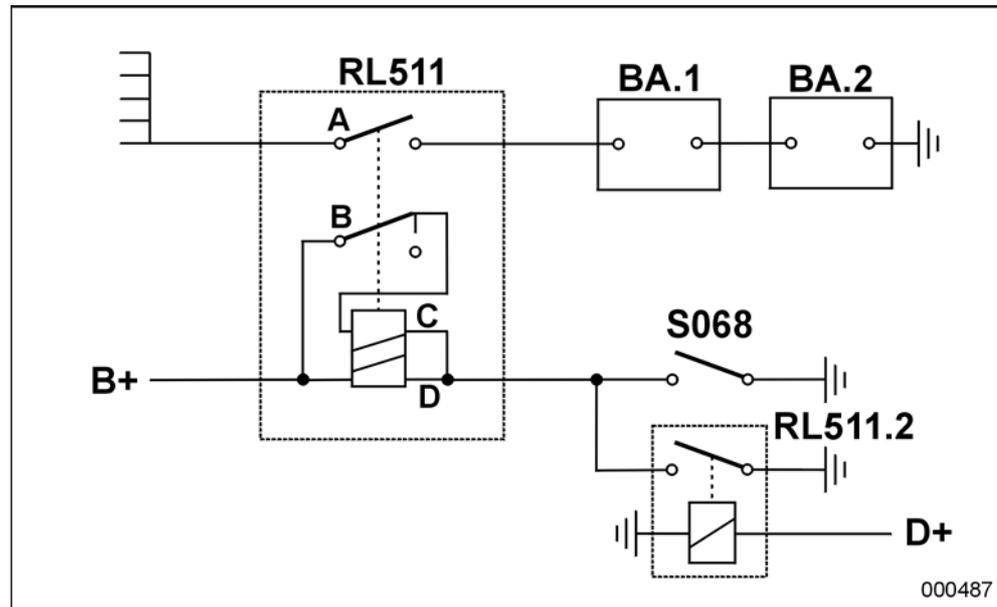
Figure: remote relay of electric battery switch



Parts of electric battery switch

The electric battery switch consists of a remote relay near the batteries, which is operated by a switch on the dashboard. Depending on vehicle model the operating switch is either the key contact or a separate switch.

Figure: circuit diagram of electric battery switch (example)



B+: Directly to battery plus
D+: Voltage with running engine
BA: Battery
RL511: Remote relay
RL511.2: Safety relay
S068: Operating switch

How electric battery switch operates

The table below describes how the electric battery switch is closed.

Stage	Description
1	Someone closes S068.
2	Current flows through attractive coil (C) and holding coil (D) of remote relay (RL511).
3	Armature of remote relay (RL511) is attracted and main contact (A) closes.
4	Auxiliary contact (B) interrupts current flow to attractive coil (C); holding coil (D) remains powered. <i>NOTE: As holding coil only remains powered, less power is consumed to keep remote relay engaged.</i>

Safety relay

Safety relay (RL511.2) prevents remote relay (RL511) from being switched off with the engine running.

continued on next page

Cut-off delay

Some vehicles have a delay circuit that triggers a cut-off delay after (S068) has been opened. This time is needed for the self-testing of electronic controls such as EDC.

Mechanical battery switch

Applicable vehicles

Vehicles with one battery pack

Function of the mechanical battery switch

With the mechanical battery switch it is possible to immediately separate all vehicle power consumers from the batteries.

NOTE: Contrary to the mechanical battery switch, the electric battery switch is not able to cut-off the power to the "B+" circuits. Besides, power is cut-off with delay.

Location of mechanical battery switch

Refer to chapter 1.1, under "Access doors and controls at the outside".

What to pay attention to before opening the mechanical battery switch?

Observe the following precautions to avoid damage to an alternator or deranging any electronic systems.



CAUTION!

Never open the mechanical battery switch while the engine is running.



CAUTION!

Before opening the mechanical battery switch, always switch off the electric battery switch first and wait for the delayed cut-off of the batteries. Take into account a waiting time of 90 seconds to be sure that on-board voltage is no more present.

120 VAC system: to test ground-fault circuit interrupters (GFCI)

Applicable models

Vehicles with a 120 VAC system.

GFCI?

GFCI is short for "Ground Fault Circuit Interrupter".

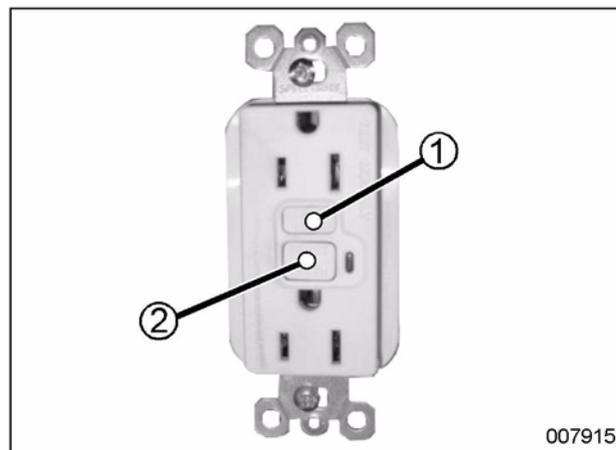
To be carried out when?

Refer to chapter 1.1, "Maintenance schedule".

Location of GFCI's

Each 120 VAC circuit has been equipped with a ground-fault circuit interrupter. They are located two by two in small boxes near the voltage inverters.

Figure: ground-fault circuit interrupter



- 1 "TEST" button
2 "RESET" button

Procedure

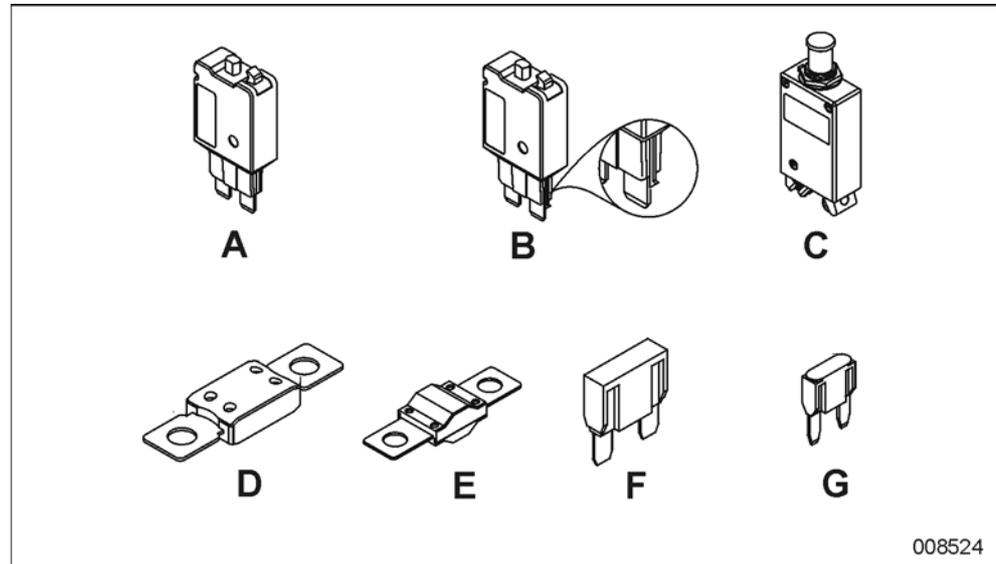
NOTE: Carry out the procedure for each ground-fault circuit interrupter.

Step	Action
1	Start the engine.
2	Switch on the 120 VAC system by means of the dashswitch.
3	Connect a lamp to the ground-fault circuit interrupter.
4	Press the "TEST" button of the ground-fault circuit interrupter.

Step	Action
5	<p>Does the "RESET" button pop out and does the lamp go out?</p> <ul style="list-style-type: none"> • If so, proceed immediately with step 7. • If not, go to step 6.
6	<ul style="list-style-type: none"> • If the "RESET" button pops out but the lamp does not go out, the ground-fault circuit interrupter has been wrongly connected. Connect the ground-fault circuit interrupter correctly. • If the "RESET" button does not pop out, the ground-fault circuit interrupter is faulty. Change the ground-fault circuit interrupter.
7	<p>Press the "RESET" button to switch the ground-fault circuit interrupter back on.</p>

Circuit breakers and fuses

Figure: circuit breakers and fuses



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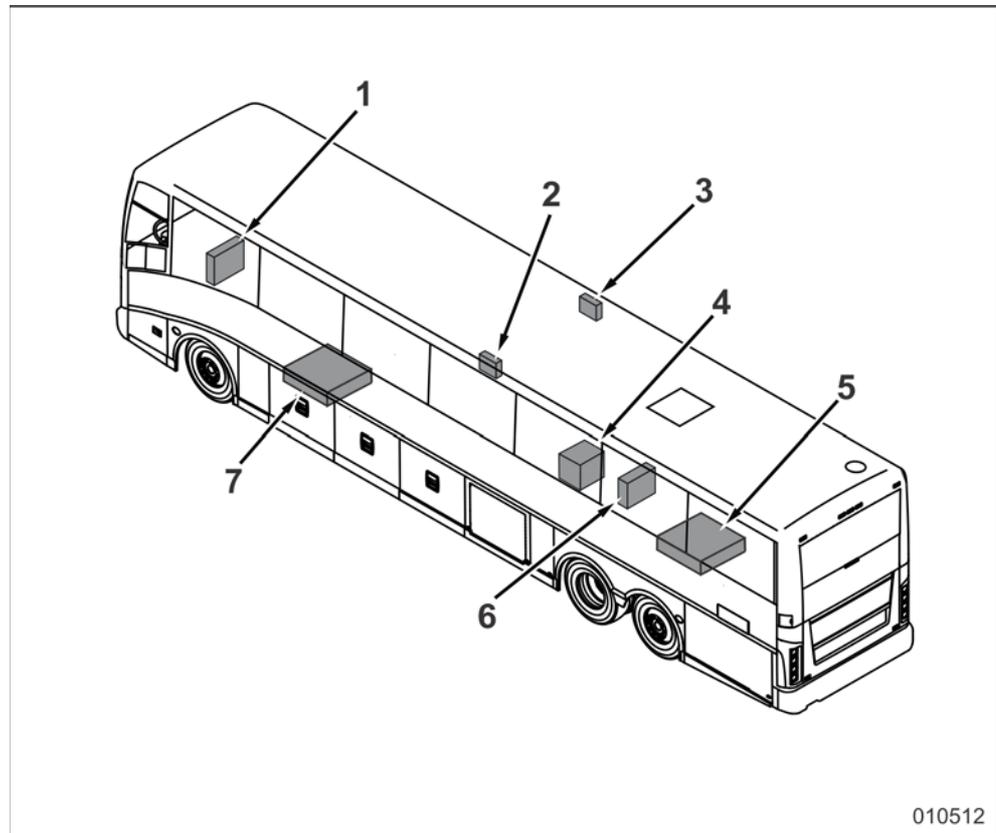
Overview

Type	Ampere	Van Hool No.	Letter in figure
Circuit breaker	6	10521076	A
	8	10521077	
	10	10599052	
	15	10521078	
	20	10679438	B
	25	10521079	
	10	10627930	C
7.5	660763515		

Type	Ampere	Van Hool No.	Letter in figure
Fuse	150	10531356	D
	125	10531355	
	100	10531354	
	80	10772049	E
	50	10774226	
	40	10930133	
	30	10930132	
	80	10605973	F
	50	10531352	
	40	10703212	
	30	10531351	
	20	10583491	
	25	660746316	G
	15	660746315	
	10	660746317	
	7.5	660746314	
	5	660746319	
	3	660746318	
1	11080677		

continued on next page

Figure:
location of
junction boxes



- 1 Junction box EKF
- 2 Junction box of left-hand evaporator fans
- 3 Junction box of right-hand evaporator fans
- 4 Junction box of 120 VAC system voltage inverter
- 5 Junction box EKA
- 6 Junction box EKB
- 7 Junction box EKV

**In junction box
EKV**

Number	Ampere	Circuit	Letter in figure
02	50	Climate control main fuse	E
14	50	Supply to monitors in luggage racks (only in case of round luggage racks)	E
21	8	Cornering lights	A
22.1	15	Driver's cab climate control unit fan	A

continued on next page

Number	Ampere	Circuit	Letter in figure
25	8	Socket for portable light in engine compartment, windshield sun blinds, luggage-compartment lighting	A
26	8	Luggage compartment lighting	A
28	15	"+15" main fuse	A
29.2	8	Amplifier for loudspeakers	A
31	8	Axle-load measuring system	A
32	10	Passenger-compartment climate-control system: motor reversing switch of inside/outside air flaps	A
33	15	ABS system	A
35	8	Guide reading light, video box lighting	A
36	8	Exterior mirrors adjustment	A
37	8	ZF Intarder	A
38	8	Horn	A
38.1	6	Exhaust aftertreatment system (Cummins)	A
39	8	Cigarette lighter	A
42	8	EDC engine management system, engine diagnostics socket (Detroit Diesel), kickdown switch, automatic fire suppression system, transmission	A
46.1	8	Toilet, flash light and buzzer at passenger door to indicate that the vehicle is raising/lowering, raising/lowering system	A
46.2	8	Tire-pressure monitoring system	A
47	8	12 volt main relay, exterior lighting	A
49	8	Engine diagnostics socket (Cummins)	A
80	8	Emergency switch	A
81.1	8	Hazard warning signal	A
81.2	8	Master switch	A
82	8	Digital clock, coolant heater programmable control, RoadRelay	A
83.1	15	Coolant heater	A
83.2	15	Coolant heater	A

continued on next page

Number	Ampere	Circuit	Letter in figure
84	8	Multiplex system computer module	A
85	8	Dashboard node	A
86	8	Gateway	A
95	8	Low beam, right-hand	A
96	8	Low beam, left-hand	A
97	8	High beam, right-hand	A
98	8	High beam, left-hand	A
111	6	"+15" engine fuse	A
112	8	Allison transmission	A
113	8	ABS system, Allison transmission	A
114	8	ABS system	A
115	8	Lane departure warning system	A
116	8	Adaptive cruise control	A
130	50	Node 1	E
131	8	Driver's cab climate control unit	A
151	30	Main fuse of 12 volt sockets	E
152	8	Radio communication system socket (12 volt)	A
153	15	Audio/video (12 volt)	A
154	10	Audio/video	G
155	10	Flash light and buzzer at passenger door to indicate that the vehicle is raising/lowering, audio/video (12 volt), back-up camera	G
156	3	Antenna amplifier	G
158	15	Front fog lamps	G
159	1	Audio/video	G
160	15	Allison transmission	G
161	7.5	Allison transmission	G
185	8	Passenger door, luggage compartment central locking system	A
200	15	Node 2	A
201	15	Node 2	A
202	15	Node 2	A
203	15	Node 2	A
204	15	Node 2	A
300	15	Node 3	A

continued on next page

Number	Ampere	Circuit	Letter in figure
301	15	Node 3	A
302	15	Node 3	A
303	15	Node 3	A
304	15	Node 3	A
650.1	1	Step lighting	G
651	7.5	Interior heating water-circulation pump (option)	G
F21M	10	Climate-control system	A
F22M	10	Climate-control system	A
F23M	10	Climate-control system	A
F24M	10	Climate-control system	A
F25M	10	Climate-control system	A
F26M	10	Climate-control system	A

**In junction box
EKB**

Number	Ampere	Circuit	Letter in figure
06	125	"+30" main fuse of junction box EKV	D
15	30	Audio/video main fuse	E
84	80	12 volt battery equalizer	E
85	40	24 volt battery equalizer	E
88	30	"B+" main fuse of junction box EKV	E
89.1	50	Engine main fuse (Detroit Diesel)	E
150	50	12V-system main fuse	E
201	150	120 VAC-system main fuse	D
F2	30	EDC engine management system (Cummins)	E

**In junction box
EKA**

Number	Ampere	Circuit	Letter in figure
01	30	Transmission main fuse	E
03	50	Engine main fuse (Cummins)	E
05	100	Wheelchair lift	D
07	150	Main fuse of junction box EKA	D

continued on next page

Number	Ampere	Circuit	Letter in figure
08	200	"B+" fuse of alternator 1	D
09	200	"B+" fuse of alternator 2	D
69	15	Fuel Pro fuel filter	A
70	8	"D+" fuse of alternator 1	A
71	8	"D+" fuse of alternator 2	A
89.2	15	Allison transmission main fuse	A
	10	ZF Astronic transmission main fuse	A
400	15	Node 4	A
401	15	Node 4	A
402	15	Node 4	A
403	15	Node 4	A
404	15	Node 4	A
405	8	Wheelchair lift system lighting	A
406	8	Axle-load measuring system	A
407	8	Wheelchair lift	A
500	15	Node 5	A
501	15	Node 5	A
502	15	Node 5	A
503	15	Node 5	A
504	15	Node 5	A
505	8	Climate-control system	A
506	8	Reversing lights, stop lights	A
600	15	Node 6	A
601	15	Node 6	A
602	15	Node 6	A
603	15	Node 6	A
604	15	Node 6	A
605	8	Climate-control system	A
F1	6	EDC engine management system (Cummins)	A
	10	EDC engine management system (Detroit Diesel)	A
F2	15	EDC engine management system (Detroit Diesel)	A
F3	20	Exhaust aftertreatment system (Detroit Diesel)	A

continued on next page

Number	Ampere	Circuit	Letter in figure
F4	15	EDC engine management system (Detroit Diesel)	A
F5	15	Exhaust aftertreatment system (Cummins)	A
	8	EDC engine management system (Detroit Diesel)	A
F6	10	Exhaust aftertreatment system (Cummins)	A
	15	Exhaust aftertreatment system (Detroit Diesel)	A
F7	10	Exhaust aftertreatment system (Cummins)	A
F9	30	Fuel Pro fuel filter	E
F1M	50	Climate control system: right-hand evaporator fans	E
F2M	50	Climate control system: left-hand evaporator fans	E

**In junction box
EKF**

Number	Ampere	Circuit	Letter in figure
51	15	Windshield wipers	A
100	15	Node 1	A
101	15	Node 1	A
102	15	Node 1	A
103	15	Node 1	A
104	15	Node 1	A
105	8	Multiplex system diagnostics socket	A
650.2	1	Step lighting	G
650.3	1	Step lighting	G

**In-line fuse
above
batteries**

Number	Ampere	Circuit	Letter in figure
900	15	Automatic fire suppression system	G

continued on next page

**In junction box
of left-hand
evaporator
fans**

Number	Ampere	Circuit	Letter in figure
500	15	Evaporator fan	G
501	15	Evaporator fan	G
502	15	Evaporator fan	G

**In junction box
of right-hand
evaporator
fans**

Number	Ampere	Circuit	Letter in figure
503	15	Evaporator fan	G
504	15	Evaporator fan	G
505	15	Evaporator fan	G

Chapter 18: Electric circuit diagrams

Overview

Introduction This chapter deals with the electric circuit diagrams.

Number of pages 16

Chapter publication date 21 September 2016

Contents

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Electrical wiring diagram booklet

Introduction

For convenience purposes the electrical wiring diagram for your vehicle has been divided into subdiagrams on A4 format. Each subdiagram combines a number of electrical components, the function of which is related. The subdiagrams have been compiled into an “Electrical wiring diagram booklet”, which is supplied separately with the vehicle.

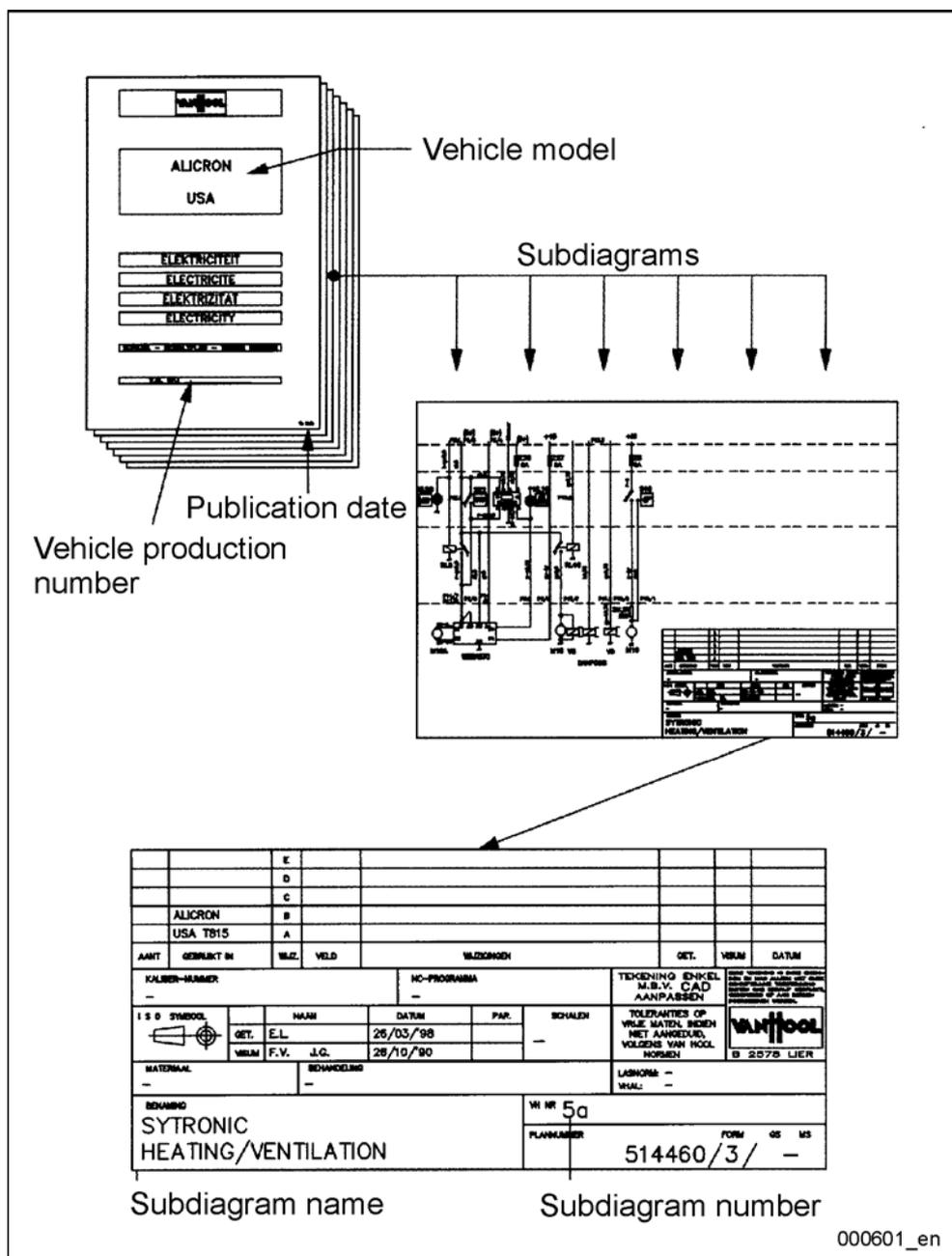
Data on front page of wiring diagram booklet

The front page of the wiring diagram booklet contains the following data:

- Name of the vehicle model the wiring diagram booklet applies to;
- Publication date;
- Production number(s) of the vehicle – or the vehicle model series – the wiring diagram booklet applies to.

NOTE: Before using the wiring diagram booklet, check the data on the front page so as to make sure the booklet you are holding actually goes with your vehicle.

Figure:
structure of
wiring diagram
booklet



000601_en

Subdiagrams

Subdiagram number

The subdiagrams have been numbered according to their contents. The subdiagram number consists of numbers and letters. It is stated in the title corner of the subdiagram.

The table below represents a list of all possible subdiagrams for a Van Hool vehicle. The numbering in the list corresponding with the numbering in the wiring diagram booklet, the list will help you to find the subdiagram you are looking for more quickly. Your wiring diagram booklet does include only those subdiagrams from the list that apply to your vehicle.

Subdiagram no.	Circuit
05A	Current distribution, starting
05E	12V system
05F	220V system
19B	Indicator lights
19C	Instruments
19D	Engine equipment
19E	Transmission
19F	Retarder
19H	Electric horn, air horn, air dryer
19I	Height control
19K	Fuel heating
19L	Extra fuel tank
19M	Consumption meter
19N	ABS/ATC
19O	Auxiliary steering pump
19P	Emergency circuit
19Q	Third axle
19S	Vehicle articulation protection
19T	Central lubrication
19U	Soot filter
19W	Snow chains
19X	Brake wear indicators
26B	Door control
26D	Lift
26F	Wheelchair ramp
26G	Central locking

continued on next page

Subdiagram no.	Circuit
26H	Driver's gate
26U	Door 1
26V	Door 2
26W	Door 3
26X	Door 4
30A	Route indicators
30B	Payment system
30C	Counting system
36A	Exterior lighting
36B	Turn signals
36D	Alarm systems
36F	Ski box lighting
37A	Interior lighting
37B	Digital clock, cigarette lighter, interior accessories
37D	Driver's sleeping compartment
37E	Crew call system, stop request
38A	Windshield wipers and washer
40A	Public address system
40B	Audio, video
40C	Speakers
40D	Intercom
40E	Camera system
40F	Communication system
40G	Navigation system
42A	Adjustable mirrors
44A	Toilet
44B	Water heater, oven
45A	Refrigerator
46A	Electric driver's window
46B	Heated windshield (top)
46C	Electric roof hatches
50A	Heating, ventilation
50B	Interior heating
50C	Roof heating
50D	Temperature gauges
50E	Climate control
50F	Driver's climate unit

continued on next page



Components

Component location

The subdiagrams have been divided into sections by means of horizontal dotted lines. Most of the sections have been named with letters (EKV, IB,...). They are mentioned in the diagram right margin.

Each section named corresponds with a particular location in the vehicle. The components depicted in such a named section are actually found in the location represented by that section.

There is also an unnamed diagram section. This section contains the components that are not grouped in one place in the vehicle. In most cases the location of a component from the unnamed section can be deduced from its name or function description.

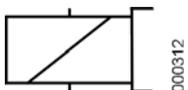
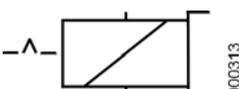
The table below lists the section names and their meaning.

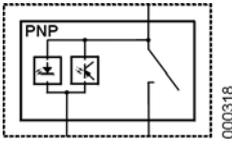
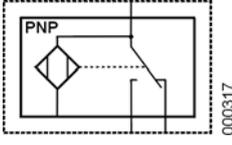
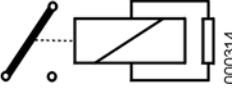
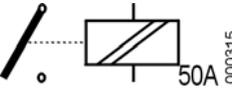
Letters	Location within vehicle
EKA	Rear junction box
EKB	Junction box near batteries
EKE	Junction box near engine
EKF	Front junction box
EKS	Junction box in toilet compartment
EKV	Main junction box
IB	Instrument panel

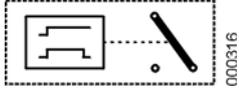
Component symbols

In the diagrams all electrical components (lights, relays, switches...) have been represented by a standard symbol. The table below lists the symbols used and their explanations.

Symbol	Explanation
	Glow plug
	Chime
	Buzzer

Symbol	Explanation
 000310	Loudspeaker
 000303	Microphone
 000296	Pressure switch
 000299	(Temperature) sensor
 000297	Thermal switch
 000298	Float contact
 000305	Diode
 000306	Resistor
 000307	Fuse
 000312	Permanently energized valve
 000313	Impulse valve
 000302	Indicator light

Symbol	Explanation
	Light
	Instrument
	Microswitch
	Photo-electric cell
	Proximity switch
	Reed contact
	Engine
	Relay with resistor
	High-power relay
	Key switch
	Change-over switch

Symbol	Explanation
	Time switch

Component numbers

Each component has been designated by its own number in the diagram. This designation is right next to the component symbol. The letter in the number designation indicates the nature of the component (switch, relay, light, etc.).

You can look up the function of the component in the components list on the page opposite the diagram by using the component number.

Power supply

Designation of power supply

In the drawings power circuits start at the top, with the circuit fuse. The designation of the power connection is found at the starting point of the circuit (B+, +30...). Thus you can see the path along which the circuit is connected to the power source (battery, alternator), which allows you to know, when it is conducting.

The table below lists the distinguishing marks of the power connection.

Connection mark	Explanation
B+	Direct to battery plus. The circuit is always live with power. Used for coolant heater, hazard warning flashers, memory of electronic control units.
+30	Voltage after battery switch. Used for all body equipment, such as: climate control, lighting, audio system.
+15	Voltage after turning on ignition. Used for all components that are important for driving.
D+	Voltage with running engine. Used for circuits with high-power equipment, to spare batteries.
+58	Voltage with side marker lights turned on.
+56	Voltage with low beam or high beam lights turned on.

Situation to which diagram applies

Rest state

Some component symbols have been conceived in such a way that the position of the symbol parts represents the state the component is in (switch on or off, relay powered or not...). Symbols in Van Hool diagrams always represent the position that corresponds with vehicle rest state. The conditions for this rest state are:

- batteries disconnected;
 - Compressed-air system charged to maximum operating pressure;
 - all doors and hatches closed;
 - transmission in neutral;
 - all brakes released;
 - engine off;
 - all systems switched off, control switches in rest position;
 - temperature 70 °F.
-

24V-system electrical wires

Wire colors

Van Hool use differently colored electrical wires to connect junction boxes and devices. There are wires with single-color insulation and wires with two-color insulation. The two-color wires have a strip lengthwise in a contrasting color running over the main color of the insulation material.

In the diagram the connection represented bears a letter code, which refers to the wire color. The table below lists the meaning of the colors.

If a wire has two colors, this is indicated in the diagram as follows:

GE-R= yellow wire with red stripe

NOTE: Nowadays the regular color for ground wires is brown. In older vehicles, however, black ground wire has been used.

Letter code	Wire color
Z	Black
BR	Brown
R	Red
O	Orange
GE	Yellow
GN	Green
B	Blue
V	Violet
GS	Gray
W	white
T	Transparent
RO	Pink

Wire cross-section

The diagram mentions the wire section, expressed in square millimeters (mm²), after the wire color code. If the section is not mentioned, it is 1 mm² (in older vehicles: 1.5 mm²).

Example:

BR2.5 = brown wire with 2.5 mm² section

“American Wire Gauge (AWG)”

Consult the table below when using "AWG" electrical wires by way of replacement.

continued on next page

Indication of wire cross-sections on the electrical diagram (mm ²)	"AWG" equivalent
0.75	18
1	16
1.5	14
2.5	12
6	8
16	4
35	1
70	3/0

Cross-references

Cross-reference "XY" within same subdiagram

In a subdiagram a connecting line can be represented interruptedly; only the beginning and the end have been drawn. The corresponding locations that have been segmented bear cross-reference marks. The mark consists of the pair of letters "XY", followed by a number. To find where the line continues, look in the same subdiagram for an XY designation with the same number.

Cross-reference "XX" to another subdiagram

There are also connecting lines that proceed from one subdiagram to another one. On the first subdiagram this type of line stops at a cross-reference mark; on the second subdiagram it continues starting from the same mark. In such case the cross-reference mark consists of a box containing the reference number of the subdiagram the line proceeds to and, either below or above that, two Xs followed by a number.

Example:

Cross-reference	Explanation
	Go to diagram 05A and find XX10

Connector designation

Introduction

All connectors, except for component connections, have been designated with the letter "P" in the diagram, followed by the reference of the connector, followed by a dot and the reference number of the connector contact the conductor that has been represented passes through.

Example: P223.5

P= connector

223= connector number

5= contact number

Figure:
contact
numbering of
connector
P223

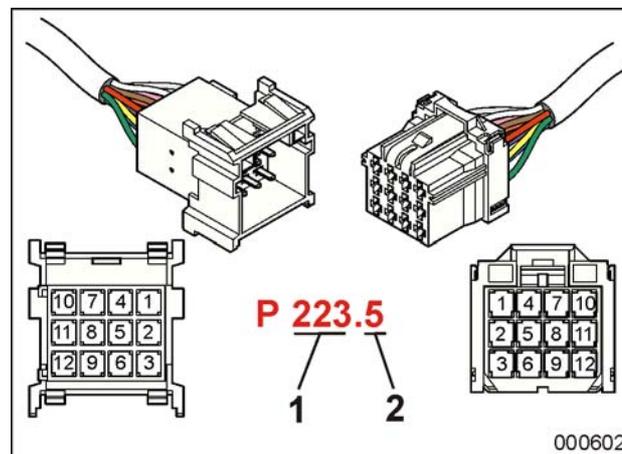


Figure shows plug on the left, socket on the right. The contact numbers have been considered from wire input side.

1 Connector number

2 Contact number



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